Risks of Metolachlor Use to 26 Evolutionarily Significant Units of Endangered and Threatened Pacific Salmon and Steelhead

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Pesticide Effects Determination

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Washington, D.C. 20460

June 19, 2006

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Table of Contents

1. Summary 4

2. Background (Problem Formulation) 7
   - 2.1 Purpose of Assessment 7
   - 2.2 Regulatory Context (Defining the Action) 9
   - 2.3 Previous Assessments 11
   - 2.4 Nature of the Chemical 12
     - 2.4.1 Physical and Chemical Properties 12
     - 2.4.2 Stereochemistry 13
     - 2.4.3 Mode of Action 14
     - 2.4.4 Use Characterization 14
     - 2.4.5 Product Label Information 16
   - 2.5 Initial Area of Concern 19
     - 2.5.1 Ecosystems Potentially at Risk 27
     - 2.5.2 Refinement of the Initial Area of Concern and Ecosystems Potentially at Risk to Identify the Action Area 33
       - Action Area Defined from Potential Effects to Aquatic Plants 33
       - Action Area Defined from Potential Effects to Terrestrial Plants . . 42
       - Spatially-Based Sources of Error in Defining Action Area 47
   - 2.6 Listed Salmonid Habitat 48
     - 2.6.1 Geographic Locations - Critical Habitat 50
     - 2.6.2 Characteristics of Water Bodies Supporting Listed Salmonids 50
       - a. Aquatic Plants 53
       - b. Riparian Areas 53
       - c. Dimensions for a Representative Salmonid Stream 55

3. Analysis Plan 58
   - 3.1 Assessment Endpoints 58
   - 3.2 Incorporation of Open Literature 60
   - 3.3 Degradates 61
   - 3.4 Conceptual Model 63
   - 3.5 Measures of Effects 65
     - 3.5.1 Direct Effects 65
     - 3.5.2 Indirect Effects 65
   - 3.6 Measures of Exposure 66
     - 3.6.1 Aquatic Organisms 66
     - 3.6.2 Terrestrial Insects 68
     - 3.6.3 Terrestrial Plants 68
     - 3.6.4 Sediment Loading to Salmonid Habitat 69
   - 3.7 Risk Characterization Approach 70

4. Exposure and Effects Analysis 71

4.1 Effects Summary 71
4.1.1 Fish 71
a. Registrant-Submitted Studies 72
b. Open Literature 79
c. Degradates 82
4.1.2 Aquatic Invertebrates 83
a. Registrant-Submitted Studies 84
b. Open Literature 88
c. Degradates 91
4.1.3 Aquatic Plants 92
a. Registrant-Submitted Studies 92
b. Open Literature 94
c. Degradates 94
4.1.4 Terrestrial Plants 94
a. Registrant-Submitted 95
b. Open Literature 98
c. Degradates 102
4.1.5 Terrestrial Invertebrates 102
a. Registrant-Submitted Studies 102
b. Open Literature 102
4.2 Uncertainties in the Hazard Assessment 103
4.3 Exposure Analysis 104
4.3.1 Environmental Fate Data 104
4.3.2 Aquatic Exposure 105
a. Metolachlor in the Aquatic Environment 105
b. National Surface Water Monitoring Data Assessment 106
c. Regional Surface Water Monitoring Data Assessment 107
d. Regional NAWQA Data 110
e. California Department of Pesticide Regulation (CDPR) Data . . 110
f. Washington State Department of Agriculture (WSDA) Surface Water Monitoring Program 110
g. Washington State Department of Ecology (WSDE) Monitoring Data 111
h. Modeling Assessment 111
Surface Water Modeling of Metolachlor 113
Surface Water Modeling of ESA and OA Degradates 123
i. Atmospheric Transport of Metolachlor 126
j. Occurrence of Metolachlor, Metolachlor ESA, and Metolachlor OA in Groundwater and Potential for Contribution to Surface Water Exposures 127
k. Uncertainties in the Aquatic Exposure Assessment 132
4.3.3 Terrestrial Plant Exposure 134
a. Metolachlor and Terrestrial Plants 134
b. Degradates and Terrestrial Plants 135
4.3.4 Off-Target Exposure from Spray Drift 136

5. Risk Characterization 143
5.1 Risks Estimation (RQs) 143
5.1.1 Fish 143
Degradates 148
5.1.2 Aquatic Invertebrates 150
Degradates 153
5.1.3 Terrestrial Invertebrates 156
5.1.4 Aquatic Plants 156
a. Metolachlor Risk Quotients 156
b. Degradate Risk Quotients 159
5.1.5 Non-target Terrestrial Plants 160
a. Metolachlor Risk Quotients 160
b. Degradate Risk Quotients 161
5.1.6 Reported Incidents 162
5.2 Risk Description 163
5.2.1 Potential for Direct Effects to Listed Salmonids 163
a. Dose Mortality Slope 163
b. Sublethal Effects 164
c. Potential for Acute Effects Resulting from Spray Drift to Small Streams 165
5.2.2 Potential for Indirect Effects 166
a. Food Chain Effects 167
Aquatic Invertebrates 167
Terrestrial Insects 168
Aquatic Plants 169
b. Aquatic Plants as Shelter 171
c. Terrestrial Plants - Riparian Health 171
Spray Drift to Riparian Vegetation 173
Riparian Vegetation Exposure via Runoff 180
Likelihood of Effects to Salmonids Via Damaging Riparian Vegetation 182
5.2.3 Conclusions 186

REFERENCES 187

Appendix A. Representative PRZM/EXAMS Model Input and Output A-1

Appendix B. Tabular Summaries of Open Literature Toxicity Data B-1

Appendix C. References Identified Using the ECOTOX Open Literature Search Method C-1

Appendix D. Metolachlor Usage Data by State and County. D-1

Abbreviations

a.i.- active ingredient
AAPCO - Association of American Pesticide Control Officials
ARP - Acetochlor Registration Partnership
CDPR - California Department of Pesticide Regulation
CI - confidence interval
EC25 - 25% effect concentration
EC50- 50% effect concentration
ECOTOX - EPA managed database
EEC - estimated environmental concentration
EFED - Environmental Fate and Effects Division
EIM - Environmental Information Management (EIM) System
ESA - ethane sulfonic acid degradate of metolachlor
ESU - evolutionarily significant unit
FIFRA - Federal Insecticide Fungicide and Rodenticide Act
FQPA - Food Quality Protection Act
GENEEC - GENeric Estimated Exposure Concentration model
HPLC - high pressure liquid chromatography
Koc - organic carbon partitioning coefficient
LC50 - concentration lethal to 50% of a population
LD50 - dose that is lethal to 50% of a population
LOAEC - lowest observable adverse effect concentration
LOAEL - lowest observable adverse effect level
LOC - level of concern
LOD - level of detection
LOEC - lowest observable effect concentration
LOQ - level of quantitation
MATC - maximum acceptable toxicant concentration
MLRA - major land resource areas
MRID - master record identification number
NASS - National Agricultural Statistics Service
NAWQA - National Water Quality Assessment
NCOD - National Contaminant Occurrence Database
NLCD - National Land Cover Dataset
NMFS - National Marine Fisheries Service
NOAA - National Oceanic and Atmospheric Administration
NOAEC - no observable adverse effect concentration
NOAEL - no observable adverse effect level
NOEC - no observable effect concentration
NRCS - Natural Resources Conservation Service
NTUs - nephelometric turbidity units
OA - oxanilic acid degradate of metolachlor
OPP - Office of Pesticide Programs
OPPTS - Office of Prevention, Pesticides and Toxic Substances
ORD - Office of Research and Development

PCA - Percent Cropped Area
ppb - parts per billion
ppm - parts per million
PRZM/EXAMS - Pesticide Root Zone Model/EXposure Analysis Modeling System
QA - quality assurance
QC - quality control
RCC - river continuum concept
RED - reregistration eligibility decision
REMM - Riparian Ecosystem Management Model
RQ - risk quotient
STORET - STOrage and RETrieval database
t ½ - halflife
TerrPlant - terrestrial plant exposure/risk model
TMDL - total maximum daily load
TRED - tolerance reassessment eligibility decision
USDA - U.S. Department of Agriculture
USGS - U.S. Geological Survey
USLE - Universal Soil Loss Equation
WSDA - Washington State Department of Agriculture
WSDE - Washington State Department of Ecology

1. Summary

The direct and indirect risks of metolachlor use were evaluated using the approach described in Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs (U.S. EPA 2004a) in order to determine if this herbicide's use is likely to affect 26 Evolutionarily Significant Units (ESUs) of listed salmonids and their critical habitat in the Pacific Northwest and California. To estimate risk, toxicity data on fish, aquatic and terrestrial invertebrates, and terrestrial and aquatic plants for metolachlor and its degradates, were collected from registrant-submitted studies and the open literature. After determining the most sensitive effects endpoints related to survival, growth, or reproduction, environmental fate and transport models were used to estimate high-end exposures that may occur in the Pacific Northwest as a result of metolachlor use in accordance with label directions.

In this determination, risk quotients were used as quantitative measures of potential high-end risks. After risk quotients were calculated, they were compared to predefined "Levels of Concern" (LOCs) to identify instances that metolachlor use has the potential to adversely affect listed salmonids through direct toxicity, indirect effects on prey, or via effects to the constituent elements of salmonid ecosystems and critical habitat. When the risk quotient for a particular type of effect is below the LOC, an effect is not expected to occur and, thus, there is a determination that the pesticide has "no effect" on the species. When risk quotients exceed LOCs, a potential to cause adverse effects to listed species or modification of critical habitat is identified leading to a conclusion of "may affect". When a "may affect" was identified, a further determination was made to categorize the effects as "not likely to adversely affect" or "likely to adversely affect" the listed salmonids, and determine if the potential effect to critical habitat is appreciable. The evaluation and comparison of exposure and effect information suggested that metolachlor is not likely to adversely affect listed salmonids or appreciably diminish critical habitat. A summary of the risk conclusions for metolachlor is presented in Table 1a.

Table 1a. Effects Summary for Listed Salmonids and Critical Habitat in the Pacific Northwest and California			
Entity	**Linkage of entity to listed salmonids**	**Level effect of action**	**Summary justification**
Salmonids	Growth, survival, and reproduction of individuals	No effect	Risk quotients are below levels of concern
Salmonid prey	Food source for salmonids	No effect to salmonids or critical habitat	Risk quotients are below levels of concern
Aquatic plants	Primary producers in salmonid ecosystem and shelter	Not likely to adversely affect listed salmonids and no appreciable effect to designated critical habitat	Aquatic plant risk quotients are above levels of concern but exposure is expected to be infrequent and of short duration. Effects to aquatic plants are expected to be insignificant to salmonid food supply and shelter needs.
Riparian vegetation	Water temperature	No effect to salmonids or critical habitat	Wood plants responsible for shading salmonid streams are insensitive to metolachlor.
	Water quality (suspended sediment levels from upland erosion, naturally occurring organic materials) and stream integrity (bank stability)	Not likely to adversely affect listed salmonids and no appreciable effect to designated critical habitat	Metolachlor use is expected to result in insignificant increases in suspended sediment and streambank instability. Mobile salmonid life stages and the constituent elements of their habitat are tolerant of resulting levels of suspended sediment.
	Deposition of fine sediment from erosion may prevent aeration of spawning gravels needed for early salmonid life stage respiration and shelter	Not likely to adversely affect listed salmonids and no appreciable effect to designated critical habitat	Low levels of usage make it unlikely that metolachlor use would occur under the conditions, areas, and times that could lead to effects on the quality of spawning gravels (i.e. under high drift or runoff conditions, in proximity to sparsely vegetated riparian zones in high quality spawning areas).

Because metolachlor and its degradates exhibit low toxicity to fish and invertebrates, risk quotients were below levels of concern for these taxa. Risks estimated for metolachlor's degradates did not exceed any levels of concern, so are not expected to affect salmonids or any of the constituent elements of the salmonid ecosystem and critical habitat. Thus, no direct effects to listed salmonids or effects to prey items are expected to result from metolachlor exposure. Metolachlor's higher toxicity to plants, however, resulted in risk quotients that exceed levels of concern for aquatic and terrestrial plants. As a consequence the potential risks to aquatic and terrestrial plants in relation to listed salmonids were further evaluated in order to better characterize the potential for indirect effects to listed salmonids and critical habitat.

Aquatic plants can be important to salmonids as primary producers in the food web and as shelter to young salmonids and prey. Risk quotients for aquatic plants are above levels of concern, indicating that metolachlor use may indirectly affect listed salmonids. However, upon further evaluation metolachlor's effect on aquatic plants was considered to be insignificant and discountable relative to listed salmonids. This conclusion was based on the following facts: 1) effects from metolachlor to aquatic plants appeared to be limited to algae, 2) exposures exceeding algal levels of concern (50% growth inhibition levels) were not expected to occur more than 10 times over a period of 30 years, 3) the highest exposure levels would be expected to last only a few hours, and 4) algae would be expected to recover rapidly. Thus, metolachlor's use is not likely to adversely affect listed salmonids or appreciably modify critical habitat by affecting aquatic plants.

Riparian plants are known to benefit water and stream quality in a number of ways in both adjacent stream reaches and areas farther downstream. Because risk quotients for terrestrial plants are above levels of concern, metolachlor use is considered to have the potential to affect listed salmonids through impacting plants in riparian areas and causing subsequent effects to important aspects water quality. In determining the potential effect of metolachlor to terrestrial plants four attributes of salmonid habitat were linked to riparian vegetation: water temperature, streambank stability, suspended sediment and deposited sediment. The potential effects to each attribute were evaluated and categorized as to their level of effect.

1) Water temperature: Metolachlor is not toxic to woody plants; thus, no effect is expected to shrubs and trees which shade water and moderate water temperature.

2) Streambank stability: Metolachlor's effect on streambank stability is insignificant. Woody vegetation is insensitive to metolachlor, and metolachlor is not expected to denude riparian zones; thus, metolachlor use is not likely to adversely affect listed salmonids or appreciably modify critical habitat through affecting streambank stability.

3) Suspended sediment in salmonid-supporting water bodies: Metolachlor's effect on suspended sediment levels is insignificant. Metolachlor is unlikely to affect established vegetated riparian areas, and effects to the sediment filtering capabilities of vegetation adjacent to water bodies are expected to be relatively small. Salmonids and the constituent elements of their habitat are expected to be tolerant of the small potential increase in suspended sediment resulting from metolachlor use. Thus, increased suspended sediment levels are not likely to adversely affect listed salmonids or appreciably modify critical habitat.

4) Deposited sediment in spawning/rearing areas: If sufficient quantities of metolachlor were to contact soil or seedlings in denuded areas near high quality rearing and spawning gravels, the regrowth of plants in these areas would be delayed and increased sediment loading to nearby gravels in streams could occur. Early salmonid life stages are highly sensitive to the effects of deposited sediment. However, low usage of metolachlor in action area counties makes it unlikely that detrimental quantities of metolachlor laden spray drift and runoff will reach bareground areas adjacent to high quality spawning and rearing gravels. Thus, metolachlor's effects on sedimentation of spawning gravels is discountable. Because metolachlor usage is low and

bareground areas near high quality spawning gravels are expected to be rare, metolachlor's use is not likely to adversely affect listed salmonids or their critical habitat through effects to riparian vegetation.

2. Background (Problem Formulation)

2.1 Purpose of Assessment

The purpose of this assessment is to determine the potential of metolachlor use, as described on product labels, to either directly or indirectly affect the survival, growth, and/or reproduction of 26 ESUs of salmonids listed as threatened or endangered by the U.S. National Marine Fisheries Service (NMFS) or adversely modify the designated critical habitat of the listed salmonids. The species addressed by this assessment are endangered Pacific chinook, chum, sockeye, and coho salmon, and steelhead as identified below. These species are referred to as salmonids in reference to their taxonomic family name, Salmonidae.

A. Steelhead

1. Southern California Steelhead ESU. The Southern California steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997).

2. South Central California Steelhead ESU. The South Central California steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997).

3. Central California Coast Steelhead ESU. The Central California coast steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final, as threatened, a year later (62FR43937-43954, August 18, 1997).

4. California Central Valley Steelhead ESU. The California Central Valley steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final in 1998 (63FR13347-13371, March 18, 1998).

5. Northern California Steelhead ESU. The Northern California steelhead ESU was proposed for listing as threatened on February 11, 2000 (65FR6960-6975) and the listing was made final on June 7, 2000 (65FR36074-36094).

6. Upper Columbia River steelhead ESU. The Upper Columbia River steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997).

7. Snake River Basin steelhead ESU. The Snake River Basin steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a

year later (62FR43937-43954, August 18, 1997).

8. Upper Willamette River steelhead ESU. The Upper Willamette River steelhead ESU was proposed for listing as threatened on March 10, 1998 (63FR11798-11809) and the listing was made final a year later (64FR14517-14528, March 25, 1999).

9. Lower Columbia River steelhead ESU. The Lower Columbia River steelhead ESU was proposed for listing as endangered on August 9, 1996 (61FR41541-41561) and the listing was made final a year later (62FR43937-43954, August 18, 1997).

10. Middle Columbia River Steelhead ESU. The Middle Columbia River steelhead ESU was proposed for listing as threatened on March 10, 1998 (63FR11798-11809) and the listing was made final a year later (64FR14517-14528, March 25, 1999).

B. Chinook Salmon

1. Sacramento River Winter-run Chinook Salmon ESU. Sacramento River Winter-run chinook was emergency listed as threatened in 1989 (54FR32085-32088, August 4, 1989). In 1994, the winter-run was reclassified as endangered because of significant declines and continued threats (59FR440-441, January 4, 1994).

2. Snake River Fall-run Chinook Salmon ESU. The Snake River fall-run chinook salmon ESU was proposed as threatened in 1991 (56FR29547-29552, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992).

3. Snake River Spring/Summer-run Chinook Salmon. The Snake River Spring/Summer-run chinook salmon ESU was proposed as threatened in 1991 (56FR29542-29547, June 27, 1991) and listed about a year later (57FR14653-14663, April 22, 1992).

4. Central Valley Spring-run Chinook Salmon ESU. The Central valley Spring-run chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed on September 16, 1999 (64FR50393-50415).

5. California Coastal Chinook Salmon ESU. The California coastal chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed on September 16, 1999 (64FR50393-50415).

6. Puget Sound Chinook Salmon ESU. The Puget Sound chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999).

7. Lower Columbia River Chinook Salmon ESU. The Lower Columbia River chinook salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999).

8. Upper Willamette River Chinook Salmon ESU. The Upper Willamette River Chinook Salmon ESU was proposed as threatened in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999).

9. Upper Columbia River Spring-run Chinook Salmon ESU. The Upper Columbia River Spring-run Chinook Salmon ESU was proposed as endangered in 1998 (63FR11482-11520, March 9, 1998) and listed a year later (64FR14308-14328, March 24, 1999).

C. Coho Salmon

1. Central California Coast Coho Salmon ESU. This ESU was proposed in 1995 (60FR38011-38030, July 25, 1995) and listed as threatened on May 5, 1999 (64FR24049-24062).

2. Southern Oregon/Northern California Coast Coho Salmon ESU. The Southern Oregon/Northern California coastal coho salmon ESU was proposed as threatened in 1995 (60FR38011-38030, July 25, 1995) and listed on May 6, 1997 (62FR24588-24609).

3. Oregon Coast coho salmon ESU. The Oregon coast coho salmon ESU was first proposed for listing as threatened in 1995 (60FR38011-38030, July 25, 1995), and listed several years later 63FR42587-42591, August 10, 1998).

D. Chum Salmon

1. Hood Canal Summer-run chum salmon ESU. The Hood Canal summer-run chum salmon ESU was proposed for listing as threatened, and critical habitat was proposed, in 1998 (63FR11774-11795, March 10, 1998). The final listing was published a year later (63FR14508-14517, March 25, 1999).

2. Columbia River Chum Salmon ESU. The Columbia River chum salmon ESU was proposed for listing as threatened, and critical habitat was proposed, in 1998 (63FR11774-11795, March 10, 1998). The final listing was published a year later (63FR14508-14517, March 25, 1999).

E. Sockeye Salmon

1. Ozette Lake Sockeye Salmon ESU. The Ozette Lake sockeye salmon ESU was proposed for listing in 1998 (63FR11750-11771, March 10, 1998). It was listed as threatened on March 25, 1999 (64FR14528-14536).

2. Snake River Sockeye Salmon ESU . The Snake River sockeye salmon was the first salmon ESU in the Pacific Northwest to be listed. It was proposed and listed in 1991 (56FR14055-14066, April 5, 1991 & 56FR58619-58624, November 20, 1991).

2.2 Regulatory Context (Defining the Action)

Undesirable plants in agricultural fields can reduce crop yields by reducing the availability of

sunlight, water, nutrients, and space for crops. Farmers improve crop yields through controlling weeds. The two most commonly used and widespread means of weed control in U.S. row crop agriculture are chemical control (herbicides) and tillage. Metolachlor is a herbicide registered in the U.S. to control weeds in agriculture. As a herbicide marketed in the United States, EPA is required under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA) to assess the chemical's potential to cause unreasonable adverse effects to the environment. In addition to evaluating environmental risks, EPA also considers the benefits resulting from pesticide use. Pesticide use may benefit human health, the environment, as well as provide economic benefits. When EPA determines that risks associated with pesticide use are acceptable, and the benefits of pesticide use outweigh environmental risks, a product registration is granted. The end result of the EPA pesticide registration process is an approved product label defining acceptable conditions for product use. A label represents the legal document which stipulates how and where a given pesticide may be used. Product labels, or end-use labels, describe the formulation type, acceptable methods of application, to what crops or use sites the product may be applied, and any restrictions on how applications may be conducted. Thus, the specific registered uses of metolachlor are "the actions" permitted by EPA, and the subject of this assessment. For purposes of this assessment, the federal actions under review are the registered uses of metolachlor in watersheds that could contribute to exposure or effects to any of 26 ESUs of listed Pacific salmonids.

The Endangered Species Act of 1973 amended FIFRA to define unreasonable adverse effects to include situations involving unreasonable hazard to the survival of a species declared by the Secretary of the Interior to be endangered or threatened (P.L. 93-205, December 28, 1987, 87 Stat. 903). NMFS is the branch of the Department of Commerce responsible for listing endangered anadromous fish, like salmonids. This assessment follows EPA guidance on conducting ecological risk assessments (EPA 1998) and the Office of Pesticide Program's policies for assessing risk to non-target and listed organisms (U.S. EPA 2004a).

This risk assessment is for currently registered uses of racemic metolachlor. The Agency has registered uses for racemic metolachlor and S-metolachlor as separate pesticides. S-metolachlor is an enriched version of racemic metolachlor first registered in 1997. Racemic metolachlor consists of a 50:50 mixture of both R-metolachlor and S-metolachlor, while the enriched isomer consists of a 88:12 mixture of S-metolachlor and R-metolachlor (see "2.4.2 Stereochemistry"). Subsequent to the registration of S-metolachlor the principal manufacturer of racemic metolachlor (Syngenta) cancelled all registrations of racemic metolachlor. However, several "Me Too"[1] registrations have been granted since cancellation of Syngenta's racemic registrations. The actual and potential use of these products in the area of the threatened or endangered salmonids form the basis for this risk assessment.

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[1] In the case of metolachlor, the "Me-Too" registration represent generic registrations of pesticides whose patent protection has expired. The conditions under which a "Me-Too" registration may be granted can be found in Section 3(c)(7)(A) of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

2.3 Previous Assessments

Several ecological risk assessments have been completed by EPA since metolachlor use was first registered in 1976. The most comprehensive risk assessment was conducted for the Reregistration Eligibility Decision (RED) process and was completed in1994 (U.S. EPA, 1994) . The 1994 ecological risk assessment incorporated all registrant-submitted data available at that time and included an evaluation of potential risk to aquatic and terrestrial organisms including non-target aquatic and terrestrial plants. The results of that assessment were incorporated into the Reregistration Eligibility Decision for metolachlor in 1995[2].

The 1994 metolachlor risk assessment for the RED identified an exceedance of the endangered species risk level of concern (LOC) for acute and chronic exposures to fish, signaling the need to further explore the potential of metolachlor to have an effect on listed fish. The endangered species LOCs were exceeded only for shallow water bodies with the relatively high application rate associated the roadside use of metolachlor. The 1994 assessment used a simple index that is no longer used to estimate runoff contributions to adjacent water bodies. Spray drift contributions to aquatic concentrations, which are included in current assessments, were not included in the 1994 assessment.

In 2002, the Agency completed a tolerance reassessment (TRED) for metolachlor as required by the Food Quality Protection Act (FQPA). FQPA pertains only to human health concerns but as part of this process the Environmental Fate and Effects Division (EFED) completed a human drinking water assessment (U.S. EPA 2002) that incorporated both surface water and groundwater monitoring data, registrant submitted monitoring studies, and computer modeling to provide estimated concentrations of metolachlor in drinking water sources for use in the dietary assessment of metolachlor. The TRED drinking water assessment was a national-scale assessment intended to provide conservative drinking water concentrations across the U.S. The TRED drinking water assessment used the most recent exposure assessment methods. Many of the same data sources, tools and techniques employed in the 2002 assessment are used in this assessment.

Since completion of the 1994 RED risk assessment, the Agency has completed several risk assessments for local uses or individual crops (Section 18's, and Section 24c registrations). These localized registrations have allowed for emergency uses that are limited both temporally and spatially, however, there are currently no active registrations under these categories. Nor are there any active experimental use permits for metolachlor or S-metolachlor.

An ecological and human health risk assessment conducted by the U.S. Geological Survey for the Lower Missouri River focused on the potential for metolachlor to affect aquatic plants and risks to humans via drinking water exposure (Fairchild *et al.* 1999). The assessment used toxicity data on an algal species (*Selenastrum capricornutum*) and an aquatic vascular plant

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[2] The 1995 Reregisitration Eligibility Decision for metolachlor is available via the internet at http://www.epa.gov/oppsrrd1/REDs/0001.pdf

(*Lemna minor*) compared to monitored and modeled metolachlor concentrations. While modeled concentrations were expected to result in effects to aquatic plants, peak monitored values were below toxic levels. The assessment concluded "...that adverse impacts of herbicides on non-target aquatic plant communities of the Lower Missouri River are unlikely."

In 2002 EPA conducted a species-specific assessment relative to the potential effects of metolachlor on 26 ESUs of listed Pacific salmonids.[3] The assessment was a refinement of the 1994 risk assessment in support of the metolachlor RED. The refined assessment of 2002 resulted in determinations under the Endangered Species Act of no effect on 6 ESUs; may affect, but not likely to adversely affect 5 ESUs; and may affect 15 ESUs. It is the 2002 species-specific assessment on which the EPA is currently engaged in consultation with NMFS and to which further refinements have resulted in this Pesticide Effects Determination.

2.4 Nature of the Chemical

The combination of physical and chemical properties, stereochemistry, biological mode of action, formulations, and use patterns can be used to describe the overall qualities of metolachlor. All references in this document to metolachlor are for the racemic form (50% S-isomer : 50% R-isomer) whereas all references to S-metolachlor refer to the enriched isomer form (88% S-isomer : 12% R-isomer). Where the enantiomeric ratio has not been determined the reference is for metolachlor/S-metolachlor.

2.4.1 Physical and Chemical Properties

Empirical formula: $C_{15}H_{22}NO_2Cl$
Molecular weight: 283.8
CAS Registry Nos.: 51218-45-2 and 87392-12-9

Metolachlor is a pale yellow to light brown liquid with a boiling point of 334 degrees C; density of 1.117 g/cm^3 at 20 degrees C; log P_{ow} of 3.05 at 25 degrees C; and vapor pressure of 2.8 x 10^{-5} mm Hg at 25 degrees C. Metolachlor is completely miscible in n-hexane, methanol, acetone, toluene, and n-octanol at 25 degrees C.

[3] http://www.epa.gov/oppfead1/endanger/effects/#1

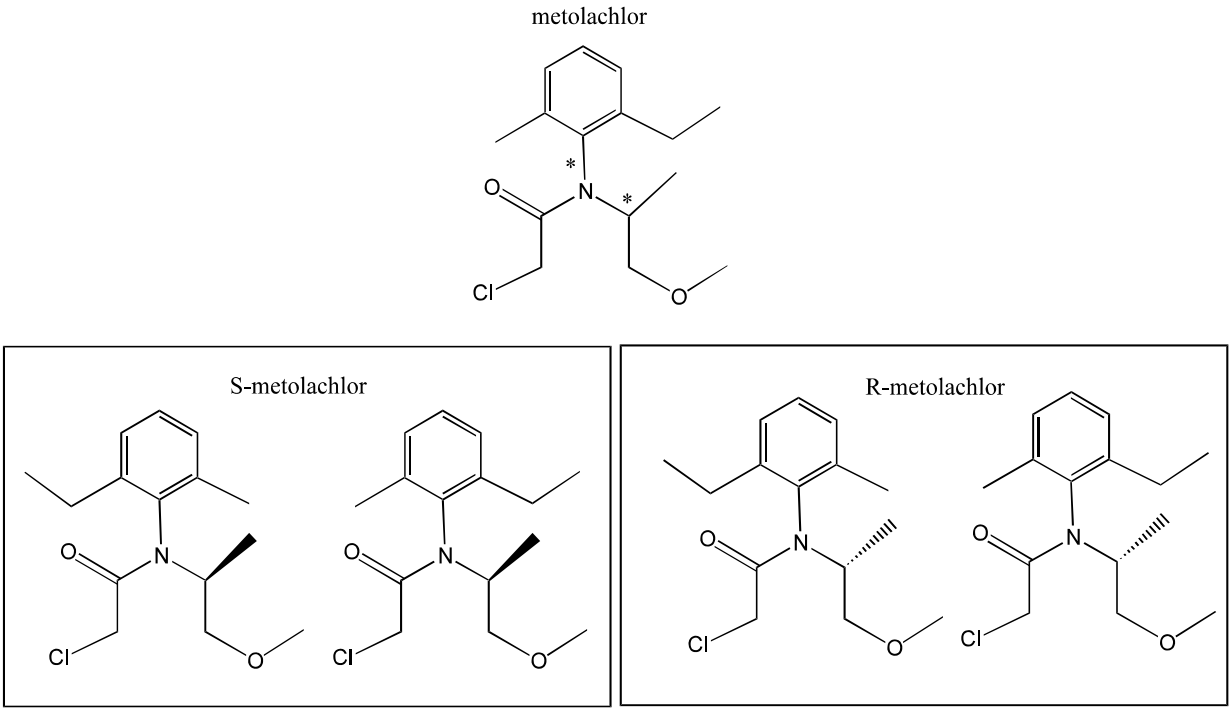


Figure 2.6.1. Chemical structure of metolachlor (racemic) and all stereochemical conformations of R- and S-forms of metolachlor.

2.4.2 Stereochemistry

Metolachlor is a racemic mixture of 50% S-metolachlor isomer and 50% R-metolachlor isomer. Of the two isomers, S-metolachlor is the more herbicidally active form. However, in this and previous risk assessments, data generated for both the racemic and an enriched form of S-metolachlor are used. The Agency has determined that both the environmental fate and ecotoxicity data submitted for racemic metolachlor and S-metolachlor are comparable (Federal Register 2003). Thus, certain data on S-metolachlor may be useful in assessing the exposure and effects of metolachlor.

Metolachlor has four stable stereoisomers because there is one chiral center (resulting in the R and S enantiomers) and one chiral axis (U.S. PTO 1991). The chiral axis results from the restricted rotation around the phenyl-nitrogen bond. Because rotation around this bond is limited and the methyl and ethyl groups on the phenyl ring make it asymmetrical, the orientation of the ring creates two possible stereochemical conformations. These stereoisomers exist as diastereomers (non-mirror images) that have different physical properties (i.e., solubility, melting point, density, etc.) and similar (not identical) chemical properties.

2.4.3 Mode of Action

Metolachlor's chemical structure defines it as a chloroacetanilide herbicide. A number of other herbicides are also included in this chemical class with alachlor, acetochlor, and butachlor being very similar in chemical structure. Most chloroacetanilide herbicides, including metolachlor, are used pre-plant, pre-emergence, or early post-emergence. Effective weed control requires that weeds be exposed at the seedling stage. Target weed species are generally grasses but some broadleaf weeds are also susceptible. In general, metolachlor application is coordinated with another herbicide to control a wider spectrum of weeds (Colby *et al.* 1989).

A single specific biochemical target of metolachlor and other chloroacetamide herbicides has not been defined and it appears that the chemical may act via multiple pathways. Alkylation appears to be important in phytotoxicity (Jablonkai 2003) and lipophilicity has been correlated with algal reproduction effects (Junghans *et al.* 2003). Covalent inhibition of coenzyme A elongation (Schmalfuss *et al.* 2000) and covalent inhibition of very-long-chain fatty acid synthesis via chalcone synthase have been proposed as mechanisms of action in terrestrial plants (Eckermann *et al.* 2003). Inhibition of protein biosynthesis has also been proposed as a mechanism of action in plants (Pillai *et al.* 1979). Several proposed mechanisms of action in plants involve irreversible, covalent binding to cysteine residues. Consistent with cysteine reactivity, glutathione S- transerfase has been shown to be important in detoxifying chloroacetanilide herbicides in tolerant plants (Rossini *et al.* 1998).

Metolachlor is classified as a seedling shoot growth inhibitor. Germinating monocots primarily absorb metolachlor through the shoot just above the seed while germinating dicots absorb at the shoot and roots. These herbicides are most effective at controlling small-seeded grass and broadleaf weeds. Large-seeded crops and weeds and mature plants are not usually affected (Zimdahl 1993).

Symptoms in plants exposed to metolachlor include stunting of shoots and seedlings failing to emerge from the soil. Grasses may "leaf-out" underground or blades may not unfurl normally. Broadleaf plants may develop crinkled leaves or show a shortened mid-vein. [4]

2.4.4 Use Characterization

Metolachlor is a broad spectrum herbicide first registered in 1976. Metolachlor is typically applied at rates between 1 and 2 pounds of active ingredient per acre (lbs a.i./A) by band, broadcast, soil incorporation, directed spray, or in-furrow treatment.

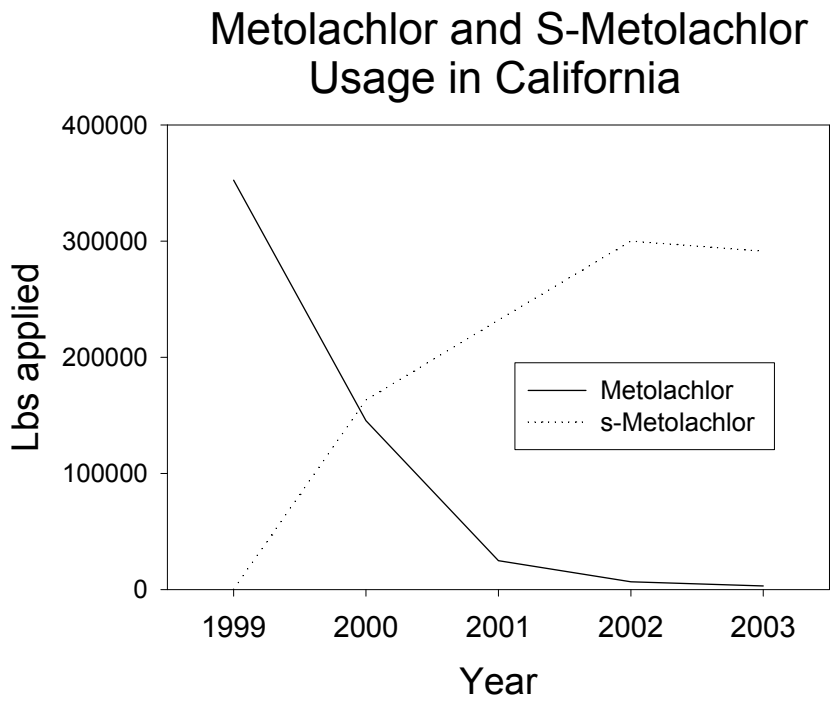
In 1997 the Agency granted registration to S-metolachlor which is an enriched isomer of racemic metolachlor with an 88:12 mixture of S and R isomers. Subsequent to the registration of S-metolachlor all racemic registrations were discontinued. However, several manufacturers requested registration of racemic metolachlor under the Agency's "Me-Too" program which

[4] http://www.extension.umn.edu/distribution/cropsystems/DC3832.html#part5

allows registration of pesticides whose patent protection has expired. Several of these "Me-Too" registrations were granted in and after 2002 and these form the basis of this assessment of racemic metolachlor[5].

Analysis of pesticide use data available on the USDA's National Agricultural Statistics Service (NASS) website (http://www.pestmanagement.info/nass/) indicate that racemic metolachlor is not currently being used in the states containing listed salmonids. Additionally, analysis of the California Department of Pesticide Regulation's (CDPR's) Pesticide Use Reports[6] from 1998 to 2003 indicates that use of racemic metolachlor has declined from a peak of 352,444 lbs in 1999 to 3,071 lbs in 2003 (the last year use data are available), while S-metolachlor use has increased from no use in 1998 to 291,159 lbs in 2003 (Figure 2.4.4).

Figure 2.4.4.



These data confirm that the registration of S-metolachlor has resulted in a conversion of

[5] Notices of pesticide registration can be viewed online through EPA's Pesticide Product Label System (http://oaspub.epa.gov/pestlabl/ppls.home).

[6] CDPR Pesticide Use Reports are available online at http://www.cdpr.ca.gov/docs/pur/purmain.htm.

use from racemic metolachlor to S-metolachlor. It is likely that the remaining use of racemic metolachlor in California represents a depletion of existing stocks since no racemic metolachlor products are currently registered in California.

An evaluation of existing metolachlor usage data was conducted for the Pacific Northwest states of Idaho, Oregon and Washington (Appendix D). This analysis focuses on the highest rates of use between 1998 and 2002 and does not account for decreased metolachlor usage. The analysis suggests that when historic metolachlor usage is averaged over farmed acres, the resulting county-wide application rates are less than 0.1 lbs/acre and frequently less than 0.01 lbs/acre. Assuming a typical application rate of 1 lb/acre, the analysis suggests that during the period between 1998 and 2002 less than 1-in-10 farmed acres in every county were treated with metolachlor. In most counties fewer than 1-in-100 farmed acres were treated. Although more recent usage data are not available, based on more recent data from California, the number of acres treated after 2002 in the Pacific Northwest is expected to be lower.

2.4.5 Product Label Information

Labels may be categorized into two types: labels for technical products and labels for formulated, or end use, products. Technical products contain racemic metolachlor of high purity and are used only to make formulated products. Formulated products can be applied to specific crops or use sites to control weeds. The formulated product labels limit metolachlor's potential use to fields where potatoes, corn, cotton, pod crops, peanuts, sorghum, and soybeans are grown. Technical metolachlor labels allow metolachlor to be formulated into products that can be applied to crops and sites not currently included on the formulated product labels. The sites on technical labels but not currently included on formulated product labels include nurseries, turf, landscape plantings, non-bearing citrus, non-bearing grapes, stone fruits, tree nuts, cabbage, peppers, and alfalfa for seed. Before any formulated products can be sold allowing uses that are not currently on formulated product labels, new product labels must be submitted to, and approved by EPA. Therefore, only uses currently on formulated product labels are included in this risk assessment and considered to be part of the federal action.

Table 2.4.5 Summary of Current Racemic Metolachlor Uses				
EPA Reg. No. Label	**Trade Name**	**% Active Ingredient**	**Application Method**	**Uses**
19713-412	**Drexel Metolachlor Technical***	95.0	For Formulation Only	corn, cotton, peanuts, potatoes, pod crops, safflower, sorghum, soybeans, nurseries, turf, landscape plantings, buffalo grass, Guymon Bermuda grass for seed, non-bearing citrus, non-bearing grapes, stone fruits, tree nuts, cabbage, peppers, alfalfa for seed
19713-539	**Drexel Metolachlor Technical Herbicide***	96.0	For Formulation Only	corn, cotton, peanuts, potatoes, pod crops, safflower, sorghum, soybeans, nurseries, turf, landscape plantings, buffalo grass, Guymon Bermuda grass for seed, non-bearing citrus, non-bearing grapes, stone fruits, tree nuts, cabbage, peppers, alfalfa for seed, radishes for seed
60063-17	**Sipcam Metolachlor Technical***	97.0	For Formulation Only	corn, cotton, peanuts, pod crops, potatoes, safflower, sorghum, soybeans, nursery stock, turf, landscape plantings
56077-67	**Technical Metolachlor II***	96.8	Manufacturing Purposes Only	
19713-548	**Me-Too-Lachlor**	86.4	Aerial, Ground and Chemigation	corn, cotton, peanuts, pod crops, potatoes, safflower, sorghum, soybeans
19713-555	**Drexel Me-Too-Lachlor IV Herbicide**	84.4	Aerial, Ground and Chemigation	corn
19713-547	**Drexel Trizmet II**	26.1	Aerial and Ground	corn
60063-22	**Stalwart C**	84.1	Aerial, Ground and Chemigation	corn
62719-240	**Broadstrike SF + Dual**	79.9		corn, soybean
19713-549	**Drexel Me-Too-Lachlor II Herbicide**	84.4	Aerial, Ground and Chemigation	corn
19713-556	**Drexel Me-Too-Lachlor III Herbicide**	84.1	Aerial, Ground & Chemigation	corn
42750-69	**Metolachlor 8E**	86.4	Aerial,	corn, cotton, peanuts, pod crops, potatoes, safflower, sorghum, soybeans

Table 2.4.5 Summary of Current Racemic Metolachlor Uses				
EPA Reg. No. Label	**Trade Name**	**% Active Ingredient**	**Application Method**	**Uses**
60063-23	**Stalwart Xtra Herbicide**	26.1	Aerial and Ground	corn
62719-239	**Broadstrike + Dual**	79.9	Ground	corn, soybean
42750-71	**Metolachlor AT**	34.8	Aerial and Ground	field and pop corn
3125-366	**Turbo 8 EC**	70.0	Aerial, Ground and Chemigation	soybeans and potatoes
56077-68	**Inter Plus II**	84.4	Aerial and Ground	corn, cotton, peanuts, pod crops, potatoes, safflower, sorghum, soybeans
56077-69	**Inter 8E II**	86.4	Aerial and Ground	corn, cotton, peanuts, pod crops, potatoes, safflower, sorghum, soybeans
42750-70	**Metolachlor 8E Plus**	84.4	Aerial, Ground and Chemigation	Field and pop corn

* Technical products are not labeled for direct use. The technical product is sold for making formulated products.

Metolachlor is formulated mainly as emulsifiable concentrates. Other formulations include flowable concentrates, soluble concentrates, and granular formulations.

Application equipment for the agricultural uses includes ground application (the most common application method), aerial application, irrigation systems, and chemigation (center pivot only). Risks from ground boom and aerial applications are considered in this assessment because they are expected to result in the highest off-target levels of metolachlor due to generally higher spray drift levels. Ground boom and aerial modes of application tend to use lower volumes of application applied in finer sprays than applications coincident with irrigation and thus have a higher potential for off-target movement via spray drift. Runoff associated with large rain events is expected to be responsible for the greatest off-target movement of metolachlor. Smaller runoff events resulting from over irrigation would result in lower levels of off-target movement.

2.5 Initial Area of Concern

The term "action area" is defined in the Code of Federal Regulations (50 CFR 402.02) as "...all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." Metolachlor that is applied to agricultural fields has the potential to move off-target via spray drift, runoff, and other routes of transport, thus its effects may not be limited to the treated field. The distance from use sites that metolachlor may cause effects is dependent upon its toxicity to off-target receptors and the level of exposure that occurs away from the application site. The action area for metolachlor may be broadly defined as the area where metolachlor exposure resulting from labeled uses directly or indirectly affects the environment. To more specifically determine the metolachlor action area it is necessary to understand metolachlor's environmental toxicity and transport. Because metolachlor use is allowed on agricultural fields in all states, portions of the action area exist nationwide. The scope of this assessment is limited to listed Pacific salmonids which are only found in California, Oregon, Washington, and Idaho. The action area was defined and evaluated in this assessment through the process of identifying an "initial area of concern" and the "ecosystem potentially at risk", described below. The assessment focuses on the subset of the national action area that occurs in the same (or nearby) states that listed Pacific salmonids and salmonid habitat are found. Metolachlor use in States far from listed salmonids and their habitat is expected to have no effect on them.

NMFS has defined ESUs relevant for each species of salmonid. An ESU is defined as a population that is substantially reproductively isolated from conspecific populations and that represents an important component of the evolutionary legacy of the species. Isolation does not have to be absolute, but it must be strong enough to permit evolutionarily important differences to accrue in different population units. The second criterion would be met if the population contributed substantially to the ecological/genetic diversity of the species as a whole. For the listed salmonids in the

Pacific Northwest and California, there are 26 ESUs.[7]

Because product labels define the use sites where pesticides may be applied, they are useful in defining the ecosystem potentially at risk. An evaluation of the currently registered labels for metolachlor was conducted for this assessment. The label analysis indicated that there are currently no geographic limitations on the use of metolachlor. However, the use of metolachlor is limited by crop. A summary of the crops included on current metolachlor labels is presented in Table 2.5. The crop location data were obtained from the United States Department of Agriculture (USDA) Census of Agriculture (AgCensus) for 2002 (http://www.nass.usda.gov/census/) and includes all metolachlor-registered crops except potato and safflower. Year 2002 data are not currently available for either potato or safflower, but 1997 AgCensus data show that potatoes are grown in eastern Washington and southern Idaho. Safflower is grown in California mostly in Yolo and Sutter counties. Generated using AgCensus data from 1997 and 2002, Figure 2.5a presents the extent of crop acreage for all currently registered racemic metolachlor uses. Figure 2.5b presents the extent of crop acreage on which racemic metolachlor may be used in the four states containing listed salmonids.

[7] Since EPA began consultation on these actions, two additional ESUs have been listed. While EPA acknowledges its responsibility to also assess potential effects to these newly listed ESUs, this partial assessment focuses only on the 26 ESUs that are the subject of the 2002 EPA Pesticide Effect Determinations. More detail on the listed salmonid ESUs may be found at: http://www.salmonrecovery.gov/remand/court_docs/federal_defendants_first_quarterly_status_report/e_backintro.pdf.

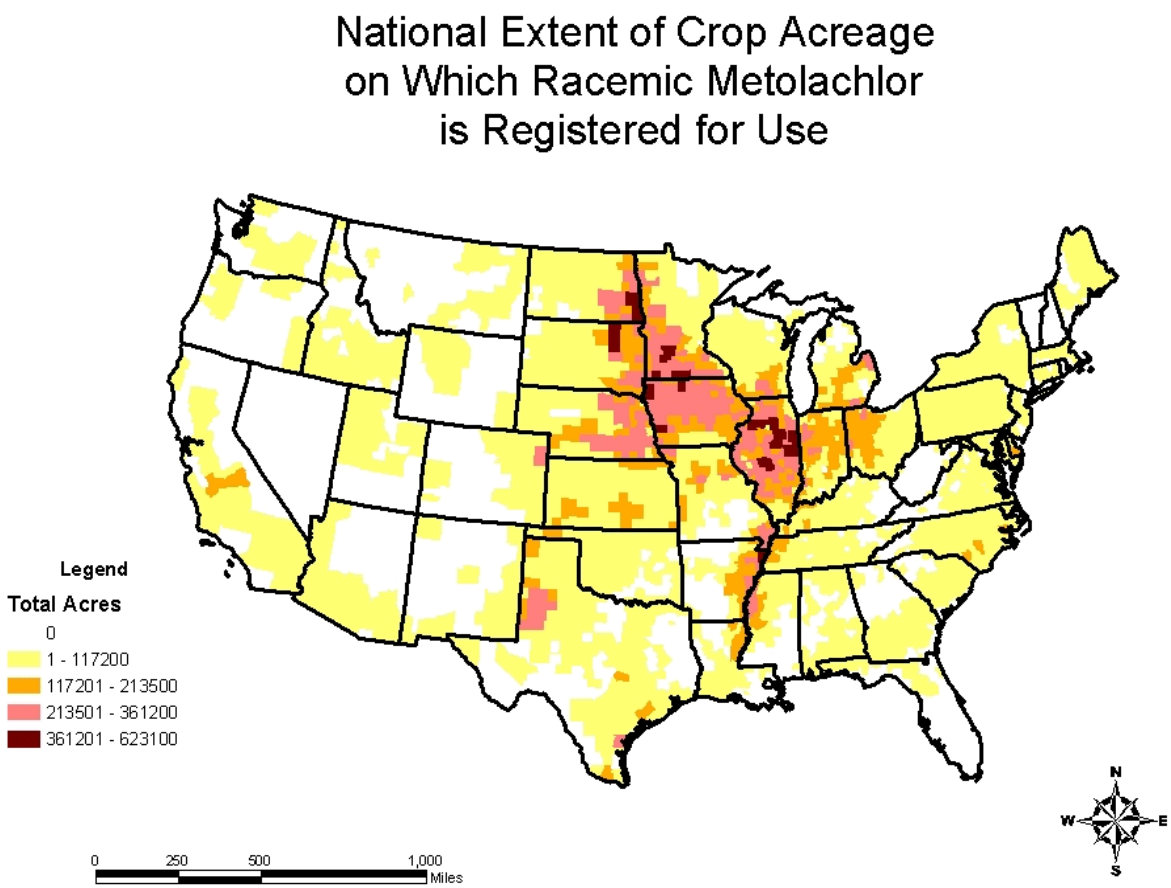


Figure 2.5a. National Extent of Crop Acreage with Potential Metolachlor Use

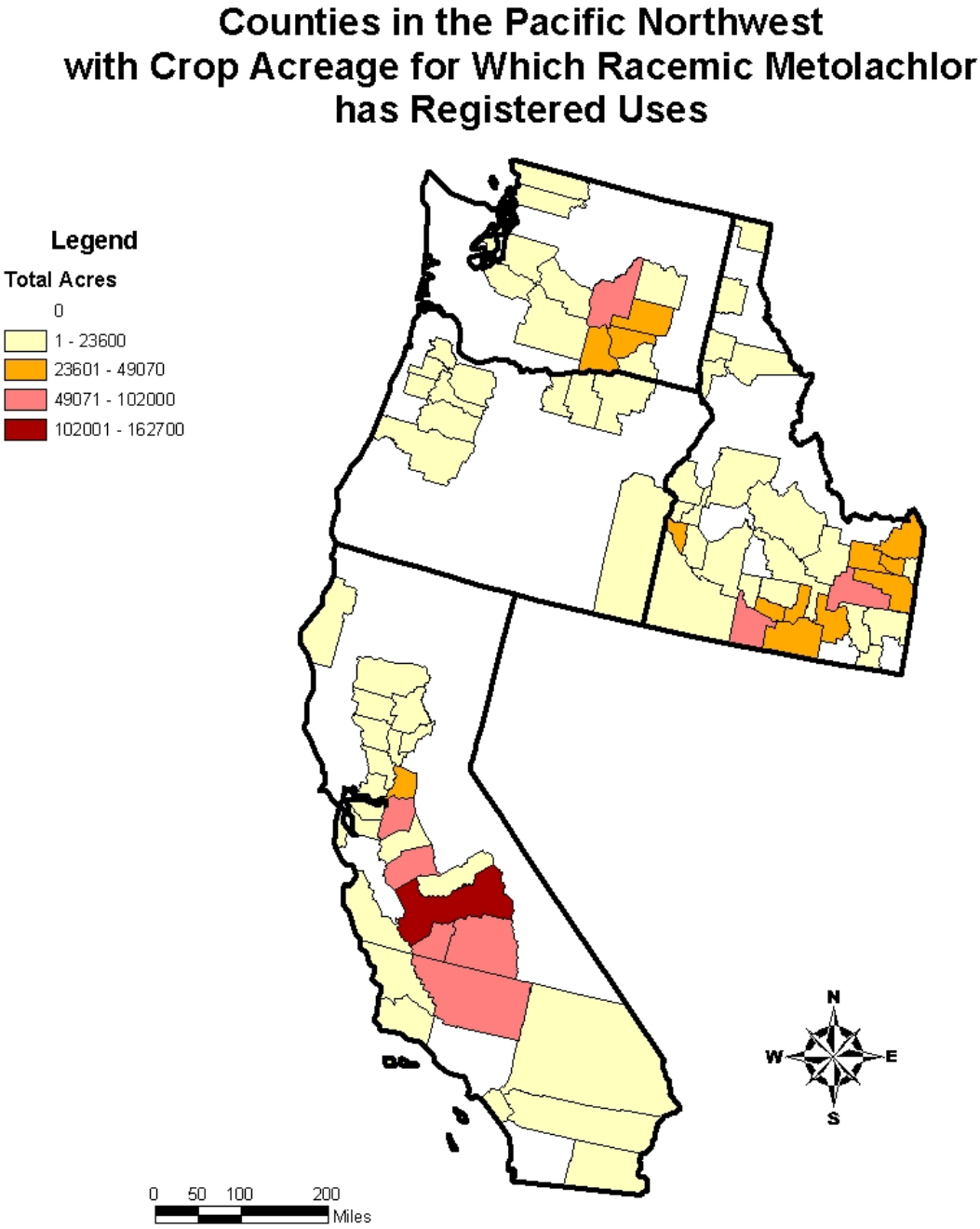


Figure 2.5b. Counties and acreages in Pacific Northwest States (California, Idaho, Oregon, and Washington) with crops on which metolachlor may be used.

The relative importance of the registered uses to the states included in this assessment have been evaluated. This reevaluation was completed to focus the risk assessment to areas where metolachlor may be used in proximity to salmonid supporting waters and to assist in determining the representativeness of surface water modeling completed for the exposure assessment. A more thorough discussion of this analysis is presented in the section on the modeling approach (see 4.3.2h). Figure 2.5c presents a flow chart representing the process by which pesticide specific information is integrated into the problem formulation phase of the risk assessment to define the initial area of concern and subsequently to identify ecosystems potentially at risk, consistent with the Ecological Risk Assessment Framework (U.S. EPA 1998). As seen in Figure 2.5d, this approach consists of an iterative process by which the risk assessor may refine the initial area of concern and potentially at risk ecosystem designations at various stages in the risk assessment which allows for subsequent refinement as needed.

Available data were evaluated to define the initial area of concern for this assessment. The USGS's National Land Cover Dataset (NLCD) was developed from early to mid 1990's satellite data (http://landcover.usgs.gov/natllandcover.asp). The data shows the location of agricultural land within counties and describes the general type of agricultural use (*e.g.* orchard, forestry, row crops) but does not describe the specific crops grown in individual counties. The NLCD is available as a general agricultural crop land coverage for use in GIS applications. This crop land coverage (http://maps.ers.usda.gov/AgResources/index.asp) is useful for determining the potential use area for pesticides that are used on agricultural crops, such as metolachlor. Figure 2.5e presents the location of the USDA's Cropland coverage relative to the states containing listed salmonids.

USDA's Census of Agriculture (AgCensus) provides estimates of the amount of acres associated with specific crops within counties but does not specify where in the counties the crops are grown. Counties containing metolachlor-registered crops have the potential for metolachlor use. For these counties, the NLCD can be used to identify where metolachlor use may occur and the proximity of the use to salmonid supporting waters. As shown in Figure 2.5e, the highlighted counties represent those areas based on 1997 and 2002 AgCensus data where crops represented by racemic metolachlor labels are present. The figure also shows the location of cropland within these counties. The area defined by the cropland within the counties where metolachlor may potentially be used represents the initial area of concern.

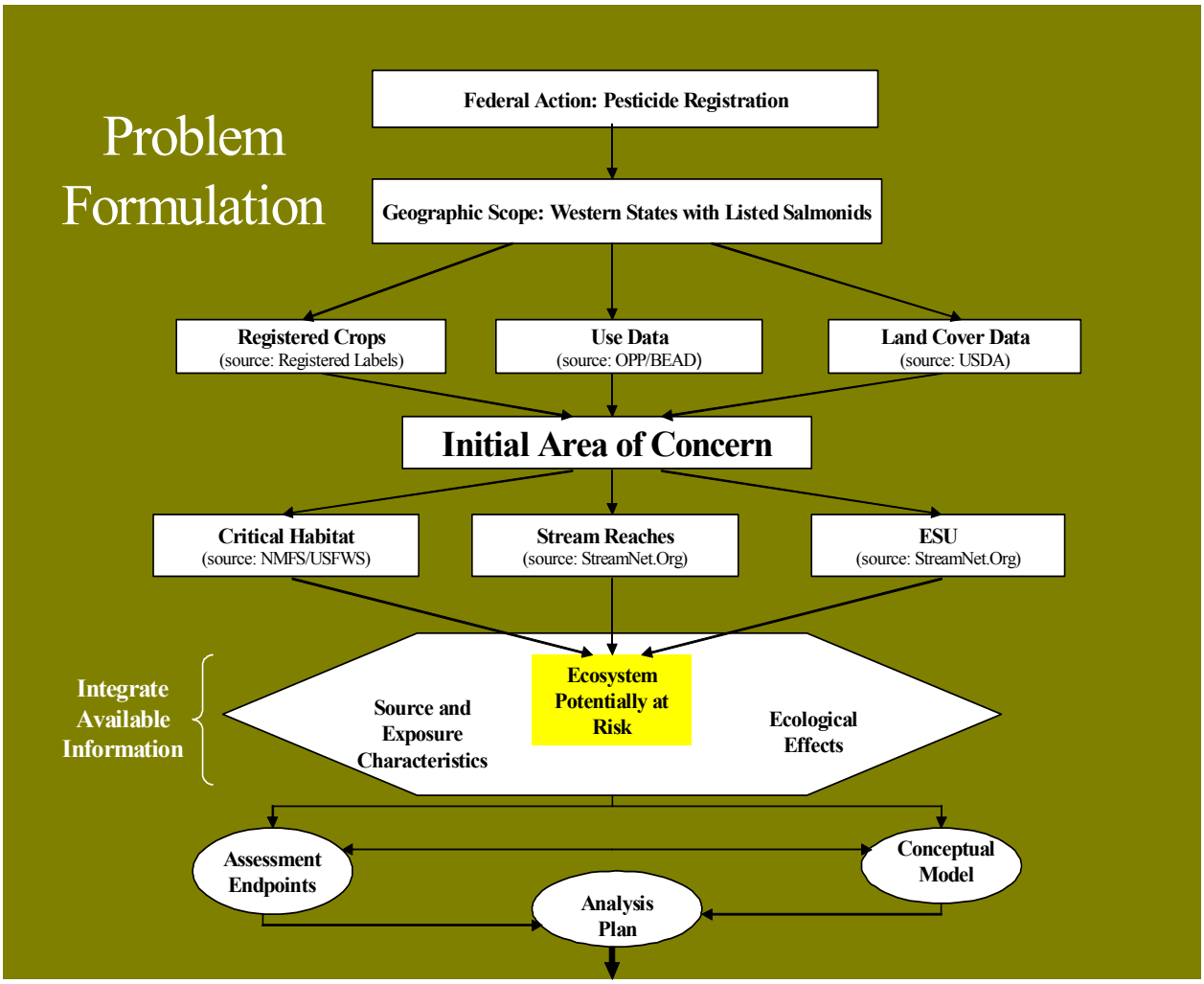


Figure 2.5c. Steps within Problem Formulation to Define the Initial Area of Concern and Identify Ecosystems Potentially at Risk

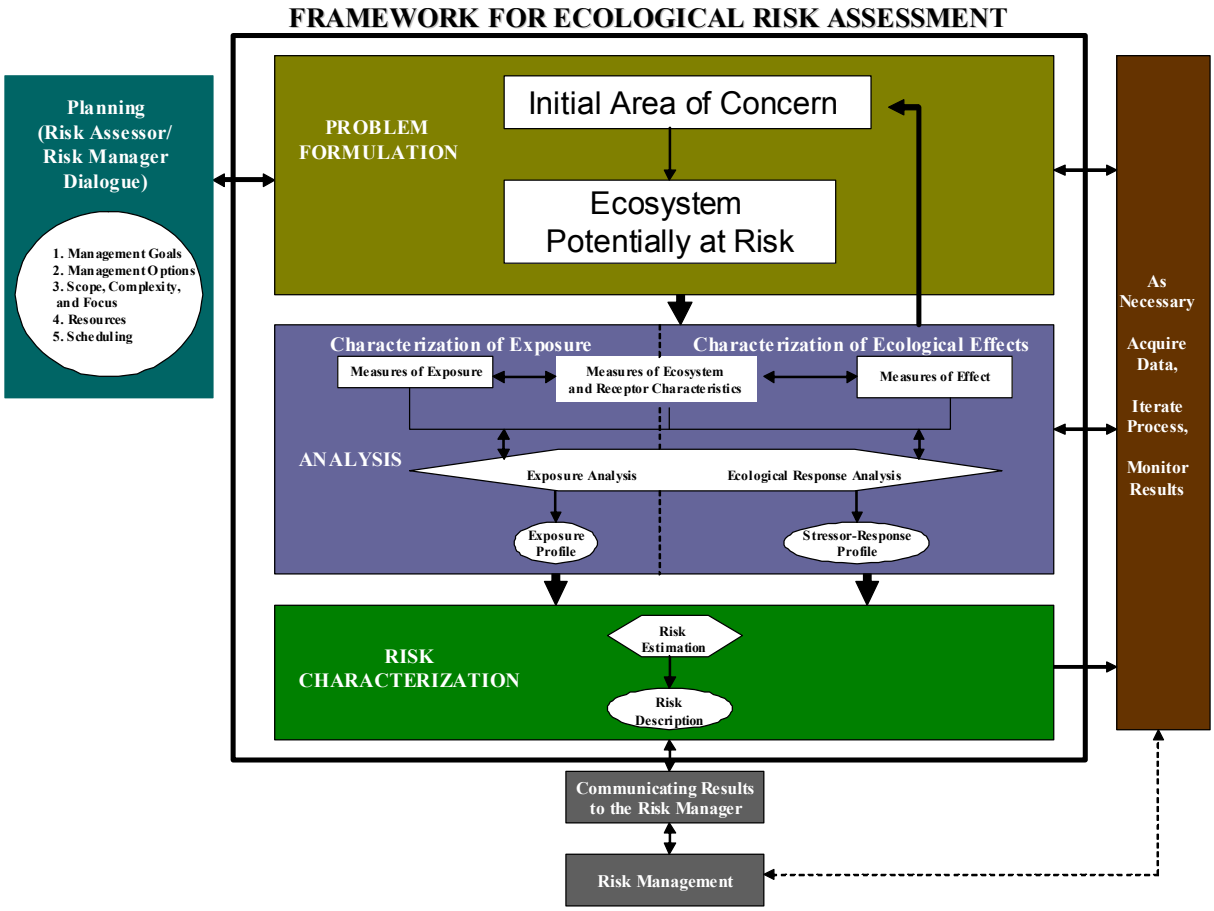


Figure 2.5d. Definition of Initial Area of Concern and Ecosystems Potentially at Risk within the Context of the Overall Ecological Risk Assessment Framework

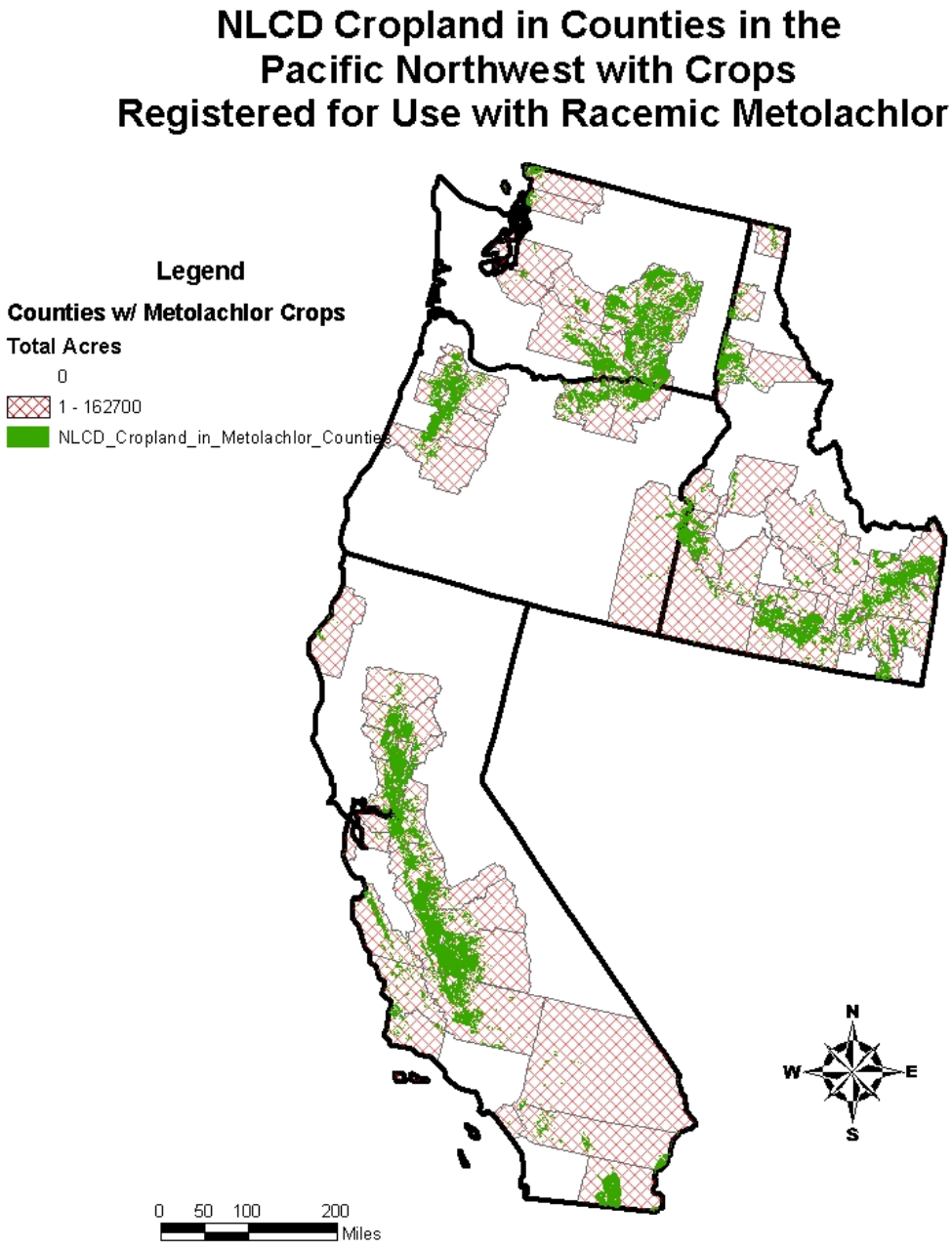


Figure 2.5e. Initial Area of Concern: NLCD information on the occurrence of crops on which metolachlor may be used within states where listed Pacific salmonids are found.

2.5.1 Ecosystems Potentially at Risk

To further refine the risk assessment, an evaluation of the ecosystems potentially at risk was conducted (see Figure 2.5c). In this exercise, the co-occurrence of cropland with potential metolachlor use is evaluated relative to the ESUs, stream reaches, and any available salmonid critical habitat information.

The first step in evaluating the ecosystems potentially at risk is comparison of the initial area of concern identified above with the ESUs identified by NMFS. Figure 2.5.1a presents the location of the ESUs, while Figure 2.5.1b presents the area of cropland within the listed ESUs. Because racemic metolachlor is only registered for use on agricultural crops, this type of analysis provides a reasonable refinement for identifying ecosystems potentially at risk. To provide context to this analysis, Figure 2.5.1c was prepared. This figure shows the relationship of the cropland within the ESUs, to where metolachlor registered crops are likely to be found. Overall, this analysis showed that many areas where racemic metolachlor could be intensively used (southern Idaho, south-central California) are outside the area of the ESUs. This allows for a more focused assessment on relevant ecosystems.

Figure 2.5.1d shows the co-occurrence of the initial area of concern with stream reaches within the Willamette Valley in western Oregon. Figure 2.5.1e shows the co-occurrence of the initial area of concern with stream reaches in the Columbia River basin of central Oregon and Washington as well as northern Idaho. Figure 2.5.1f shows the co-occurrence of the initial area of concern with stream reaches in the Central Valley and Salinas Valley of Central California. These areas represent the major areas of potential racemic metolachlor use and are the focus for evaluating ecosystems potentially at risk.

The highest potential for risk to listed salmonids is expected to occur in the areas where salmonid supporting waters overlap with locations where metolachlor can be used. Thus, these areas define where ecosystems important to listed salmonids are most likely to be affected. If direct or indirect risks to salmonids do not exceed levels of concern in these areas, it is improbable that risks would exceed levels of concern further downwind or downstream. If risks are unacceptable at the edge of the treatment area, then the spatial extent of the potentially affected ecosystem is increased. Both exposure and toxicity are considered in determining the spatial extent of the ecosystem potentially affected.

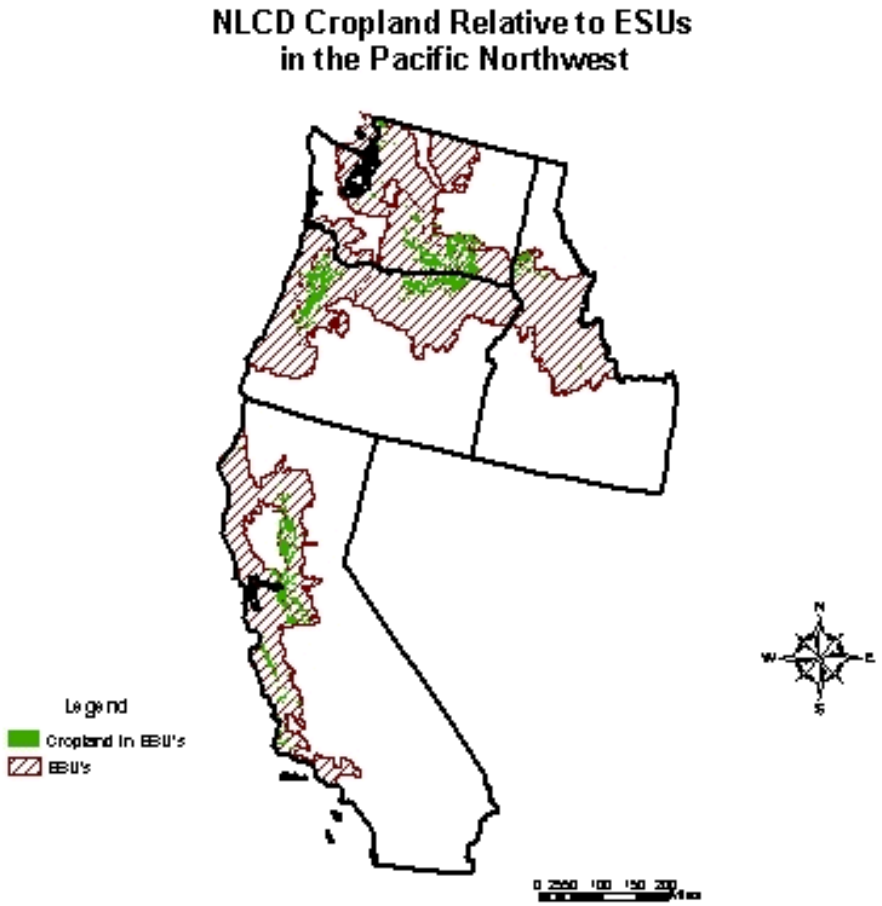


Figure 2.5.1a. Agricultural Cropland from National Land Cover Data (NLCD) Relative to ESUs in the Pacific Northwest.

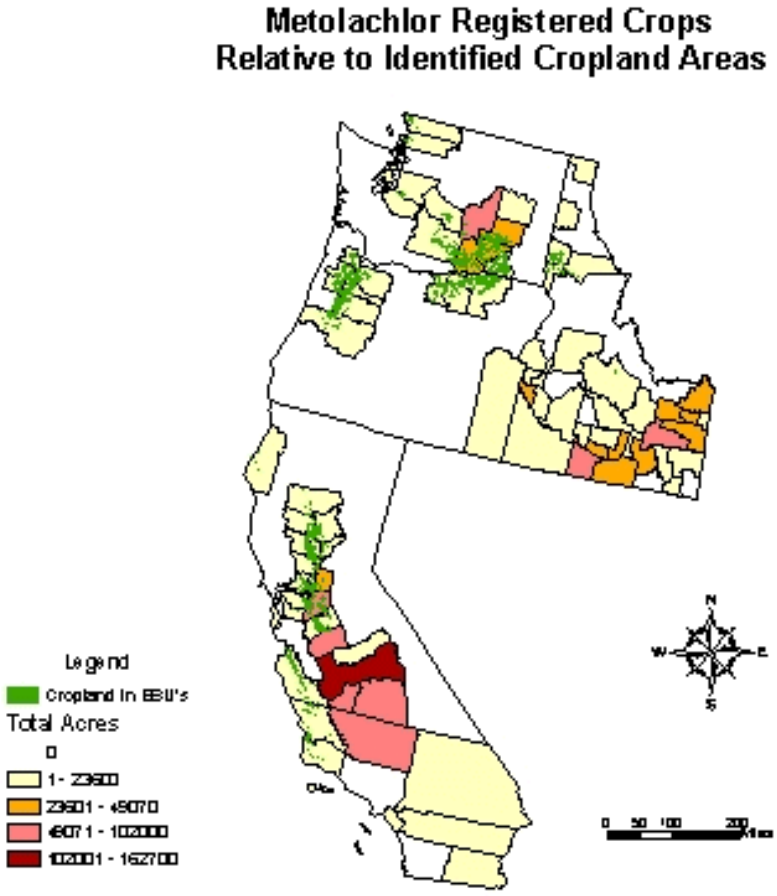


Figure 2.5.1b. Extent of NLCD Cropland within ESUs Relative to Counties with Potential Metolachlor Crop Acreage

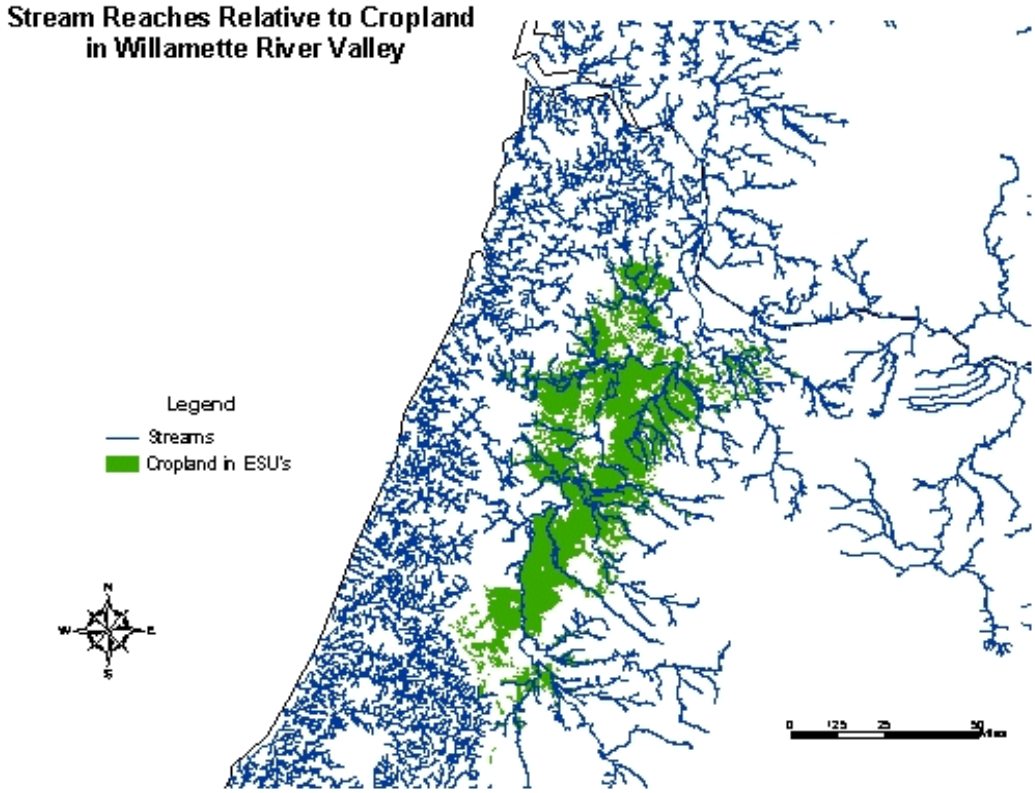


Figure 2.5.1c. Stream Reaches Relative to NLCD Cropland in Willamette River Valley

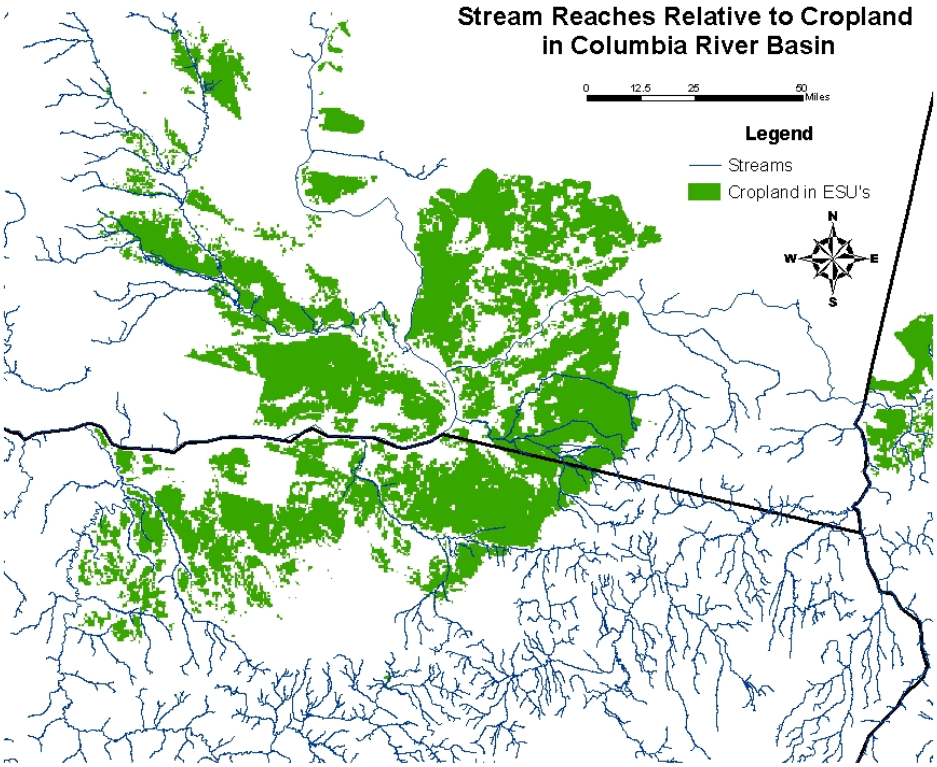


Figure 2.5.1d. Stream Reaches Relative to NLCD Cropland in Columbia River Basin

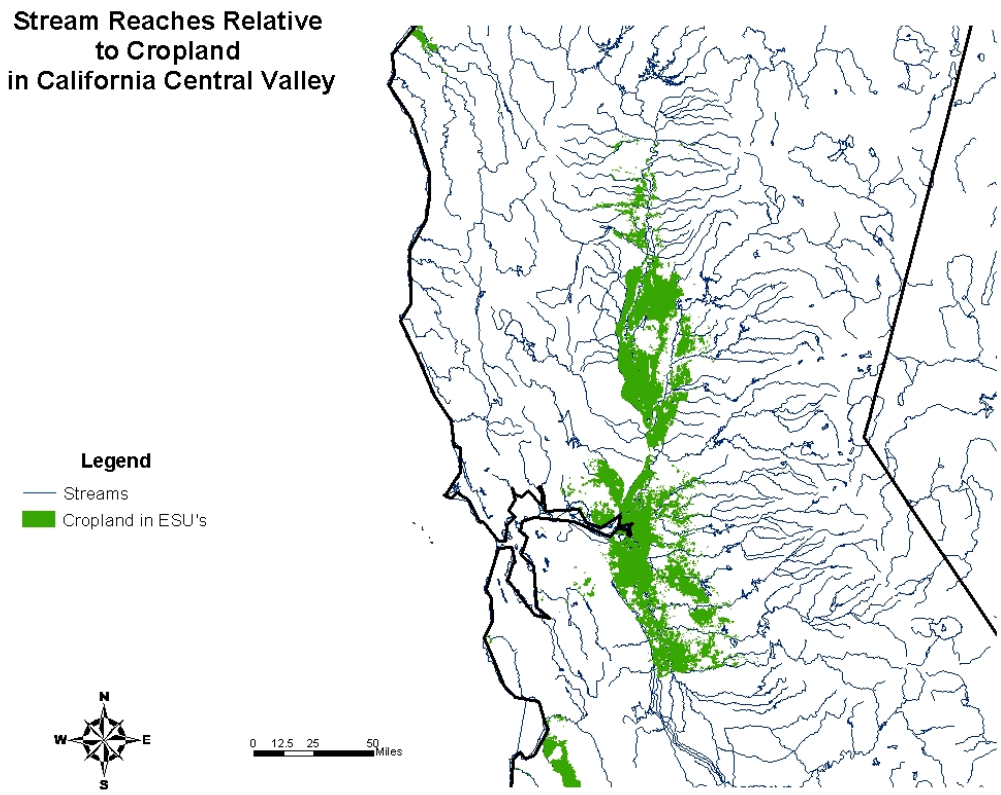


Figure 2.5.1e. Stream Reaches Relative to NLCD Cropland in California Central Valley

2.5.2 Refinement of the Initial Area of Concern and Ecosystems Potentially at Risk to Identify the Action Area

The initial area of concern and ecosystem potentially at risk were established based on the environmental fate profile of metolachlor and using information on the known habitat of salmonids. The environmental fate profile suggests that given the persistence, leaching potential, degradation pathway, and volatility, that runoff and drift are likely to be the major routes of exposure for aquatic organisms. However, other routes have been evaluated including atmospheric transport (Section 4.3.2i) and recharge of surface water (baseflow) via groundwater (Section 4.3.2j). In both cases, these processes are considered not important relative to overall exposure. Other processes considered but which lack either models or monitoring data or are considered unlikely are recycling through irrigation, and windblown exposures via dust, among others.

The ecosystem potentially at risk is defined as those streams where salmonids or critical habitat may be found within the initial area of concern (see Sections 2.5 and 2.5.1). The initial area of concern and ecosystems potentially at risk may be further expanded depending on the findings of the screening-level risk assessment. For example, if a risk assessment concludes no direct or indirect effects are likely to occur from the registered use of a given pesticide within the initial area of concern and ecosystems potentially at risk, no effects farther from a field would need to be assessed because the potential for risk is greatest in the initial area of concern. However, if an assessment concluded either a direct, or indirect effect is possible, it may be necessary to determine how far outside the initial area of concern effects may be expected. For an aquatic assessment, this would likely require an evaluation of whether effects may be expected downstream from the initial definition of the ecosystem potentially at risk identified in the screening-level assessment.

For this assessment of metolachlor, the screening-level assessment method of comparing risk quotients to levels of concern indicated there are no direct effects to salmonids (see section 5.2.1). However, risk quotients for plants indicated a potential for indirect effects to salmonids due to exceedances of the LOC for terrestrial and aquatic plants (see sections 5.1.4 and 5.1.5). Therefore, a reassessment of the initial area of concern and ecosystem potentially at risk has been completed to determine the action area. Because of differences in the ways that terrestrial and aquatic plants could be exposed to metolachlor and their relationship to salmonids, different methods were required to identify the portions of the action area defined due to the potential for effects to aquatic plants and the portions defined due to the potential for effects on terrestrial riparian plants. Although the areas identified as potentially affected from impacts on terrestrial plants overlap with areas identified as having potential for effects on aquatic plants, they do not completely coincide.

Action Area Defined from Potential Effects to Aquatic Plants

The portion of the action area defined by the potential of metolachlor to indirectly affect salmonids via aquatic plants is the streams reaches draining catchments that are more than 50% cropped. Catchments with lands that are less than 50% cropped are expected to

dilute surface water concentrations more than two-fold, the amount necessary to reduce the RQ for aquatic plants below the LOC. A geospatial analysis of watersheds in or adjacent to 20 ESUs[8] was conducted to graphically demonstrate how far downstream from potential use sites there is a potential for metolachlor concentrations to result in an exceedance of aquatic plant risk levels of concern.

Geospatial data sets were used to define the initial area of concern and ecosystem potentially at risk within 20 ESUs for which data were available. The National Hydrography Dataset (NHD) (www.nhd.usgs.gov), at a 1:100,000 scale, served as the basis for the watershed-based analysis. Upstream/downstream navigation was achieved using publically available software tools designed specifically for the NHD. The methodology also requires information on agricultural land use within a watershed. The National Land Cover Data Set (www.nlcd.usgs.gov) served as the basis for determining the proportion of agricultural lands within a watershed. This analysis utilized the USDA's Cropland Coverage, (http://landcover.usgs.gov/natllandcover.asp), a product derived from the NLCD, in which all agricultural land classes are aggregated into a single class representing total agricultural land. To estimate the proportion of agricultural land within a watershed (percent cropped area or PCA) contributing runoff to a given stream segment, it was necessary to delineate catchments for each segment. The catchments represent the areal extent that drains into the target stream. Stream catchments based on the NHD and derived for the entire U.S. were previously generated by Oak Ridge National Laboratory (ORNL) for use in surface water assessments using a Thiessen polygon approach for delineation (ORNL undated). The Thiessen polygons are estimations of drainage areas for stream reaches, assuming that boundaries of the drainage areas are equidistant from neighboring reaches.

The methodology requires two steps. First, PCAs are calculated for all stream segment polygons within a target watershed. This step produces a base data layer that can be used in an analysis of the effects of any chemical. The second step is chemical specific and applies information about the magnitude of the RQ relative to the LOC to determine the extent of downstream effects.

The PCA component requires two initial processing steps. First, the PCA for each stream segment polygon within the watershed is calculated based on the NLCD. This step produces a map, in which each stream segment is assigned a PCA value. Second, the stream navigation tools are used to navigate upstream from each stream segment within the basin, and delineate the total contributing upstream PCA. In this way, the approach provides an "in-segment" PCA and a "catchment" PCA.

Once the PCA map is created, it is then possible to analyze the potential for downstream effects. The downstream effects analysis is completed by using a target dilution factor. The dilution factor is the dilution level needed to reduce the screening-level EEC to where the calculated RQ is below the LOC. This ratio represents a target dilution factor

[8] The 20 ESUs used to demonstrate this methodology are those for which the NMFS had available information in a form conducive to this demonstration.

for metolachlor in streams within the initial area of concern. The dilution factor is used with hydrography data to estimate the downstream distance where effects are possible and thus refines or expands the initial area of concern.

If the screening-level assessment identifies a potential for either direct or indirect effects due to RQs exceeding LOCs for multiple taxa, then the approach is applied to the taxa with the greatest exceedance. For example, if the screening-level assessment indicates that direct effects to fish require a 10x dilution factor but indirect effects to aquatic invertebrates require a 20x dilution factor, the action area analysis should be conducted for the 20x factor which would yield the greatest increase in initial area of concern.

This approach, is expected to be conservative because it assumes that all cropland within an action area is treated with a pesticide simultaneously at the maximum allowable rate. The approach also assumes that runoff across the watershed will contribute uniformly to streams (which is unlikely) and that there is no baseflow contribution to the streams. It provides a simple dilution factor which can be applied to the exposure value used in the RQ calculation (whether predicted by modeling or from monitoring data) and allows for a recalculation of the RQ at that specific point in the stream.

For metolachlor, the maximum RQ for acute risk to aquatic plants is 1.99 (see section 5.1.4) while the LOC is 1. The estimated exposure is based on the assumption that 100% of the watershed is treated. Therefore, because the RQ is a simple ratio of exposure to toxicity, the estimated metolachlor concentration will need to be diluted by a factor of 2 (or a PCA of 50%) to obtain exposures below the LOC. This approach is applied to the representative ESU by identifying all stream segment polygons represented by 100% "in-segment" PCA (the initial area of concern where 100% of the polygon is assumed cropped), all stream segment polygons where the "catchment" PCA is greater than 50%, and all stream segment polygons where the "catchment" PCA is less than 50%. These data are then used to locate all stream segments downstream from the initial area of concern (defined by the 100% "in-segment" PCA) where the "catchment" PCA is greater than 50%. It is assumed from this analysis that all downstream segments where the "catchment" PCA is less than 50% that these streams are receiving sufficient non-agricultural water to dilute the screening-level EEC to below the LOC.

To map the action area, Thiessen polygons are drawn around all stream reach segments, including segments outside the initial area of concern, to define a catchment area for each stream segment (Figure 2.5.2a). Using the NLCD cropland coverage and the boundaries of the polygons, an individual, or "in-segment", PCA is calculated for each polygon. In addition, watershed boundaries are drawn for each stream segment and a "catchment" PCA is calculated for each polygon (Figure 2.5.2b) which represents the ratio of cropland to watershed area for the upstream contribution to each polygon (Figure 2.5.2c). Using the dilution factor approach, geospatial analysis associates a PCA with each stream reach (Figure 2.5.2d) and identifies those polygons downstream from the initial area of concern which have catchment PCA's greater than the target PCA (derived by dividing the LOC by the RQ). The downstream reaches within these polygons are considered to be within the final action area while those with PCA's less than the target value are considered to be outside the action area. This methodology, is conservative for several reasons noted

above and below. It is likely that there are many crops within a given action area on which metolachlor is not registered for use. For those crops within a given action area on which metolachlor is registered for use, they are unlikely to all receive applications of metolachlor at the same time or application rate due to differences in pest pressures, growth stages, logistics of applying pesticides, and economic factors. Thus, the approach uses simplifying assumptions which are conservative. This analysis was used to revisit the initial area of concern based on findings of the screening-level risk assessment. The results of this analysis are presented in Table 2.5.2a.

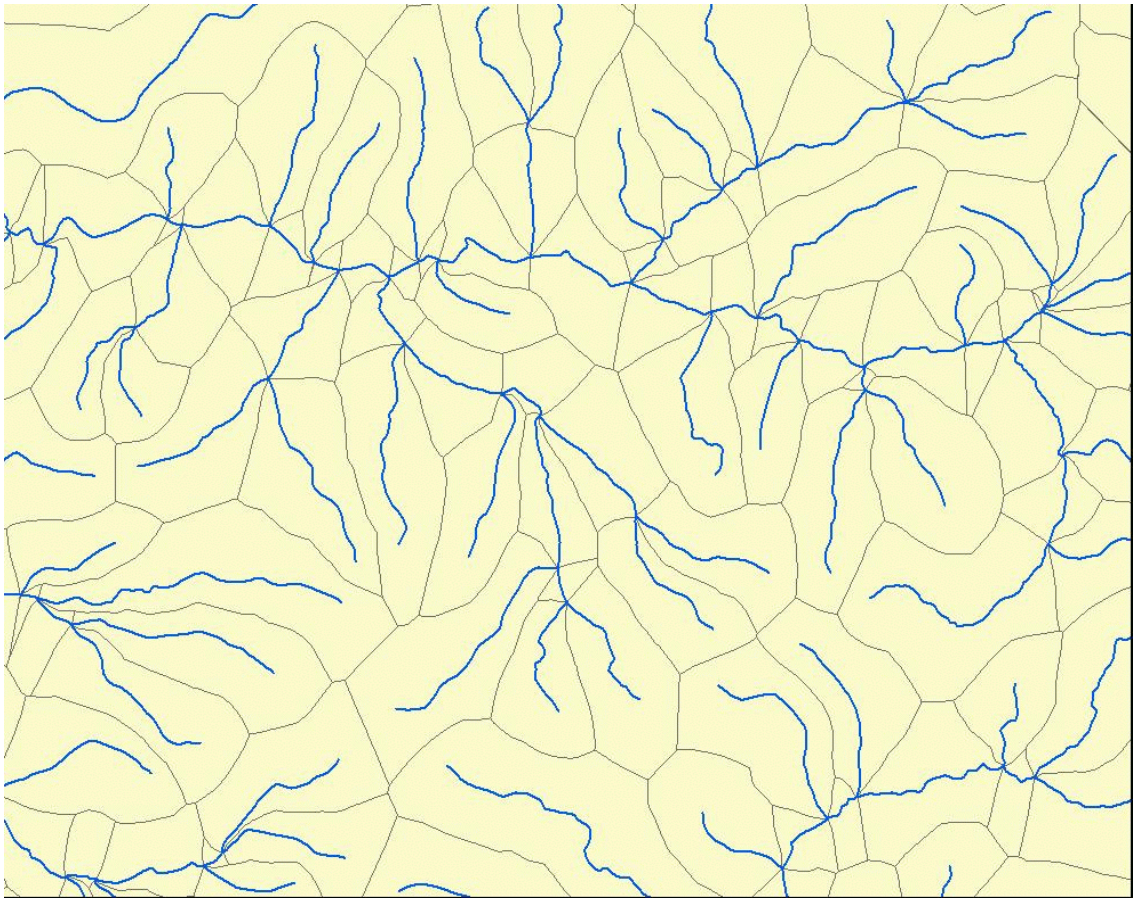


Figure 2.5.2a. Thiessen polygons are drawn around each stream reach segment to define a catchment area for each stream segment.

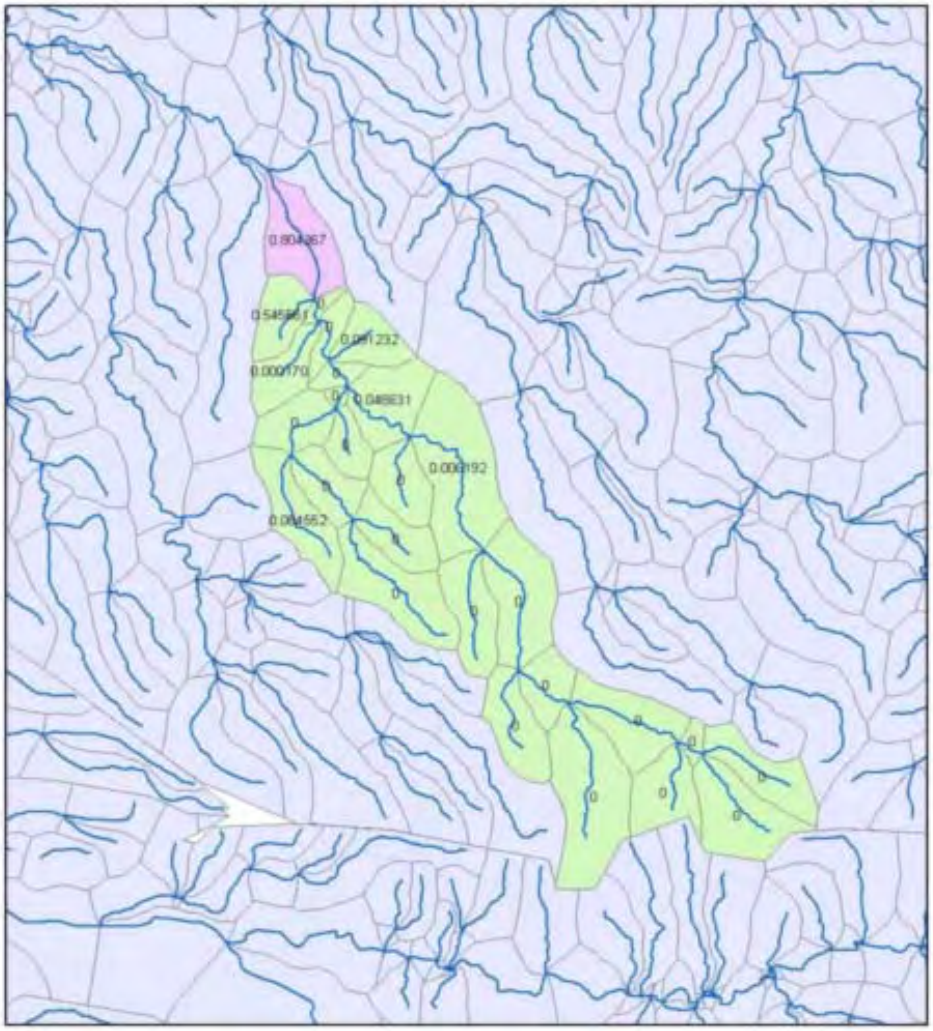


Figure 2.5.2b. An individual, or "in-segment", PCA is calculated for each polygon.

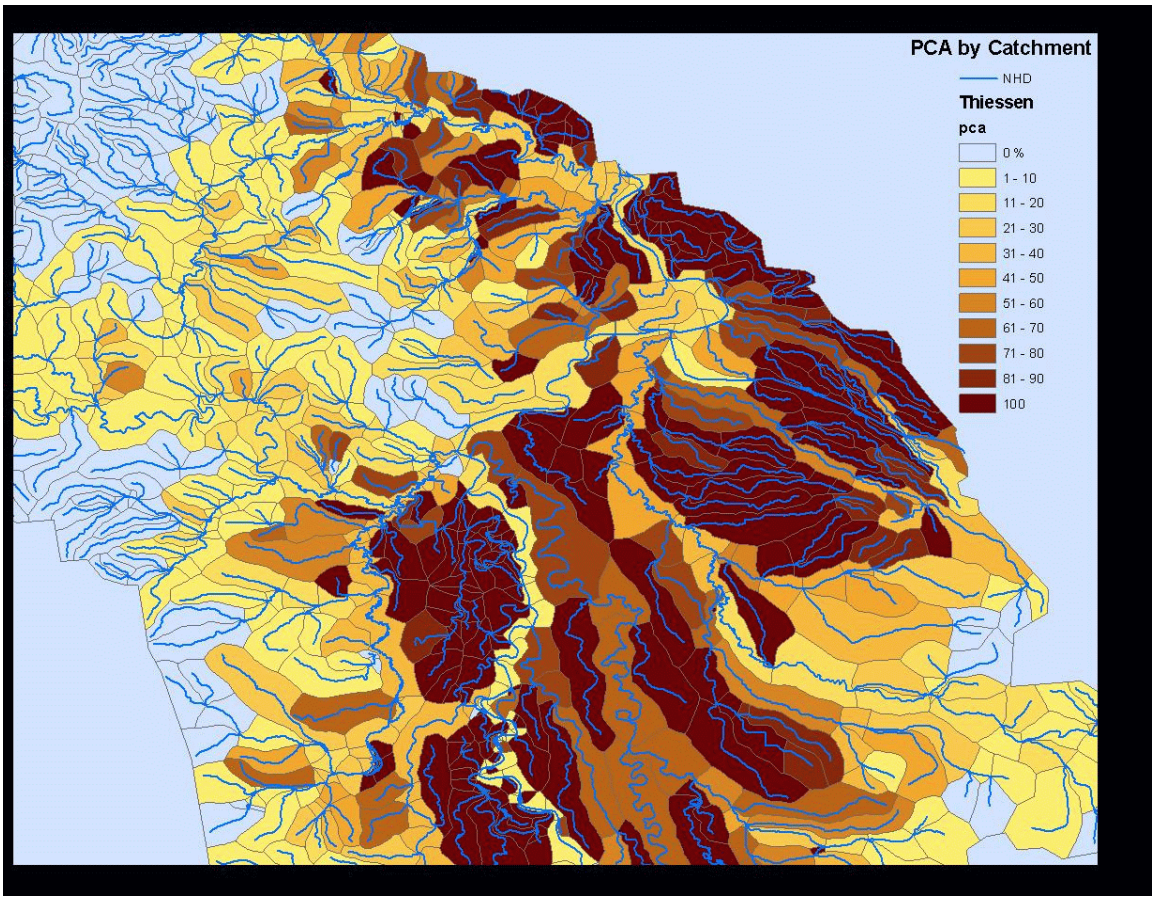


Figure 2.5.2c. A "catchment" PCA is calculated for each polygon which represents the ratio of cropland to watershed area for the upstream contribution to each polygon.

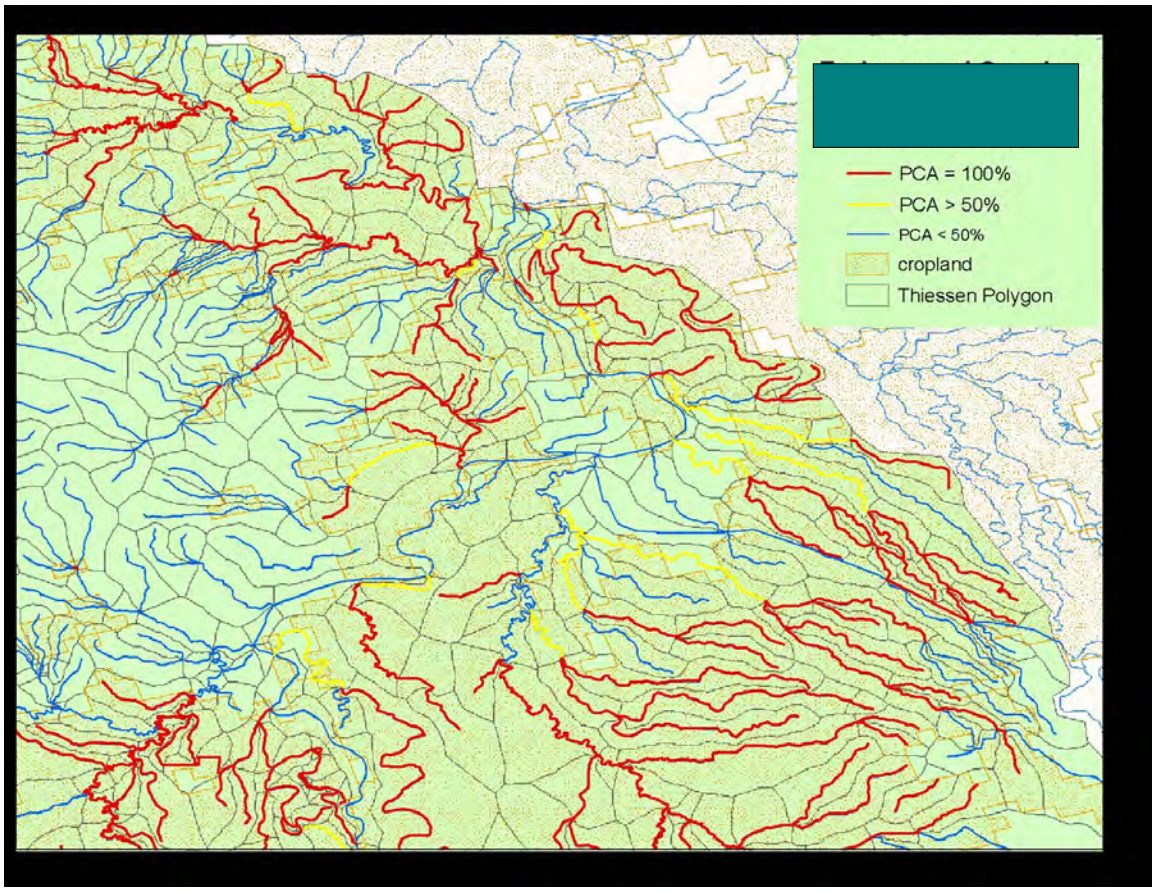


Figure 2.5.2d. Using the dilution factor approach, geospatial analysis associates a PCA with each stream reach and identifies those polygons downstream from the initial area of concern which have catchment PCA's greater than the target PCA (derived by dividing the LOC by the RQ).

Table 2.5.2a. Stream miles in 20 ESUs included in the action area determined by metolachlor's potential to affect aquatic plants. Also included in the table is the NOAA code for describing the ESU, the ESU name, miles of stream in the ESU as present in the National Hydrography Dataset.

No.	NOAA Code	Evolutionarily Significant Unit Name	NHD Stream Miles	Action Area (length in miles)
1	cklcr	Chinook Lower Columbia	1671	32
2	ckpug	Chinook Puget Sound	2347	135
3	ckucs	Chinook Upper Columbia Spring Run	1203	132
4	ckuwr	Chinook Upper Willamette	2023	267
5	cmcol	Chum Columbia River	753	25
6	cmhsc	Chum Hood Canal Summer Run	96	2.5
7	coorc	Coho Oregon Coast	6190	48
8	soozt	Sockeye Ozette Lake	41	0
9	stlcr	Steelhead Lower Columbia River	2363	83
10	stmcr	Steelhead Middle Columbia River	6550	425
11	stsnr	Steelhead Snake River Basin	8801	553
12	stucr	Steelhead Upper Columbia River	1568	73
13	stuwr	Steelhead Upper Willamette River	1936	392
14	cc chinook	Chinook California Coastal	1815	0
15	ccc steelhead	Steelhead Central California Coast	3116	0
16	ccv steelhead	Steelhead California Central Valley	4690	102
17	ch sc steelhead	Southern California Steelhead	2346	1.9
18	ch sccc slo co steelhead	Steelhead South Central California Coast	359	0
	sccc steelhead less slo coast		3373	6.8
19	csvr chinook	Chinook Central Valley Spring Run	2832	53
20	nc steelhead	Northern California Steelhead	3324	0

Varying NOAA GIS datasets are available for each of the four states in the analysis area, providing species location information in terms of a digital hydrography network system unique to that state. The spatial scales varied from 1:24,000 to 1:100,000. Field biologists surveyed the physical stream networks to collect species information and indexed this information to the respective stream networks. In the case of a 1:100,000 scale hydrography, small streams were typically omitted from the species location maps, but for some species missing streams were hand digitized and added to the existing stream networks. The methodologies were not consistent across states.

The *Watershed PCA approach* is based on the ability to navigate upstream and downstream from a stream segment identified as salmon habitat. Stream navigation within the hydrography network requires seamless integration of all four component state digital stream networks as well as complete attribute data that provide upstream and downstream flow information. Although navigation within a state is possible, any watershed that crosses a state boundary is un-navigable. The combination of using four different sources of stream data, and stream segments being manually added but not properly attributed, made it impossible to adopt a watershed-based approach to analyzing upstream and downstream effects on the species where state boundaries are concerned.

The National Hydrography Dataset (NHD) provides a seamless and navigable stream network at a 1:100,000 spatial scale. In order to conduct a watershed-based approach, the species location data from the four data sources were translated into NHD streams. The four source data sets used a different system for delineating stream segments than that of the NHD. The NOAA stream data are based on an approach in which a river or stream is represented by a single line segment. Points along the river, such as confluences, are identified by measurement in feet, from the source headwaters. In the NOAA system, the Columbia River is represented by a single line segment. In the NHD-based system, a stream or river is broken into segments at every confluence. In this case, the Columbia River is represented by numerous stream segments.

Action Area Defined from Potential Effects to Terrestrial Plants

The portion of the action area defined by the potential of metolachlor to indirectly affect salmonids via riparian plants is stream reaches containing high quality spawning gravels within 2000 ft of agricultural lands where metolachlor may be used. Only high quality spawning gravels are expected to have the potential to be impacted by metolachlor's effects on riparian vegetation, and 2000 ft is the maximum distance at which significant effects to riparian vegetation may occur as a result of metolachlor use. A geospatial analysis of stream reaches was conducted to graphically demonstrate the extent of the action area in 20 ESUs for which GIS data were available.

The action area in the 20 ESUs was graphically demonstrated using a geospatial analysis of all cropland and its proximity to stream reaches with containing or potentially containing high quality spawning gravels. Only reaches used for spawning were considered in the assessment because mobile salmonid life stages are not expected to be affected by deposited sediment (see section 5.2.2c). The assessment excludes reaches

offering less than high quality spawning gravels because any small increase in sedimentation resulting from metolachlor use would not be expected to be significant in compromised systems (see section 5.2.2c). NOAA habitat quality designations were used to identify areas potentially containing high quality spawning gravels. The nomenclature used by NOAA Critical Habitat Analytical Review Teams (CHARTs) to identify the quality in the Pacific Northwest was different from that used for California. In the Pacific Northwest stream reaches used for spawning were identified as being of either high, medium, or low conservation value. High conservation value spawning/rearing reaches were the only reaches assumed to contain high quality gravels. The system used to grade habitat quality in California varies between ESUs. Unless specific information was available stating reaches were not occupied or of less than high value for spawning, reaches in California were conservatively assumed to contain high quality spawning gravels. The stream quality designations in a geospatial format were downloaded from the NOAA NMFS Northwest and Southwest Regions' websites: (http://www.nwr.noaa.gov/1salmon/salmesa/mapswitc.htm, http://swr.nmfs.noaa.gov/salmon/layers/gis.htm).

The NOAA geospatial data were used to identify stream miles most likely to be impacted by degradation of riparian zones. In this approach, the length attribute was used to calculate total occupied stream miles for each ESU in the Pacific Northwest. The calculated stream miles for each ESU were verified against the total occupied stream miles reported in the documentation on the NOAA website. Using the query function in ArcGIS, the total occupied stream miles were screened by selecting only occupied reaches that may contain spawning areas and which were at least potentially high quality, as described above. If no information was available to determine if a reach was occupied or not, it was assumed to be occupied. If no information was available to determine the existence or quality of spawning gravels in a given stream segment, the segment was assumed to contain high quality gravels. Thus, the identified reaches conservatively represent the lengths of stream most likely to contain high quality spawning gravels. When possible, the length attribute in the reduced data set was then used to calculate total stream miles in each ESU with potentially high quality spawning sites.

Next, the geospatial analyst within ArcGIS was used to draw buffers of 2000 feet and 135 feet around the NLCD cropland. These buffers represent the maximum distance estimated in this screening-level assessment within which significant effects to riparian zones may occur when metolachlor is applied by aerial and by ground application methods, respectively. The geospatial analyst was then used to intersect the potentially high quality spawning stream miles that were within the 2000 foot buffer, the 135 foot buffer, and the NLCD cropland without buffers. The intersect tool within ArcGIS will graphically clip a stream reach but will retain the entire stream reaches attributes, including it's length. The length was recalculated as a new attribute (mylength) that represents the clipped stream's length. The results of this analysis are presented in Table 2.5.2b.

Table 2.5.2b. Number of salmonid stream miles used for spawning in 20 ESUs potentially affected by metolachlor impacts on riparian areas. Aerial applications have the potential to significantly affect riparian areas within ~2000 ft. Ground boom applications have the potential to significantly affect riparian areas within ~135 ft.

Evolutionarily Significant Unit	Miles of streams containing (or potentially containing) high quality spawning gravels within X feet of NLCD cropland			Total Occupied Miles
	0	135 ft	2000 ft	
California Coastal Chinook	343	361	514	9856
California Central Coast Steelhead	41	47	47	
California Central Valley Steelhead	7	9	38	
Southern California Steelhead	26	28	61	
S. Central CA Coast Steelhead (SLO County)	18	21	43	
S. Central CA Coast Steelhead (outside SLO County)	44	49	102	
Central Valley Spring Run Chinook	33	37	95	
Northern California Steelhead	95	104	212	
Lower Columbia Chinook	29	35	114	1502
Puget Sound Chinook	127	142	307	2151
Upper Columbia Chinook	1	1	10	1023
Upper Willamette Chinook	49	55	134	1795
Hood Canal Summer Run Chum	2	2	8	88
Columbia River Chum	4	4	7	714
Oregon Coast Coho	88	97	211	6663
Ozette Lake Sockeye	0	0	0	40
Lower Columbia Steelhead	52	63	223	2669
Middle Columbia Steelhead	233	253	513	6263
Snake River Basin Steelhead	181	199	439	8285
Upper Columbia Steelhead	1	2	12	1333
Upper Willamette Steelhead	77	84	145	1829

As an example, a map of the Lower Columbia ESU showing the action area estimated based on effects to riparian plants is shown in Figures 2.5.2e and f.

Figure 2.5.2e. The Lower Columbia River ESU as an example displaying high conservation value spawning habitat and cropped areas surrounded by 2000 ft buffers.

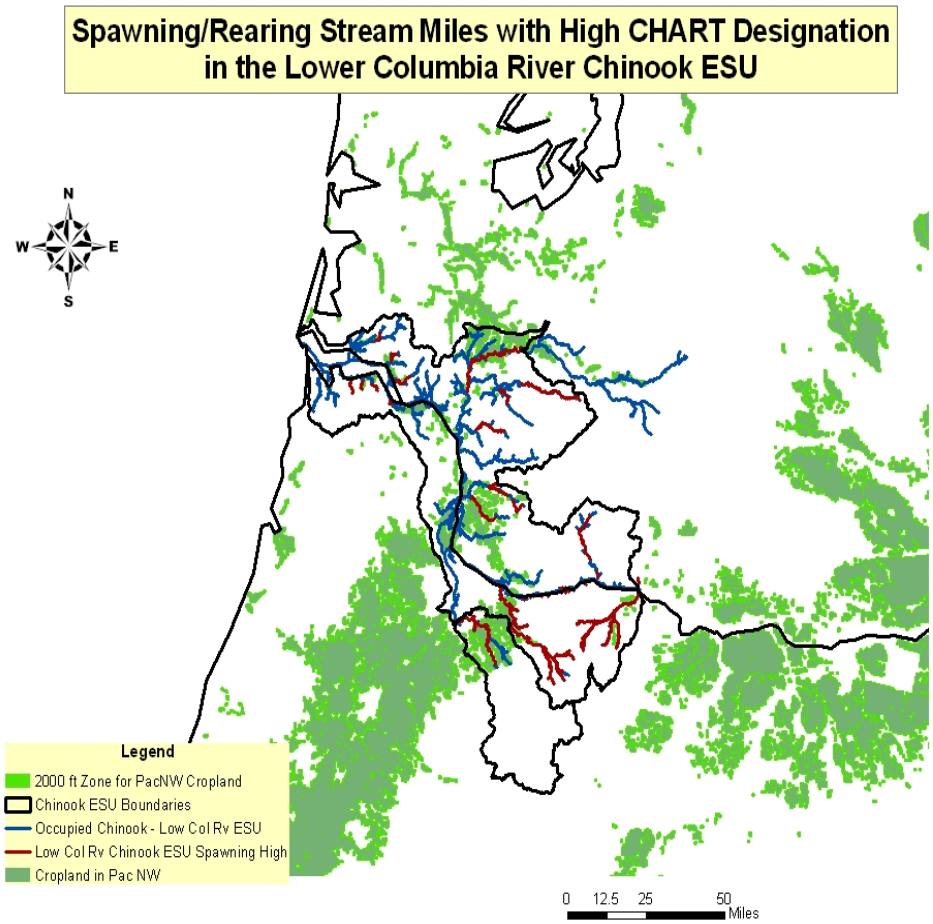
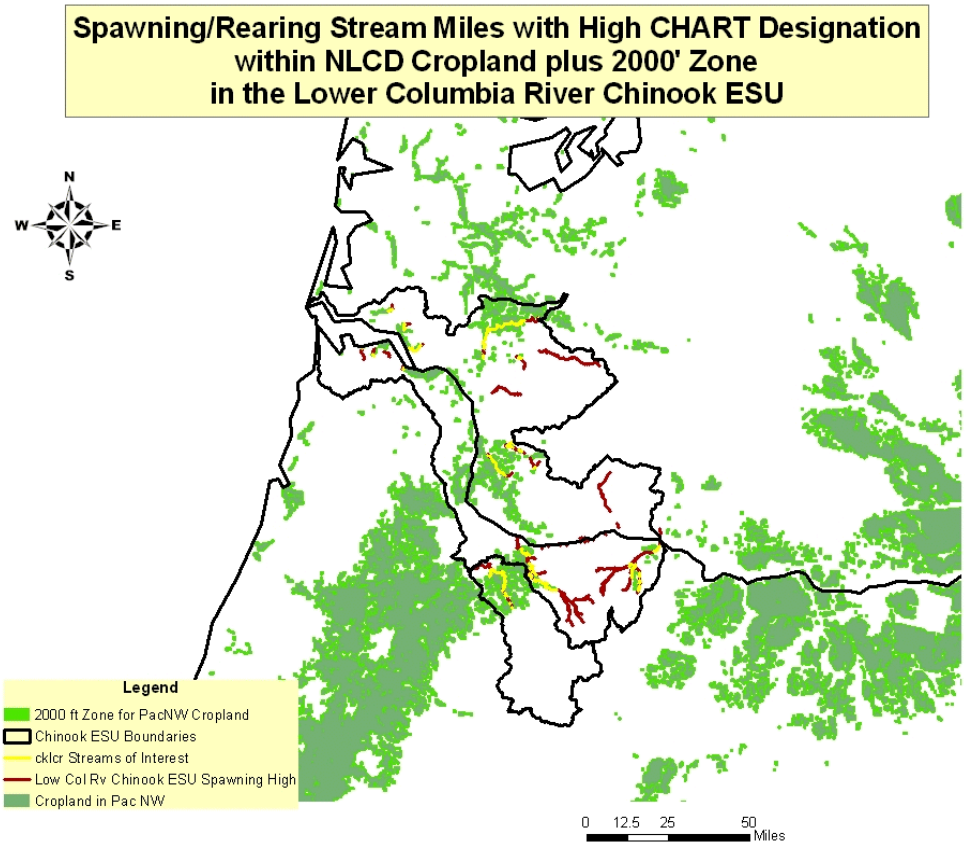


Figure 2.5.2f. The Lower Columbia River ESU as an example displaying high conservation value spawning habitat coming within 2000 feet of NLCD cropland.



Spatially-Based Sources of Error in Defining Action Area

Combining sources of information that are in different spatial resolutions necessarily introduces error into a spatial analysis. Sources of potential error include the field-to-digital stream network translation, use of the NLCD data set, the NOAA to NHD data conversion, and the final NHD upstream and downstream analysis.

The original generation of the GIS layers representing species location information adds several sources of potential error. The field biologists surveyed streams and noted the locations of species habitat and spawning areas using paper maps that were marked up and later indexed to the GIS-based digital stream network. In many circumstances, the digital hydrography network does not precisely represent what is physically observed. The time of year of the field observation, rainfall conditions, land use change since production of the digital hydrography, irrigation, damns, and development, among other reasons, can all affect the physical appearance of hydrography at a point in time. In addition, the NHD digital stream network was originally digitized from USGS topographic maps tiled together. The combination of the generation of the original topographic sheets, the digitization of the original maps, and the heads-up or manual translation of stream flow information, can all introduce error into the process of interpreting field notes into a digital spatial data set.

The NLCD (http://landcover.usgs.gov/natllandcover.asp), at a1:100,000 spatial scale, is produced from satellite imagery collected during the time period 1988 – 1991. The image classification places agricultural lands into four component classes, row crops, hay and pasture, fallow, and orchards and vineyards. The USDA Cropland Coverage used in this analysis, aggregates the component agriculture land cover classes into a single generalized cropland map. The individual agricultural classes reported high error rates. In order to reduce the error to an acceptable level, the four component agriculture classes were aggregated into a single generalized agriculture class. An accuracy assessment of the NLCD can be found at http://landcover.usgs.gov/accuracy/index.asp.

Translating the NOAA state-by-state datasets to the seamless NHD system introduces potential error into the estimates of total stream miles as described in the *Action Area Defined from Potential Effects to Aquatic Plants* section above. Because the NOAA datasets do not contain attribute information from their GIS data layers it was not possible to perform automated translation using publically available tools. The resulting discrepancies between miles tabulated between NOAA data sets and the NHD were relatively small for Oregon, Idaho, and Washington, within 15%, and larger for some ESUs in California, as large as 50%.

Once the four state-based data sets are translated and aggregated into a single data source, the upstream and downstream analysis is performed. Errors may be introduced at this step when flow information, coded into the stream network, is missing or incomplete. In this case, a stream that clearly flows into another stream, as seen in the digitized lines, has not been properly coded to reflect the true flow. In some circumstances flow direction is not obvious, such as in areas of high water inundation, braided or meandering streams, canals, irrigation ditches, springs, etc. In these special

cases, flow data are either missing or incorrect. If flow direction is incorrect, this will have the effect of cutting short the upstream or downstream navigation.

Several potential sources of error are introduced into the methodology at every step. In general, data sets that cover large areas, such as the NHD, necessarily compromise on local accuracy for the sake of enabling the adoption of watershed based approaches. The combination of the sources of error, and the coarseness of the spatial resolution of the GIS data, reduces the accuracy of the estimate of habitat and spawning stream miles. However, the analysis used several conservative assumptions and was based on the best available data.

2.6 Listed Salmonid Habitat

As a herbicide, metolachlor could have effects on salmon habitat through effects on plants. Metolachlor residues in salmon supporting streams could potentially decrease the populations of aquatic plants or change the community composition of the plants. Runoff or drift into the terrestrial riparian buffer could damage or destroy the riparian vegetation, which provides important ecosystem services such as temperature regulation, energy input, and stream bank stabilization. The Willamette/Lower Columbia Technical Recovery Team[9] has identified preservation and restoration of salmon habitat as critical to species recovery. In the habitat criteria, some specific plant-associated habitat attributes have been identified, and correlated with the life-history stages for which they are important. A modified version of the habitat attribute table is presented below.

[9] Interim Report on Viability Criteria for Willamette and Lower Columbia Basin Pacific Salmonids, WLC-TRT; www.salmonrecovery.gov/remand/court_docs/federal_defendants_first_quarterly_status_report/h_complete.pdf, accessed 8/11/04

Table 2.6 Salmonid Habitat Attributes and Associated Life History Stages (After Table 7-1, WLC-TRT, 2003)

Habitat	Potentially Affected Organisms	Type of Effect	Mitigating Factors	Salmonid Use	Salmonid Life Stages Present
Stream	Riparian vegetation	Loss of shading (water temperature increase) Reduction in allochthonous input Streambank destabilization	Width and quality of buffer Offset from application swath Timing of application	Spawning Rearing	Eggs Alevins Fry Juveniles Spawning adult
	Periphyton	Food chain modifications	Width and quality of buffer Sheet runoff versus channelized runoff Flow rate at time of application		
River	Riparian Vegetation	Streambank destabilization	Width and quality of buffer Offset from application swath Timing of application	Spawning Rearing Migration	Eggs Alevin Fry Juveniles Smolts Adults Spawning adults
	Periphyton and phytoplankton	Food chain modifications	Width and quality of buffer Sheet runoff versus channelized runoff Flow rate at time of application		
	Submerged and emergent vegetation	Loss of in-stream cover Food chain modifications			
Lake	Phytoplankton	Food chain modifications	Proximity of agricultural lands Size of water body	Rearing Migration	Juvenile Smolt Adult Spawning adult
	Submerged and emergent vegetation	Loss of cover Food chain modifications			

Habitat	Potentially Affected Organisms	Type of Effect	Mitigating Factors	Salmonid Use	Salmonid Life Stages Present
Estuary	Phytoplankton	Food chain modifications	Proximity of agricultural lands Size of waterbody	Rearing Migration	Smolt Adult Spawning adult
	Submerged and emergent vegetation	Loss of cover Food chain modifications			
Open Ocean/ Coastal Waters	Phytoplankton	Food chain modifications	Proximity of agricultural lands Size of waterbody	Rearing Migration	Smolt Adult Spawning adult
	Submerged and emergent vegetation	Loss of cover Food chain modifications			

2.6.1 Geographic Locations - Critical Habitat

Section 4(b)(2) of the Endangered Species Act requires NMFS to designate critical habitat for threatened and endangered species "on the basis of the best scientific data available and after taking into consideration the economic impact, and any other relevant impact, of specifying any particular area as critical habitat." The Endangered Species Act defines critical habitat under section 3(5)(A) as: "(i) the specific areas within the geographical area occupied by the species, at the time it is listed . . ., on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed . . . upon a determination by the Secretary that such areas are essential for the conservation of the species."

Designated and proposed Critical Habitat is described on the NMFS website.[10] This assessment reflects the hydrology and habitat consistent with current and proposed critical habitat designations.

2.6.2 Characteristics of Water Bodies Supporting Listed Salmonids

In order to complete their life-cycle successfully, salmonid species require a complex mosaic of "waterscapes", and because of variability both within and among species, it is difficult to describe a "typical" habitat. Thus, for the purposes of risk assessment, the better option is to select several representative types of habitats, and evaluate the potential impact of the pesticide on these representative habitats. In many cases, site-specific characteristics such as the width and quality of a riparian buffer, or the actual dimensions and flow rates of a stream will be determinants of the degree of risk posed by pesticide use. Evaluations at the site-specific level are not possible at this time due to

[10] http://www.nwr.noaa.gov/

lack of information on site-specific characteristics of water bodies, thus in all the representative habitat scenarios a conservative risk estimate is used, and the mitigating factors are clearly identified.

In general, the typical life history of an anadromous salmonid includes a duration in a freshwater habitat (stream, river or both), a duration in an estuarine habitat, and time in the open ocean. In some cases, the fish may also spend a substantial amount of time in a lake or impoundment. When in its life cycle and for how long the fish resides in each of these habitats varies by species and also within species, by race[11]. Within a species, there may be a "stream-type race," which completes its entire life-cycle in the freshwater, and an "ocean-type" race, which migrates to the ocean to mature and returns to freshwater to spawn (Groot and Margolis, chapter 3). Environmental factors, such as water temperature, river discharge, and food supply play an important part in determining the timing and distance of the various migrations. The interplay of specific factors which drive the migrations and habitat selection are complex, and at this point, not well understood. At any given time "salmon-supporting waters" may contain multiple species, multiple races, and multiple age classes/developmental stages.

Essentially, there are five representative habitats the salmonids may occupy. The physical characteristics of these habitats influence both the potential fate of the pesticide and the potential effects.

Habitat 1 - Low-order streams.($\leq 4^{th}$ order by Strahler classification system (Allan 1995))
Habitat 2 - Rivers
Habitat 3 - Lakes
Habitat 4 - Estuaries
Habitat 5 - Open ocean and coastal waters

In each of these habitats several important factors will be examined: the dimensions of the water body (which affects potential concentrations and residence time of the pesticide and its degradates), the proximity of agricultural land (which determines potential pesticide input), the primary producers (food-chain effects), and the importance of riparian and emergent vegetation in terms of structure and function. To assist in determining the potential effects of the herbicide on the stream's structure and function, the Rosgen stream classification system is used (Rosgen 1996).

Habitat 1 - Low-order streams.

For the purposes of this risk assessment, a low-order stream is defined as $\leq 4^{th}$ order by the Strahler classification system (Allan 1995). According to the river continuum concept (RCC), the primary energy sources in this type of system are leaves and detritus from streamside vegetation and periphyton (Allan 1995). Invertebrate assemblages are dominated by the collector, shredder, and grazer guilds. In high gradient areas, these streams are typically step-pool streams that are classified as Rosgen stream

[11]"Race" or "stock" is used to "describe a group of fish that are genetically self-sustaining and isolated geographically or temporally during reproduction (Meehan 1991 pg.47).

type A or B. In lower gradient areas, such as meadows and valleys, streams are often meandering, riffle-pool type systems, classified as Rosgen stream types C and E. Other than those C type streams that have a bed material of bedrock or boulder, the controlling influence of vegetation on C and E type streams is classified as very high (Rosgen 1996). Degradation of the riparian vegetation could severely destabilize the C and E stream types, but would have a lesser effect on the A and B stream types. Low order streams may be used by the salmonids for spawning and rearing.

Habitat 2 - Rivers

For the purposes of this risk assessment, a river is defined as > 4th order by the Strahler classification system (Allan 1995), and may have significantly higher discharge rates than the low-order streams. Based on the RCC, primary production in these kinds of systems will be a mixture of periphyton and vascular hydrophytes. In some of the larger rivers, especially in the lowlands, phytoplankton may be important as well. Dependent on the size of the river, invertebrate assemblages are generally a mix of collectors, grazers, and predators. Rivers may also be step-pool type systems (Rosgen type A or B), or riffle-pool systems (Rosgen type C or E). Degradation of the riparian vegetation in rivers would have the same effect as degradation in a low-order stream. Rivers may be used by salmonids for spawning and rearing, but are also important as migration corridors.

Habitat 3 - Lakes

For the purposes of this risk assessment, lakes are characterized as bodies of standing water. Typically, primary production in lakes is dominated by emergent vegetation near the shore, and by phytoplankton in the open water (Cole1994). Invertebrate assemblages also differ by zone, with a diverse group of grazers, collectors, and predators inhabiting the near-shore vegetation, and various types of zooplankton dominating the open water. For some salmonids, a substantial portion of their life-cycle may be spent in freshwater lakes, and uses include rearing and maturation.

Habitat 4 - Estuaries

For the purposes of this risk assessment, estuaries are those bodies of water subject to tidal influence, ranging from tidal freshwater to euryhaline zones, and include a range of brackish water environments (Nybakken 1997). While the specific organisms inhabiting estuaries may be substantially different than lakes, there is a similar near-shore versus open water distinction. The near-shore is dominated by emergent vegetation, and a diverse invertebrate community, and the open water areas by phytoplankton and zooplankton. Estuaries serve as nursery areas for many fish species, and these juvenile fish may be important prey items for some salmonids. The tidal marshes fringing the estuary are important foraging habitat for some species, such as chinook (Groot & Margolis 1991; chap.3). Typical uses of estuaries include rearing, maturation, and migration.

Habitat 5 - Open ocean and coastal waters

Salmonids spend a substantial portion of their life-cycle in the open ocean and coastal waters. This habitat is expected to be the least vulnerable to the effects of metolachlor due to dilution. Quantitative analysis of risks to salmonids in the Pacific

Ocean is beyond the scope of this assessment.

a. Aquatic Plants

Typically, in streams and rivers, the autotrophic primary producer of greatest importance is periphyton (Allan 1995), thus a major concern in the risk assessment of an herbicide is whether concentrations in the stream (either pulse or chronic), are high enough to affect the algal community. The algal community in streams is dominated by freshwater diatoms and green algae (Allan 1991). Although juvenile salmon in freshwater environments typically feed on benthic invertebrates, especially the larval stages of various insects (Groot & Margolis 1991), disruptions in the algal community could affect the abundance of variety of these insects.

Emergent and floating plants provide refugia for small fish to hide from predators, and can also serve as support structures for the growth of periphyton (Cole 1994). The quantity and importance of these plants varies widely, dependent on the characteristics of the particular stream (Allan 1991). In slow moving waters, including the lakes and estuaries where some salmon species may spend a portion of their life history, they are of greater importance. In many lakes and estuaries, the most productive areas (both primary and secondary production) are the grass beds. Thus, loss of these habitat areas could have a significant impact on salmon populations, primarily in terms of rate of recruitment, and juvenile survivability.

b. Riparian Areas

Riparian vegetation serves several functions in the stream ecosystem. The most important of these functions are that of an energy source, providing organic matter to the stream, and providing shading, which ensures thermal stability of the stream. The vegetation also serves as a buffer, helping to filter out sediment, nutrients, and contaminants before they reach the stream.

Riparian vegetation usually consists of three distinct types of plants; a groundcover of grasses and forbs, an understory of shrubs and young trees, and an overstory of mature trees. These plants serve as structural components for streams, with the root systems helping to maintain stream stability, and the large woody debris from the mature trees providing instream cover for both the mature salmonids and the young fish. Riparian vegetation has been shown to be essential to maintenance of a stable stream (Rosgen 1996). Destabilization of the stream can have a severe impact on salmon habitat quality. Following a disturbance, the stream will downcut and widen, releasing sediment from the stream banks and scouring the stream bed. Bed scour can move redds (egg nests) after the fish have spawned, and/or decrease the number of good spawning sites by changing the size of gravel available. In cases where the stream is severely destabilized, bed features will lose definition, and there may be inadequate pools available for the mature fish.

Riparian vegetation is also important in moderating the amount of sediment loading from upland sources. The roots and stems of riparian vegetation can intercept eroding upland

soil (USDA NRCS 2000) and riparian plant foliage can reduce erosion from within the riparian zone by covering soil, reducing the impact energy of raindrops onto to soil (Bennett 1939).

Large quantities of suspended sediment can modify salmon behavior (Hicks *et al.* 1991). The magnitude of the effect of suspended sediment can range from no effect to behavioral and sublethal effects to lethal effects and are dependent on the particle size of the sediment, duration of exposure, concentration, developmental stage, and species (Newcombe and Jensen 1996). The lethal effects threshold to juvenile and adult salmonids was estimated at 1-hour exposures to be ~22 g/L suspended sediment and with month-long exposures to be ~3 mg/L . Eggs and larvae show similar or less sensitivity to short duration exposures to sediment but are more sensitive over longer periods of time with lethal effects expected with 6 days of exposure to suspended sediment at ~3 mg/L (Newcombe and Jensen 1996).

Fish may avoid areas of suspended sediment, cease feeding, or alter social behavior. Avoidance and disrupted behavior have been reported in water with turbidity of 60-70 NTUs (nephelometric turbidity units) (Bjornn and Reiser 1991). Fry and juveniles appear even more sensitive to sediment effects, with reduced growth and increased emigration noted in the 25-50 NTU range (equivalent to 125-275 mg/L of bentonite clay). Increased turbidity from suspended sediment could also reduce light transmission, potentially affecting aquatic plants (Cloern 1987, Weissing and Huisman 1994) that are important for salmonid shelter and food for salmonid prey items.

Increased siltation in the stream can affect spawning, by settling on spawning gravel and reducing flow of water and dissolved oxygen to the eggs and fry (Everest *et al.* 1987). Reduced oxygen levels can result in direct mortality of early salmonid life stages or delayed maturation which has been associated with lowered success in later life stages. Fine sediments can also physically occlude pore spaces preventing fry from emerging. Decreases of 2% to 3.4% in fry survival have been noted for each 1% increase in fine sediment (Cederholm *et al.* 1981, Everest *et al.* 1987). A sensitive relationship between gravel coarseness and fry emergence has been demonstrated in several other studies (*e.g.* Bjornn 1968, Phillips *et al.* 1975) and deposited sediment has been suggested as a contributor to poor salmonid success in an agricultural watershed (Soulsby *et al.* 2001). In addition, fine particles settling on the streambed can also disrupt the food chain by reducing habitat quality for aquatic invertebrates, and affecting groundwater-surface water interchange (Nelson *et al.* 1991).

Currently, there is no widely used numerical water quality standard for sediment, as the amount of sediment a stream may naturally carry varies widely by stream type and watershed. A concentration of 25 mg/L has been proposed as providing a high level of protection for aquatic organisms (Thurston *et al.* 1979) and noted in a salmonid Biological Opinion (NOAA 2003) . Different concentration estimators have been used in developing biological opinions for other Federal actions, and for developing total maximum daily loads (TMDLs) consistent with requirements under the Clean Water Act. In rendering a biological opinion for a dredging action (NOAA 2004), NMFS included a requirement to limit turbidity increase to 10% above background, as measured 100 ft

downstream from the project site. The TMDL document for the Navarro River, CA, suggested anthropogenic sediment load be limited to the estimated natural sediment delivery rate plus 25% (EPA 2000).

The specific characteristics of a riparian zone that are optimal for salmonids is expected to vary with developmental stage, the use of the reach adjacent to the riparian zone, and the hydrology of the watershed among other things. Criteria based largely on professional judgement have been proposed to assess the health of riparian zones and their ability to support fish habitat that may be used to assess the health of riparian zones (Fleming *et al.* 2001). General criteria are identified for the width of vegetated area (*i.e.* distance from cropped area to water), structural diversity of vegetation, canopy shading, and the diversity of vegetation.

Table 2.6.2b. Semi-quantitative criteria related to riparian vegetation for assessing the health of riparian areas for supporting aquatic habitats. Adapted from Fleming *et al.* 2001.

Criteria	**Quality**			
	Excellent	**Good**	**Fair**	**Poor**
Buffer width	>18m	12 - 18m	6 - 12m	<6m
Vegetation diversity	>20 species	15 - 20 species	5 - 14 species	<5 species
Structural diversity	3 height classes grass/shrub/tree	2 height classes	1 height class	sparse vegetation
Canopy shading	mixed sun/shade	sparse shade	90% sun	no shade

To maintain at least "good" water quality for fish in general, riparian areas should contain at least a 12 m wide vegetated area, 15 plant species, vegetation of at least two height classes, and provide at least sparse shade (>10% shade). The criteria above are not specific to salmonids. Because salmonids require colder water than many other fish species, a greater degree of shading may be necessary to achieve good quality habitat.

c. Dimensions for a Representative Salmonid Stream

In order to estimate concentrations of a pesticide in running waters, it is helpful to know several stream parameters, including width, depth, and flow rate. A number of sources were found that list stream velocities and depths correlated with various activities of salmonids, but none included data on the stream dimensions. Attempts to back calculate the stream parameters from these types of studies were unsuccessful, possibly because the measurements were taken at a single point in the stream, and did not represent an average depth and velocity, which can vary considerably in a heterogeneous streambed.

Information correlating the number of spawning chinook salmon with discharge was located (Healey 1991, pg 317, Figure 4). The majority of the spawning populations were correlated with river discharge of 250-5000 cubic feet per second (cfs). Published relationships between discharge and channel dimensions were then used to estimate the dimensions of streams with listed salmonids. For a known discharge, bankfull dimensions can be estimated using documented discharge-channel dimension relationships, known as "regional curves" (Dunne & Leopold 1978, Rosgen 1996, Rosgen 2001). This method was used to develop dimensions for representative streams. Although it is recognized that bankfull events occur on average somewhere between once a year, and once every two years (Dunne & Leopold 1978), and are higher flow events than normal, this method is the best available approach to calculate stream dimensions necessary to estimate pesticide concentrations in flowing water bodies.

Dimensions for four discharges (shown in Table 2.6.2c, below) were estimated using the regional curves for the South Umpqua River, Oregon, contained in *The River Field Book* (Leopold *et al.* 2000). The estimation procedure was as follows (Rosgen 2001):

1) Drainage area (mi^2) was estimated for discharges of 250 cfs, 500 cfs, 1000 cfs, and 5000 cfs using the bankfull discharge-drainage area graph on pg 243 (Leopold *et. al* 2000).

2) Cross-sectional area (ft^2) and depth (ft) of the stream was estimated using the drainage area-bankfull channel dimension graph on pg 246 (Leopold *et. al* 2000). Width is generally the most variable of the channel dimensions, and was calculated from cross-sectional area and mean depth[12].

3) Velocity (ft/s) was determined by dividing discharge (cfs) by cross-sectional area (ft^2).

4) Values were converted to the appropriate units for input into the AgDRIFT stream assessment module.

[12]Cross-sectional area (A)=width (w) X depth (d)

Table 2.6.2c. Representative stream dimensions for salmonids metolachlor risk assessment									
	Data from *River Field Book* regional curve for South Umpqua River, Oregon pg 243					Units for AgDRIFT Stream Assessment			
discharge (cfs)[1]	drainage area (mi^2)	depth (ft)	width (ft)	cross-sectional area (ft^2)	velocity (ft/sec)	depth (ft)	width (ft)[3]	discharge (gal/sec)[4]	velocity (mph)[5]
250	7	1.8	30	45	5.56	1.8	25	1870	3.79
500	15	2.6	43	90	5.56	2.6	35	3740	3.79
1000	30	3.7	60	140	7.14	3.7	38	7480	4.87
5000	180	7.5	130	550	9.09	7.5	73	37400	6.20
[1]Representative values based on chinook spawning population and discharge correlation graph, pg 317, Healey 1991									
[2]velocity(m/sec)=velocity(ft/sec)*0.3048(m/ft)									
[3]input width=graph cross-sectional area/graph depth									
[4]discharge(gal/sec)=discharge(cfs)*7.48 (gal/cf)									
[5]velocity(mph)=(velocity(ft/sec)*3600(sec/hr))/5280(ft/mi)									

Although stream velocities produced using this method tend toward the high end (bankfull events are high flow), the values are not unreasonable when compared with measured velocities associated with the various life stages of salmonids. Bjornn and Reiser (1991, Table 4.1) have compiled data showing the maximum water velocity for salmonids to migrate upstream is generally between 6.6 and 8.2 ft/s, except for smaller trout. For activities such as spawning and feeding, the fish tend to seek lower flow rate areas (pools and pocket water in riffles), and velocities associated with these activities range from 0.7 ft/s to 3.3 ft/s (Bjornn and Reiser 1991, Tables 4.5 & 4.10). Velocities produced by the bankfull estimation method range from 5.6 ft/s to 9.1 ft/s. An overestimation of velocity will tend to lower the estimated duration of exposure for stationary organisms in the stream.

The relationship of discharge to stream dimensions varies by hydro-physiographic regions (Dunne & Leopold 1978), however, the values used to calculate the stream dimensions are based on data from the Pacific Northwest, and were considered to be the best available information.

3. Analysis Plan

The analysis plan is the final step in problem formulation. The analysis plan describes the conceptual model for the risk assessment and the approaches and data that were used to quantify the risk to listed salmonids.

3.1 Assessment Endpoints

In accordance with the Overview Document this assessment considers both direct and indirect effects (U.S. EPA 2004a). Risk estimations are based on the endpoints of survival, growth, and reproduction of the organism at the individual level, based on the premise that these effects on individuals can be reasonably extrapolated to impacts at a population level. While a growing body of scientific literature exists on biochemical (*e.g.*, physiological changes, endocrine disruption, immune system deficiencies) and behavioral (*e.g.*, predator avoidance, foraging activity, homing instincts) effects of pesticides, the specific impacts of these changes generally cannot be evaluated at an individual or population level, thus they are not used as quantitative endpoints (U.S. EPA 2004a, U.S. FWS and NMFS 2004).

The generic direct assessment endpoints are the survival, growth, and reproduction of the listed salmonid species. An additional indirect endpoint is the integrity of the habitat required to support salmonids. The integrity of the habitat is specifically related to the availability of food, shelter, acceptable water quality (temperature and suspended solids), and spawning substrate.

The generic risk hypotheses evaluated in this assessment are as follows:

- Metolachlor may affect salmonids directly by reducing individual fish survival, growth, or reproduction.
- Metolachlor may affect salmonids indirectly by adversely modifying the food web.
- Metolachlor may affect salmonids indirectly by adversely modifying the habitat.

NMFS has provided specific assessment endpoints and associated assessment measures for salmonids. These are listed in Table 3.1, along with the correlative EFED generic endpoint and risk estimator.

Table 3.1 -Assessment Endpoints and Measures			
NMFS Specific Assessment Endpoints	**NMFS Specific Assessment Measures**	**EFED Generic Assessment Endpoints**	**EFED Generic Assessment Measures**
Juvenile growth	Foraging behavior	Behavioral	Not assessed
	Growth rate	Growth	Acute toxicity test, Chronic toxicity test (weight and length)
	Condition index	Growth	Acute toxicity test, Chronic toxicity test (weight and length)
Reproduction	Courtship behavior	Behavioral	Not assessed
	Number of eggs produced	Reproduction	Early life stage (ELS) test
	Fertilization success	Reproduction	Early life stage (ELS) test
Early development	Gastrulation	Reproduction	Early life stage (ELS) test
	Organogenesis	Reproduction	Early life stage (ELS) test
	Hatching success	Reproduction	Early life stage (ELS) test
Smoltification	Anion exchange (i.e., gill Na+/K+ ATPase activity	Biochemical	Not assessed
	Blood hormone (i.e., thyroxin)	Biochemical	Not assessed
	Salinity tolerance	Biochemical	Not assessed
Disease induced mortality	Immunocompetence	Biochemical	Not assessed
	Pathogen prevalence in tissue	Biochemical	Not assessed
	Histopathology	Biochemical	Not assessed
Predation-induced mortality	Predator detection	Behavioral	Not assessed
	Shelter use	Behavioral	Not assessed
	Schooling or schoaling behavior	Behavioral	Not assessed
Migration or distribution	Use of juvenile rearing habitats	Behavioral	Not assessed
	Adult homing behavior	Behavioral	Not assessed
	Selection of spawning sites	Behavioral	Not assessed

Acceptable data to evaluate growth (acute and chronic) and reproduction (chronic) endpoints were available and have been incorporated into the risk assessment. No open literature data regarding the effect of metolachlor on the behavior or biochemical processes of salmonids were located, thus, consistent with the procedures described in U.S. EPA (2004a) and U.S. FWS and NMFS (2004), the most reliable endpoints for

assessing effects were used in the assessment.

3.2 Incorporation of Open Literature

Guidelines for incorporation of open literature into ecological risk assessments are described in U.S. EPA (2004b). Toxicity data from open literature are identified via the ECOTOX search engine, maintained by EPA/ORD. In order to be included in the ECOTOX database, papers must meet the following criteria:

(1) the toxic effects are related to a single chemical exposure;
(2) the toxic effects are on an aquatic or terrestrial plant or animal species;
(3) there is a biological effect on live, whole organisms;
(4) a concurrent environmental chemical concentration/dose or application rate is reported; and
(5) there is an explicit duration of exposure.

Data that pass the ECOTOX screen are evaluated relative to the data provided by the registrant, and may be incorporated qualitatively or quantitatively into the risk assessment. Specific studies may warrant inclusion in the risk assessment when:

(1) tested endpoints are more sensitive than those in registrant data;
(2) the test data are based on under represented taxa;
(3) the data include ecologically relevant endpoints not normally evaluated in registrant studies;

ECOTOX located 1,055 articles related to metolachlor in the open literature. Of these articles, 138 had toxicity data meeting the ECOTOX requirements. Citations for all data and references located (download date 10/08/04) and the rationale for excluding the use of particular citations in determining effect endpoints are attached as Appendix C. A brief summary of the types of data located is included in Table 3.2.

Table 3.2 - Summary of Open Literature Located		
Taxa	**Type of Test**	**Result Lower than Registrant Submitted?**
Freshwater fish	Acute	No
Freshwater arthropods	Acute	Yes
Freshwater arthropods	Other	N/A
Other aquatic animals	Acute	No
Other aquatic animals	Chronic	No
Other aquatic animals	Other	N/A
Nonvascular aquatic plants	Acute	No
Nonvascular aquatic plants	Other	N/A
Vascular aquatic plants	Acute	No
Vascular aquatic plants	Other	No
Terrestrial monocots	Acute	No
Terrestrial monocots	Other	N/A
Terrestrial dicots	Acute	No
Terrestrial dicots	Other	N/A

3.3 Degradates

Metolachlor is expected to degrade over time in the environment. Submitted studies quantifying metolachlor degradation and the production of degradates were reviewed to evaluate the persistence of metolachlor and the production of degradates in soil and water environments under varying conditions. Major degradates (>10% of applied mass) in submitted studies were further considered for toxicity and exposure potential. As the material degrades to smaller, naturally occurring compounds (*e.g.* CO_2) risks from exposure to degradates is expected to subside.

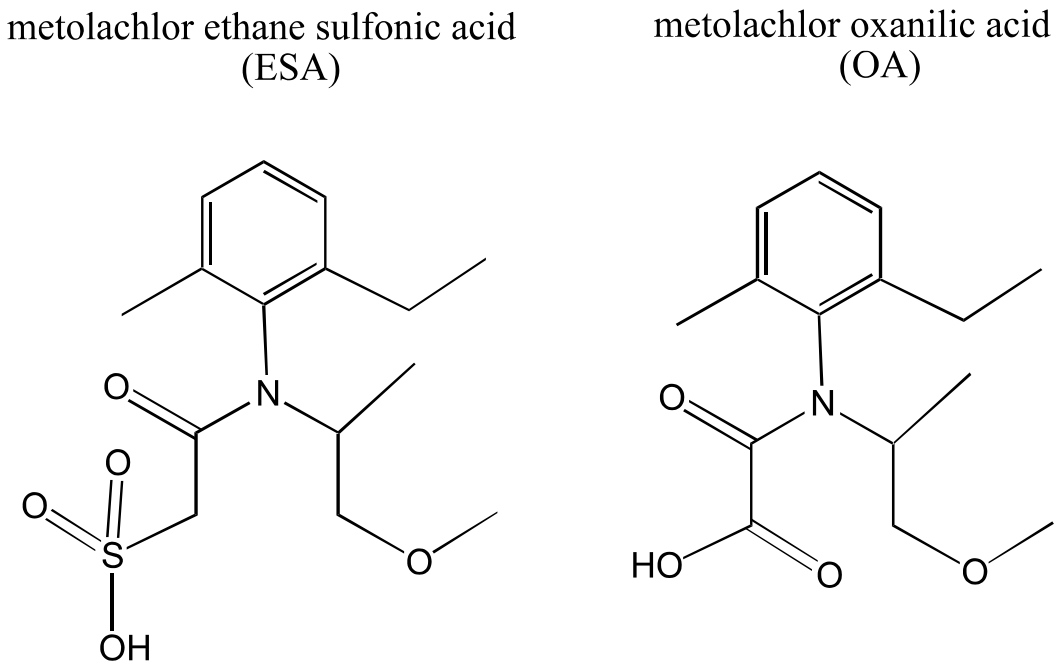
In general, environmental transformation products of pesticides tend to have lower toxicity than the parent pesticide. When a pesticide is prone to degradation at multiple sites, exposure to individual degradates is frequently less than the exposure to the parent. However, if the persistence of degradates is greater than the persistence of the parent compound or soil binding affinity is lower than parent, exposure via runoff may be increased.

To assess the potential for metolachlor degradates to cause direct or indirect effects to listed salmonids major degradates from submitted laboratory studies designed to represent soil and water environmental compartments, were evaluated for their potential to reach the aquatic environment and terrestrial plants important for maintaining water quality. The potential toxicities of, and exposures to degradates were evaluated consistent to the approach used by the OPP Health Effects Division's Hazard and Exposure Assessment Review Committee (EPA 2003). When toxicity data submitted to EPA were available for major degradates they were evaluated. In the absence of toxicity data the similarity of the degradate's structure and expected chemical properties were compared to the parent compound to evaluate the degradate's potential to cause similar effects. Degradates with structures similar to the parent were quantitatively included in the assessment.

Two metolachlor degradates were identified as being potentially of concern to cause direct or indirect effects to listed salmonids. The ethane sulfonic acid (ESA) and oxanilic acid (OA) degradates of metolachlor were evaluated as stressors because they are major degradates (account for at least 10% of the applied material) in several environmental studies, have lower soil binding properties than metolachlor suggesting increased potential to be dissolved in runoff, tend to be relatively persistent, are detected in several monitoring studies, and are structurally similar to metolachlor. Although the overall structures of the ESA and OA degradates are similar to metolachlor they lack the reactive chlorine atom of metolachlor. Considering what is known about metolachlor's mode of action (section 2.6.3), this chlorine is likely responsible for the covalent reactivity of the molecule. Thus, the degradates are expected to be less toxic to plants than metolachlor.

The structure for the ESA and OA are shown in Figure 3.3.

Figure 3.3. Chemical structures of metolachlor ethane sulfonic acid and metolachlor oxanilic acid.



3.4 Conceptual Model

Individual fish with the greatest potential to experience *direct* effects from metolachlor use are those that occur in surface water with the highest concentrations of metolachlor. The water bodies with the highest metolachlor levels are near use sites. The major mechanisms of aquatic loading for metolachlor are expected to be runoff from use sites and spray drift deposition occuring during or shortly after application. Pesticides reach aquatic environments from terrestrial use sites via many routes; such as via deposition of pesticide laden dust, vapor phase pesticide and precipitation containing metolachlor, and through recharge of groundwater containing metolachlor; but the overall contributions of metolachlor via these routes is generally insignificant for water bodies adjacent to use sites relative to the contributions from runoff and spray drift. Water bodies in proximity to use sites generally experience higher levels of runoff and spray drift than more distant water bodies. Farther away from use sites, runoff becomes more diluted as runoff from areas not receiving metolachlor applications joins with metolachlor laden runoff. Spray drift deposition levels also dissipate with distance as droplets fall out or are carried upward in thermal turbulence. Thus water bodies farther away from use sites will generally have lower metolachlor concentrations and the most vulnerable water bodies for direct effects to listed salmonids will be in close proximity to use sites.

Listed salmonid species could potentially be indirectly affected by metolachlor's effects on:

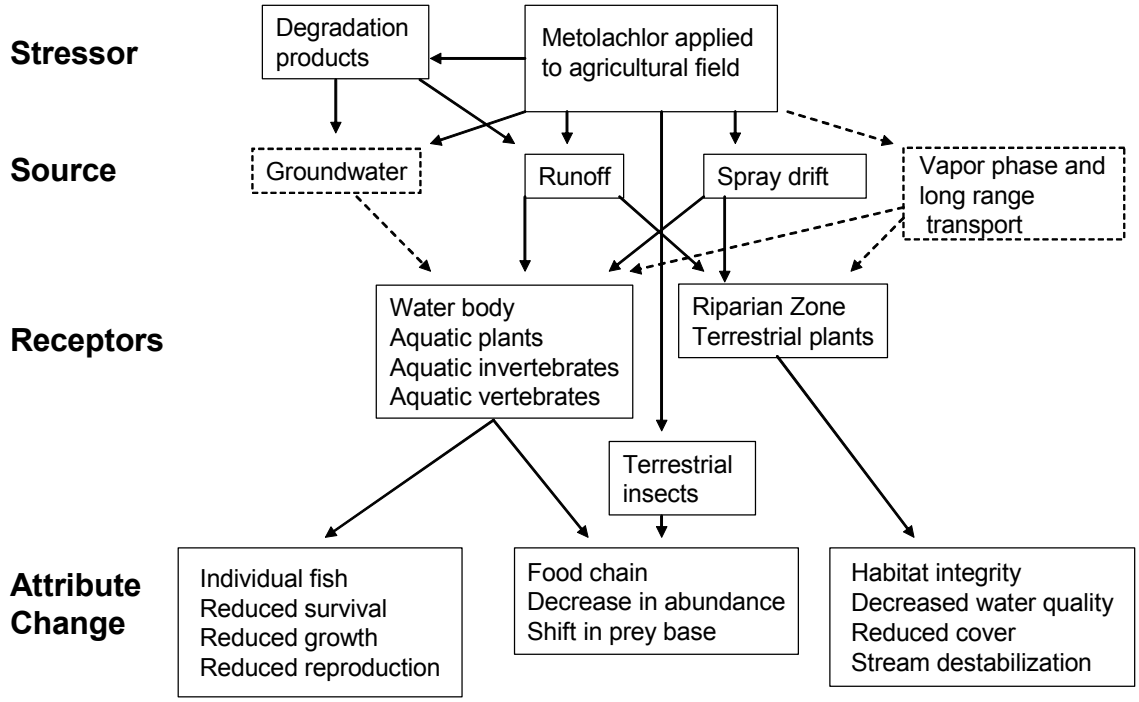
1) terrestrial and aquatic invertebrates and fish which serve as food sources

2) aquatic vegetation which is required to support aquatic invertebrates and provide shelter for salmonids
3) terrestrial vegetation required to maintain acceptable habitat quality and stream characteristics

Individual fish with the greatest potential to experience *indirect* effects are also those fish that rely on the streams most vulnerable to metolachlor exposure (*i.e.* those near or adjacent to application areas) for food, migratory passages, and/or shelter.

Figure 3.4, below provides a graphic description of the conceptual model used in assessing potential risk to listed salmonids.

Figure 3.4. Conceptual model for direct and indirect effects on listed salmonids from registered metolachlor use. Exposure routes shown in dashed lines are not quantitatively considered because the resulting exposures are expected to be so low as to not cause effects.



In order to assess potential risks, high-end concentrations of metolachlor in water bodies near use sites resulting from runoff and spray drift will be estimated and compared to toxicity values for fish, aquatic invertebrates, and aquatic plants. Exposures to riparian vegetation from spray drift and runoff will also be estimated and compared to phytotoxicity data. In instances where screening-level quantitative risk estimates (risk quotients) are above levels of concern, further evaluation of available information on exposure and effects is used to identify the likelihood of adverse effects.

In addition to evaluating the potential for effects from metolachlor, this assessment also

evaluates the potential of metolachlor degradates to directly or indirectly affect listed salmonid species. The predominant route of metolachlor degradation is expected to occur in the soil environment thus metolachlor soil degradate exposure to fish, aquatic plants, aquatic invertebrates, and terrestrial plants is also assessed.

3.5 Measures of Effects

3.5.1 Direct Effects

Direct effects are those that result from salmonid exposure to metolachlor or its degradates. Toxic effects that are likely to affect survival and reproduction of individual salmonid organisms are used to assess direct risks from metolachlor use. Toxicity tests identifying the concentrations required to reduce growth, survival, and reproductive success of fish are used to identify metolachlor and degradate levels that have the potential to directly impact listed salmonid species. Because toxicity data are not available for the specific salmonids which are the focus of this assessment, the endpoint from the most sensitive available fish species is used to assess risk for salmonids. The specific toxicity endpoints used are the LC_{50} for acute exposure and the no observable adverse effect concentration (NOAEC) for chronic exposure. Because sublethal effects were only observed at doses where mortality occurred, sublethal effects to fish are not considered in quantifying risks to fish and risk quotient calculations used lethal exposure values.

3.5.2 Indirect Effects

Indirect effects are those that result from metolachlor and metoalchlor's degradates' effects on the constituent elements of salmonid habitat. The lowest concentrations of metolachlor expected to significantly reduce the availability of food and shelter or expected to impair water quality are used to define indirect effect levels of concern. Toxicity tests identifying concentrations that affect survival, growth, and reproductive success of organisms that are food items, shelter, primary producers, or plants important for maintaining water quality and stream integrity are used to identify metolachlor and degradate levels with the potential to cause indirect effects to listed salmonid species. The specific toxicity endpoints used varies between plants and invertebrates.

For plants, three screening thresholds are used to screen for indirect effects to listed animal species:

1) When the endangered plant LOC is not exceeded, no indirect risk to a listed animal is expected. For terrestrial and aquatic plants, the NOAEL or the 5% effect level (EC_{05}) is the screening effect level used to define the endangered plant LOC.
2) When plant exposures exceed the endangered plant LOC but are below the non-endangered plant LOC, a potential risk is identified for obligate animal-plant relationships (*e.g.* the animal requires a specific plant species to complete its life cycle). For terrestrial plants the 25% effect level (EC_{25}) is the screening effect level used to define the non-endangered LOC. For aquatic plants the 50% effect

level (EC_{50}) is the screening effect level.

3) When exposures are above the endangered and non-endangered LOC, a potential for indirect effects is identified for obligate plant species and species related to more general dependencies.

Because no obligate relationships are established for listed salmonids the non-endangered LOC for plants is used to identify the potential for indirect effects.

For aquatic invertebrates, the endangered species and chronic LOCs are used to identify the potential for indirect effects to the listed salmonids. The endangered LOC is one twentieth (0.05) of the LC_{50} or EC_{50} for mortality/immobility and the NOAEC is used for the chronic exposure LOC. The most sensitive tested species is used as a surrogate to represent organisms important to salmonids.

No standard methods are available for assessing the potential for indirect effects resulting from effects to terrestrial invertebrates. However, a qualitative description of the potential for indirect effects based on exposure and toxicity to terrestrial insects is included in the Risk Description part of this document (see section 5.2.2a).

Additionally, no standard methods exist for assessing the effects from potential increases in aquatic sediment that is a potential result of damage to riparian vegetation. An evaluation of existing data on salmonid sensitivity to sediment was conducted in order to qualitatively evaluate the hazard of sediment to different salmonid life stages. The descriptions of hazard to sediment are included in the Risk Description (section 5.2.2), and Salmonid Habitat (section 2.6) portions of this assessment. Descriptions of exposure to sediment are described in the Risk Description (section 5.2.2) and the Measures of Exposure (section 3.6.4) sections.

3.6 Measures of Exposure

3.6.1 Aquatic Organisms

Aquatic organism exposure is assumed to occur through direct contact with water containing metolachlor. The Pesticide Root Zone Model and the Exposure Analysis Modeling System (PRZM-EXAMS) was used for metolachlor runoff and spray drift modeling and the AgDRIFT model to evaluate potential spray drift exposure. Concentrations of degradates expected to be predominately formed in the soil environment were assessed using the runoff component of the GENEEC2 screening model. The PRZM-EXAMS modeling reflects typical and high intensity use scenarios for soil, weather, and hydrologic conditions consistent with use sites in watersheds supporting listed salmonids. The GENEEC2 model conditions represent high intensity use of metolachlor in a generalized area highly vulnerable to runoff. The highest concentration resulting from runoff and spray drift likely to occur in a period of ten years of use is used for exposure assessment. This one-in-ten-year peak daily value is compared to acute toxicity data and the one-in-ten-year peak 21-day and 60-day averages are used for chronic risk assessment.

The PRZM-EXAMS and GENEEC model results reflect concentrations expected in a small, fixed volume, static water body while in agricultural areas the listed salmonids are found primarily in flowing water bodies. The size of the water body modeled represents a generic, highly-vulnerable surface water body and, because it is static, the estimated peak concentrations are considered to be higher than what would be expected in first order and larger streams in a similar agricultural setting. Peak metolachlor and degradate concentrations in the water body are expected to persist longer than peak concentrations in flowing waters because dissipation occurs as a result of downstream movement, dilution and degradation processes, while in static water bodies dissipation is more reliant on degradation processes alone (Larson *et al.* 1997, chapter 5). Concentrations in smaller streams are expected to be more variable than in static water bodies, larger streams, and rivers. The only streams expected to have higher peak concentrations than the static water body are those streams that have smaller volumes, and with sufficiently low flow rates to result in less dilution of runoff. Metolachlor entering larger streams and rivers would be more diluted, resulting in lower peak and average concentrations than predicted by PRZM-EXAMS and GENEEC. The highest surface water concentrations of metolachlor are expected to occur in undiluted runoff from fields treated with metolachlor. Undiluted runoff can form streams but because runoff is ephemeral, streams consisting entirely of runoff from treated fields are not expected to be adequate to support listed salmonids. Instead, streams supporting listed salmonids are understood to be derived from runoff, groundwater recharge and snowmelt from watersheds where only a fraction of the area may be comprised of potential metolachlor use sites.

PRZM-EXAMS modeling requires the selection of scenarios for simulation. A scenario represents a crop grown in a specific U.S. county, and considers soil conditions appropriate for the crop and county, agronomic practices consistent with the culture of the crop, and 30-years of historical meteorological data for the site from the Solar and Meteorological Surface Observational Network (SAMSON). Metolachlor scenarios were chosen from existing PRZM-EXAMS scenarios, which have undergone quality assurance and quality control (*e.g.*, FIFRA Scientific Advisory Panel 1997, 1998; Durburow *et al*. 2000; Parrish *et al*. 1992; Ma *et al*. 1998 and others), by identifying scenarios which represent crops grown in the Western U.S. on which metolachlor may be applied.

AgDRIFT (Bilanin *et al.* 1989, Bird *et al*. 2002) spray drift modeling requires the input of application and meteorological parameters to determine the amount of sprayed material expected to deposit downwind of application areas. Metolachlor product labels were used to determine the allowable conditions for metolachlor application. For parameters that were not found on product labels and have a relatively strong effect on downwind deposition, conservative default inputs and inputs more consistent with typical conditions were used to assess downwind deposition. SAMSON weather data included in the AgDRIFT model and specific to the potential metolachlor use areas in the Western U.S. were used to identify typical meteorological parameters.

More information on peer review and comparisons of PRZM/EXAMS predicted concentrations with monitoring data may be found at the following websites:

http://www.epa.gov/scipoly/sap/1998/july/1part5.pdf

http://www.epa.gov/fedrgstr/EPA-PEST/1999/November/Day-10/6044.pdf

http://www.epa.gov/scipoly/sap/1999/may/pca_sap.pdf

Information on aquatic exposure models, specific model versions used, and input parameter selection guidance is available on the internet at:

http://www.epa.gov/oppefed1/models/water/index.htm.

3.6.2 Terrestrial Insects

Terrestrial insects may be exposed to metolachlor in two ways, either via direct contact from spray treatments, or by coming into contact with pesticide residues on foliage. Label application rates of metolachlor can be used to estimate the mass of metolachlor depositing per unit area in the treatment zone. Exposure potential is expected to be highest in the treatment area. The metolachlor product labels describe application rates in units of lbs a.i./acre. These units were converted to suitable units for comparison to insect toxicity data. Two approaches were used to estimate insect exposure values for insects in the treatment area at the time of application. First, the Kenaga nomogram (Fletcher *et al.* 1994), which is used to estimate dietary exposure to animals eating sprayed plants and insects, was used to estimate exposure in terms of mass of metolachlor contacting insects per mass of insect. Second, a representative insect size, surface area, and weight was assumed and the amount of material deposited on the surface area of the insect was estimated. This was then converted to yield the mass of metolachlor deposited per mass of insect. Exposure values were then compared to registrant-submitted toxicity data on the honey bee *(Apis mellifera)*. No other insect toxicity data for metolachlor were identified through a search of open literature (see section 3.2).

3.6.3 Terrestrial Plants

Terrestrial plants may be exposed to metolachlor from spray drift from treated agricultural fields and to metolachlor and its degradates in runoff. As noted in section 2.6.2b, riparian vegetation is the terrestrial vegetation important to salmonid habitat. Concentrations of metolachlor and its degradates on the riparian vegetation will be estimated using TerrPlant and AgDRIFT models, considering use conditions likely to occur in the Pacific Northwest. The TerrPlant model (U.S. EPA 2001) evaluates exposure to plants via runoff and spray drift. The estimated runoff loading is based on the solubility of the chemical and assumptions concerning the drainage and receiving areas. The default spray drift component of TerrPlant assumes that 1% and 5% of the application rate deposits in the receiving area for ground boom and aerial applications, respectively. The AgDRIFT model is used to provide more refined estimates of spray drift exposure and is used to supplement TerrPlant results. Estimated concentrations of metolachlor and degradates will be compared with plant toxicity endpoints.

3.6.4 Sediment Loading to Salmonid Habitat

Salmonid exposure to increased sediment levels (both suspended and deposited) from riparian areas damaged by metolachlor was also evaluated (see conceptual model, section 3.4). The Universal Soil Loss Equation (USLE) (USDA 1978), developed by the USDA, relies on estimations of parameters known to influence erosion yields, including rainfall/runoff (R), soil erodibility (K), slope/length (L), slope/steepness (S), cover management (C), and support practices (P). The USLE equation has been incorporated into a number of numerical models including PRZM, RUSLE2 (Revised Universal Soil Loss Equation version 2)(USDA ARS 2003), and REMM (Riparian Ecosystem Management Model) (USDA ARS undated) for estimating erosion from various land cover types. However, use of each of these models is predicated on accurate information for each of the parameters discussed above. While each of these models shows promise for predicting sediment loading from various cover management types, only the REMM model has been developed specifically for riparian zones.

Lack of necessary model inputs as well as limitations in the modeled processes limit the utility of erosion models in this assessment. It is not possible to generically model the potential effects of metolachlor on sediment loading because there is no single representative example of a riparian zone nor is there information available on the range and quality of riparian zones covered under this assessment. The available models are limited in their ability to predict the effect of channelized flow (both rill and gully) which is thought to be the primary sediment transport process from agricultural fields. Also, the erosion models do not evaluate the effects of riparian vegetation on streambank erosion and stability. Therefore, this assessment describes the potential effects of metolachlor on aquatic sediment loading in qualitative terms.

As an example of the difficulties associated with quantitatively estimating sediment yields, a bounding comparison was performed. Sediment yield from a healthy riparian zone, may be represented by the range grass yield of 2.5 tons per acre per year as predicted by the RUSLE2 program. The high-end loading situation is represented by rough, bare, freshly disturbed soil where all vegetation is removed from the riparian zone, yielding 9.1 tons per acre pre year, a value 3.6 times that predicted by the range grass scenario. However, it is unlikely that all vegetation within a riparian zone will ever be completely killed due to metolachlor use (see section 5.2.2c). Assuming linearity between the sediment yield for the healthy riparian site and the bare ground site, it is possible to interpolate an increase in sediment yield given a percentage loss of vegetation in the riparian zone. For example, using an assumption of 50% reduction of riparian vegetation relative to the range grass system due to off-site impacts from metolachlor would predict an increase of sediment loss from the riparian zone by a factor of roughly 1.8 relative to the range grass scenario. However, it should be pointed out that these are annual estimates of sediment loading using different cover management types. Metolachlor's effects are transitory in that the plant assemblage will recover within a shorter time frame than the year time frame on which these estimates are based. Therefore, these estimates are likely to over predict loading. Also, the appropriateness of the range grass cover type as a surrogate for a healthy riparian zone is uncertain, but likely conservative.

The NMFS (Beechie *et al.* 2003) has developed a criteria for potential impact of sediment load to cold-water fisheries based on "natural" loads versus increases over "natural" due to various landscape indicators. NMFS concludes that sediment loading of greater than 100 cubic meters per square kilometer per year (m^3 km^{-2} $year^{-1}$) are indicative of impaired waters, except when those water have "natural" sediment loads of greater than 100 m^3 km^{-2} $year^{-1}$). When "natural" loads are greater than this criterion the increase in sediment load due to human activities should be no more than 1.5 times the natural load. When converted to comparable units and compared with PRZM predictions of sediment yield, only certain agricultural settings (California corn and Oregon corn and beans) predict sediment yields above this value. However, using the RUSLE2 approach many of the land cover types (both agricultural and non-agricultural) give sediment yields above these criteria. The discrepancies between models and the lack of published mechanistic information on erosion from riparian zones suggest that well understood and validated tools to quantitatively estimate sediment loading to salmonid bearing surface water are not available. Thus, the effects of metolachlor on sediment loading to surface water is qualitatively addressed in this assessment.

3.7 Risk Characterization Approach

Exposure estimates for salmonids and other organisms important to salmonids will be compared with toxicity levels using the risk quotient (RQ) method. The RQ method is a means of quantifying potential risk by dividing an exposure value by a toxicity value. Thus, as exposure increases or the amount of chemical required to elicit a toxic response decreases the associated RQ increases. Larger RQs suggest a greater potential for risk than lower RQs, however, the relationship between RQ values and risks may or may not be linear. Depending on the slope of the dose-response relationship, a small increase in an RQ value may result in a large or small increase in effect.

The RQ method is useful for screening risks. By calculating high-end exposures and comparing them to toxicity values from relatively sensitive organisms it is possible to determine high-end environmental risks. If high-end potential risks associated with a given pesticide's use are considered to be acceptable, more commonly occurring, lower exposures to less sensitive organisms would also be considered acceptable.

Predefined levels of concern (LOCs) are used to determine if the estimated risk to a particular taxonomic group is potentially significant (U.S. EPA 2004a, U.S. FWS and NMFS.2004). If the RQ for a particular organism is below the LOC for that taxonomic group, the assessed pesticide use is considered have no direct effect on the taxonomic group. The LOC used for direct effects to endangered fish is 0.05 for acute exposures and 1.0 for chronic exposures. For indirect effects to endangered and threatened fish, the LOC used for aquatic invertebrate food items is 0.05 for acute exposures and 1.0 for chronic exposures[13], and 1.0 for terrestrial plants.

When dose-response slopes are available with toxicity studies they are used to provide an

[13] RQ levels of concern have not been defined for terrestrial invertebrates.

estimate of the fraction of exposed organisms that are likely to experience adverse effects. For example, when the slope of the dose-mortality curve for fish is available it is used to estimate the probability of individual effects at an exposure corresponding to the LOC or 0.05 (one twentieth of the LC_{50}).

4. Exposure and Effects Analysis

4.1 Effects Summary

The toxicity to fish, invertebrates, and plants are summarized below. The species and test with the lowest toxicity endpoint for each type of organism is identified for use in calculating risks. Toxicity to aquatic fish and invertebrates is categorized using the following system from Zucker (1985):

LC_{50} (ppm)	Toxicity Category
< 0.1	Very highly toxic
> 0.1 - 1	Highly toxic
> 1 - 10	Moderately toxic
> 10 - 100	Slightly toxic
> 100	Practically nontoxic

EFED has not defined toxicity categories for plants or terrestrial invertebrates.

Summarized toxicity data are derived from studies which have undergone review and were classified as "Core"/"Acceptable" (conducted under guideline conditions and considered to be scientifically valid) or "Supplemental"(study conditions deviated from guidelines but the results are considered to be scientifically valid). Results from invalid studies are not summarized. For more details on EFED's study classification system and study guidelines see OPPTS 2004.

The Agency has determined that both the environmental fate and ecotoxicity data submitted for racemic metolachlor and S-metolachlor are comparable (Federal Register 2003). Thus, data on S-metolachlor may be useful in assessing the effects of metolachlor.

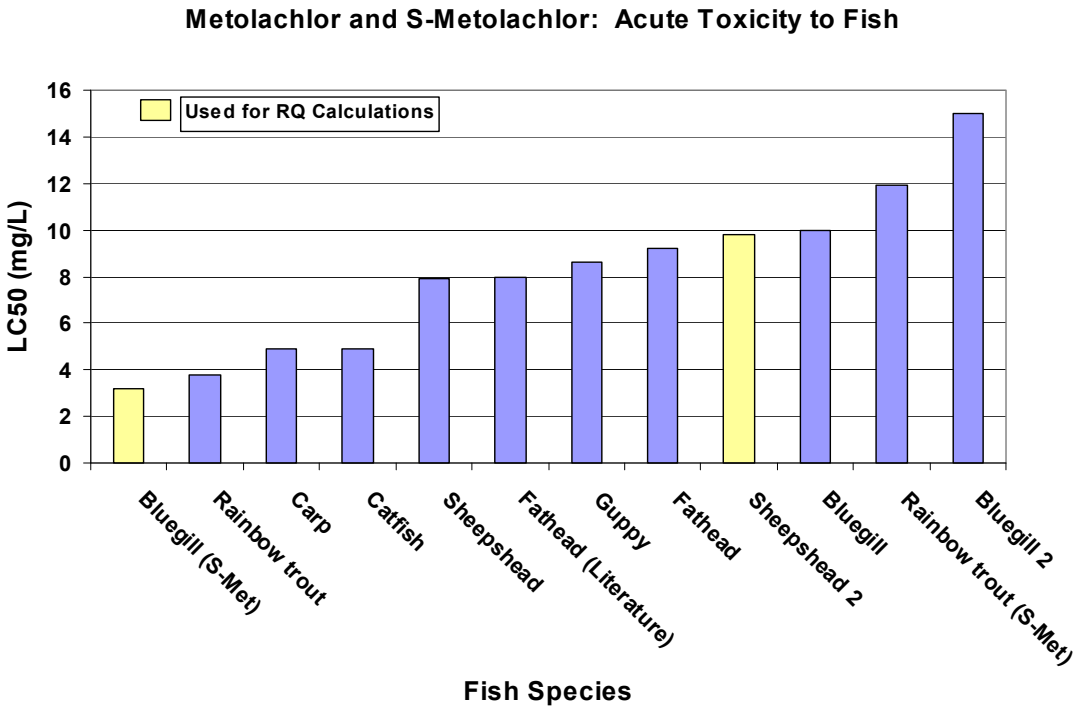
4.1.1 Fish

Available metolachlor and S-metolachlor fish toxicity data are fairly consistent across species and test conditions, showing lethality and sublethal effects from acute exposure at low part-per-million levels. As a result, metolachlor and S-metolachlor are generally considered to be moderately toxic to fish.

The lowest LC_{50} value was 3.2 mg/L for an acute (96-hour) exposure to bluegill sunfish (*Lepomis macrochirus*) with S-metolachlor. This value is comparable to the LC_{50} value of 3.8 mg/L in Rainbow trout (*Onchorhyncus mykiss*) exposed to metolachlor for 96 hours. The lowest NOAEC for chronic exposure was 0.03 mg/L from a study conducted with S-metolachlor on fathead minnows *(Pimephales promelas)*.

Figure 4.1.1 provides a graphical representation of the acute toxicity data conducted with either metolachlor or S-metolachlor on fish. One fish study was found in the literature and is included in the graphical representation as well.

Figure 4.1.1. Metolachlor and S-metolachlor toxicity to fish and values used in calculating freshwater and estuarine/marine risk quotients.



Acute toxicity studies on the two degradates of metolachlor, the ethane sulfonic acid (ESA) and the oxanilic acid (OA) derivatives indicate that they are significantly less toxic than the parent. In rainbow trout, the 96-hour LC_{50}s were 48 ppm and greater than 96.3 ppm for ESA and OA, respectively. The acute toxicity of OA in carp is similar to rainbow trout.

a. Registrant-Submitted Studies

A summary of the endpoints and concentrations identified from registrant-submitted studies on fish is presented in Table 4.1.1a (acute exposure) and 4.1.1b (chronic exposure).

Table 4.1.1a Summary of Registrant Submitted Acute Toxicity Studies for Fish

Acute Aquatic Toxicity	Compound	LC50/EC50 ppm	Slope	95% C.I. ppm	LOAEC ppm	NOAEC ppm	MRID	Toxicity	Classification	Notes:
Lepomis macrochirus Bluegill sunfish	Technical (racemic-CGA-24705)	10.0	N/A	8.6-12	8.8	6	00018723	Moderately toxic	Core	1978 study.
Onchorhyncus mykiss Rainbow trout		3.8	N/A	3.3-4.6	4.1	2.8	00018722	Moderately toxic	Core	1978 study.
Carassius carassius Crucian Carp		4.9	N/A	3.6-6.8	N/A	N/A	00015534	Moderately toxic	Supplemental	1974 study. Sub-lethal effects: hypersensitivity, loss of equilibrium and apathy
ctalurus punctatus Channel catfish		4.9	N/A	3.6-6.8	2.1	1	00015534	Moderately toxic	Core	
Lepomis macrochirus Bluegill sunfish		15.0	N/A	N/A	N/A	N/A	00015534	Slightly toxic	Supplemental	
Lebistes reticulatus Guppy		8.6	N/A	7.4-10.5	N/A	N/A	00015534	Moderately toxic	Supplemental	
Pimephales promelas Fathead minnow		9.2	N/A	7.9-11.0	N/A	N/A	00162428	Moderately toxic	Supplemental	Mortality to juvenile fish observed at 2.6 ppm and above.
Cyprinodon variegatus Sheepshead minnow		9.8	N/A	8.5-11.4	6.2	3.6	43487101	Moderately toxic	Core	Sub-lethal effects at 6.2 ppm and higher: lethargy and loss of equilibrium.
Cyprinodon variegatus Sheepshead minnow		7.9	N/A	4.4-infinity	9.4	4.4	43044602	Moderately toxic	Supplemental	Only one partial kill (70%) at highest concentration tested.
Lepomis macrochirus Bluegill sunfish	S-metolachlor (CGA-77102)	3.2	14.8	2.8-4.6	2.59	1.5	43928910	Moderately toxic	Core	Sub-lethal effects: fish swimming on surface at 3.29 ppm and 8.51 ppm concentrations.
Onchoryhyncus mykiss Rainbow trout		11.9	N/A	8.3-15	5.3	2.5	43928911	Slightly toxic	Core	Sub-lethal effects at 5.3 ppm and above: partial/complete loss of equilibrium, extended abdomen, lethargy, and residing on bottom.
Onchoryhyncus mykiss Rainbow trout	OA Metabolite (CGA-51202)	>96.3	N/A	N/A	N/A	>96.3	44929501	Practically non-toxic	Invalid (Pending Supplemental)	Purity not available; however, analytical measurements available

Table 4.1.1a Summary of Registrant Submitted Acute Toxicity Studies for Fish										
Acute Aquatic Toxicity	**Compound**	**LC50/EC50 ppm**	**Slope**	**95% C.I. ppm**	**LOAEC ppm**	**NOAEC ppm**	**MRID**	**Toxicity**	**Classification**	**Notes:**
Cyprinus carpio Common Carp	OA Metabolite (CGA-51202)	>93.1	N/A	N/A	N/A	>93.1	44929502	Practically non-toxic invalid	Invalid (Pending Supplemental)	Purity not available; however, analytical measurements available
Onchoryhyncus mykiss Rainbow trout	ESA Metabolite (CGA-354743)	48 43 (nominal)	N/A 25.7 (nominal)	36-64	64	36	44931702	Slightly toxic	Supplemental	At 58 and 100 ppm, erratic swimming, loss of equilibrium, pigmentation changes. Only 7 fish/group.

Table 4.1.1b Summary of Registrant-Submitted Chronic Toxicity Studies for Fish									
Chronic Aquatic Tests	**Most Sensitive Endpoint**	**Compound**	**MATC ppm**	**95% C.I. ppm**	**LOAEC ppm**	**NOAEC ppm**	**MRID**	**Classification**	
Cyprinodon variegatus Sheepshead minnow	length	Technical (racemic-CGA-24705)	1.5	1.0-2.2	2.2	1	43044602	Supplemental	**Notes:** Hatch rate affected at 8.6 ppm. Increase in mortality at 5 ppm and above. Abnormal fry included in these values.
Pimephales promelas Fathead minnow	dry weight	S-metolachlor (CGA-77102)	0.041	N/A	0.056	0.03	44995903	Core	No sublethal effects reported

Freshwater Fish Acute Ecotoxicity

Seven scientifically valid acute toxicity studies are available for freshwater fish: one each with rainbow trout *(onchorhyncus mykiss)*, crucian carp *(Carassius carassius)*, channel catfish *(Ictalurus punctatus)*, guppy *(Lebistes reticulatus)* and fathead minnow *(Pimephales promelas)* and two with bluegill sunfish (*Lepomis macrochirus)*.

Metolachlor was tested in rainbow trout at concentration levels ranging from 1.9 to 8.8 ppm (MRID 00018722). This study was originally evaluated by the Agency in 1978 using a probit analysis. The LC_{50} at 96 hours was estimated to be 3.9 ppm with a 95% confidence interval of 3.3 - 4.6 ppm. The NOAEC and LOAEC were determined to be 2.8 ppm and 4.1 ppm, respectively, based on mortality. Since there was only one partial mortality concentration, the probit analysis is not considered to be appropriate and a binomial test was conducted to confirm the LC_{50} value and the confidence intervals. The re-estimated LC_{50} is 3.8 ppm with a 95% confidence interval of 2.8 - 6 ppm. Metolachlor was classified as moderately toxic to rainbow trout.

Two studies were conducted with bluegill sunfish and both studies indicate that of the tested fish species, this species is the least sensitive. The first study conducted in 1974 was classified as Supplemental because the temperature of the water was too low (14 ± 2°C in comparison to the preferred temperature range of 19 - 26°C for warm water species; MRID 0015534). The test concentrations ranged from 1 - 49 ppm metolachlor. Only one concentration had partial mortality (75% at 21 ppm). The remainder of the concentrations had either 0% mortality (1 and 10 ppm) or 100% mortality (49 ppm). Since there was only one concentration where partial mortality was observed, a linear regression line was constructed and a 96-hour LC_{50} of 12 ppm was estimated with a large confidence interval. In addition to mortality, it was reported that approximately 4-6 hours following addition of the test material, hypersensitivity, loss of equilibrium and later, apathy were observed at concentrations where mortality occurred. Metolachlor was classified as moderately toxic to bluegill sunfish.

In the second bluegill sunfish study (conducted in 1978), nominal concentrations were reported as ranging from 1.9 to 28 ppm metolachlor (MRID 0018723). The results support the first study (MRID 0015534). Using the Weil technique, an LC_{50} value was estimated to be approximately 10.3 ppm with a 95% confidence interval of 9.5 - 11.1 ppm. The study was classified as Core and metolachlor was classified as moderately toxic to bluegill sunfish.

Studies using carp, catfish, bluegill sunfish and guppy were included in the same report with the above study on bluegill sunfish (MRID 0015534). Carp and catfish were approximately as sensitive to metolachlor as rainbow trout (summarized above). Metolachlor was tested in these two fish species at concentrations ranging from 1 to 10 ppm. The 96-hour LC_{50} for both species was 4.9 ppm with 95% confidence limits of 3.6 - 6.8 ppm. The NOAEC and LOAEC, based on mortality were 1 and 2.1 ppm, respectively. Guppies were slightly less sensitive than the carp and catfish. When guppies were tested at concentrations ranging from 1 ppm to 21 ppm, the 96-hour LC_{50} was reported to be 8.6 ppm with a 95% confidence interval of 7.4 - 10.5 ppm. The

NOAEC and LOAEC for guppies based on mortality were 1 ppm and 6.5 ppm, respectively. The similarities of NOAECs between the carp, catfish and guppies are due to the pre-selected spread in concentration levels. For example, only 1/12 guppies died at 6.5 ppm (the LOAEC for guppies) whereas 7/12 catfish and carp died at 6.5 ppm. Although the NOAEC/LOAEC for rainbow trout were slightly higher than that of the carp and catfish (2.8/4.1 ppm for trout versus 1/2.1 ppm, respectively for carp and catfish), the use of the lower estimated LC_{50} from the trout data are protective of the other fish species.

As reported with bluegill sunfish, the carp, catfish, and guppy studies reported that approximately 4-6 hours following addition of the test material, hypersensitivity, loss of equilibrium and later, apathy were observed at concentrations where mortality occurred. These symptoms were observed at 2.1 ppm in both carp and catfish and at 6.5 ppm in guppies. For carp, the test temperature (14°C ± 2°C) was below the recommended range (19 - 26°C) for warm water species. Since neither the carp nor the guppy are recommended test species and the temperature of the water was below the recommended range for carp, the study was classified as Supplemental for carp and guppy and Core for catfish. As with other tested fish species, metolachlor was classified as moderately toxic to carp, guppies and catfish.

An acute toxicity test was conducted with fathead minnows (MRID 00162428) to estimate concentrations to be used in a complete life cycle study. Based upon mean measured concentrations, the 96-hour LC_{50} was estimated to be 9.2 ppm with a 95% confidence interval of 7.9 to 11.0 ppm. The only other information provided was that mortality to juvenile fish was observed in mean measured test concentrations as low as 2.6 ppm. The study was classified as Supplemental and metolachlor was classified as moderately toxic to fathead minnows.

While the results from the acute freshwater fish studies conducted with S-metolachlor show a different rank order of species sensitivity relative to racemic metolachlor the results are essentially the same. The reported freshwater fish acute toxicity values for both S-metolachlor and metolachlor are in the same order of magnitude. The apparent discrepancies may be due to a variety of test conditions, including dose spread.

S-Metolachlor was found to be moderately acutely toxic to bluegill sunfish (*Lepomis macrochirus*) (MRID 43928910). When tested at measured concentrations ranging from 0.66 to 8.51 ppm, the 96-hour LC_{50} was determined to be 3.2 ppm with a 95% confidence interval of 2.8 to 4.6 ppm and a probit slope of 14.8. The NOAEC was 1.5 ppm and the LOAEC was 2.59 ppm based on mortality. Fish exposed to 3.29 ppm and 8.51 ppm were observed swimming on the surface. The study was classified as Core. There were several guideline deviations; however, these were not significant enough to affect the study classification. Of the fish species used to test metolachlor and S-metolachlor, this study provides the most protective LC_{50} for estimation of RQ values for the selected crop scenarios. The LC_{50} value of 3.2 ppm or 3200 ppb, was used to quantify direct acute risk (freshwater fish) to listed salmonids.

In rainbow trout (*Oncorhynchus mykiss*), S-metolachlor had a 96-hour LC_{50} of 11.9 ppm

with a 95% confidence interval of 8.3 to 15 ppm using a nonlinear interpolation method (binomial test) (MRID 43928911). The mean measured concentrations ranged from 2.5 to 42 ppm, allowing for an observed NOAEC of 2.5 ppm and a LOAEC of 5.3 ppm based on one or more of the following observations: partial to complete loss of equilibrium, extended abdomen, lethargy, residing on the bottom or death. Mortality was observed at concentrations of 15 ppm and above. The study was classified as Core, although it is noted that the oxygen concentration fell below the recommended level in one treatment solution during the final 72 hours of the study (concentration levels ranged from 38-93% saturation during the first 48 hours and 35-67% of saturation during the second half of the test).

Marine/Estuarine Fish Acute Ecotoxicity Studies

Two acute toxicity studies are available with sheepshead minnows (*Cyprinodon variegatus*). In the first study, metolachlor was tested at mean measured concentrations ranging from 0.59 to 9.4 mg/L (MRID 43044602). The 96-hour LC_{50} was 7.9 mg/L with a lower 95% confidence limit of 4.4 mg/L using the binomial test. An upper confidence bound could not be calculated because only the highest concentration had mortality. The NOAEC was 4.4 mg/L and the LOAEC was 9.4 mg/L based on mortality. The study was classified as Supplemental due to numerous deviations from the EPA testing guidelines. Metolachlor was classified as moderately toxic to sheepshead minnow.

In the second study, metolachlor was tested with sheepshead minnows at mean measured concentrations ranging from 2.8 to 19 mg/L (MRID 43487101). Using the moving average method, the 96-hour LC_{50} was estimated to be 9.8 mg/L with 95% confidence limits of 8.5 to 11.4 mg/L. The NOAEC was 3.6 mg/L and the LOAEC was 6.2 mg/L based on mortality. Sublethal effects (lethargy and loss of equilibrium) were observed among all surviving fish exposed to the 11 mg/L treatment level and to one fish in the 6.2 mg/L treatment level. The size of the fish in this study was smaller than recommended (0.11 - 0.35 g versus 0.5 - 5 g in the guidelines). However, the study was classified as Core and metolachlor was classified as moderately toxic to sheepshead minnow. Although the first study (MRID 43044602) has a lower LC_{50}, this study was selected for estimation of the acute RQs for marine/estuarine fish because there is more confidence in the data because the 95% confidence limits are tighter and dose-related mortality was observed at more than one concentration level.

No acute ecotoxicity studies on marine/estuarine fish are available for S-metolachlor.

Freshwater Fish Chronic Ecotoxicity Studies

No acceptable freshwater fish chronic ecotoxicity studies are available for metolachlor. A life-cycle toxicity test was conducted with technical metolachlor on fathead minnows [*Pimephales promelas* (MRID 00162428)]; however, this study has been classified as Invalid because both dilution water and solvent control solutions were contaminated with the test material and complete mortality occurred in one of the solvent control replicates. In addition, raw water quality, analytical and biological data were not submitted for review.

In an early life-stage toxicity test conducted with fathead minnows, S-metolachlor was tested at concentrations ranging from 31 to 1000 µg S-metolachlor/L (MRID 44995903). Based on mean measured concentrations, the LOAEC and NOAEC are 56 ppb and 30 ppb S-metolachlor, respectively with a geometric mean MATC of 41 ppb based on reduced dry weight of larval fish. The study has been classified as Core. In the absence of an acceptable chronic toxicity NOAEC for metolachlor and because of the similarity of S- and racemic metolachlor, the NOAEC from this study was used to evaluate risk to freshwater fish from chronic exposure to metolachlor.

Marine/Estuarine Fish Chronic Ecotoxicity Studies

In an early life stage study with sheepshead minnows (*Cyprinodon variegatus*), metolachlor was tested at mean measured concentrations ranging from 0.55 to 8.6 mg/L (MRID 43044602). The overall NOAEC for the study was determined to be 1 mg/L and the LOAEC was 2.2 mg/L based on length. Hatch rate was affected at 8.6 mg/L, the highest concentration tested. Abnormal fry were included in these values. Increases in mortality were observed at concentration levels of 5.0 mg/L and above; however, it is noted that the study was terminated at day 26 because of mortalities caused by the addition of artificial salt. The MATC ranged from 1.0 - 2.2 mg/L with a geometric mean of 1.48 mg/L. The study was classified as Supplemental because it was not conducted under the current guideline protocols; however, the data are of sufficient quality that the NOAEC from this study was used to evaluate risk to estuarine/marine fish from chronic exposure to metolachlor.

No chronic ecotoxicity studies on marine/estuarine fish are available for S-metolachlor.

b. Open Literature

Table 4.1.2c summarizes the open literature toxicity studies for fish and amphibians. Summaries of these studies follow the table. A more detailed tabular summary of the open literature data is presented in Appendix B.

Table 4.1.1c Summary of Studies from the Open Literature for Fish and Amphibians

Genus	Species	Common name	Major Group Effect	Measurement	Endpoint	Duration (Hours)	Conc mean	Conc Units	Exposure Type	Ref#
Freshwater Fish										
Pimephales	*promelas*	Fathead minnow	Mortality	Mortality	LC_{50}	96	8	ppm	Static	6797
Pimephales	*promelas*	Fathead minnow	Mortality	Mortality	LC_{50}	96	8.40	ppm	Static	6797
Amphibians										
Xenopus	*laevis*	African Clawed Frog	Mortality	Mortality	LC_{50}	96	13.6	ppm	Renewal	66376
Xenopus	*laevis*	African Clawed Frog	Growth	Abnormal	EC_{50}	96	76	ppm	Renewal	66376
Xenopus	*laevis*	African Clawed Frog	Growth	Length	NOAEL	96	1	ppm	Renewal	66376
Rana	*catesbeiana*	American Bullfrog	Mortality	Mortality	NR-LETH	<=24	17.38	ppm	Static	20274
Rana	*catesbeiana*	American Bullfrog	Cell(s)	Damage	LOAEL	24	0.272	ppm	Static	20274

NR = Not reported

Freshwater Fish and Amphibian Acute Ecotoxicity

Fathead minnow (*Pimephales promelas*) were tested with technical metolachlor (95.4%) and with an emulsifiable concentrate (87%) in 96-hour acute toxicity tests under static test procedures (Ref. # 6797). Data on temperature, pH and hardness of the water were provided. The 96-hour LC_{50}'s of the technical material and the formulation were 8.0 mg/L (confidence interval 5.4 to 12.0 mg/L) and 8.4 mg/L (confidence interval 6.4 to 11.0 mg/L), respectively.

Bullfrog *(Rana catesbeiana)* tadpoles were exposed to dilutions of the metolachlor formulation, Dual-960E for 24 hours under static conditions (Ref. # 20274). These concentrations are considered to be nominal values because the study does not provide analytical methods. Four of 4 tadpoles died within 24 hours at 17.38 ppm. No other details were provided in the study.

Metolachlor (99%) and two degradation products (2,6-diethylaniline (>98%) and 2-ethyl-6-methylaniline (>97%) were tested in African clawed frogs (*Xenopus laevis*; Ref. # 66376). The frogs were obtained from ponds at the shores of Lake Victoria in Kenya and acclimated for 6 weeks prior to first breeding. Embryos of stage 8 (midblastula) to stage 11 (early gastrula) were obtained from at least 3 different male/female pairs for each bioassay. A standard static renewal assay was used as a guideline. Nominal concentrations ranging from 3.5 to 352.4 µM metolachlor, 10.1 to 335.0 µM 2,6-diethylaniline or 7.4 to 739.6 µM 2-ethyl-6-methylaniline were tested. The 96-hour $LC_{50'}$'s of metolachlor, 2,6-diethylaniline and 2-ethyl-6-methylaniline were 47.92 (40.41 - 55.44 C.I.), 129.99 (115.58 - 144.40) and 508.84 (493.23 - 524.45) µM, respectively. This corresponds to 13.6 ppm, 19.40 ppm and 68.8 ppm, respectively for each chemical.

Marine/Estuarine Fish Acute Ecotoxicity

No open literature studies are available.

Freshwater Fish and Amphibian Chronic Ecotoxicity

Metolachlor (99%) and two degradation products (2,6-diethylaniline (>98%) and 2-ethyl-6-methylaniline (>97%) were tested in African clawed frogs (*Xenopus laevis*; Ref. # 66376). The frogs were obtained from ponds at the shores of Lake Victoria in Kenya and acclimated for 6 weeks prior to first breeding. Embryos of stage 8 (midblastula) to stage 11 (early gastrula) were obtained from at least 3 different male/female pairs for each bioassay. A standard static renewal assay was used as a guideline. Nominal concentrations ranging from 3.5 to 352.4 µM metolachlor, 10.1 to 335.0 µM 2,6-diethylaniline or 7.4 to 739.6 µM 2-ethyl-6-methylaniline were tested. In those embryos exposed to metolachlor, edema (48%) was the most frequently observed disorder. In addition, gut malformations (19%), axial flexures (22%) and eye abnomalities (11%) were observed. The two degradation products induced edema to a lower extent (6 and 7% for 2,6-diethylaniline and 2-ethyl-6-methylaniline respectively). Axial flexures (52 and 49% of all abnormalities, respectively). Gut and eye abnormalities comprised 3 and 39%, respectively of all abnormalities for 2,6-diethylaniline and 11 and 33%,

respectively for 2-ethyl-6-methylaniline. The study authors rated metolachlor and its degradation products for teratogenic potential using their TI values (LC_{50}/EC_{50} for malformations). Based on TIs from standard compounds, a TI ≥ 2 indicates the need for further testing, a TI between 1.5 - 2.0 indicates that the test material should be treated as a potential teratogen and a TI value < 1.5 indicates that embryolethality is more significant. According to the test results, metolachlor, 2,6-diethylaniline and 2-ethyl-6-methylaniline have TI values of 0.2, 2.1 and 2.7, respectively. The latter degradation product has a much higher potential to be teratogenic than metolachlor itself. The EC_{50}'s for abnormalities are 268.15, 61.91 and 188.60 µM for metolachlor, 2,6-diethylaniline and 2-ethyl-6-methylaniline, respectively. This corresponds to 76, 9.3 and 25.5 ppm, respectively. Metolachlor and 2-ethyl-6-methylaniline reduced growth at all concentrations tested. The 2,6-diethylaniline degradation product did not inhibit growth at any concentration tested. The NOAEC's for growth for metolachlor and 2-ethyl-6-methylaniline cannot be determined. The LOAEC's are both approximately 1 ppm.

Marine/Estuarine Fish Chronic Ecotoxicity

No studies are available in the open literature.

c. Degradates

Ethane Sulfonic Acid Derivative (ESA or CGA 354743)

ESA was tested in an acute toxicity study on rainbow trout (*Oncorhynchus mykiss*) in a static system at mean measured concentrations ranging from 10.6 to 112 ppm (MRID 44931702). The study was classified as Supplemental because only seven fish were tested per group, dechlorinated tap water was used as dilution water and the temperature was measured every 24 hours rather than the recommended every six hours for tests with waterbaths. The 96-hour LC_{50} was 48 ppm with 95% confidence intervals of 36-64 ppm. The NOEC was 36 ppm and the LOEC was 64 ppm. At 96 hours, there were no concentrations at which a partial kill was observed. At the two highest concentrations (64 and 112 ppm), total mortality was observed; signs of toxicity at these concentrations included erratic swimming, loss of equilibrium and pigmentation changes. ESA was classified as slightly toxic to rainbow trout.

Oxanilic Acid Derivative (OA or CGA - 51202)

OA was tested in an acute toxicity study on rainbow trout (*Oncorhynchus mykiss*) in a static system at mean measured concentrations ranging from 9.1 to 96.3 ppm (MRID 44929501). There are questions concerning the study because the purity of the test material was not reported. However, high pressure liquid chromatography (HPLC) was used to analyze the concentration of OA in the test solutions. A sample chromatogram of OA was included in the study report, indicating that the HPLC method accurately measures the concentration of OA in the test solutions and that there were no other significant impurities. Ten fish were tested per group, dechlorinated tap water was used as dilution water and the test solutions were aerated during the test. The 96-hour LC_{50}

was greater than 96.3 ppm, the highest concentration tested. No signs of sublethal toxicity were observed. The NOAEC was 96.3 ppm. OA was classified as practically non-toxic to rainbow trout.

OA was tested in an acute toxicity study in common carp (*Cyprinus carpio*) in a static system at mean measured concentrations ranging from 8.7 to 93.1 ppm (MRID 44929502). There are questions concerning the study because the purity of the test material was not reported. However, high pressure liquid chromatography (HPLC) was used to analyze the concentration of OA in the test solutions. A sample chromatogram of OA was included in the study report, indicating that the HPLC method accurately measures the concentration of OA in the test solutions and that there were no other significant impurities. Ten fish were tested per group, dechlorinated tap water was used as dilution water and the test solutions were aerated during the test. The 96-hour LC_{50} was greater than 93.1 ppm, the highest concentration tested. No signs of sublethal toxicity were observed. The NOAEC was 93.1 ppm. OA was classified as practically non-toxic to common carp.

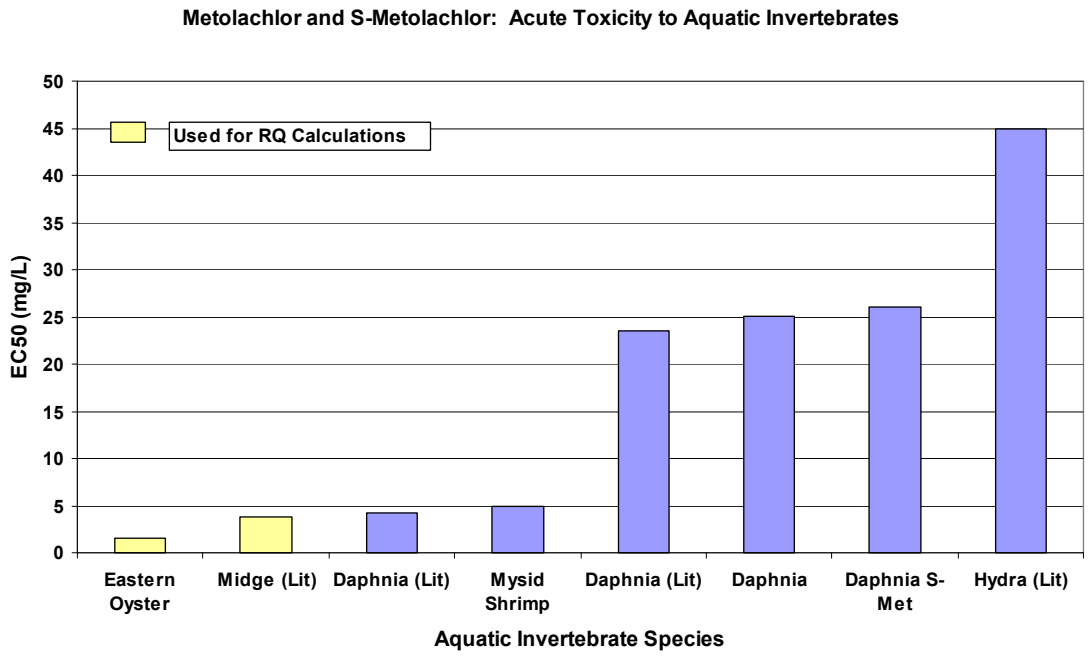
4.1.2 Aquatic Invertebrates

Available metolachlor and S-metolachlor aquatic invertebrate toxicity data indicate that the studies using the midge (*Chironomus plumosus),* eastern oyster (*Crassostrea virginica*) and mysid shrimp (*Mysidopsis bahia)* provide the most protective toxicological endpoints for use in risk assessment. Effects following acute exposure are at the low part-per-million levels. Metolachlor and S-metolachlor are considered to be slightly to moderately toxic to aquatic invertebrates.

The lowest metolachlor EC_{50} value is 1.6 mg/L for an acute (96-hour) exposure to the eastern oyster (*Crassostrea virginica*). The lowest NOAEC for chronic exposure is 0.13 mg/L from a study conducted with S-metolachlor on mysid shrimp (*Mysidopsis bahia)*.

Figure 4.1.2 provides a graphical representation of the acute toxicity data conducted with either metolachlor or S-metolachlor on aquatic invertebrates. Since one of the studies obtained from the literature provides the most protective endpoint for freshwater invertebrates, the literature studies are included in the graphical representation as well.

Figure 4.1.2. Metolachlor and S-metolachlor toxicity to aquatic invertebrates and values used for freshwater and estuarine/marine risk quotient calculations.



Acute toxicity studies on the two degradates of metolachlor, the ethane sulfonic acid (ESA) and the oxanilic acid (OA) derivatives indicate that their toxicity to aquatic invertebrates is either in the same range or significantly less than that of the parent. In daphnia, the 48-hour EC_{50}s were greater than 108 and 15 mg/L for ESA and OA, respectively.

a. Registrant-Submitted Studies

All registrant-submitted data were collected with three pelagic invertebrate species (invertebrates primarily found in the water column). Although no registrant toxicity data were submitted on benthic invertebrates (sediment dwelling invertebrates), one of the test species, *Americamysis bahia*, is generally found at the sediment-water interface.

A summary of the endpoints and related concentrations from registrant-submitted studies on aquatic invertebrates is shown in Table 4.1.2a (acute exposure) and Table 4.1.2b (chronic exposure).

Table 4.1.2a Summary of Registrant Submitted Acute Toxicity Studies for Aquatic Invertebrates

Acute Aquatic Toxicity	Compound	LC50/EC50 ppm	Slope	95% C.I. ppm	LOAEC ppm	NOAEC ppm	MRID	Toxicity	Classification	Notes:
Crassostrea virginica Eastern oyster	Technical metolachlor (racemic, CGA-24705)	1.6	5	1.4 - 1.9	1.1	0.7	43487102	Moderately toxic	Core	LOAEC based on reduced mean shell deposition. Other observations: reduced feeding, fecal and pseudofecal production at 4.5 ppm (highest concentration).
Mysidopsis bahia Mysid Shrimp		4.9	6.6	4.2-5.9	4	2.3	43487103	Moderately toxic	Core	At 4.0 and 7.1 ppm, surviving mysids exhibited dark pigmentation and lethargy.
Daphnia magna Water flea		25.1		21.4-29.1	10	5.6	00015546	Slightly toxic	Core	
Daphnia magna Water flea	S-metolachlor (CGA-77102)	26	9.1	23-30	7.9	4.8	43928912	Slightly toxic	Core	Sub-lethal effect: lethargy. Also observed in both controls; however, considered to be treatment related at concentrations of 7.9 ppm and greater.
Daphnia magna Water flea	Metabolite-OA (CGA-51202)	15.4	6.1	13.0-18.4	9.1	5.2	44929503	Slightly toxic	Supplemental	
Daphnia magna Water flea	Metabolite-ESA (CGA-354743)	>108	N/A	N/A	N/A	108	44931703	Practically non-toxic	Core	108 ppm was highest concentration tested.

Table 4.1.2b Summary of Registrant-Submitted Chronic Toxicity Studies for Aquatic Invertebrates									
Chronic Aquatic Tests	**Most Sensitive Endpoint**	**Compound**	**MATC ppm**	**95% C.I. ppm**	**LOAEC ppm**	**NOAEC ppm**	**MRID**	**Classification**	
Daphnia magna Water flea	growth & reproduction	Technical (racemic-CGA-24705)	4.7	5.9-12	6.9	3.2	43802601	Supplemental	**Notes:**
Mysidopsis bahia Mysid Shrimp	female growth, offspring/female	S-metolachlor (CGA-77102)	0.18	N/A	0.25	0.13	44995902	Core	LOAECs for other endpoints: Neonates produced 0.51, length 0.25, survival >0.51, dry weight 0.25

Freshwater Invertebrate Acute Ecotoxicity Studies

In an acute toxicity study with daphnia (*Daphnia magna*), metolachlor was tested at concentrations ranging from 5.6 to 56 ppm (MRID No. 00015546). Using the Finney probit model, the 48-hour LC_{50} was confirmed to be 25 ppm with a 95% confidence interval of 21.4-29.1 ppm. The NOAEC and LOAEC were 5.6 and 10 ppm based on mortality. The study was classified as Core and metolachlor was classified as slightly toxic to daphnia.

In an acute toxicity study with daphnia (*Daphnia magna*) (MRID 43928912) mean measured concentrations of S-metolachlor ranging from 2.9 to 41 ppm were used to estimate a 48-hour EC_{50} of 26 ppm with a 95% confidence interval of 23 - 30 ppm and a probit slope of 9.1. The NOAEC was 4.8 ppm and the LOAEC was 7.9 ppm based on an observed increase in lethargy when compared to the control groups. The statistical results were validated using a Binomial Test EC_{50}, a Moving Average Angle EC_{50} and a Probit $EC_{50.}$ The study was classified as Core.

Marine/Estuarine Invertebrate Acute Ecotoxicity Studies

Metolachlor was tested with the eastern oyster (*Crassostrea virginica*) at mean measured concentrations ranging from 0.71 to 4.5 mg/L (MRID 43487102). Using the Williams test and comparing the results from the treated groups with the solvent control values, the 96-hour EC_{50} was 1.6 mg/L with 95% confidence limits of 1.4-1.9 mg/L. The NOAEC was 0.71 mg/L and the LOAEL was 1.1 mg/L based on decreased mean shell deposition when compared to the control groups. No mortality was observed at any treatment level. Other findings include reduced feeding and reduced fecal and pseudofecal production at the highest treatment level. These effects were observed at the 24-, 48-, 72- and 96-hour intervals. The study was classified as Core and metolachlor was classified as moderately toxic to the eastern oyster under the conditions of the study. This study was selected for estimation of the acute RQs for marine/estuarine invertebrates because it is the most sensitive of the tested invertebrate species.

In an acute toxicity study with mysid shrimp (*Americamysis bahia*, formerly *Mysidopsis bahia*), metolachlor was tested at mean measured concentrations ranging from 0.61 to 7.1 mg/L (MRID 43487103). Using a Probit Analysis, the 96-hour LC_{50} was 4.9 mg/L with 95% confidence limits of 4.2-5.9 mg/L. The NOAEC was 2.3 mg/L and the LOAEC was 4.0 mg/L based on mortality. At 4.0 and 7.1 mg/L, surviving mysids exhibited dark pigmentation and were lethargic by the end of the study. The study was classified as Core and metolachlor was classified as moderately toxic to marine/estuarine mysid shrimp under the conditions of the study.

No acute ecotoxicity studies on marine/estuarine invertebrates are available for S-metolachlor.

Freshwater Invertebrate Chronic Ecotoxicity Studies

In a full life cycle toxicity study conducted with *Daphnia magna*, metolachlor was tested at nominal concentrations ranging from 2.5 to 40 mg/L (MRID 43802601). Based on growth, reproduction and the lowest measured concentration of each treatment level, the NOAEC, LOAEC and MATC values were 3.2, 6.9 and 4.7 ppm, respectively. The study has been classified as Supplemental because measured concentrations were highly variable at all treatment levels throughout the study. The highest measured concentration was as much as 3.7 times higher than the lowest measured concentration within the same treatment level. In addition, the study did not include raw growth data and thus, the growth data statistics could not be verified. Using the lowest measured concentrations for each treatment level provides a conservative estimate of toxicity that may be used for assessment of risk.

No freshwater invertebrate chronic ecotoxicity studies are available for S-metolachlor.

Marine/Estuarine Invertebrate Chronic Ecotoxicity Studies

No chronic toxicity studies are available for metolachlor on marine/estuarine invertebrates.

In a life-cycle toxicity test with mysid shrimp (*Mysidopsis bahia*), S-metolachlor was tested at mean measured concentrations ranging from 18 to 510 µg a.i./L (MRID 44995902). The NOAEC was 130 ppb and the LOAEC was 250 ppb based on significant decreases in length and dry weight in females. The mean number of young per female per reproductive day was significantly affected at 510 ppb with a NOAEC of 250 ppb. The geometric mean MATC was 180 ppb. No other signs of toxicity were reported. The study was classified as Core. The study was evaluated against the ASTM Standard Guide for Conducting Life-Cycle Toxicity Tests with Saltwater Mysids (E1191-90). The results from this study were used for assessment of risk to estuarine/marine invertebrates following chronic exposure to metolachlor.

b. Open Literature

Open literature data are available for both pelagic and benthic freshwater invertebrate species. In addition, data exist for one species that lives on the sediment-water interface (rusty crayfish) and one that lives on vegetation (hydra). No other usable studies on either freshwater or marine estuarine invertebrates were located in the open literature. Table 4.1.2c summarizes the open literature studies for aquatic invertebrates and more detailed tabular summaries are presented in Appendix B. Summaries of several representative studies follow the table.

Table 4.1.2c. Summary of Studies from the Open Literature for Aquatic Invertebrates

Genus	Species	Common name	Major Group Effect	Measurement	Endpoint	Duration (Hours)	Conc mean	Conc Units	Exposure Type	Ref#
Aquatic Invertebrates										
Daphnia	*magna*	Water Flea	Physiology	Immobilization	EC_{50}	48	4.25	ppm	NR	67700
Daphnia	*magna*	Water flea	Physiology	Immobilization	EC_{50}	48	23.50	ppm	Static	6797
Daphnia	*magna*	Water flea	Physiology	Immobilization	EC_{50}	48	26.00	ppm	Static	6797
Chironomus	*plumosus*	Midge	Physiology	Immobilization	EC_{50}	48	3.80	ppm	Static	6797
Chironomus	*plumosus*	Midge	Physiology	Immobilization	EC_{50}	48	4.40	ppm	Static	6797
Orconectes	*rusticus*	Rusty Crayfish	Behavior	Locating food source, behavior towards alarm signal	LOAEL	96	0.025	ppm	Renewal	68515
Hydra	*attenuata*	Hydra	Mortality	Mortality	LC_{50}	48	>45	ppm	NR	67700
Panagrellus	*redividus*	Sour Paste Nematode	Growth	Maturation, Condition Index	LOAEL	96	2	ppm	NR	67700
Ceriodaphnia	*dubia*	Water Flea	Mortality	Mortality	LC_{50}	48	15.93	ppm	Static	13689
Ceriodaphnia	*dubia*	Water Flea	Reproduction	General Reproduction	NOEC	168	6.25	ppm	Renewal	13689

NR = Not reported

Freshwater Invertebrate Acute Ecotoxicity Studies

Benthic

A midge species (*Chironomus plumosus*) was tested with technical metolachlor (95.4%) and with an emulsifiable concentrate (87%) in 48-hour acute toxicity tests under static test procedures (Ref. # 6797). Data on temperature, pH and hardness of the water were provided. The 48-hour LC_{50}s of the technical material and the formulation were 3.8 mg/L (confidence interval 2.1 to 10.3 mg/L) and 4.4 mg/L (confidence interval 3.2 to 6.1 mg/L), respectively. Since this study provides the most protective endpoint for assessment of risk, the results from this study were used to quantify acute risk to freshwater aquatic invertebrates.

Technical metolachlor (purity not stated) was tested in a behavior (perception of chemical stimuli) study with rusty crayfish (*Orconectes rusticus*) (Ref. # 68515). The crayfish were obtained from the Portage River in Wood County, Ohio. The crayfish were tested for their ability to respond appropriately to two odor cues: a food odor (a homogenized frozen haddock fillet) and an alarm signal (a homogenized crayfish). A flow-through tank was used in the study and was set up with odor stimulus injected into the inflow. Trials lasted for 2 minutes. Analysis of dye trials prior to injection of the odor stimulus indicated that the odor reached the end of the tank within 20.6 seconds and then spread throughout the tank within 118 seconds. The trials were videotaped and digitized to obtain X and Y spacial coordinates of the animals' movements. The spacial parameters were then analyzed to determine any changes in behavior, which included walking speed (in general and toward or away from the odor source), the length of time utilized to locate the odor source, the % success in locating the odor source and the time spent motionless. The crayfish were exposed to either 0 (aged tank water only), 0 (vehicle control), 25, 50 or 75 ppb metolachlor for 96 hours prior to each test. The overall NOAEC for the study is < 25 ppb. At the LOAEC of 25 ppb, the treated group had less success in locating the food source, took longer to find the food source and there was a significant overall effect on the behavior towards an alarm signal. Metolachlor induced a general decrease in walking speed at 75 ppb, the highest concentration tested, but in the presence of the alarm signal, the 75 ppb group animals increased their walking speed when compared to the control groups. There was a dose-response for this effect, but the effects were not statistically significant at the two lower concentration levels. Although the results from this study would provide the most conservative NOAEC for assessment of acute risk to freshwater invertebrates, a clear correlation between these behavioral effects and the assessment endpoints established in this risk assessment for the listed species has not been established (U.S. EPA 2004a, U.S. FWS and NMFS 2004). The potential effects to listed salmonids from impaired crayfish behavior is not clear because crayfish have been documented to both negatively impact salmonids through competing with juvenile salmon for habitat and preying on salmon eggs and positively affect salmon through serving as prey items for more mature salmonids (Griffiths *et al* 2004, Tabor *et al* 2004). Therefore, the results from this study were not used in assessing risk to listed salmonids.

Pelagic

Metolachlor was tested with *Daphnia magna* as part a bioassay intercalibration for the WaterTox Network sponsored by the International Research Development Centre (IRDC) (Ref. # 67700). The paper stated that "tests were performed using the standardized procedure of the NWRI [National Water Research Institute] using neonates of 24 h, reading immobility as the endpoint after 48 hours of exposure." The concentration range was not provided . The mean 48-hour EC_{50} was 4.25 mg/L with a standard deviation of 0.39 and a 9% coefficient of variation. Negative and positive controls were included in the test protocol.

Daphnia magna were tested with technical metolachlor (95.4%) and with an emulsifiable concentrate (87%) in 48-hour acute toxicity tests under static test procedures (Ref. # 6797). Data on temperature, pH and hardness of the water were provided. The 48-hour LC_{50}s of the technical material and the formulation were 23.5 mg/L (confidence interval 18.7 to 29.5 mg/L) and 26.0 mg/L (confidence interval 19.4 to 34.9 mg/L), respectively.

Metolachlor was tested with *Hydra attenuata* as part of a bioassay intercalibration for the WaterTox Network (Ref. # 67700). The concentration range was not provided. The mean 48-hour LC_{50} was >45 mg/L (no standard deviation or % coefficient of variation were provided).

c. Degradates

Oxanilic Acid Derivative (OA or CGA - 51202)

Freshwater Invertebrate Acute Ecotoxicity Studies

In an acute toxicity study conducted with OA (CGA 51202) (MRID 44929503), daphnia were tested at concentrations ranging from 5.8 to 58 ppm. The study was classified as Supplemental because the purity of the test material was not submitted and because the hardness of the test dilution water was above U.S. EPA-recommended limits. In this study, the 48-hour EC_{50} was determined to be 15.4 ppm with a 95% confidence interval of 14.2 - 19.4 ppm using a Probit analysis. The NOAEC was 5.2 ppm and the LOAEC was 9.05 ppm (mean measured concentrations) based on mortality. OA is classified as slightly toxic to daphnia.

Ethane Sulfonic Acid Derivative (ESA or CGA 354743)

An acute toxicity study on *Daphnia magna* was conducted with ESA (CGA 354743). Mean measured concentrations ranging from 10.3 to 109 ppm were tested (MRID 44931703). The study was classified as Core. No toxicity was observed up to the highest concentration tested. Therefore, the 48-hour EC_{50} and the NOAEC were greater than 109 ppm. ESA is classified as practically non-toxic to daphnia.

4.1.3 Aquatic Plants

Results for aquatic plants from both registrant-submitted and open literature studies are presented in their respective sections below. Based on a review of studies obtained through the ECOTOX search (see section 3.2), the endpoints and test durations employed in open literature studies appear to be similar to the EPA guideline studies conducted by the registrant. Due to the variable solubility and stability of various compounds in aqueous solutions, EPA requires concentrations of the pesticide to be measured at the beginning, during, and at the end of aquatic tests, to ensure exposure is adequately characterized. Additionally, there are specific requirements for the initial density of algal cultures and the growth rate of the controls. The extent to which these conditions were controlled and documented in the open literature studies will determine their comparability to the registrant-submitted studies.

a. Registrant-Submitted Studies

The registrant submitted aquatic plant studies for racemic metolachlor, S-metolachlor, and for two degradates, ESA and OA. For the racemic metolachlor, all five standard aquatic plant species were tested. EC_{50} values ranged from 0.010 ppm (green alga) to 1.2 ppm (blue-green alga). NOAEC values for these tests ranged from 0.0007 ppm (green alga) to 0.063 (blue-green alga). This classifies racemic metolachlor as very highly toxic to aquatic plants. For S-metolachlor, data were submitted for the three aquatic plants most sensitive to metolachlor (green algae, duckweed, marine diatom). S-metolachlor EC_{50} values ranged from 0.008 ppm (green alga) to 0.11 ppm (marine diatom). NOAEC values for these tests ranged from 0.0015 ppm (green alga) to 0.021 (marine diatom). Each of the degradates was tested with two aquatic plants (green alga and duckweed). Both degradates are significantly less toxic than the parent compounds. Duckweed is the more sensitive of the two to ESA, with an EC_{50} of 43 ppm and an NOAEC of 4 ppm. Green alga is more sensitive to OA, with an EC_{50} of 57 ppm and an NOAEC of 29 ppm. A synopsis of the submitted studies, results, and reference MRID numbers are provided in Table 4.1.3a.

Table 4.1.3a Summary of registrant-submitted aquatic plant studies.

Aquatic Plant Tests	Compound	EC50	Slope	95% C.I.	LOAEC	NOAEC	MRID	Classification
		ppm		ppm	ppm	ppm		
Selenastrum capricornutum (green alga)	Technical (racemic-CGA-24705)	0.010	1.7	0.006-0.020	0.0014	0.0007	43541301	Core
Navicula pelliculosa (FW diatom)		0.38	0.89	0.27-0.56	0.013	0.0037	43541302	Core
Anabeana flos-aquae (bluegreen alga)		1.2	1.2	0.9-1.6	0.19	0.063	43487104	Core
Lemna gibba (duckweed)		0.048	N/A	0.043-0.056	0.015	0.0084	43487105	Core
Skeletonema costatum (Marine diatom)		0.061	N/A	0.049-0.076	0.0048	0.0017	43487106	Core
Selenastrum capricornutum (green alga)	S-metolachlor (CGA-77102)	0.008	3	0.0026-0.025	0.003	0.0015	43928929	Core
Lemna gibba (duckweed)		0.021	N/A	0.019-0.023	0.018	0.0076	43928931	Core
Skeletonema costatum (Marine diatom)		0.11	N/A	0.091-0.128	0.081	0.021	43928930	Core
Selenastrum capricornutum (green alga)	Metabolite-ESA (CGA-354743)	>99.45	N/A	N/A	>99.45	99.45	44931719	Supplemental
Lemna gibba (duckweed)		43	1.6	30-61	6.1	4	44931720	Core
Scenedesmus subspicatus (green alga)	Metabolite-OXA (CGA-51202)	57.1	N/A	29.3 - infinity	92.2	29.3	44929515	Supplemental
Lemna gibba (duckweed)		>95.4	N/A	N/A	>95.4	95.4	44929514	Core

b. Open Literature

A number of aquatic plant studies were located in the open literature. These studies evaluated some non-guideline endpoints and non-guideline species. EC_{50} values in this data set range from 0.04 ppm (*Pseudokirchneriella subcapitala*, ref #19186) to 19 ppm (*Chorella vulgaris*, ref #65938). These values appear to be in the same general range as, but slightly higher than, the registrant data. Detailed tabular summaries of open literature data are presented in Appendix B.

c. Degradates

Registrant submitted toxicity studies were available for both metolachlor degradates (ESA and OA). ESA was tested on a green alga (MRID 44931719) and no effects were noted at the concentrations tested. The NOAEC based on this test is 99.45 ppm. The EC_{50} and LOAEC were not determined, and have been quantified as >99.45 ppm. This study was classified as Supplemental. ESA was also tested on the aquatic vascular plant duckweed (MRID 44931720). In this study metolachlor produced chlorosis in the fronds at the concentrations tested. The EC_{50} was 43 ppm (95% C.I. 30-61 ppm), the NOAEC was 4 ppm, and the LOAEC was 6.1 ppm. This study was classified as Core.

OA was tested on a green alga (MRID 44929515). The calculated EC_{50} was 57.1 ppm, and the observed NOAEC was 29.3 ppm. A reliable LOAEC cannot be determined, as the percent inhibition for the algal cells was -18.9% at the 29.3 ppm (indicating a stimulatory effect), and 94.0% at the next highest concentration, 92.2 ppm. This study was classified as Supplemental. OA was also tested on Lemna (MRID 44929514). At the tested concentrations, no effects of OA on Lemna were noted. The NOAEC was 95.4 ppm, and both EC_{50} and LOAEC were >95.4 ppm. This study was classified as Core.

4.1.4 Terrestrial Plants

Plant toxicity data from both registrant-submitted studies and studies in the scientific literature were reviewed for this assessment. Registrant-submitted studies are conducted under conditions and with species defined in EPA toxicity test guidelines. Sub-lethal endpoints such as plant growth, dry weight, and biomass are evaluated for both monocots and dicots at both seedling emergence and vegetative life stages. A guideline study generally evaluates toxicity to ten crop species. These tests are only conducted on herbaceous crop species, and extrapolation of effects to other species, such as the woody shrubs and trees and wild herbaceous species, contributes uncertainty to risk conclusions. Commercial crop species have been selectively bred, and may be more or less resistant to particular stressors than wild herbs and forbs. The direction of this uncertainty for specific plants and stressors, including metolachlor, is largely unknown. Homogenous test plant seed lots also lack the genetic variation that occurs in natural populations, so the range of effects seen from tests is likely to be smaller than would be expected from wild populations.

Open literature data can be used to supplement registrant-submitted studies and provide toxicity data collected with non-crop species. Open literature is rarely directly comparable, due to varying test products, experimental designs, endpoint measurements and data handling techniques.

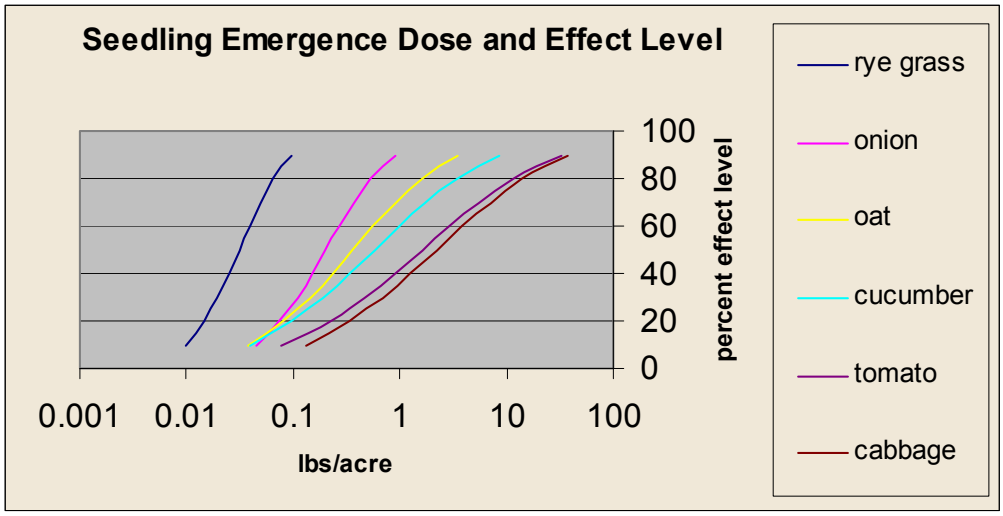
a. Registrant-Submitted Studies

Registrant-submitted studies are available for racemic metolachlor, S-metolachlor, and two metolachlor degradates, ESA and OA. A summary of the results from the registrant-submitted data for the most sensitive tested species is shown in Table 4.1.4a.

Overall, the tested monocots tend to be more sensitive to racemic metolachlor than the dicots in both the seedling emergence and the vegetative vigor tests. The lowest EPA-calculated EC_{25} (25% effect level) values for racemic metolachlor for both the monocots and dicots were measured in the vegetative vigor study (ryegrass EC_{25} 0.016 lb a.i./acre and cucumber EC_{25} = 0.03 lb a.i./acre). The most sensitive EC_{25} values in the seedling emergence study were similar (ryegrass EC_{25} 0.02 lb a.i./acre and cucumber and lettuce EC_{25} = 0.09 lb a.i./acre).

Dose response relationships for metolachlor are presented in Figures 4.1.4a and b. The dose response relationships were calculated using the EC_{25} and EC_{50} values reported in the study and assuming a linear log dose and probit response relationship. No dose response relationship is shown for plants that had no quantifiable EC_{25} and/or EC_{50} endpoints.

Figures 4.1.4 a and b. Dose-response relationships for racemic metolachlor and terrestrial plants. The responses shown were for reduction in plant height or dry weight, whichever was more sensitive. The curves shown are based on EC_{25} and EC_{50} values assuming a linear log probit relationship.



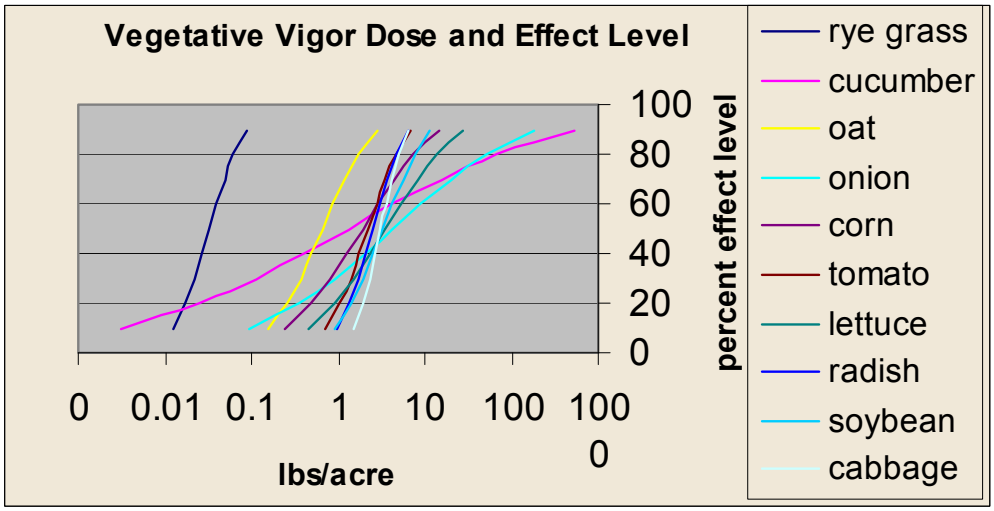


Table 4.1.4a Summary of results for the most sensitive species from registrant-submitted terrestrial plant toxicity studies. Presented values are based on EPA's analysis of the raw toxicity data.

Terrestrial Plant Tests	Most Sensitive Endpoint	Compound	EC25	95% C.I.	LOAEC	NOAEC	MRID	Classification	Notes:
			lb a.i./acre	lb a.i./acre	lb a.i./acre	lb a.i./acre			
Seedling emergence	X plant height,dry weight	Metolachlor (racemic-CGA-24705)	0.02 (monocot-ryegrass)	0.017-0.033	0.0061	0.0031	43487107	Core	1995 (Part of re-registration data call)
	dry weight		0.09 (dicot-lettuce)	0.012-0.62	0.25	0.012			
	dry weight		0.09 (dicot-cucumber)	0.043-0.19	>0.049	0.049			
Vegetative Vigor	dry weight		0.016 (monocot-ryegrass)	0.012-0.20	0.0061	0.0031	43487108	Core	1995 (Part of re-registration data call)
	dry weight		0.03 (dicot-cucumber)	0.020-0.046	0.049	0.025			
Seedling emergence	X phyto-toxicity	S-metolachlor (CGA-77102)	0.0048 (monocot-ryegrass)	N/A	0.011	0.001	43928932	Supplemental	Supplemental because only six tests were run rather than the required ten. Data is fine. NOAECs are predicted EC_{5s}.
	dry weigh		0.0057 (dicot-lettuce)	0.0011-0.0308	0.0037	0.0003			
Vegetative Vigor	dry weight		0.021 (monocot-ryegrass)	0.012-0.037	0.033	0.011	43928933	Supplemental	Supplemental because only six tests were run rather than the required ten. Data is fine. Lettuce NOAEC is predicted EC_5.
	phyto-toxicity		0.27 (dicot-cucumber)	0.12-0.65	0.033	0.01			
Seedling emergence	X dry weight	Metabolite-ESA (CGA-354743)	<0.5 (monocot-ryegrass)	N/A	N/A	<0.5	44931718	Core	Tier I tests. Rye grass shoot dry weight was reduced by 31% at the 0.5 lb/acre dose tested
	varied		>0.5 (dicot)	N/A	N/A	<0.5 (tomato, cucumber, carrot,			
Vegetative Vigor	varied		>0.5 (monocot & dicot))	N/A	N/A	0.5 (monocot & dicot)	44931718	Core	Tier I tests.
Seedling emergence	varied	Metabolite-OXA (CGA-51202)	>0.5 (monocot & dicot)	N/A	N/A	<0.5 (onion, corn, tomato, cucumber)	44929513	Core	Tier I tests.
Vegetative Vigor	varied		>0.5 (monocot & dicot)	N/A	N/A	<0.5 (monocot & dicot)			

"X" denotes the endpoint used for risk quotient calculations.

Results on S-metolachlor have also been included in Table 4.1.4a, although it is not the subject of this action. Because S-metolachlor is understood to be the more active enantiomer of metolachlor it is expected to affect plants at lower exposure levels. Based on the lowest seedling emergence EC_{25} values, S-metolachlor is 4 times more toxic to monocots and 16 times more toxic to dicots.

With S-metolachlor, the tested plants were generally more sensitive in the seedling emergence study than in the vegetative vigor study. It is not clear why the S-metolachlor was more potent during seedling emergence than vegetative vigor and racemic metolachlor toxicity was similar in vegetative vigor and seedling emergence. In the seedling emergence studies for both racemic and S-metolachlor, the test substance consisted of the technical active ingredient in water with 50% acetone. In the vegetative vigor studies for racemic metolachlor, the test substance was the same as that used for seedling emergence. With the S-metolachlor vegetative vigor study a surfactant (Triton) was added. Both technical racemic metolachlor and S-metolachlor were at 97.3% purity. Differences in the test substance may have contributed to difference in relative toxicities.

Tier I (single concentration) tests were submitted by the registrant for two metolachlor metabolites, ESA and OA (MRIDs 44931718 and 44929513). These compounds were tested at an application rate of 0.5 lbs a.i./acre. Only one species, rye grass, showed a greater than 25% effect as a result of the exposure in either the vegetative vigor or seedling emergence tests. The ESA exposure in the seedling emergence test resulted in a 31% reduction in rye grass dry weight. For both monocots and dicots, the NOAEC was $\leq$0.5 lbs a.i./acre for some or all of the species tested.

The most conservative values for racemic metolachlor were used in the screening-level assessment to establish risk quotients.

b. Open Literature

A number of terrestrial plant studies were located in the open literature. Tabular summaries of published studies which met EPA criteria (see section 3.2) are shown in Appendix B. Tables 4.1.4b and 4.1.4c below show a subset of plant data from the open literature focusing on metolachlor's effects on grasses, forbs, and trees. Independent studies often evaluate formulated products, plants not included in registrant-submitted studies, and effects under field conditions where plants may be exposed to stressors not experienced by plants grown under more controlled conditions. Brief summaries of open literature reports which provide additional insight into metolachlor's effects on different types of plants and plants at different life stages are presented below.

Table 4.1.4b Summary of Studies from the Open Literature for Terrestrial Plants

Genus	Species	Common name	Major Group Effect	Measurement	Endpoint	Duration	Conc mean	Conc Units	Exposure Type	Ref#
Grass and Forbs										
Abutilon	*theophrasti*	velvet leaf	gro	hght	NOAEL	14 d	0.11	Lb a.i./acre	lab	73233
Digitaria	*sanguinalis*	purple crabgrass	gro	hght	90% red	14 d	0.11	Lb a.i./acre	lab	73233
Echinochloa	*crus-galli*	barnyard grass	gro	hght	90% red	14 d	0.11	Lb a.i./acre	lab	73233
Panicum	*millaceum*	millet	gro	hght	50% red	14 d	0.11	Lb a.i./acre	lab	73233
Seteria	*faberi*	mutton bluegrass	gro	hght	90% red	14 d	0.11	Lb a.i./acre	lab	73233
Sorghum	*bicolor*	broomcorn	gro	hght	NOAEL	14 d	0.11	Lb a.i./acre	lab	73233
Trees										
Acer	*tataricum*	tatarian maple	gro		LOAEL	~1 yr	3.0	Lb a.i./acre	field	73251
Acer	*saccharum*	sugar maple	gro, mor		NOAEL	549 d	8.0	Lb a.i./acre	field	73249
Betula	*pendula*	European white birch	gro		NOAEL	~1 yr	9.1	Lb a.i./acre	field	73251
Betula	*nigra*	river birch	gro, mor		NOAEL	369 d	8.0	Lb a.i./acre	field	73249
Cercis	*canadensis*	Eastern redbud	gro,mor		NOAEL	369 d	8.0	Lb a.i./acre	field	73249
Cornus	*florida*	flowering dogwood	mor		LOAEL	549 d	8.0	Lb a.i./acre	field	73249
Cornus	*florida*	flowering dogwood	gro		NOAEL	549 d	8.0	Lb a.i./acre	field	73249
Liquidambar	*styraciflua*	sweetgum	gro, mor		NOAEL	369 d	8.0	Lb a.i./acre	field	73249
Quercus	*palustris*	pin oak	gro, mor		LOAEL	549 d	8.0	Lb a.i./acre	field	73249
Quercus	*palustris*	pin oak	gro, mor		NOAEL	549 d	4.0	Lb a.i./acre	field	73249
Quercus	*phellos*	willow oak	gro		LOAEL	549 d	8.0	Lb a.i./acre	field	73249
Quercus	*phellos*	willow oak	mor		NOAEL	549 d	8.0	Lb a.i./acre	field	73249

In the literature studies, reported NOAELs for grasses and forbs range from 0.11-8 lbs a.i./acre. For terrestrial trees and shrubs, reported NOAELs range from 1.5-9.1 lbs a.i./acre and LOAELs range from 1.3-8.0 lbs a.i./acre. Overall, endpoints for the literature studies are approximately two orders of magnitude higher concentrations of the chemical than the registrant submitted studies, and the woody plants, for the most part, appear to be slightly less sensitive to metolachlor than the herbaceous plants.

The open literature study reporting the effects at the lowest exposures (reference 73233, Hatton *et al.* 1996) evaluated the effect of treating soil with a previously registered formulated metolachlor product (Dual 8E) on weed species. Two crop species (corn and sorghum) were evaluated with 4 grass weeds and one broadleaf weed species. The grass species experienced the greatest effect with a 90% reduction in plant height on day 14. A summary of the effect on plant height at 7 and 14 days is presented in Table 4.1.4d.

Table 4.1.4d. Seedling height reduction as a result of spraying metolachlor (Dual 8E) on soil at 0.11 lbs active ingredient/acre (adapted from Hatton *et al.* 1996). Plants were held in a greenhouse with supplemental lighting (14 h/day) at a minimum temperature of 21 deg C. Controls were exposed to water alone.

plant species	common name	% effect	
		7d	14d
Zea mays	corn	10	10
Abutilon theophrasti	velvetleaf	0	0
Sorghum bicolor	sorghum	0	0
Digitaria sanguinalis	large crabgrass	70	90
Echinochloa crus-galli	barnyard grass	80	90
Panicum miliaceum	broomcorn millet	95	50
Setaria faberi	japanese bristlegrass	90	90

The height reduction of grass seedlings reported in Hatton *et al.* 1996 is consistent with the results of the registrant-submitted seedling emergence study for metolachlor (MRID 43487107). The single dose used in Hatton *et al*, 0.11 lbs a.i./acre, causing a 90% reduction in plant height, is consistent with the dose-response curve for rye grass shown in Figure 4.1.4a, except that rye grass appears to be slightly more sensitive. The fact that the measurement of the rye grass height was conducted on day 21, compared to day 14 for the grasses in Hatton *et al*, may explain the difference in sensitivity.

Published studies evaluating the effects of metolachlor on woody plants complements the registrant-submitted toxicity data on herbaceous plants. Warren and Skroch (1991) (reference 73249) evaluated the effects of a previously registered granular formulation of metolachlor (Pennant 5G) on growth and survival of seven species of tree seedlings. The study was conducted in raised beds in North Carolina and used mature seeds collected in the state. The test species were River birch (*Betula nigra*), Pin oak (*Quercus palustris* Muenchh.), Willow oak (*Quercus phellos* L.), Redbud (*Cercis canadensis* L.), Flowering dogwood (*Cornus florida* L.), Sugar maple (*Acer saccharum* Marsh.), Sweet gum (*Liquidambar styraciflua* L.), and Red maple (*Acer rubrum* L.). A single application of 8 lbs a.i./acre was tested on 49 seeds of each species. Effects on shoot height, diameter, and survival were reported. Significant effects of metolachlor were noted on the oak species. For Willow oak, metolachlor reduced seedling height by 36% and for Pin oak metolachlor reduced seedling height, diameter, and survival by 40%, 19%, and 16%, respectively. No effects were noted on the other tested species.

Hood and Klett (1992) (reference 73251) tested four woody plants, two desirable herbaceous species, and six weed species for effects related to metolachlor exposure. Plants were exposed to a previously registered formulation (Dual 8E) only through the soil treatment at a rate of 3 or 6 lbs a.i./acre. The tested species were Tatarian maple (*Acer tataricum* L.), virginal mock orange (*Philadelphia virginalis* L.), daylily (*Hemerocallis* L. sp.), clematis (*Clematis recta* L.), yellow foxtail (*Setaria glauca* L. Beauv.), barnyardgrass (*Echinochloa crus-galli* L. Beauv.), annual bluegrass (*Poa annua* L.), common chickweed (*Stellaria media* L.), sheperdspurse (*Capsella bursapastoris* L.), and common groundsel (*Senecio vulgaris* L.). Metolachlor controlled grassy weeds but failed to control broadleaf weed species. The only effect noted by the authors on desirable species was growth reduction in the tatarian maple, however, the results presented in the paper suggest that the response was not correlated with dose.

Staats and Klett (1993) (reference 73252) tested nine desirable plant species and six weed species. The desirable plants were lamb's ears (*Stachys byzantina* C. Koch), peachleaf bellflower (*Campanula persicifolia* L.), common yarrow (*Achillea millefolium* L.), Lance coreopsis (*Coreopsis lanceolata* L.), baby's breath (*Gypsophila pacifica* Kom.), Chinese wisteria (*Wisteria sinensis* Sims.), common lilac (*Syringa vulgaris* L.), perennial phlox (*Phlox paniculata* L.), garden dahlia (*Dahlia* Cav. x *hybrida*). Weed species included the same as those in Hood and Klett (1992) except redroot pigweed (*Amaranthus retroflexus* L.) was added. Desirable plants were transplanted in test containers. Weed species were planted as seeds. Metoalchlor (Pennant 7.8E) was applied to the soil of the test containers at 4 or 8 lbs a.i./acre. Metolachlor was reported to result in 93% or greater weed control and no adverse effect to desirable plants.

Metolachlor levels required to affect emergent wetland plant species were reported in Walsh *et al.* 1991 (reference 4057). Both freshwater and saltwater species were exposed to technical metolachlor (98% pure) dissolved in fresh or salt water in a controlled laboratory environment. The salt water plant *Spartina alterniflora* Loisel and two varieties of *Echinochloa crusgalli* L., all of the grass family, were tested during

germination and growth stages. Tests on growth and survival were conducted in the presence of sediment. Metolachlor recovery from water samples was considered adequate by the study authors but low recoveries from sediment precluded the authors from conducting this analysis. Metolachlor did not affect seedling germination of the plants. Growth was inhibited at the LOAEC of 0.25 mg/L for the *E. crusgalli* varieties and 0.5 mg/L for *S. alterniflora*.

c. Degradates

The registrant submitted seedling emergence and vegetative vigor Tier I toxicity studies for both metolachlor degradates (ESA and OA). For ESA (MRID 44911718), the seedling emergence EC_{25} and NOAEC for monocots was < 0.5 ppm (ryegrass). In the seedling emergence test, dicots were slightly less sensitive, with an EC_{25} >0.5 ppm (all species tested), but an NOAEC of <0.5 ppm (tomato, cucumber, carrot). This study was classified as Core. Vegetative vigor endpoints (MRID 44911718) were less sensitive than seedling emergence endpoints, with EC_{25} >0.5 ppm and an NOAEC of 0.5 ppm for all species tested, both monocots and dicots. This study was classified as Core.

For OA (MRID 44911718), the seedling emergence EC_{25} for both monocots and dicots was >0.5 ppm, and the NOAEC and EC_{25} were >0.5 ppm for both monocots and dicots. Vegetative vigor results were similar, with both monocots and dicots having an EC_{25} >0.5 ppm and an NOAEC EC_{25} >0.5 ppm. This study was classified as Core.

4.1.5 Terrestrial Invertebrates

A review of available registrant and open literature terrestrial insect toxicity data was conducted. Summaries of available data are presented below.

a. Registrant-Submitted Studies

The only guideline terrestrial insect tests are for honeybees. Registrant submitted studies include acute contact and acute oral toxicity studies for both racemic metolachlor and S-metolachlor. Both studies (MRIDs 44718401 and 44718402, respectively) were classified as core. The acute contact LD_{50} and the oral LD_{50} for racemic metolachlor are both >110 µg a.i./bee. The acute contact and oral dose NOAELs are 110 µg a.i./bee. For S-metolachlor, the acute contact LD_{50} is >200 µg a.i./bee and the oral LD_{50} >85 µg a.i./bee. NOAELs for S-metolachlor are 200 µg a.i./bee for acute contact and the 85 µg a.i./bee for oral dose. No mortality was seen in any of the tests. These values classify both racemic and S-metolachlor as practically non-toxic to bees.

b. Open Literature

No open literature reports were located regarding the toxic effects of metolachlor on terrestrial insects.

4.2 Uncertainties in the Hazard Assessment

There are a number of areas of uncertainty in the hazard assessment that merit discussion. These include the following:

1. **This assessment accounts only for exposure of organisms to technical grade metolachlor (i.e., only the active ingredient), and does not address the formulated products, recommended tank mixtures or environmental mixtures.** When pesticides are applied adjuvants may be included in tank mixes to enhance permeation into plant tissue and spreading. Little information is available on tank mixes that may be used with metolachlor products and the effects of adjuvants on the toxicity of the active ingredient to non-target organisms is mostly unknown. Although this assessment made use of available toxicity data on formulated products, toxicity data on formulated products was not available for all formulations and all taxa. No data were located to indicate that there is a significant difference in toxicity between the active ingredient and the formulation for fish or aquatic invertebrates. Chemicals used in formulating pesticides are assessed separately through OPP's Inerts program.

2. **This assessment does not account for environmental stressor not present in tests used to evaluate toxicity.** The available toxicity data do not account for other potential environmental stressors. No information was available to determine how much other environmental stressors may affect metolachlor toxicity.

3. **The risk quotient analysis only considers the most sensitive species tested.** Risk quotients are based on toxicity data for only one species (the most sensitive one) for each of the general class of taxa evaluated. Responses to a toxicant can be expected to be variable across species. Sensitivity differences between species can be considerable (even up to four orders of magnitude) for some chemicals (Mayer and Ellersieck 1986). The position of the tested species relative to the distribution of all species' sensitivities to metolachlor is unknown. Extrapolating the risk conclusions from the most sensitive tested species to non-tested species may either underestimate or overestimate the potential risks to those species. Efforts are made to select the organisms most likely to be affected by the type of compound and usage pattern, but there is an inherent uncertainty in extrapolating across phyla. OPP's levels of concern (LOCs) are intentionally set very low, and conservative estimates are made in the screening-level risk assessment to account for these uncertainties.

4. **Effects on wild plants may be different from effects on the crop species tested in guideline studies.** Generally, studies located in the open literature show that toxicity values derived from registrant submitted studies are lower than those measured in field applications and on woody plant species. Thus, the uncertainty in this term would tend to be more protective of the wild plants.

4.3 Exposure Analysis

4.3.1 Environmental Fate Data

At the time of the reregistration eligibility decision (RED) for metolachlor in 1994, the environmental fate data base was not complete. Subsequent to the RED, the registrant submitted environmental fate data comparing racemic metolachlor and S-metolachlor. The basic approach was to compare half-lives ($t_{1/2}$) as well as the type and quantities of transformation products between racemic metolachlor and S-metolachlor. Although this approach was reasonable, it was complicated because the experimental conditions were not similar among the various environmental fate studies. The Agency commented on these data in a memo dated August 17, 2000 and noted that the data indicate that metolachlor and S-metolachlor are expected to have similar degradation pathways and rates in soil and water environments. Based on data submitted subsequent to the RED, the fate database has been upgraded and is now complete.

The information from all acceptable environmental fate data indicate that parent metolachlor appears to be moderately persistent to persistent in soil. It also ranges from mobile to highly mobile in different soils and it has been detected extensively in surface water and groundwater. Metolachlor degradation appears to be dependent on microbially mediated (aerobic soil metabolism $t_{1/2}$ = 66 days, 37.8 days, 37.8 days, 14.9 days, 13.9 days, and 50.3 days, anaerobic soil metabolism $t_{1/2}$ =81 days) and abiotic processes (photodegradation in water $t_{1/2}$ = 70 days under natural sunlight and photodegradation on soil $t_{1/2}$ = 8 days under natural sunlight).

The major degradates were identified as CGA-51202 (metolachlor OA), CGA-50720, CGA-41638, CGA-37735, and CGA-13656. Subsequent studies identified CGA-354743 (metolachlor ESA) as a major degradate. Of these major degradates, metolachlor ESA and metolachlor OA have been identified in both groundwater and surface water. Depending on the soil and its organic matter content, metolachlor has the potential to range from a moderately mobile to a highly mobile compound with K_d values ranging from 0.11 to 44.8, and Koc values ranging from 21.6 to 367.

There is no significant difference in soil sorption affinity between metolachlor and S-metolachlor. There is no statistical difference between Koc values in non-paired batch equilibrium studies; similar Koc coefficients for metolachlor (mean K_{oc}=249.250) and S-metolachlor (mean K_{oc}=265.875) were observed. These data suggest that metolachlor and S-metolachlor are both expected to be highly mobile to mobile in soil and water environments.

Field dissipation studies indicate that metolachlor is persistent in surface soil with half lives ranging from 7 to 292 days in the upper six inch soil layer depending on geographic location. Metolachlor was reportedly detected as deep as the 36 to 48 inch soil layer in

some of the studies. Metolachlor OA (CGA-51202), was detected (0.11 ppm) as deep as the 30-36 inch soil depth (MRID 41335701); CGA-40172 was detected as deep as the 36-48 inch depth (MRID 41309802); CGA-40919 was detected in the 36-48 inch depth (0.21 ppm in MRID 41309802); and CGA-50720 was not detected (LOD = 0.07 ppm) in any soil segment at any interval.

Exposure of aquatic organisms to metolachlor is expected to be predominantly by runoff and drift. Aquatic exposures are based on these two primary routes and are discussed quantitatively in Section 4.3.2. However, given the fate profile for metolachlor, minor routes of exposure are expected to be transport of parent metolachlor due to volatility and groundwater recharge to surface waters via base flow. The relative importance of the minor routes of transport are addressed in Sections 4.3.2i and 4.3.2j below.

4.3.2 Aquatic Exposure

Aquatic estimated environmental concentrations (EECs) resulting from metolachlor use were derived using PRZM 3.12/EXAMS 2.98, a Tier 2 screening model designed to estimate pesticide concentrations found in water at the edge of a treated field. As such, it provides high-end values of the pesticide concentrations that might be found in ecologically sensitive environments at the edge of agricultural fields following pesticide application.

PRZM-EXAMS is a multi-year runoff model that also accounts for spray drift from multiple applications. In the ecological exposure assessment, PRZM-EXAMS simulates a 10 hectare (ha) field immediately adjacent to a 1 ha water body, 2 meters deep with no outlet. The location of the field is specific to the crop being simulated using site specific information on the soils, weather, cropping, and management factors associated with the scenario. Based on historical rainfall patterns, the water body receives multiple runoff events during the years simulated. Acute risk assessments are performed using 1 in 10 year peak EEC values for single and multiple applications. The 1 in 10 year peak concentration represents the 90th percentile concentration from 30 years of peak annual concentrations. Chronic risk assessments for invertebrates and fish are performed using the average 21-day and 60-day EECs, respectively.

a. Metolachlor in the Aquatic Environment

The assessment involved the analysis of surface water and groundwater monitoring data, prospective groundwater study data, and Tier I (GENEEC) and Tier II (PRZM/EXAMS) modeling for selected vulnerable sites. This assessment strategy was designed to assess concentrations of the parent compound and the ESA and OA degradates. Note that this aquatic exposure assessment evaluates exposure to both racemic metolachlor and S-metolachlor. All references in this document to metolachlor are for the racemic form (50% S-isomer : 50% R-isomer) whereas all references to S-metolachlor refer to the enriched isomer form (88% S-isomer : 12% R-isomer). Where the enantiomeric ratio has not been determined the reference is for metolachlor/S-metolachlor.

b. National Surface Water Monitoring Data Assessment

In the 2002 TRED, several monitoring studies were evaluated to estimate acute and chronic exposures. Extensive monitoring data exist for metolachlor/S-metolachlor that allow distributions of concentrations to be estimated.

Four large monitoring data sets were analyzed in regarding to the frequency and magnitude of metolachlor/S-metolachlor occurrence: The U.S. Geological Survey's (USGS's) National Water Quality Assessment[14] (NAWQA), the Acetochlor Registration Partnership (ARP) (Hackett 1996-2002, Simmons 2000), EPA's Storage and Retrieval database[15] (STORET), and USGS-EPA Pilot Reservoir Monitoring Program (USGS 2001). The frequency of detection of metolachlor/S-metolachlor from the entirety of the monitoring data evaluated suggest that metolachlor/S-metolachlor are commonly found in both surface water and groundwater on a national scale. The two primary degradates, metolachlor ESA and metolachlor OA, are detected in surface and groundwater resources in Iowa and Illinois at frequencies (99% for ESA and 92% for OA) and at concentrations exceeding metolachlor/S-metolachlor. Where metolachlor/S-metolachlor is detected in surface and groundwater, it is likely that the degradates are present as well. The frequency and magnitude of the degradates in these two states suggest that there is a higher potential for the occurrence of degradates in surface water than for metolachlor/S-metolachlor.

From the available national-scale data, the highest annual maximum concentration of metolachlor/S-metolachlor in surface water is **77.6 μg/l** from the NAWQA surface water monitoring data. The maximum value detected from all data evaluated was **138.8 μg/l** from the STORET data, however, this value was not recommended as a peak EEC for risk assessment due to the age of the data (collected in 1980's). From the available data, the maximum time-weighted mean concentration of metolachlor/S-metolachlor in surface water is **4.3 μg/l** from the NAWQA surface water monitoring data. These concentrations were primarily detected in the Midwestern corn belt and are higher than those expected in the Pacific Northwest. In general, the Midwest corn belt is in an area of much higher metolachlor use and is generally more vulnerable to runoff than the Pacific Northwest.

From the available national-scale data, the maximum peak concentration of metolachlor ESA is **12.40 μg/l** and the maximum time-weighted mean concentration of metolachlor ESA is **7.30 μg/l** from the Iowa NAWQA surface water monitoring data. From the available data, the maximum peak concentration of metolachlor OA is **6.75 μg/l** and the maximum time-weighted mean concentration of metolachlor OA is **2.27 μg/l** from the Iowa NAWQA surface water monitoring data. More details on the results of the evaluation of surface water monitoring data may be found in EPA's TRED drinking

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[14] http://water.usgs.gov/nawqa/

[15] http://www.epa.gov/storet/dbtop.html

water assessment (U.S. EPA 2002).

c. Regional Surface Water Monitoring Data Assessment

Several sources of regional surface water monitoring data were available for review and analysis and were evaluated for maximum annual peak and overall average concentrations.

Surface water monitoring data were accessed specific to the states containing listed salmonids. Data were obtained from the NAWQA program for those monitoring stations within the salmonid ESUs. Surface water monitoring data were also downloaded from the California Department of Pesticide Regulation (CDPR) website. Figure 4.3.2ca presents the location of CDPR and NAWQA monitoring locations in California while Figure 4.3.2cb presents the locations of the NAWQA surface water monitoring locations in Oregon, Washington, and Idaho.

No surface water monitoring studies which specifically targeted metolachlor use were available for analysis as part of this assessment. Generally, targeted monitoring data are collected with a sampling program designed to capture both spatially and temporally the maximum use of a particular pesticide. Because none of these regional monitoring studies were designed specifically for metolachlor they are considered to be non-targeted. EFED has relied on an evaluation of monitoring data for metolachlor collected by others. Each monitoring data set evaluated in this assessment was collected with a different study objective. The NAWQA data represents surface-water concentrations collected on a national basis with an emphasis on high agricultural use areas. The CDPR data is focused on a mixture of uses and land use types and is concentrated in the Central Valley of California. Finally, the Washington State Department of Agriculture in cooperation with the Department of Ecology recently completed a preliminary report on pesticides and semi-volatile organic compounds in two watersheds. The surface water monitoring program was designed to assess the impact of pesticide use on salmonid habitat and is part of a larger ongoing project and represents a progress report.

The frequency of sampling from the monitoring data evaluated also adds uncertainty to this assessment. Estimates of acute exposure are based on monitoring data with varying sampling frequencies. Because peak concentrations of pesticides in water bodies frequently exist for only a short time, it is likely that water samples were not collected at the times when the highest concentrations were present. Therefore, it is likely that the monitoring data have not captured the maximum peak concentration from the locations sampled.

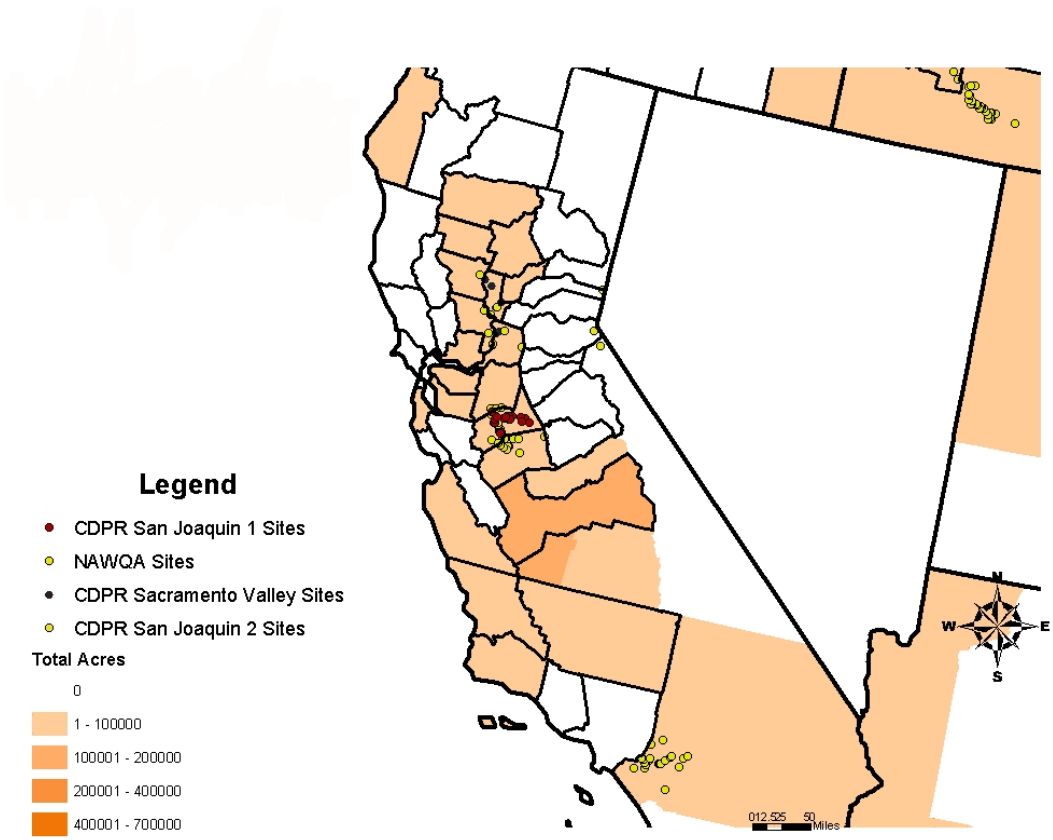

Figure 4.3.2ca. California Department of Pesticide Regulation (CDPR) and NAWQA Surface Water Monitoring Locations and 2002 Potential Metolachlor Crop Acreage.

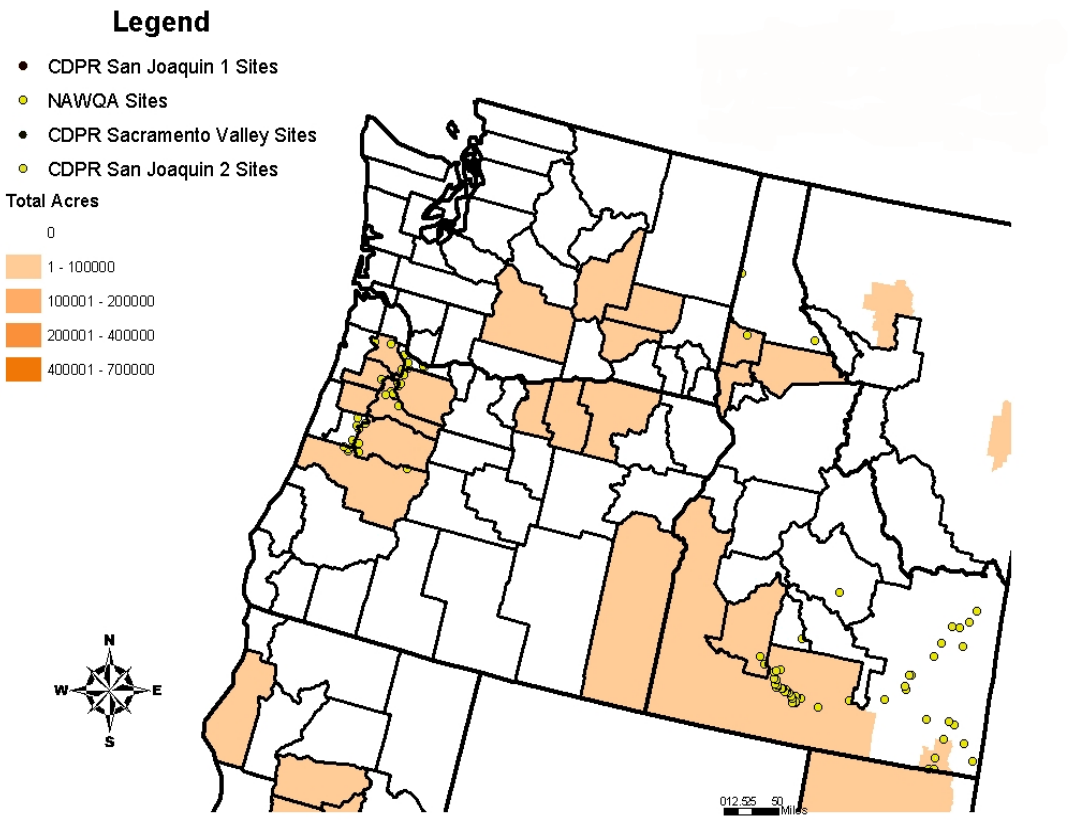

Figure 4.3.2cb. NAWQA Surface Water Monitoring Locations and 2002 Potential Metolachlor Crop Acreage

d. Regional NAWQA Data

In 1991 the USGS NAWQA program began collecting surface and groundwater data from selected watersheds in order to catalog the quality of water resources in the United States. The information obtained consists of chemical, biological and physical water quality data from 59 study units across the United States. The occurrence of metolachlor/S-metolachlor in surface water from the national data for the states of California, Idaho, Oregon, and Washington was evaluated for this assessment. Metolachlor/S-metolachlor was detected in 1572 samples from a total regional data set of 2388 samples (65.8%), of which 345 were estimated below the limit of quantitation (LOQ). The maximum concentration detected was **1.9 μg/l** and the mean concentration was **0.009 μg/l**. No degradate data were available in this analysis.

e. California Department of Pesticide Regulation (CDPR) Data

The California Department of Pesticide Regulation's (CDPR) Surface Water Database[16] is designed to collect and make available information concerning the presence of pesticides in California surface waters. California rivers, creeks, urban streams, agricultural drains, the San Francisco Bay delta region, and urban stormwater runoff are monitored and the resulting data are available on the CDPR website. As of January 2004, the database contained results from 48 studies conducted by federal, state, and local agencies, private industry, and public interest groups. Nearly 6,000 samples were taken in 21 counties from over 200 sampling sites, from August 1990 through September 2003. The database contains over 130,000 chemical analysis records. Each chemical analysis record is the result of one analysis for a single pesticide active ingredient or breakdown product.

Metolachlor/S-metolachlor was detected in 457 samples from a total regional data set of 1424 samples (32%). The maximum concentration detected was **1.6 μg/l** and the average concentration was below the limit of quantitation and reported as **0.0 μg/l**. No degradate data were available in this analysis.

f. Washington State Department of Agriculture (WSDA) Surface Water Monitoring Program

The Washington State Department of Agriculture in cooperation with the Washington State Department of Ecology (WDE) recently completed a report summarizing preliminary results of a monitoring program in selected watersheds (WSDA 2004). The summary report presents results for a single urban watershed and a single agricultural watershed. This report is a snapshot of a longer term study to evaluate the effect of pesticide use on Salmonid waters in the state of Washington. Metolachlor is included in

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[16] http://www.cdpr.ca.gov/docs/sw/surfcont.htm

this assessment as a pesticide of interest. Although preliminary, the results indicate that metolachlor was only detected in one sample at **0.017 µg/l** from a total of 99 samples (detection frequency of 1%) within the agricultural watershed. No degradate data were available in this analysis.

g. Washington State Department of Ecology (WSDE) Monitoring Data

The Washington State Department of Ecology maintains a database of multi-media monitoring data known as the Environmental Information Management (EIM) System[17]. The EIM database for surface water data for metolaclor was accessed. As of September 2004 the database contained results from over 400 studies conducted by state and local entities. Nearly 1.7 million environmental records were available from over 10,000 locations between 1990 and 2003.

Metolachlor/S-metolachlor was detected in one sample from a total data set of 650 samples (<0.001%). The single concentration detected was **0.033 µg/l** detected in 1995. No degradate data were available in this data set.

h. Modeling Assessment

In order to augment the existing monitoring data, an additional set of surface water exposure assessments were completed using modeling predictions. Monitoring data have been collected during a time period when both metolachlor and S-metolachlor were used and non-stereospecific analytical methods were employed. Both racemic metolachlor and enriched S-metolachlor were modeled. The fate data for metolachlor and S-metolachlor were considered equivalent and used to estimate model inputs.

An analysis of existing PRZM/EXAMS scenarios was conducted to determine if new model scenarios are needed to simulate metolachlor use near listed salmonids and critical habitat. PRZM/EXAMS modeling options include using existing scenarios from states outside those containing listed salmonids as surrogates for use in the Northwest and California. The existing scenarios could be used with available meteorological data from areas within the states containing listed salmonids. Or, new crop scenarios could be developed that are specific for metolachlor use within the watersheds containing listed salmonids and critical habitat. This analysis is presented in Figures 4.3.2ha through 4.3.2ce

From the following figures it appears that for the registered uses of racemic metolachlor there is generally good coverage using existing scenarios. Metolachlor is currently registered for use on corn, cotton, peanuts, pod crops (beans and peas), potatoes, safflower, sorghum, and soybeans. Of these, crop acreage data were available from the 2002 USDA Census of Agriculture (AgCensus) for all but potatoes and safflower. 1997

[17] http://www.ecy.wa.gov/eim

AgCensus data were available for potatoes and was used in this analysis.

Of the crops evaluated, peanuts and soybeans are not grown in the western United States, while safflower is principally grown in South Dakota. Therefore, these uses are not included in the assessment. Of the remaining uses, the attached figures suggest that there is generally good coverage using the existing five scenarios selected. These scenarios are Oregon sweet corn, Oregon snap beans, California corn, California cotton, and Idaho potatoes. The following is a brief summary of the relevant crops.

In the states containing listed salmonids, corn is principally grown in Eastern and Northeastern Oregon, South Central Washington, Southern Idaho, and the central valley of California (Figure 4.3.2ha). Two existing scenarios provide coverage for corn use in this area including the Oregon sweet corn and California corn. Therefore, no additional scenarios or surrogates are needed for this crop.

Cotton is principally grown in the southern Central Valley and Imperial Valley of California (Figure 4.3.2hb). This crop is represented by the California cotton scenario located in Fresno county. Therefore, no additional scenarios or surrogates are needed for this crop.

Relatively small amounts of pod crops (beans and peas) are grown in the West relative to other parts of the United States. Based on data from the 2002 AgCensus there are no peas currently grown in the western United States. Western beans are grown principally in central and coastal California, southeastern Washington, and southwestern Idaho. An existing Oregon scenario based on the Willamette Valley can be used to represent metolachlor use on beans in the Northwest. To better represent the costal areas of California, which are expected to have greater runoff than inland areas in California, an additional general vegetable scenario was developed based on soils and management practices in Monterrey County. Comparison of this scenario with dry bean acreage is presented in Figure 4.3.2hc.

Potatoes are generally grown in southern Idaho (principally southeastern Idaho) and central and eastern Washington (Figure 4.3.2hd). Currently a single potato scenario in southeastern Idaho is available. Given the similarity of climatic conditions between southern Idaho and eastern Washington no additional potato scenario is needed at this time.

Finally, metolachlor usage on sorghum appears to be minor in the states containing listed salmonids relative to the great plains and Texas. Based on the 2002 AgCensus sorghum is being grown in the southern Central Valley, the Sacramento area, and the Imperial Valley in far southern California (Figure 4.3.2he). There is currently no sorghum scenario in the states containing listed salmonids, however, given limited acreage for this crop it is believed that the California cotton scenario should provide a reasonable surrogate for sorghum.

Surface Water Modeling of Metolachlor

Surface water concentrations of metolachlor were modeled using the PRZM/EXAMS programs. Input parameters used in PRZM version 3.12/EXAMS version 2.97.5 modeling were selected using Agency guidance ("*Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides, Version II"* dated February 28, 2002). Degradation rate constants were derived from review of registrant submitted environmental fate studies. Input parameter guidance can be found at:

http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.htm.

Pre-emergence treatment with metolachlor was modeled for four uses with five scenarios including corn in California and Oregon, cotton in California, potatoes in Idaho, and peas/beans in Oregon. Modeling was performed using the current racemic metolachlor label rates. Predicted EEC for both drift and no-drift scenarios are presented in Tables 4.3.2a and 4.3.2b, respectively. Input parameters for PRZM/EXAMS modeling are presented in Table 4.3.2c. Copies of the input and output files are provided in Appendix A. More details on the individual PRZM/EXAMS scenarios may be found at:

http://www.epa.gov/oppefed1/models/water/index.htm.

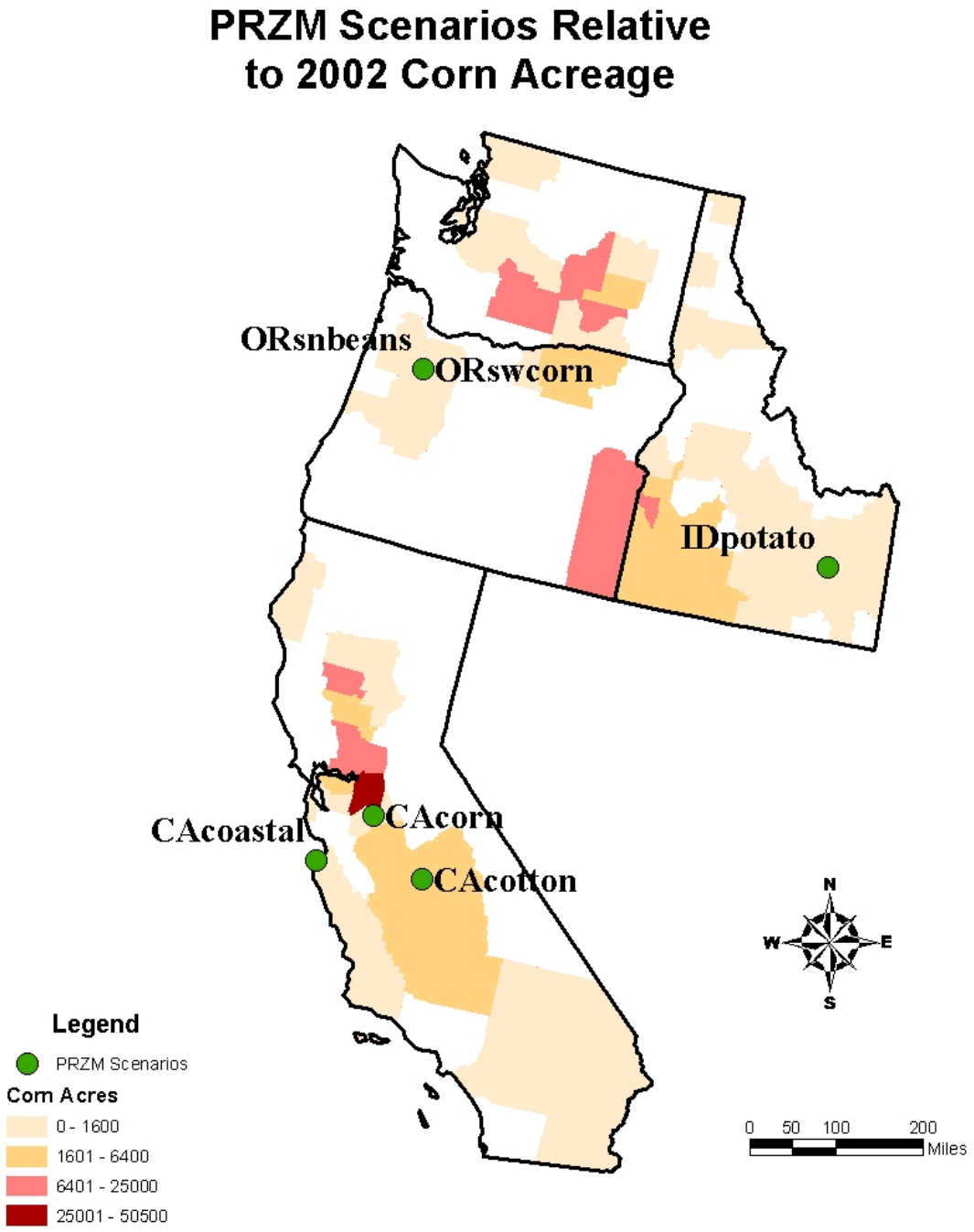


Figure 4.3.2ha. 2002 AgCensus Corn Acreage and Existing PRZM/EXAMS Modeling Scenarios

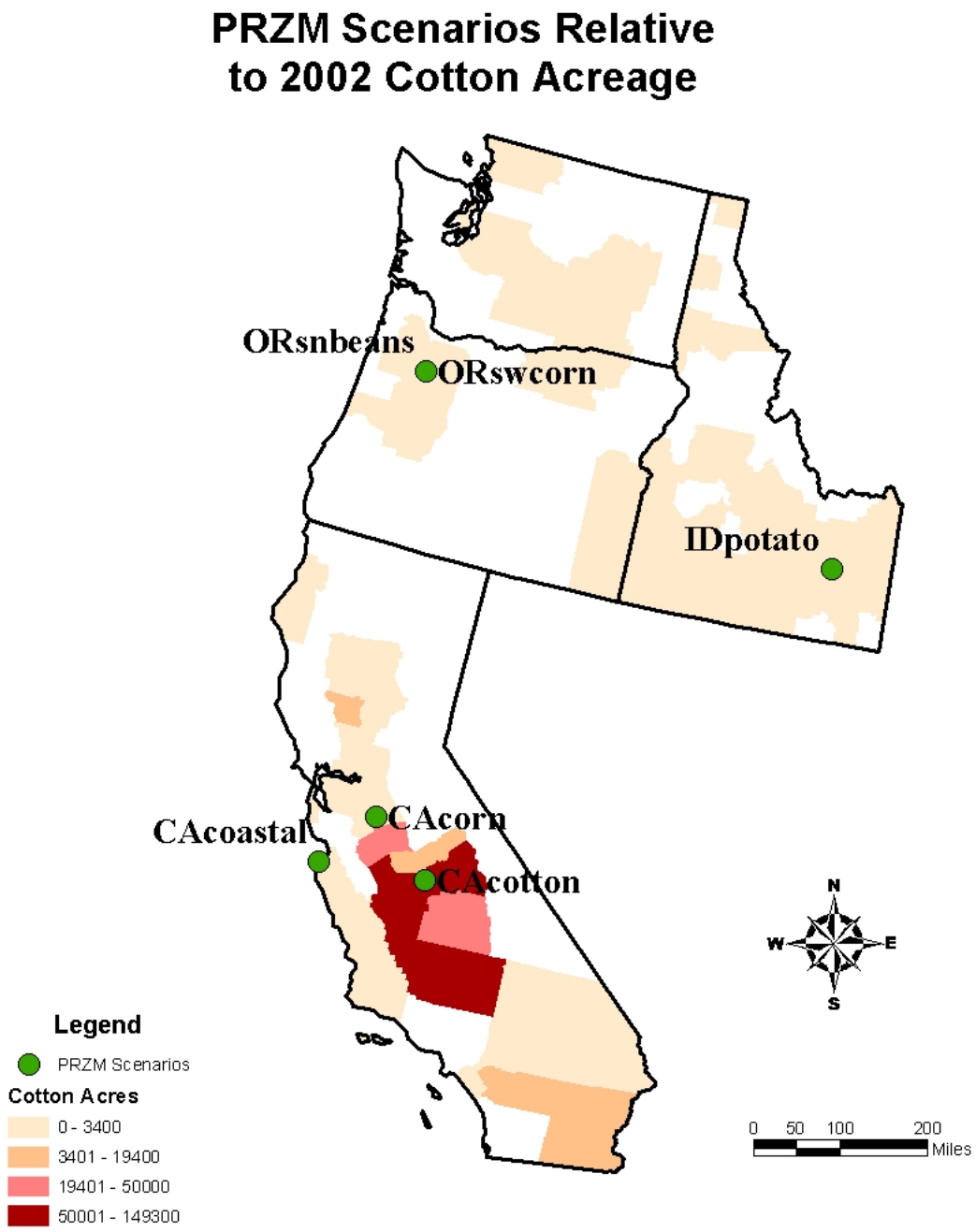


Figure 4.3.2hb. 2002 AgCensus Cotton Acreage and Existing PRZM/EXAMS Modeling Scenarios

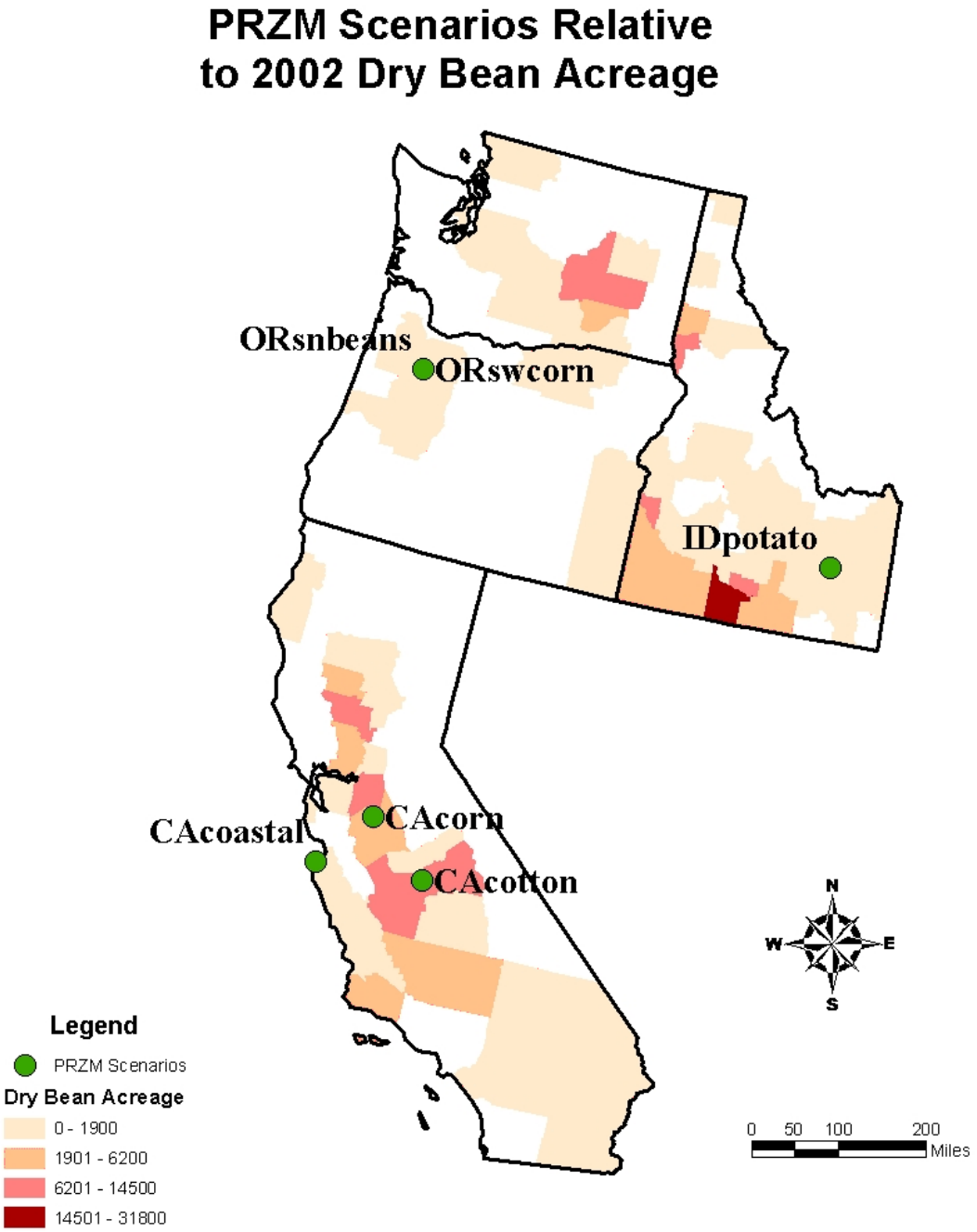


Figure 4.3.2hc. 2002 AgCensus Dry Bean Acreage and Existing PRZM/EXAMS Modeling Scenarios.

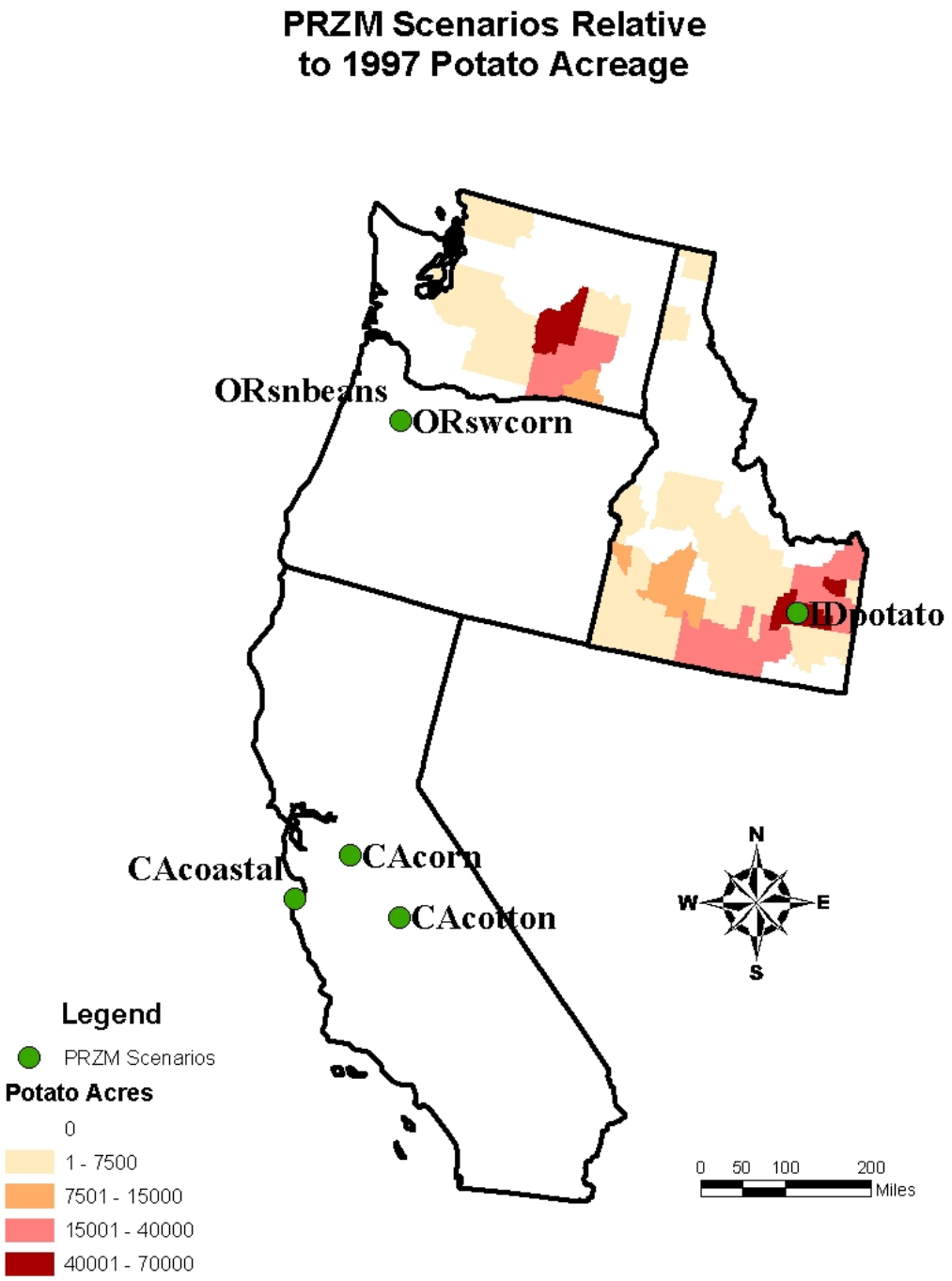


Figure 4.3.2hd. 2002 AgCensus Potato Acreage and Existing PRZM/EXAMS Modeling Scenarios.

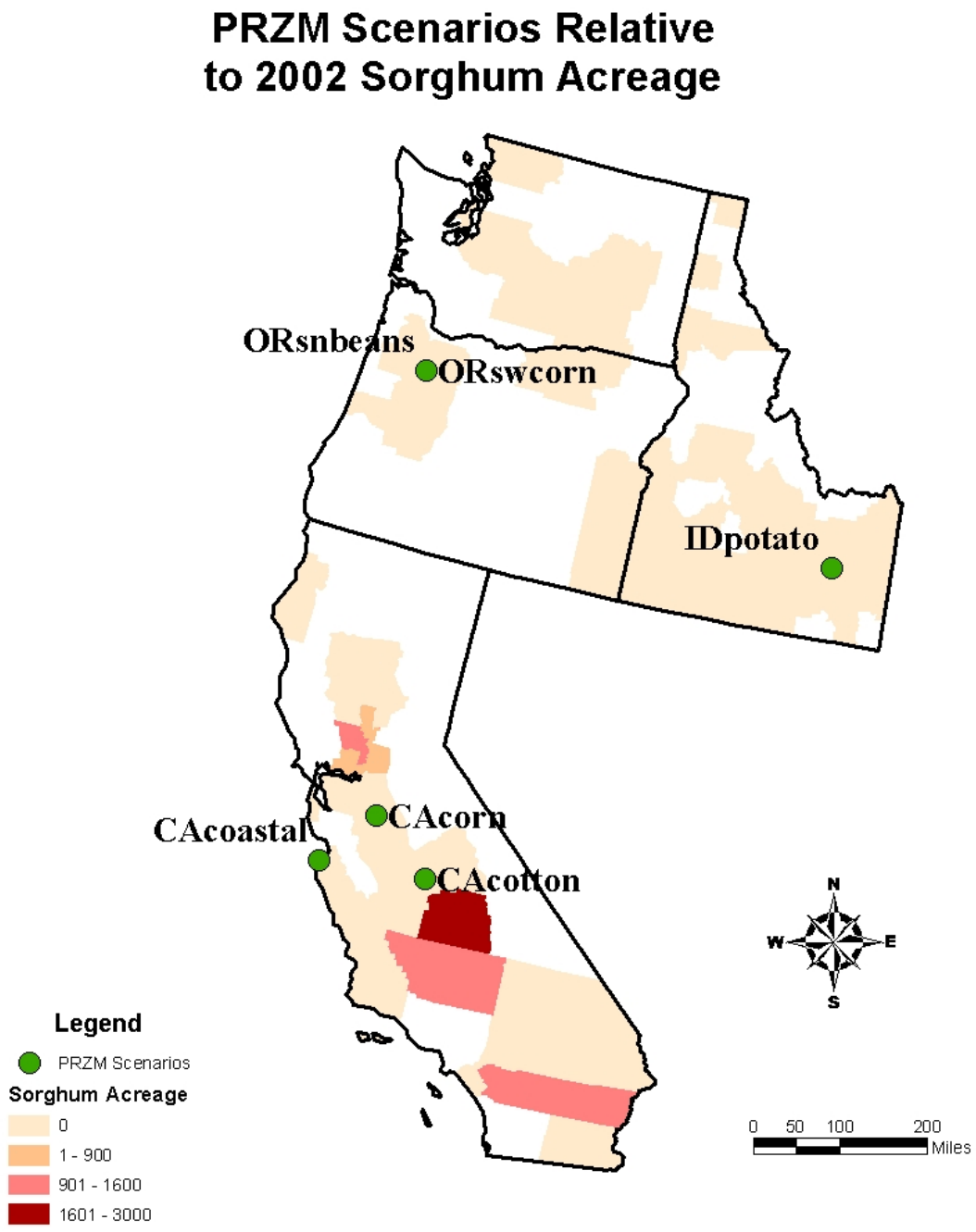


Figure 4.3.2he. 2002 AgCensus Sorghum Acreage and Existing PRZM/EXAMS Modeling Scenarios

Table 4.3.2a Tier II Concentrations of Metolachlor in Surface Water for Aquatic Ecological Assessment using PRZM/EXAMS Scenarios						
Crop	**Application Rate per Acre lbs/acre (label #)**	**# of Applications (interval)**	**First Application**	**1/10 Peak Annual (µg/l)**	**21-Day Average (µg/l)**	**60-Day Average (µg/l)**
CA corn - no irrigation	2.0	2 (60 days)	April 1	10.29	7.43	4.41
CA cotton - irrigated	1.33	1	June 15	3.72	2.08	1.01
CA cotton - no irrigation	1.33	1	June 15	3.72	2.08	1.01
CA coastal vegetable - no irrigation	2.0	1	April 1	19.90	11.54	6.43
ID potato - no irrigation	2.67	1	May 1	13.27	6.63	3.12
OR pea - no irrigation	2.0	1	June 1	12.66	8.73	5.27
OR corn - no irrigation	2.0	2 (60 days)	May 1	19.30	12.51	6.81

Table 4.3.2b Tier II No Drift Concentrations of Metolachlor in Surface Water for Aquatic Ecological Assessment using PRZM/EXAMS Scenarios						
Crop	**Application Rate per Acre lbs/acre (label #)**	**# of Applications (interval)**	**First Application**	**1/10 Peak Annual (µg/l)**	**21-Day Average (µg/l)**	**60-Day Average (µg/l)**
CA corn - no irrigation	2.0	2 (60 days)	April 1	8.73	5.64	2.94
CA cotton - irrigated	1.33	1	June 15	1.97	1.33	0.76
CA cotton - no irrigation	1.33	1	June 15	2.36	1.46	0.86
CA coastal vegetable - no irrigation	2.0	1	April 1	16.66	10.53	5.52
ID potato - no irrigation	2.67	1	May 1	6.14	3.01	1.34
OR pea - no irrigation	2.0	1	June 1	8.84	5.73	3.47
OR corn - no irrigation	2.0	2 (60 days)	May 1	14.57	10.41	6.39

Table 4.3.2c. PRZM/EXAMS Input Parameters for Metolachlor for Use in Aquatic Ecological Exposure Assessment			
Model Parameter	**Value**	**Comments**	**Source**
Spray Drift by Scenario	cotton: 5% corn: 5% peas/beans: 5% potatoes: 5%	cotton: aerial corn: aerial peas/beans: aerial potatoes: aerial	
Aerobic Soil Metabolism $t_{½}$	48.9 days	estimated upper 90 th percentile[1]	MRID 41309801 MRID 43928936 MRID 45499606
Anaerobic Soil Metabolism $t_{½}$			
Aerobic Aquatic Degradation $t_{½}$ (KBACW)	141 days	based on 3 times single aerobic aquatic metabolism linear first order half life	MRID 41185701
Anaerobic Aquatic Degradation $t_{½}$ (KBACS)	234 days	based on 3 times single anaerobic aquatic metabolism linear first order half life	MRID 41185701
Aqueous Photolysis $t_{½}$	70 days		MRID40430202
Hydrolysis $t_{½}$	stable		MRID 40430201
Kd/Koc	181 ml/g	Average Koc[2]	MRID 00078291 MRID 43928935 MRID 40430203 MRID 40476404 MRID 43928937 MRID 40495602 MRID 40495603 MRID 40495604
Molecular Weight	283.8		Product Chemistry
Foliar Extraction	0.5[2]		

Table 4.3.2c. PRZM/EXAMS Input Parameters for Metolachlor for Use in Aquatic Ecological Exposure Assessment			
Model Parameter	**Value**	**Comments**	**Source**
Foliar Decay Rate	stable[3]		
Water Solubility	4800 mg/l	10 times reported value	Product Chemistry
Henry's Law Constant	$3.75E^{-5}$ atm-m^3/mol		Product Chemistry
Vapor Pressure	$2.8E^{-5}$ torr		Product Chemistry

1 - Upper 90th Percentile based on acceptable aerobic metabolism half lives of 66, 37.8, 37.8, 14.9, 13.9, and 50.3 days.
2- Average Koc using values 118.5, 303.0, 151.4, 241.4, 66.8, 21.6, 110.4, 74.4, 175.0, 333.3, 230.0, 244.7, 226.3, 367.2, 176.5, 120.7, 111.1 as per "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002.
3- as per "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002

In general, modeling results predict concentrations in surface water that are an order of magnitude higher than those detected in monitoring data from the Pacific Northwest. However, a direct comparison should be viewed with some caution. The amount of monitoring data in the Pacific Northwest is relatively limited and is not viewed as targeted to metolachlor use. Monitoring data from the Midwest indicates significantly higher concentrations of metolachlor in surface water.

EPA's TRED (U.S. EPA 2002) included modeling of several scenarios which are not included in this assessment. These scenarios were focused on metolachlor use on a national scale and were focused primarily in the Midwestern United States. The TRED modeling resulted in predicted EECs which were only slightly higher than the national-level monitoring data discussed in Section 4.3.2b. This suggests that modeling in the Pacific Northwest, which predicts concentrations of an order of magnitude above regional monitoring data, is a reasonable predictor of upper bound exposures. This is important because there may be situations specific to the Pacific Northwest where monitoring data are unavailable. For example, water diversion for irrigation is a major issue in California, Oregon and Washington. These waters are typically more vulnerable in that irrigation diversions are typically in close proximity to agricultural areas and are susceptible to repeated accumulation of pesticides via return flow and runoff. At this time there does not appear to be any monitoring data or modeling specifically targeted to this scenario. Therefore, the model predictions have been determined to represent the best available data for use in the risk assessment, and they are likely protective of these settings as well.

Targeted monitoring studies are designed with a sampling frequency to capture peak

runoff events coinciding with a specific pesticide use, with a duration to provide sufficient data to estimate long term exposures, and specific to geography and crop use. The monitoring data used in this assessment, while of high quality, were not collected to specifically represent metolachlor use in the Pacific Northwest and is therefore considered to be non-targeted to metolachlor use. The monitoring data evaluated in this assessment were used for comparison against model predictions.

Surface Water Modeling of ESA and OA Degradates

Unlike parent metolachlor/S-metolachlor, limited monitoring data are available on metolachlor ESA and metolachlor OA. Therefore, screening-level estimates of surface water concentrations of metolachlor ESA and metolachlor OA using the GENEEC (Tier I) program were conducted. Input parameters used in Tier I modeling were selected using standard guidance ("*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated August 6, 2000). Limited data were available on the fate characteristics of metolachlor ESA and metolachlor OA. Consequently, the aerobic soil metabolism rate constants were estimated for the ESA and OA degradates from the comparative aerobic soil metabolism study (MRID 43928936) submitted to support bridging of fate data from the racemic to the S-isomer of metolachlor. Aerobic soil metabolism half-lives were estimated using only the decline portion of the data for each degradate. Half lives for other parameters (i.e. aerobic aquatic metabolism, hydrolysis, photolysis) where no data were available were conservatively assumed to be stable, consistent with standard guidance. An adsorption/desorption study (MRID 40494605) was previously submitted for metolachlor OA. The lowest non-sand Kd value (0.079 for Maryland clay) was selected for surface water degradate modeling and the lowest Koc measured for all available soil types (2.82 for the Maryland clay) was used for groundwater modeling. An adsorption/desorption study (MRID 44931722) was previously submitted for metolachlor ESA and is currently under review. The lowest non-sand Kd value (0.041 for Maryland clay) was selected for surface water degradate modeling and the lowest Koc (2.01 for the Maryland sandy loam) was used for groundwater modeling.

Tier I (GENEEC) modeling of metolachlor ESA and OA was conducted. Racemic metolachlor is used on corn at a seasonal rate of 4 lb ai per acre (with one application at 2.8 lbs ai per acre and a second application at 1.2 lbs ai per acre). However, GENEEC does not allow for multiple applications with different rates, therefore the GENEEC scenario modeled for a seasonal maximum rate of 4 lbs ai per acre is intended to approximate the racemic metolachlor use. A maximum application rate for metolachlor ESA was estimated by multiplying the maximum single application rate for metolachlor by 12% (highest single day conversion efficiency) which represents the maximum percent of ESA formed from an aerobic soil metabolism study (MRID 43928936). The maximum application rate for metolachlor OA was estimated by multiplying the maximum single application rate for metolachlor by 28% which represents the maximum percent (highest single day conversion efficiency) of OA formed from an aerobic soil metabolism study (MRID 41309801). In addition, each application rate was corrected for molecular weight differences of each

degradate. This use of the decline portion of the formation and decline data from MRID 43928936 is intended to provide a conservative estimate of degradate half lives.

GENEEC modeling estimates that the surface water concentration of metolachlor ESA (ground application with no spray drift) is not likely to exceed 27.7 ppb for the annual peak, 21-day, and 60-day concentrations for metolachlor. GENEEC modeling estimates that the surface water concentration of metolachlor OA (ground application with no spray drift) is not likely to exceed 63.4 ppb for the annual peak, 21-day, and 60-day concentrations for metolachlor.

As a comparison, metolachlor ESA was detected in surface water from the Iowa NAWQA data at a maximum concentration of 12.4 ppb while metolachlor OA was detected at a maximum of 6.8 ppb. Additionally, metolachlor ESA was detected in surface water from the Illinois NAWQA data at a maximum concentration of 6.1 ppb while metolachlor OA was detected at a maximum of 1.5 ppb. These monitoring data suggest that the screening-level estimates from GENEEC for metolachlor ESA and metolachlor OA are protective, however, the certainty in this conclusion could be greatly improved with additional monitoring data.

There are several uncertainties in the model inputs which may influence the model predictions. Chief among these are the conversion efficiency and degradation half lives used in the model. The assumptions used to estimate these parameters may result in the over prediction of levels in surface water. However, given the limited monitoring data available for these degradates, the lack of degradate specific fate data, and the fact that this is a screening-level assessment, these model estimates are appropriate for use in this risk assessment.

Water Body Type and Model Exposure Estimates

Both modeling results and monitoring data are presented in this assessment, but the model results are considered to provide more appropriate values for estimating high-end aquatic metolachlor concentrations that could occur in the Pacific Northwest. A potential limitation in the model results, however, is that they represent concentrations expected in small, static water bodies while flowing water bodies are more representative of listed salmonid freshwater habitat. Two conceptual models, described below, support the conclusion that results based on the static ecological water body used in PRZM-EXAMS and GENEEC modeling are protective of streams considered to be large enough to be listed salmonid habitat. In addition, reviewed literature on temporal variability of pesticide concentrations in runoff suggests that the short term concentrations of metolachlor in streams may vary by more than ten-fold. Thus, although the peak exposures estimated with the static ecological water body models are expected to be conservative relative to exposures of the same duration in salmonid-supporting streams, the concentration during that period may fluctuate greatly. As stated previously (see section 3.6.1), peak concentrations are generally expected to decline more rapidly in flowing systems than in static systems. Dissipation occurs by chemical degradation in static and flowing systems, but in flowing systems, downstream movement adds an additional route of dissipation that is not present in static systems. Even in slow moving water bodies, the rate of

dissipation due to flow can result in faster dissipation than that expected by chemical degradation of metolachlor which has an estimated aerobic aquatic half life of 141 days (Table 4.3.2c). Thus, in streams and rivers supporting salmonids, the peak metolachlor concentrations are expected to decline more rapidly than suggested by PRZM/EXAMS model predictions using the static ecological water body.

In streams, metolachlor concentrations would be expected to be a result of the contribution of metolachlor from adjacent treated areas as well as treated areas higher in the watershed. Two conceptual models can be used to help characterize periods of possible high concentrations in the smallest streams providing listed salmonid habitat:

One potential high exposure scenario would occur when a recently treated field received a localized, but large, amount of rain resulting in a large, intense, runoff event to a small, adjacent salmonid stream derived from water containing low to negligible levels of metolachlor (*e.g.* snow melt or groundwater recharge). In this instance, the concentration of metolachlor in the stream would be directly related to the runoff contribution from the nearby treated field. The smallest listed salmonid-supporting streams are estimated to have flow rates of approximately 1870 gallons/second (~7070 L/s) (see section 2.6.2) whereas the ecological water body used in PRZM-EXAMS and GENEEC modeling is a static water body of 20 million liters. More than 20 million liters are expected to flow past a fixed point in the smallest salmonid-supporting stream during a period of less than one hour. Runoff events may last more or less than one hour but the greatest pesticide losses are generally associated with larger, more intense, events which would persist for more than one hour, resulting in the metolachlor input to the stream being diluted in more than 20 million liters of water. Thus, the 24-hour peak PRZM-EXAMS and GENEEC concentrations are considered to be conservative estimates of 1-hour average concentrations of metolachlor in the smallest salmonid-supporting streams. During the 1-hour period, the concentration could be expected to vary by more than ten-fold around the mean based on information presented below. After the 1 hour period the metolachlor concentration in the stream would be expected to decline to levels resulting from lesser sources of metolachlor such as contributions from subsurface flow. Subsurface flow has been identified as a mechanism of metolachlor transport from treated field to surface water but was found to be less important than surface runoff in terms of concentration (Rice *et al.* 2002) and overall mass flux (Ng and Clegg 1997). Subsurface flow is generally slower than over surface runoff and would continue after surface runoff ceased.

A second potential high exposure scenario would occur when a relatively large proportion of a watershed supporting a salmonid stream is treated with metolachlor and receives a large amount of precipitation generating a major runoff event. In this instance the total flow of the stream would be expected to increase substantially with metolachlor-laden runoff. Under these circumstances the metolachlor concentration in the stream water could be crudely, but conservatively, estimated by multiplying the estimated concentration in runoff from a recently treated field by the fraction of the watershed that was treated. For example, for a field with a runoff concentration of 160 ppb (consistent with the highest runoff concentration estimated with PRZM-EXAMS over a 30-year period with the California coastal vegetable scenario),

the resulting stream concentration would be 160 ppb times the fraction of the watershed treated with metolachlor. For the peak concentration to reach the highest peak concentration predicted by PRZM-EXAMS modeling in the ecological water body (16.6 ppb), approximately 10% of the watershed would need to be treated with metolachlor within a few days prior to the runoff event. Using the same approach, 6.3% of the watershed would need to be treated for the diluted runoff concentration to be equal to the lowest aquatic toxicity criteria (10 ppb for aquatic plants). The likelihood of 6 to 10% of a watershed being treated nearly simultaneously with metolachlor just prior to a major rain event is difficult to estimate and would be dependent upon the size and land use pattern of the watershed but, based on national trends in land use patterns and pesticide use patterns, this level of treatment seems unlikely. It is also expected to be unusual for 6 to 10% of a listed salmonid stream's watershed being comprised of crops for which metolachlor is registered. The largest monocultures (20 to 56% of watersheds) are found in the midwest[18]. The second conceptual model approach does not provide a temporal exposure estimate without making further assumptions about the hydrology of the watershed.

In practice, concentrations of pesticides in runoff from fields or watersheds are difficult to predict during the runoff events. Measured concentrations in edge-of-field sampling have been shown to vary by more than an order of magnitude during runoff events (Wauchope 1978). While runoff experiments from small plots can show predictable patterns of initially high concentrations in runoff which can decrease ten-fold in less than an hour, larger field- and watershed-scale studies show a more erratic pattern of increasing and decreasing concentrations during runoff events which can also vary by a factor greater than ten (Leonard 1990). Thus, short term concentrations in small streams may also be expected to vary by as much as a factor of ten. To simplify, most runoff models, like PRZM-EXAMS, estimate the total runoff losses over a longer time frame (*e.g.* daily) or for an entire runoff event.

i. Atmospheric Transport of Metolachlor

The process by which pesticides may be transported away from the target site through the atmosphere include spray drift and volatilization. Reports in open literature document episodes of atmospheric transport of acetanilide herbicides and impacts to non-target organisms. The Association of American Pesticide Control Officials (AAPCO) report in the 1999 Pesticide Enforcement Survey (http://aapco.ceris.perdue.edu/doc/surveys/drift99.html) that metolachlor is one of the least commonly confirmed active ingredients by state agencies as regards to drift complaints. The survey does not provide information on the magnitude of exposure arising from these reports and does not differentiate between drift and volatility. The most common confirmation techniques were visual examination and residue confirmation.

Data collected in the 1960s and 1970s, and summarized in Majewski and Capel (1995), indicate that metolachlor has been detected in rainwater samples at concentrations between 46

[18] http://www.epa.gov/oppefed1/models/water/regional_pca.htm

nanograms per liter (ng/l) and 3,000 ng/l, while metolachlor was detected in air samples at concentrations between 0.07 nanograms per cubic meter (ng/m^3) and 9.7 ng/m^3. Majewski and Capel noted that the higher concentrations were infrequently detected and the authors also noted that the high detections were located near areas where pesticides were applied and may have resulted from unusual conditions. Because the concentrations are low, none of the monitored concentrations are expected to cause effects to listed salmonids or the constituent elements of their critical habitat. The highest concentration detected in rainwater would not result in an exceedance of the acute aquatic plant risk level of concern even without considering dilution. After dilution into a water body with lower metolachlor concentrations, the risk would be further reduced.

An important consideration resulting from these data is that any analysis of surface water monitoring data cannot distinguish between routes of exposure. In other words, the analysis of surface water concentrations discussed previously cannot distinguish the source of the chemical whether the source be from runoff, drift, or deposition from rainfall. The reported values include all sources of input into the surface water. Thus, any effect volatilization of metolachlor may have on concentrations in surface water is included in monitoring data.

To assess the potential for metolachlor to partition into various media, a simple fugacity model (USEPA EpiSuite software) was used. The fugacity model predicts that the relative percentage of metolachlor that will partition into air is 0.06 percent. The results of the fugacity model suggest for metolachlor that volatilization is not a major route of dissipation. Uncertainties associated with the use of a fugacity model are that partitioning of metolachlor to soil is estimated and that the effect of interception and volatilization from plant surfaces is not accounted for. These factors could result in an underestimation of the amount partitioning to air.

This risk assessment does account for exposure resulting from spray drift loading to surface water. Longer-range transport coupled with volatility and ultimately deposition via rainfall is not accounted for in this assessment and lends additional uncertainty to the risk assessment. However, exposures resulting from long range atmospheric transport are expected to be small relative to short-range spray drift.

j. Occurrence of Metolachlor, Metolachlor ESA, and Metolachlor OA in Groundwater and Potential for Contribution to Surface Water Exposures

Groundwater recharge to surface water is a potential source of aquatic exposure when a pesticide is expected to leach. However, the simple presence of a pesticide in groundwater does not constitute a risk to aquatic organisms living in nearby streams and rivers. Groundwater must represent a significant contribution to streamflow and the chemical must be present at levels high enough to cause adverse effects. A review of monitoring data and modeling suggest that metolachlor is not expected to be present in groundwater at concentrations significant to aquatic organisms. Modeling and available monitoring data suggest that the degradates, metolachlor ESA and metolachlor OA, are more likely to be present in groundwater beneath areas where metolachlor is used but at concentrations that are

low relative to effect levels.

National-level NAWQA data, recent Iowa NAWQA data, National Contaminant Occurrence Database (NCOD) data from the Office of Water, and data from two prospective groundwater studies (http://www.epa.gov/oppsrrd1/reregistration/metolachlor/) were evaluated in 2002 as part of the EPA's TRED of metolachlor. In the TRED, acute exposures from groundwater were estimated by evaluating the annual maximum concentrations from the available data. The maximum metolachlor concentration from all reported groundwater data was 10,000 ppb reported in the NCOD data. The reported maximum (10,000 ppb) and average concentration (82.9 ppb) should be viewed with caution because no information was available at the time of the assessment to evaluate the timing and location of the reported detections in NCOD. Also, the average (477 ppb) and standard deviation (2181 ppb) from the subset of data [Public Water Supplies (PWSs) serving populations less than 500 people] containing the 10,000 ppb detection suggest that this value is an outlier. Therefore, it was reported in the TRED but was not considered as an EEC. The next high value reported in the NCOD data (from the subset of PWSs serving between 501 and 3300 people) was 40 ppb. Because of the uncertainty over the location and data quality behind this value it was only used as a check against the other data.

Using the remaining data, acute exposure to parent metolachlor from groundwater was assumed to be represented by the annual maximum concentration of 32.8 ppb from the national NAWQA data (compared with 40 ppb from NCOD discussed above). A conservative estimate for acute exposure to the metolachlor degradate, ESA, in groundwater was based on the annual maximum concentration of 63.7 ppb from the Iowa NAWQA data. A conservative estimate of acute exposure to the OA degradate from groundwater was also represented by the annual maximum concentration of 13.4 ppb from the Iowa NAWQA data.

Ideally, chronic exposure would be best estimated by analysis of time series data from individual wells within a study and then performing an analysis of the distribution of time weighted means from within the study. Then, as with the surface water data, an appropriate upper bound estimate of chronic exposure from the distribution of time weighted means could be selected for estimating chronic exposure. However, the groundwater data evaluated as part of the TRED did not have a sufficient number of samples from individual wells to calculate time weighted means (typically a single well within the study may have 2 or 3 samples analyzed). Therefore, the chronic exposure was estimated using the maximum concentration from the national NAWQA data of 32.8 ppb. As an estimate of the lower bound of the chronic exposure estimate, the average concentration of 0.02 ppb from the national NAWQA data was used.

Similarly, an upper bound chronic exposure concentration of metolachlor ESA in groundwater is represented by the maximum concentration of 63.7 ppb from the Iowa NAWQA data and the lower bound chronic exposure estimate,1.42 ppb, is the average concentration from the Iowa NAWQA data. An upper bound estimate of chronic exposure from groundwater for metolachlor OA is represented by the maximum concentration of 13.4 ppb from the Iowa NAWQA data and the lower bound chronic exposure estimate of 0.41 ppb

is from the Iowa NAWQA data.

The importance of these exposure estimates relative to an assessment of risk due to metolachlor use in the Pacific Northwest can be put into context when evaluating the contribution of groundwater to surface water flow. Figure 4.3.2ja is derived from data prepared by the USGS and indicates where areas of high baseflow are expected to occur. In these areas, the groundwater contribution to total streamflow is large and therefore, any residual pesticide present in groundwater could result in exposure in surface water environments, such as those inhabited by salmonids. In the Pacific Northwest, the majority of areas where baseflow is predicted to be high as a percentage of streamflow are outside the areas of concern as defined by the listed salmonid ESUs and NLCD cropland coverages (Figure 4.3.2jb). This is further evidence to suggests that there is a low likelihood that salmonids would be exposed to groundwater containing metolachlor or its degradates at toxicologically significant concentrations. High end runoff and spray drift events are expected to result in substantially higher aquatic metolachlor exposures than groundwater recharge (Rice *et al.* 2002).

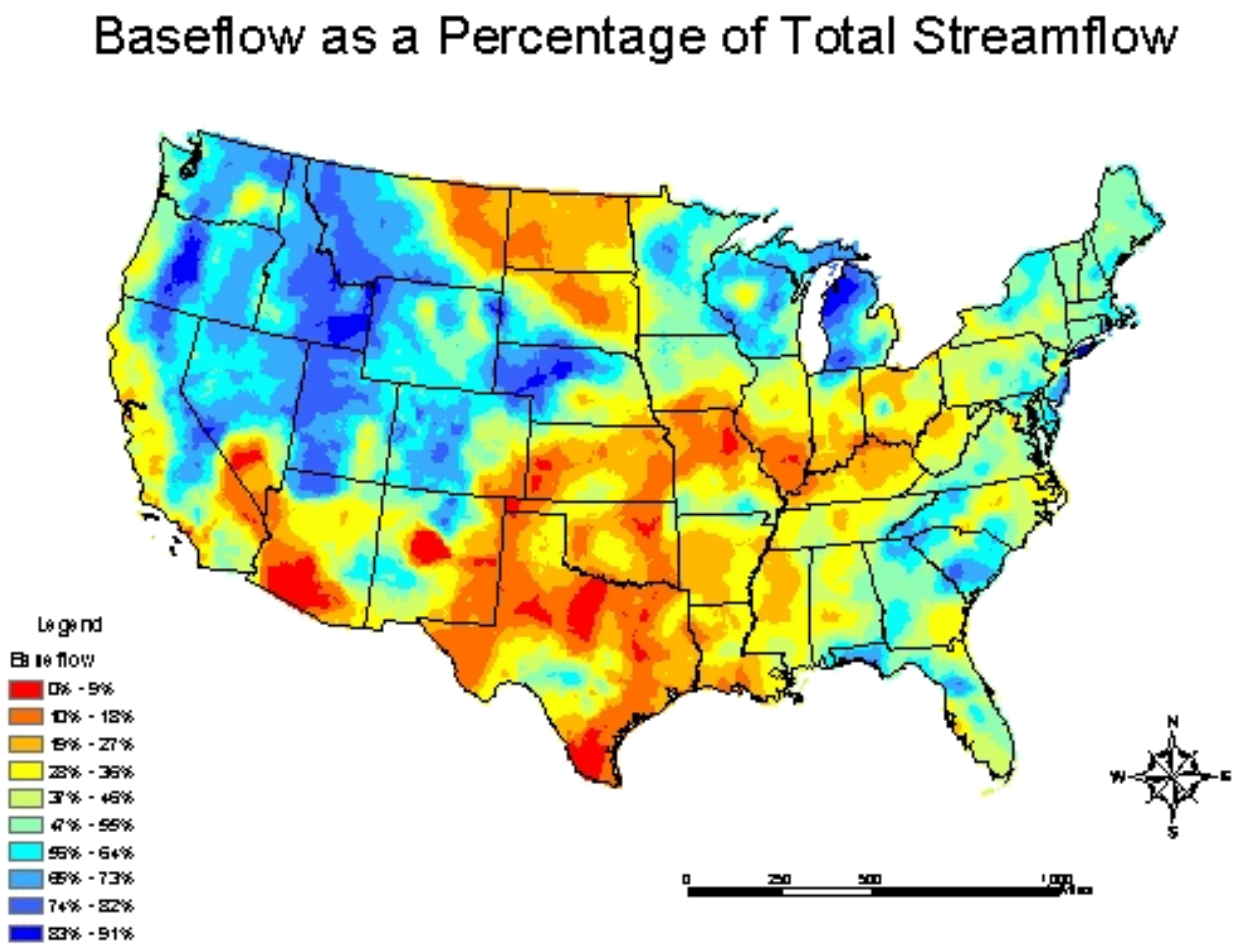


Figure 4.3.2ja. National Extent of Baseflow as Percentage of Contribution to Surface Water

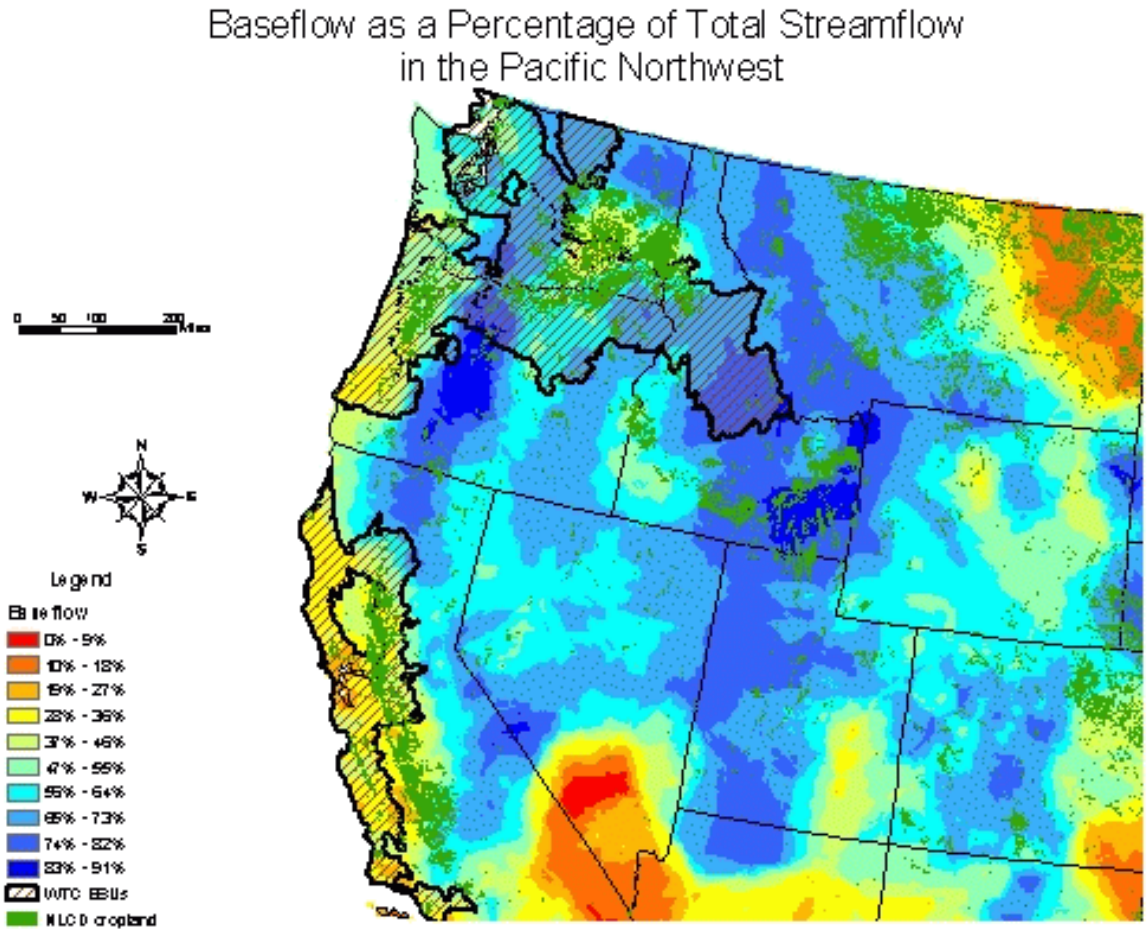


Figure 4.3.2jb. Regional Extent of Baseflow as Percentage Contributing to Surface Water

k. Uncertainties in the Aquatic Exposure Assessment

There are a number of uncertainties associated with the aquatic exposure assessment which are specific to metolachlor. The aquatic exposure assessment for metolachlor relied on both an analysis of monitoring data and modeling. There are uncertainties in this assessment for both types of analysis

Modeling relies on estimated fate parameters and assumed agricultural practices to predict concentrations of metolachlor in surface water. In this instance, the fate database is essentially complete although terrestrial field dissipation studies were deemed supplemental but given the weight of evidence repeating the studies was not deemed necessary. However, fate data for metolachlor ESA and metolachlor OA, the primary degradates of metolachlor, were estimated from a limited data set which adds uncertainty to the assessment. Sufficient information was available to estimate all fate parameters required as model inputs for both PRZM/EXAMS and SCIGROW for both metolachlor and it's degradates. The data for metolachlor is limited to those studies submitted, but to insure that an EEC is predicted which is protective of all populations, many of the model inputs used in this assessment were estimated at the upper 90th percentile in accordance with EFED guidance (see EFED "*Guidance for Chemistry and Management Practice Input Parameters for Use in Modeling the Environmental Fate and Transport of Pesticides"* dated February 28, 2002).

PRZM/EXAMS requires information on agricultural practices as inputs. The model requires a specific application date and rate to be applied for a number of scenarios. In reality, application dates and rates applied across the United States will vary depending on geography, pest pressure, climatic factors, and changes in agricultural cropping patterns. EFED attempts to capture some of this variability by modeling as many representative scenarios as possible and by using meteorological data which covers a time span sufficient to capture climatic variations which are likely to occur. However, the model is limited in its ability to capture all of the natural variation which occurs for any pesticide application and this adds uncertainty to the assessment.

No surface water or groundwater monitoring studies which specifically targeted metolachlor use were available for analysis as part of this assessment. Instead, an evaluation of monitoring data for metolachlor collected by others was used. Each monitoring data set evaluated in this assessment was collected with a different study objective.

Metolachlor, a herbicide used on multiple crop and non-crop uses over a wide geographic range, has been frequently detected in surface water and groundwater. However, as noted in the assessment, many of the sample locations from the monitoring data evaluated were not targeted to areas of highest metolachlor use and consequently, the concentrations of metolachlor in groundwater and surface water may not be representative of concentrations in all areas.

The frequency of sampling from the monitoring data evaluated also adds uncertainty to this assessment. Estimates from monitoring data of acute exposure have varying sample

frequencies and it is unclear what effect this has on peak estimates from monitoring data. Therefore, the monitoring data may not have captured the maximum peak concentration from the locations sampled. This fact, coupled with the fact that monitoring data are not targeted to metolachlor use areas, adds uncertainty to the estimation of EECs from the monitoring data.

County level use data for metolachlor have been derived from an approach developed by Thelin and Gianessi, 2000. In this approach Thelin and Gianessi relied on a combination of state level pesticide use data from the National Center on Food and Agricultural Policy (NCFAP) and county level information on harvested crop acreage taken from the USDA Census of Agriculture. This approach is limited by the fact that state level coefficients of pesticide use cannot provide precise county level estimates and do not account for local variations in cropping and management practices. Finally, the approach is limited in that the Census of Agriculture may under-report certain crops and regions due to non-disclosure.

Additional usage data for metolachlor was provided by OPP's Biological and Economic Analysis Division (BEAD). BEAD's use data is based on market survey information and data available from the CDPR website and represents more recent information on actual use amounts as well as typical application rates and number of applications. This information has been relied on for refinement and characterization of the initial screening-level assessment. All county level estimates of use (pounds applied, application rate and number of applications) are estimated based on methodologies developed by BEAD. County level use estimates for California are taken directly from CDPR pesticide use reporting (PUR), however similar estimates for states other than California, including Idaho, Oregon and Washington, are estimated using a combination of data and extrapolation from state level down to the county level. Extrapolation to the county level is more fully explained in the report provided by BEAD (Donaldson, 2004) and summarized in Appendix D, but involves using state level estimates combined with county level crop acreage information from USDA NASS.

There are also a number of general uncertainties associated with use of the PRZM/EXAMS standard runoff scenario (a 10 hectare field draining into a 1 hectare Georgia farm pond) with regional specific crop and pesticide management practices, weather, and soil types. Although there are uncertainties with the use of a standard runoff scenario for a regional aquatic exposure assessment, it is designed to represent pesticide exposure from an agricultural watershed impacting a vulnerable aquatic environment. Extrapolating the risk conclusions from this standard pond scenario may either underestimate or overestimate the potential risks.

The major uncertainties with the standard runoff scenario are associated with the physical construct of the watershed and representation of vulnerable aquatic environments for different geographic regions. The physicochemical properties (pH, redox conditions, etc.) of the standard farm pond are based on a Georgia farm pond. These properties are likely to be regionally specific because of local hydrogeological conditions. Any alteration in water quality parameters may impact the environmental behavior of the pesticide. The farm pond represents a well mixed, static water body. Because the farm pond is a static water body (no flow through), it does not account for pesticide removal through flow through or accidental

water releases. However, the lack of water flow in the farm pond provides an environmental condition for accumulation of persistent pesticides. The assumption of uniform mixing does not account for stratification due to thermoclines (e.g., seasonal stratification in deep water bodies). Additionally, the physical construct of the standard runoff scenario assumes a watershed:pond area ratio of 10. This ratio is recommended to maintain a sustainable pond in the Southeastern United States. The use of higher watershed: pond ratios (as recommended for sustainable ponds in drier regions of the United States) may lead to higher modeled pesticide concentrations when compared to the standard watershed:pond ratio.

The standard pond scenario assumes uniform environmental and management conditions exist over the standard 10 hectare watershed. Soils can vary substantially across even small areas, and thus, this variation is not reflected in the model simulations. Additionally, the impact of unique soil characteristics (e.g., fragipan) and soil management practices (e.g., tile drainage) are not considered in the standard runoff scenario. The assumption of uniform site and management conditions is not expected to represent some site-specific conditions. Extrapolating the risk conclusions from the standard pond scenario to other aquatic habitats (e.g., marshes, streams, creeks, and shallow rivers, intermittent aquatic areas) may either underestimate or overestimate the potential risks in those habitats.

4.3.3 Terrestrial Plant Exposure

The TerrPlant model is used to generate screening-level exposure values for terrestrial plants from spray drift and run off. Since soil degradates are not transported via spray drift, off-target exposure to degradates is assessed with no spray drift contribution. The required values to estimate off-target exposure with the TerrPlant model are application rate, solubility, application method, and incorporation depth. After entering the exposure-related values and the appropriate toxicity values, TerrPlant calculates risk quotients which can be compared to levels of concern.

TerrPlant calculates exposure values for terrestrial plants inhabiting two environments: dry adjacent areas and semi-aquatic areas. The 'dry adjacent area' is considered to be representative of a slightly sloped area that receives relatively high runoff and spray drift levels from up gradient treated fields. The 'semi-aquatic area' is considered to be representative of depressed areas which are ephemerally flooded such as marshes which receive relatively high levels of runoff and spray drift. In this assessment the 'dry adjacent area' scenario is used to estimate screening-level exposure values for terrestrial plants in riparian areas. The 'semi-aquatic area' scenario is used to estimate screening-level exposures to terrestrial plants inhabiting shallow estuaries and adjacent ephemerally flooded areas.

a. Metolachlor and Terrestrial Plants

The following input values were constant for estimating terrestrial plant exposure to metolachlor from all uses: solubility: 530 ppm (Colby *et al.* 1989), minimum incorporation depth: 0 inches (all product labels), application methods: ground boom and aerial (product labels). Because application rates vary with different uses, the estimated exposure values for

each use also vary. TerrPlant exposure estimates for maximum application rates associated with representative uses are presented in Table 4.3.3a.

Table 4.3.3a Screening-level Exposure Estimates for Terrestrial Plants to Metolachlor (Runoff and Spray Drift)

Use / App. Rate (lbs/acre)	Application Method	Total Loading to Semi-aquatic Areas (lbs/acre)	Total Loading to Adjacent Areas (lbs/acre)
Corn / 2.0 Pea / 2.0	Aerial	0.70	0.16
	Ground Boom	1.02	0.12
Cotton / 1.33	Aerial	0.47	0.11
	Ground Boom	0.68	0.08
Potato / 2.67	Aerial	0.93	0.21
	Ground Boom	1.36	0.16

The highest off-target loadings of metolachlor predicted by TerrPlant are approximately 50% of the application rate for semi-aquatic areas where runoff is collected and approximately 10% of the application rate for adjacent areas where spray drift is a more important source of loading.

b. Degradates and Terrestrial Plants

The following input values were constant for estimating terrestrial plant exposure to metolachlor ESA and OA from all uses: solubility: >530 ppm (the acids are assumed to posses greater solubility than parent), minimum incorporation depth: 0 inches (conservatively assumes that all material is available in the top 1 inch of the soil column), application methods: granular (in TerrPlant granular applications result in no drift exposure). To estimate an input for application rate, the highest percent conversion measured in laboratory aerobic soil metabolism tests were used. Using the same approach described in 4.3.2g, the highest level of the degradates measured (as a fraction of the of the amount applied) was multiplied by the label application rate to generate an application rate input. The highest percentages of ESA and OA observed in the aerobic soil metabolism studies were 12% and 28%, respectively.

TerrPlant exposure estimates for the ESA and OA degradates are presented in Table 4.3.3b and c.

Table 4.3.3b Metolachlor ESA: Screening-level Exposure Estimates for Terrestrial Plants (Runoff)			
Use / App. Rate (lbs/acre)	**Application Method**	**Total Loading to Semi-aquatic Areas (lbs/acre)**	**Total Loading to Adjacent Areas (lbs/acre)**
Corn / (2.0 x 0.12) 0.24 Pea / (2.0 x 0.12) 0.24	Granular (zero drift)	0.120	0.012
Cotton / (1.33 x 0.12) 0.16	Granular (zero drift)	0.080	0.008
Potato / (2.67 x 0.12) 0.32	Granular (zero drift)	0.160	0.016

Table 4.3.3c Metolachlor OA: Screening-level Exposure Estimates for Terrestrial Plants (Runoff)			
Use / App. Rate (lbs/acre)	**Application Method**	**Total Loading to Semi-aquatic Areas (lbs/acre)**	**Total Loading to Adjacent Areas (lbs/acre)**
Corn / (2.0 x 0.28 = 0.56) Pea / (2.0 x 0.28 = 0.56)	Granular (zero drift)	0.280	0.028
Cotton / (1.33 x 0.28 = 0.37)	Granular (zero drift)	0.185	0.019
Potato / (2.67 x 0.28 = 0.75)	Granular (zero drift)	0.375	0.038

Screening-level exposure estimates of the ESA, as a percentage of the associated metolachlor application rate, are 6% for semi-aquatic areas and 0.6% for adjacent areas. The estimated exposures to the OA are 14% for semi-aquatic areas and 1.4% for adjacent areas. These exposure values are used for comparison against seedling emergence toxicity data. It is not appropriate to compare the estimated exposures to vegetative vigor toxicity data because terrestrial plant foliage is not expected to be exposed to the degradates which are transported in runoff.

4.3.4 Off-Target Exposure from Spray Drift

Levels of off-target spray drift deposition are determined by a number of application and meteorology related variables. The three most important variables for estimating off-target movement of droplets from spray applications are droplet size, release height, and wind speed (Bird *et al.* 1996, Smith *et al.* 1982). By specifying droplet size, wind speed, release height

restrictions, and other important parameters, product labels can define conditions that limit the level of off-target spray deposition expected from metolachlor applications. Mandatory label directions can also be reliable inputs for spray drift estimation models to quantify off-target movement under specified conditions. Product labels frequently contain advisory statements related to spray drift to provide information to applicators on managing drift. Because the advisory statements are not mandatory conditions of use, they are not used for estimating screening-level (high-end) drift events.

A summary of mandatory spray drift-related language on existing metolachlor labels is provided in Table 4.3.4a.

Wind Speed

Six metolachlor labels restrict wind speeds for all application methods to $\leq$10 mph and seven labels specify the wind speed restriction only for aerial application. One product label restricts all applications to times when the "sustained" wind speed does not exceed 10 mph.

Release Height

Twelve product labels restrict aerial application to a release height of 10 feet unless this release height would compromise the applicator's safety. Three of the products labels are silent on release height with aerial application. All of the product labels are silent on release height in relation to ground boom and chemigation application.

Droplet Size

Fourteen of the labels are silent on the appropriate droplet size for application for any of the application methods. One product label specifies that fine sprays should not be used but does not mention a droplet size standard to define the term "fine".

Other Spray Drift-Related Labeling

Twelve of the product labels prohibit application within 300 feet of sensitive plants but no definition of "sensitive plants" is provided. Products containing atrazine (3) in addition to metolachlor require a buffer zone between the application site and either flowing or static water bodies, 66 ft or 200 ft, respectively. Twelve of the product labels also contain mandatory directions for applicators to use upwind swath displacement (accounting for wind's effect on spray swath placement) and boom width restrictions (reducing the amount of spray that can be lifted in wing tip vortices).

Table 4.3.4a Summary of Mandatory Label Statements Related to Key Spray Drift Parameters						
EPA Reg. No.	**Name**	**Application Method(s)**	**Droplet Size**	**Wind Speed**	**Release Height**	**Comments**
19713-548	**Me-Too-Lachlor**	Aerial, Ground & Chemigation	Not specified	Aerial: ≤10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan upwind swath displacement
19713-555	**Drexel Me-too-la-chlor IV Herbicide**	Aerial, Ground & Chemigation	Not specified	Aerial: ≤10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan upwind swath displacement
19713-547	**Drexel Trizmet II [1]**	Aerial & Ground	Not specified	Aerial: ≤10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan upwind swath displacement
60063-22	**Stalwart C**	Aerial, Ground & Chemigation	Not specified	Aerial: ≤10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan upwind swath displacement
62719-240	**Broadstrike SF + Dual [2]**	Not specified	Do not use a fine spray	sustained wind is ≤ 10 mph	Not specified	
19713-549	**Drexel Me-Too-Lachlor II Herbicide**	Aerial, Ground & Chemigation	Not specified	Aerial: ≤10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan upwind swath displacement
19713-556	**Drexel Me-Too-Lachlor III Herbicide**	Aerial, Ground & Chemigation	Not specified	Aerial: ≤10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan upwind swath displacement
42750-69	**Metolachlor 8E**	Aerial, Ground & Chemigation	Not specified	≤ 10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan
60063-23	**Stalwart Xtra Herbicide**	Aerial & Ground	Not specified	≤ 10 mph	10 ft for aerial	66 ft buffer from flwoing water

Table 4.3.4a Summary of Mandatory Label Statements Related to Key Spray Drift Parameters						
EPA Reg. No.	**Name**	**Application Method(s)**	**Droplet Size**	**Wind Speed**	**Release Height**	**Comments**
	[1]				unless safety is compromised	200 ft buffer from static water additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan upwind swath displacement
62719-239	**Broadstrike + Dual** [2]	Ground	Do not use a fine spray	sustained wind is ≤ 10 mph	Not specified	
42750-71	**Metolachlor AT** [1]	Aerial & Ground	Not specified	≤ 10 mph	10 ft for aerial unless safety is compromised	66 ft buffer to flowing water 200 ft buffer from static water additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan upwind swath displacement
3125-366	**Turbo 8 EC** [3]	Aerial, Ground & Chemigation	Not specified	Aerial: ≤10 mph	Not specified	
56077-68	**Inter Plus II**	Aerial & Ground	Not specified	≤ 10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan
56077-69	**Inter 8E II**	Aerial & Ground	Not specified	< 10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan
42750-70	**Metolachlor 8E Plus**	Aerial, Ground & Chemigation	Not specified	< 10 mph	10 ft for aerial unless safety is compromised	additional aerial restrictions: 300 ft buffer to sensitive plants boom width <3/4 wingspan

[1] Product contains atrazine in addition to metoachlor.
[2] Product contains flumetsulam in addition to metolachlor
[3] Product contains metribuzin in addition to metolachlor

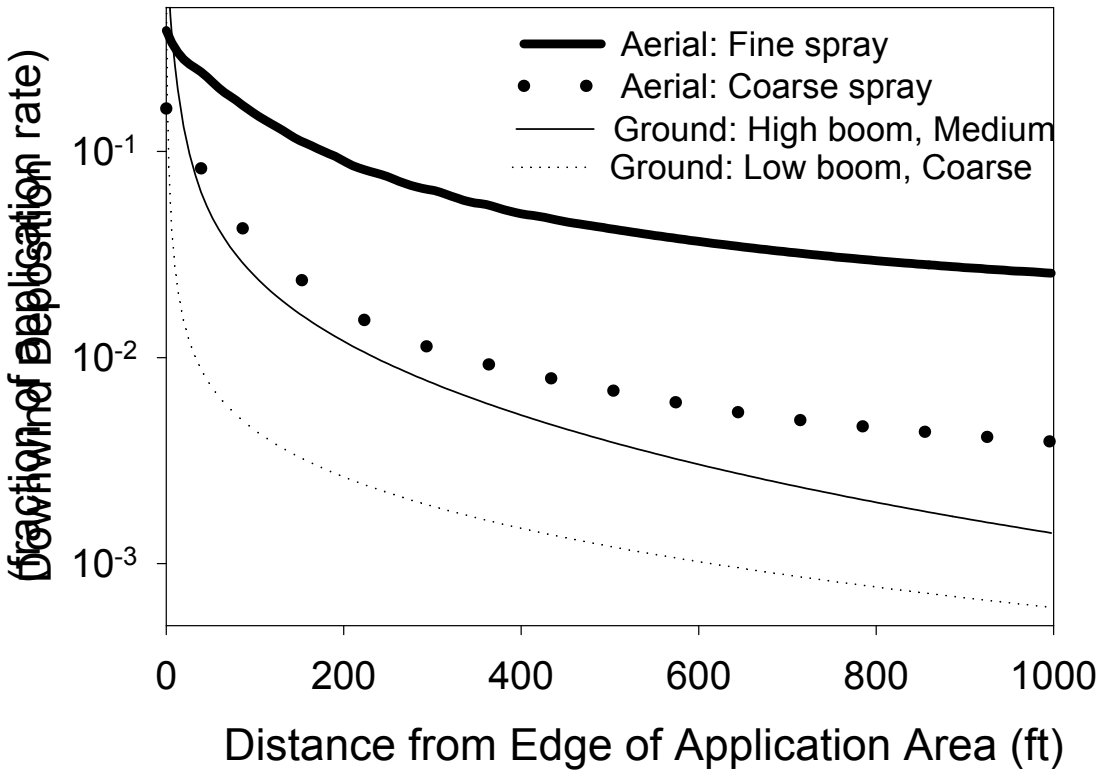
In aerial mode the AgDRIFT spray drift model uses a semi-mechanistic algorithm to estimate off-target spray drift deposition. In ground boom mode, AgDRIFT relies empirically on data collected by the Spray Drift Task Force (U.S. EPA 1999) to estimate downwind deposition consistent with a 10 mph wind. Tier 1 AgDRIFT conditions (except for droplet size of aerial applications) were used to estimate spray drift deposition from metolachlor applications as allowed by product labels. The inputs used for modeling are generally consistent with high-end wind speed and release height conditions specified on metolachlor labels (*i.e.* 10 mph wind speed and, for aerial application, 10 ft release height). An accepted spray drift model is not available for chemigation applications.

Two spray drift exposure scenarios were assessed for ground boom and aerial application method to evaluate the effects of varying parameters that are not mandatory on product labels. Two categories of droplet size were run for both application methods. For ground boom applications, the effect of boom height combined with droplet size was also assessed. Coarser sprays settle faster than finer sprays and result in lower levels of off-target deposition. Droplet size can be described using the American Society of Agricultural Engineers Standard 572 (ASAE S572). Using low boom heights also results in lower drift because releasing droplets closer to the ground decreases the time necessary for them to reach the target and decreases their probability of being entrained in air currents that can carry them off-target. Wind speed was fixed for both aerial and ground boom applications at 10 mph which is the maximum allowable speed for most aerial labels. Higher wind speeds are not available in AgDRIFT for ground boom applications. For aerial applications, the release height was also fixed at 10 ft which is generally required on labels when applicator safety is not at risk. The spray drift scenarios are described in Table 4.3.4b.

Table 4.3.4b. Assessed Spray Drift Scenarios		
Application Method	**Variables**	**Description**
Ground Boom	4 ft boom height / ASAE Medium Spray	Metolachlor labels do not place an upper limit on boom height. The highest ground boom height that can be modeled in AgDRIFT is 4 ft. High boom heights are generally used when faster applications speeds are desired or when terrain is uneven. An ASAE Medium spray is the finest spray that can be modeled for ground boom applications in AgDRIFT. Medium and finer sprays are generally used to evenly cover the target and are necessary for efficacy of contact pesticides. As a mobile, soil applied herbicide, metolachlor does not need to be applied as a Medium or finer spray.
	2 ft boom height / ASAE Coarse Spray	The lowest ground boom height that can be modeled in AgDRIFT is 2 ft. An ASAE Coarse spray is the coarsest spray that can be modeled for ground boom applications in AgDRIFT. Coarse sprays are generally effective for systemic and soil directed pesticides, like metolachlor.
Aerial	ASAE Fine Spray	Metolachlor labels do not specify a mandatory droplet size. Nozzles selection, nozzle angle, pressure, and flight speed all contribute to the droplet size produced during aerial applications. Faster flight speeds, greater nozzle angles, and higher pressures generally result in finer sprays.
	ASAE Coarse Spray	In order to produce ASAE coarse sprays aerial applicators need to select appropriate nozzles, nozzle angles, and pressure. Almost always, flight speed of fixed wing aircraft must be lower than typical.

Downwind spray drift deposition versus distance associated with the spray drift scenarios are presented in Figure 4.3.4a. The spray drift deposition levels can be used to estimate exposures for comparison to toxicity data. Estimated risks resulting from spray drift exposure are discussed in the Risk Characterization Section (see 5.2.1a and 5.2.2c).

Figure 4.3.4a. High-end estimation of spray drift deposition with distance for aerial and ground boom scenarios.



5. Risk Characterization

5.1 Risks Estimation (RQs)

5.1.1 Fish

Tables 5.1.1a and 5.1.1b summarize the most conservative acute ecotoxicity and RQ values for freshwater and estuarine/marine fish. Of all the fish species tested, the registrant-submitted acute toxicity study with S-metolachlor on bluegill sunfish (MRID 43928910) provides the most protective LC_{50} for estimation of acute RQ values. The 96-hour LC_{50} is 3.2 ppm with a 95% confidence interval of 2.8 - 4.6 ppm. The mean confidence value of the LC_{50}, 3.2 ppm or 3200 ppb, was compared to the highest estimated 1-in-10 year instantaneous peak EEC value, 19.90 ppb from the California vegetable crop scenario (2 pounds/acre), to quantify direct acute risk to listed salmonids (Table 5.1.1a). The resulting RQ of 0.006 is approximately an order of magnitude below the acute LOC for endangered fish (LOC = 0.05).

For direct acute risk to estuarine/marine fish, the LC_{50} value of 9800 ppb from a sheepshead minnow study was used (Table 5.1.1b). Using the peak EEC values estimated from the selected crop scenarios and ranging from 3.72 ppb to 19.90 ppb, along with the LC_{50} values of 3200 ppb for freshwater fish and 9800 ppb for estuarine/marine fish, the acute RQ values are all an order of magnitude lower than the acute LOC for endangered and threatened fish (0.05).

Table 5.1.1a. Freshwater Fish Acute Ecotoxicity And RQ Values For Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**Peak EEC Value (ppb)**	**Acute Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Bluegill sunfish *(Lepomis macrochirus)*	LC_{50}= 3200	CA/corn/2.0/2	10.29	<<0.01	No
Bluegill sunfish *(Lepomis macrochirus)*	LC_{50}= 3200	CA/cotton/1.33/1	3.72	<<0.01	No
Bluegill sunfish *(Lepomis macrochirus)*	LC_{50}= 3200	CA/vegetable/2.0/1	19.90	<<0.01	No
Bluegill sunfish *(Lepomis macrochirus)*	LC_{50}= 3200	ID/potato/2.67/1	13.27	<<0.01	No
Bluegill sunfish *(Lepomis macrochirus)*	LC_{50}= 3200	OR/pea/2.0/1	12.66	<<0.01	No
Bluegill sunfish *(Lepomis macrochirus)*	LC_{50}= 3200	OR/corn/2.0/2	19.30	<<0.01	No

1. Acute Risk Quotients are calculated using the following formula: EEC/LC_{50}
2. Acute LOC for endangered freshwater fish = 0.05

Table 5.1.1b . Estuarine/marine Fish Acute Ecotoxicity And RQ Values For Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**Peak EEC Value (ppb)**	**Acute Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}= 9800	CA/corn/2.0/2	10.29	<<0.01	No
Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}=9800	CA/cotton/1.33/1	3.72	<<0.01	No
Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}=9800	CA/vegetable/2.0/1	19.90	<<0.01	No
Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}=9800	ID/potato/2.67/1	13.27	<<0.01	No
Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}=9800	OR/pea/2.0/1	12.66	<<0.01	No
Sheepshead minnow (*Cyprinodon variegatus*)	LC_{50}=9800	OR/corn/2.0/2	19.30	<<0.01	No

1. Acute Risk Quotients are calculated using the following formula: EEC/LC_{50}
2. Acute LOC for endangered estuarine/marine fish = 0.05

The early life-stage toxicity test conducted with S-metolachlor on fathead minnows provides the most protective NOAEC for calculating risk following chronic exposure to metolachlor on freshwater fish (MRID 44995903). The LOAEC and NOAEC are 56 and 30 ppb S-metolachlor, respectively, based on reduced dry weight of larval fish. Table 5.1.1c provides the chronic RQs for freshwater fish. These RQs were determined using the NOAEC of 30 ppb and the 60-day EEC value for each crop scenerio. Estimations of the chronic RQs for fish are all less than 0.3 and do not exceed the level of concern for fish following chronic exposure (LOC = 1).

Table 5.1.1c . Freshwater Fish Chronic Ecotoxicity And RQ Values For Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**60-Day EEC Value (ppb)**	**Chronic Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Fathead minnow (Pimephales promelas)	NOAEC= 30	CA/corn/2.0/2	4.41	0.15	No
Fathead minnow (Pimephales promelas)	NOAEC= 30	CA/cotton/1.33/1	1.01	0.03	No
Fathead minnow (Pimephales promelas)	NOAEC= 30	CA/vegetable/2.0/1	6.43	0.21	No
Fathead minnow (Pimephales promelas)	NOAEC= 30	ID/potato/2.67/1	3.12	0.10	No
Fathead minnow (Pimephales promelas)	NOAEC= 30	OR/pea/2.0/1	5.27	0.18	No
Fathead minnow (Pimephales promelas)	NOAEC= 30	OR/corn/2.0/2	6.81	0.23	No

[1.] Chronic Risk Quotients are calculated using the following formula: EEC/NOAEC
[2] Chronic LOC for endangered estuarine/marine fish = 1

The chronic study conducted with sheepshead minnow provided the lowest available NOAEC for estuarine/marine fish following chronic exposure to metolachlor (MRID 43044602). The NOAEC from this study (1.0 ppm or 1000 ppb) was used to calculate the chronic RQs (Table 5.1.1d). The chronic RQs for fish using the NOAEC of 1000 ppb and the 60-day EEC values for each crop scenerio were all determined to be less than 0.01, which is at least two orders of magnitude less than the chronic LOC for fish (LOC = 1).

Table 5.1.1d . Estuarine/marine Fish Chronic Ecotoxicity And RQ Values For Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**60-Day EEC Value (ppb)**	**Chronic Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Sheepshead minnow (*Cyprinodon variegatus)*	NOAEC= 1000	CA/corn/2.0/2	4.41	<<0.01	No
Sheepshead minnow (*Cyprinodon variegatus)*	NOAEC=1000	CA/cotton/1.33/1	1.01	<<0.01	No
Sheepshead minnow (*Cyprinodon variegatus)*	NOAEC=1000	CA/vegetable/2.0/1	6.43	<0.01	No
Sheepshead minnow (*Cyprinodon variegatus)*	NOAEC=1000	ID/potato/2.67/1	3.12	<<0.01	No
Sheepshead minnow (*Cyprinodon variegatus)*	NOAEC=1000	OR/pea/2.0/1	5.27	<0.01	No
Sheepshead minnow (*Cyprinodon variegatus)*	NOAEC=1000	OR/corn/2.0/2	6.81	<0.01	No

[1.] Chronic Risk Quotients are calculated using the following formula: EEC/NOAEC
[2] Chronic LOC for endangered estuarine/marine fish = 1

Degradates

Ethane Sulfonic Acid Derivative (ESA or CGA 354743)

The acute toxicity study with ESA and *Oncorhynchus mykiss* (rainbow trout) was used to calculate the RQs for fish (MRID 44931702; Table 5.1.1e). The 96-hour LC_{50} is 48 ppm with a 95% confidence interval of 36 - 64 ppm. The mean confidence value of the LC_{50}, 48 ppm or 48000 ppb, was used to quantify the direct acute risk to listed salmonids. The calculated RQs for freshwater and marine/estuarine fish, using the various crop scenarios are all considerably less than 0.01, which is less than the acute LOC of 0.05 for threatened and endangered fish.

Table 5.1.1e . Freshwater Fish Acute Ecotoxicity And RQ Values For ESA

Species	Ecotoxicity Value (ppb)	Site Location/App. Rate (lbs/acre)/#	Peak EEC Value (ppb)	Acute Risk Quotient[1]	Levels Of Concern Exceeded[2]
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}= 48000	CA/corn/2.0/2	10.29	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}= 48000	CA/cotton/1.33/1	3.72	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}= 48000	CA/vegetable/2.0/1	19.90	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}= 48000	ID/potato/2.67/1	13.27	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}= 48000	OR/pea/2.0/1	12.66	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}= 48000	OR/corn/2.0/2	19.30	<<0.01	No

1. Acute Risk Quotients are calculated using the following formula: EEC/LC_{50}
2. Acute LOC for endangered freshwater fish = 0.05

Oxanilic Acid Derivative (OA or CGA 51202)

Acute toxicity studies have been conducted with OA on rainbow trout (MRID 44929501) and common carp (MRID 44929502). OA was practically non-toxic in both species with the LC_{50}'s for both greater than the highest concentration tested (96.3 ppm for trout and 93.1 ppm for carp). Although the RQs have been estimated in Table 5.1.1f, the actual RQs will be considerably less than the values provided in the table. Using the study conducted with rainbow trout, all the RQs are less than 0.01 and at least two orders of magnitude below the acute LOC for endangered fish.

Table 5.1.1f . Freshwater Fish Acute Ecotoxicity And RQ Values For OA

Species	Ecotoxicity Value (ppb)	Site Location/App. Rate (lbs/acre)/#	Peak EEC Value (ppb)	Acute Risk Quotient[1]	Levels Of Concern Exceeded[2]
Rainbow trout (*onchorhyncus mykiss*)	LC_{50} > 96300	CA/corn/2.0/2	10.29	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}= >96300	CA/cotton/1.33/1	3.72	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}= >96300	CA/vegetable/2.0/1	19.90	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}> 96300	ID/potato/2.67/1	13.27	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}> 96300	OR/pea/2.0/1	12.66	<<0.01	No
Rainbow trout (*onchorhyncus mykiss*)	LC_{50}> 96300	OR/corn/2.0/2	19.30	<<0.01	No

1. Acute Risk Quotients are calculated using the following formula: EEC/LC_{50}
2. Acute LOC for endangered freshwater fish = 0.05

5.1.2 Aquatic Invertebrates

Acute toxicity studies conducted with metolachlor using *Chironomus plumosus* (midge, ECOTOX Reference 6797) and *Crassostrea virginica* (eastern oyster, MRID 43487102) provide the lowest LC_{50}/EC_{50}'s available for calculations of the RQs for freshwater and marine/estuarine invertebrates, respectively (Tables 5.1.2a and 5.1.2b). The calculated RQs for freshwater and marine/estuarine invertebrates, using the various crop scenerios are all 0.01 or less, which is less than the acute LOC of 0.05 for a threatened or endangered species' prey.

Table 5.1.2a. Freshwater Invertebrate Acute Ecotoxicity And RQ Values For Metolachlor

Species	Ecotoxicity Value (ppb)	Site Location/App. Rate (lbs/acre)/#	Peak EEC Value (ppb)	Acute Risk Quotient[1]	Levels Of Concern Exceeded[2]
Midge (*Chironomus plumosus*)	EC_{50}= 3800	CA/corn/2.0/2	10.29	<<0.01	No
Midge (*Chironomus plumosus*)	EC_{50}= 3800	CA/cotton/1.33/1	3.72	<<0.01	No
Midge (*Chironomus plumosus*)	EC_{50}= 3800	CA/vegetable/2.0/1	19.90	<0.01	No
Midge (*Chironomus plumosus*)	EC_{50}= 3800	ID/potato/2.67/1	13.27	<0.01	No
Midge (*Chironomus plumosus*)	EC_{50}= 3800	OR/pea/2.0/1	12.66	<0.01	No
Midge (*Chironomus plumosus*)	EC_{50}= 3800	OR/corn/2.0/2	19.30	<0.01	No

1. Acute Risk Quotients are calculated using the following formula: EEC/EC_{50}
2. Acute LOC for threatened or endangered species' prey = 0.05

Table 5.1.2b . Estuarine/marine Invertebrate Acute Ecotoxicity And RQ Values For Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**Peak EEC Value (ppb)**	**Acute Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Eastern Oyster[3] (*crassostrea virginica*)	EC_{50} = 1600	CA/corn/2.0/2	10.29	<<0.01	No
Eastern Oyster (*crassostrea virginica*)	EC_{50} = 1600	CA/cotton/1.33/1	3.72	<<0.01	No
Eastern Oyster (*crassostrea virginica*)	EC_{50} = 1600	CA/vegetable/2.0/1	19.90	0.01	No
Eastern Oyster (*crassostrea virginica*)	EC_{50} = 1600	ID/potato/2.67/1	13.27	<<0.01	No
Eastern Oyster (*crassostrea virginica*)	EC_{50} = 1600	OR/pea/2.0/1	12.66	<<0.01	No
Eastern Oyster (*crassostrea virginica*)	EC_{50} = 1600	OR/corn/2.0/2	19.30	0.01	No

1. Acute Risk Quotients are calculated using the following formula: EEC/EC_{50}
2. Acute LOC for threatened or endangered species' prey = 0.05
3. The Eastern Oyster was selected as a conservative endpoint because it is the most sensitive estuarine/marine invertebrate species. A study is available on shrimp (*Americamysis bahia* formerly *Mysidopsis bahia)* in which the ecotoxicity value is 4900 ppb. The ecotoxicity value of 1600 ppb for the oyster is more protective.

Only one chronic study on freshwater invertebrates is available for assessment of risk from metolachlor: a full life cycle toxicity study conducted with *Daphnia magna* (MRID 43802601). The study had been classified as Supplemental because measured concentrations were highly variable at all treatment levels throughout the study. It was determined that using the lowest measured concentration for each treatment level provides a conservative estimate of toxicity that may be used for assessment of risk. Using the NOAEC of 3.2 ppm or 3200 ppb and the 21-day EEC value for each crop scenerio, the calculated RQs were all less than 0.01 and were less than the LOC of 1 for chronic risk to a threatened or endangered species' prey (Table 5.1.2c).

The chronic RQs for marine/estuarine invertebrates were estimated using the NOAEC of 130 ppb from a study conducted with s-metolachlor on mysid shrimp (*Americamysis bahia* formerly *Mysidopsis bahia*; MRID 44995902). The RQs are all 0.1 or less, which is ten times less than the chronic LOC of 1 for chronic risk to marine/estuarine invertebrates (Table 5.1.2d).

Table 5.1.2c . Freshwater Invertebrate Chronic Ecotoxicity And RQ Values For Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**21-Day EEC Value (ppb)**	**Chronic Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Daphnid (*Daphnia magna*)	NOAEC=3200	CA/corn/2.0/2	7.43	<<0.01	No
Daphnid (*Daphnia magna*)	NOAEC=3200	CA/cotton/1.33/1	2.08	<<0.01	No
Daphnid (*Daphnia magna*)	NOAEC=3200	CA/vegetable/2.0/1	11.54	<<0.01	No
Daphnid (*Daphnia magna*)	NOAEC=3200	ID/potato/2.67/1	6.63	<<0.01	No
Daphnid (*Daphnia magna*)	NOAEC=3200	OR/pea/2.0/1	8.73	<<0.01	No
Daphnid (*Daphnia magna*)	NOAEC=3200	OR/corn/2.0/2	12.51	<<0.01	No

[1] Chronic Risk Quotients are calculated using the following formula: EEC/NOAEC
[2] Chronic LOC for threatened or endangered species' prey = 1

Table 5.1.2d . Estuarine/Marine Invertebrate Chronic Ecotoxicity And RQ Values For Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**21-Day EEC Value (ppb)**	**Chronic Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Mysid shrimp (*Americamysis bahia)*	NOAEC= 130	CA/corn/2.0/2	7.43	0.06	No
Mysid shrimp (*Americamysis bahia)*	NOAEC= 130	CA/cotton/1.33/1	2.08	0.02	No
Mysid shrimp (*Americamysis bahia)*	NOAEC= 130	CA/vegetable/2.0/1	11.54	0.09	No
Mysid shrimp (*Americamysis bahia)*	NOAEC= 130	ID/potato/2.67/1	6.63	0.05	No
Mysid shrimp (*Americamysis bahia)*	NOAEC= 130	OR/pea/2.0/1	8.73	0.06	No
Mysid shrimp (*Americamysis bahia)*	NOAEC= 130	OR/corn/2.0/2	12.51	0.10	No

[1.] Chronic Risk Quotients are calculated using the following formula: EEC/NOAEC
[2] Chronic LOC for threatened or endangered species prey = 1

Degradates

Ethane Sulfonic Acid Derivative (ESA or CGA 354743)

In an acute study conducted with *Daphnia magna,* no toxicity was observed up to the highest concentration tested (109 ppm, (MRID 44931703)). Although the RQs have been estimated in Table 5.1.2e, the actual RQs will be considerably less than the values provided in the table. All the estimated RQs are less than 0.01 and at least two orders of magnitude below the acute LOC for a threatened or endangered species' prey.

Table 5.1.2e. Freshwater Invertebrate Acute Ecotoxicity And RQ Values For ESA					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**Peak EEC Value (ppb)**	**Acute Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Daphnid (*Daphna magna*)	EC_{50}= 109000	CA/corn/2.0/2	10.29	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 109000	CA/cotton/1.33/1	3.72	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 109000	CA/vegetable/2.0/1	19.90	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 109000	ID/potato/2.67/1	13.27	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 109000	OR/pea/2.0/1	12.66	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 109000	OR/corn/2.0/2	19.30	<<0.01	No

1. Acute Risk Quotients are calculated using the following formula: EEC/EC_{50}

2. Acute LOC for threatened or endangered species prey = 0.05.

Oxanilic Acid Derivative (OA or CGA 51202)

In an acute toxicity study conducted with OA, the 48-hour EC_{50} in daphnia was 15.4 ppm (15400 ppb) with a lower confidence interval of 14200 ppb. Estimation of the acute RQs for aquatic invertebrates, using the various crop scenerios are all less than 0.01 and thus less than the acute LOC for a threatened or endangered species' prey (0.05). Table 5.1.2f summarizes the RQ values for OA with aquatic invertebrates.

Table 5.1.2f. Freshwater Invertebrate Acute Ecotoxicity And RQ Values For OA

Species	Ecotoxicity Value (ppb)	Site Location/App. Rate (lbs/acre)/#	Peak EEC Value (ppb)	Acute Risk Quotient[1]	Levels Of Concern Exceeded[2]
Daphnid (*Daphna magna*)	EC_{50}= 15400	CA/corn/2.0/2	10.29	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 15400	CA/cotton/1.33/1	3.72	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 15400	CA/vegetable/2.0/1	19.90	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 15400	ID/potato/2.67/1	13.27	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 15400	OR/pea/2.0/1	12.66	<<0.01	No
Daphnid (*Daphna magna*)	EC_{50}= 15400	OR/corn/2.0/2	19.30	<<0.01	No

1. Acute Risk Quotients are calculated using the following formula: EEC/EC_{50}
2. Acute LOC for threatened or endangered species' prey = 0.05.

5.1.3 Terrestrial Invertebrates

EFED currently has no established methodology for evaluating the potential exposure of terrestrial insects to pesticides. A qualitative assessment of risks to terrestrial insects is described in the Risk Description section of this document (see section 5.2.2a).

5.1.4 Aquatic Plants

With the exception of the California cotton uses, all metolachlor uses result in screening-level risk quotients that exceed the acute level of concern for algae. None of the metolachlor uses result in screening-level risk quotients that exceed the acute level of concern for vascular plants.
The screening-level risk estimate considers potential exposure of aquatic plants to metolachlor via the routes of transport likely to result in the highest exposures: spray drift deposition and runoff from treated fields. Risk quotients are calculated for both vascular plants and algae, using the most conservative estimates of EC_{50} (acute risk), which were from the registrant-submitted data set for metolachlor.

For the degradates ESA and OA, no metolachlor uses result in risk quotients exceeding the acute level of concern for aquatic plants.

a. Metolachlor Risk Quotients

Tables 5.1.4a-c summarize the RQs estimated for freshwater plants (vascular and algae) and marine/estuarine plants (vascular). For all uses except the California cotton uses, acute LOCs for endangered species are exceeded for algae. The RQs exceeding the LOC range from 1.03 to 1.99. Freshwater and marine/estuarine plant RQs do not exceed the LOC for any of the metolachlor uses.

Table 5.1.4a. Freshwater Plant (Alga) Acute RQ Values for Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**Peak EEC Value (ppb)**	**Acute Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Selenastrum capricomutum (green alga)	EC_{50}= 10	CA/corn/2.0/2	10.29	1.03	Yes
Selenastrum capricomutum (green alga)	EC_{50}= 10	CA/cotton/1.33/1	3.72	0.37	No
Selenastrum capricomutum (green alga)	EC_{50}= 10	CA/vegetable/2.0/1	19.90	1.99	Yes
Selenastrum capricomutum (green alga)	EC_{50}= 10	ID/potato/2.67/1	13.27	1.33	Yes
Selenastrum capricomutum (green alga)	EC_{50}= 10	OR/pea/2.0/1	12.66	1.27	Yes
Selenastrum capricomutum (green alga)	EC_{50}= 10	OR/corn/2.0/2	19.30	1.93	Yes

1. Acute Risk Quotients are calculated using the following formula: EEC/EC_{50}
2. Acute LOC for endangered aquatic plants = 1

The lowest available EC_{50} resulting from acute metolachlor exposure to alga was used to calculate RQs for acute metolachlor exposure: 0.01 ppm (10 ppb) for green alga (Table 5.1.4a).

Table 5.1.4b. Freshwater Plant (Vascular) Acute RQ Values for Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**Peak EEC Value (ppb)**	**Acute Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Lemna gibba (duckweed)	EC_{50}= 48	CA/corn/2.0/2	10.29	0.21	No
Lemna gibba (duckweed)	EC_{50}= 48	CA/cotton/1.33/1	3.72	0.08	No
Lemna gibba (duckweed)	EC_{50}= 48	CA/vegetable/2.0/1	19.90	0.42	No
Lemna gibba (duckweed)	EC_{50}= 48	ID/potato/2.67/1	13.27	0.28	No
Lemna gibba (duckweed)	EC_{50}= 48	OR/pea/2.0/1	12.66	0.26	No
Lemna gibba (duckweed)	EC_{50}= 48	OR/corn/2.0/2	19.30	0.40	No

1. Acute Risk Quotients are calculated using the following formula: EEC/EC_{50}
2. Acute LOC for endangered aquatic plants = 1

The lowest available EC_{50} resulting from acute metolachlor exposure to duckweed was used to calculate RQs for acute metolachlor exposure to aquatic vascular plants: 0.048 ppm (48 ppb) for duckweed (Table 5.1.4b).

Table 5.1.4c. Marine/Estuarine Plant (Vascular) Acute RQ Values for Metolachlor					
Species	**Ecotoxicity Value (ppb)**	**Site Location/App. Rate (lbs/acre)/#**	**Peak EEC Value (ppb)**	**Acute Risk Quotient[1]**	**Levels Of Concern Exceeded[2]**
Skeletonema costatum (marine diatom)	EC_{50}= 61	CA/corn/2.0/2	10.29	0.17	No
Skeletonema costatum (marine diatom)	EC_{50}= 61	CA/cotton/1.33/1	3.72	0.06	No
Skeletonema costatum (marine diatom)	EC_{50}= 61	CA/vegetable/2.0/1	19.90	0.33	No
Skeletonema costatum (marine diatom)	EC_{50}= 61	ID/potato/2.67/1	13.27	0.22	No
Skeletonema costatum (marine diatom)	EC_{50}= 61	OR/pea/2.0/1	12.66	0.21	No
Skeletonema costatum (marine diatom)	EC_{50}= 61	OR/corn/2.0/2	19.30	0.32	No

1. Acute Risk Quotients are calculated using the following formula: EEC/EC_{50}
2. Acute LOC for endangered aquatic plants = 1

The lowest available EC_{50} resulting from acute metolachlor exposure to a marine diatom was used to calculate RQs for acute metolachlor exposure to marine/estuarine plants: 0.061 ppm (61 ppb) for a marine diatom (Table 5.1.4c).

b. Degradate Risk Quotients

Ethane Sulfonic Acid Derivative (ESA or CGA 354743)

The lowest available EC_{50} resulting from acute ESA exposure to alga was >99.45 ppm (99450 ppb) from a study conducted with *Selenastrum capricomutum* (green alga). This value would result in RQs considerably less than 1 and would not exceed the LOC for any site by orders of magnitude.

The lowest available EC_{50} resulting from acute ESA exposure to aquatic vascular plants was 43 ppm (43000 ppb) from a study conducted with *Lemna gibba* (duckweed). This value would result in RQs considerably less than 1 and would not exceed the LOC for any site by orders of magnitude.

Oxanilic Acid Derivative (OA or CGA 51202)

The lowest available EC_{50} resulting from acute OA exposure to alga was 57.1 ppm (57100 ppb) from a study conducted with *Selenastrum capricomutum* (green alga). This value would result in RQs considerably less than 1 and would not exceed the LOC for any site by orders of magnitude.

The lowest available EC_{50} resulting from acute OA exposure to aquatic vascular plants was >95.4 ppm (>95400 ppb) from a study conducted with *Lemna gibba* (duckweed). This value would result in RQs considerably less than 1 and would not exceed the LOC for any site by orders of magnitude.

5.1.5 Non-target Terrestrial Plants

Because salmonids are not dependent upon specific plant species, the non-listed species risk level of concern is used to evaluate the potential for indirect effects to listed salmonids and effects to critical habitat. All metolachlor uses result in screening-level risk quotients that exceed the acute level of concern for non-listed terrestrial plants. The screening-level risk estimate considers potential exposure of plants to metolachlor via the routes of transport likely to result in the highest exposures: spray drift deposition and runoff from treated fields. Risk quotients are calculated for both monocots and dicots, using the most conservative estimates of EC_{25} (acute risk), which were from the registrant-submitted data set for metolachlor.

For the degradates ESA and OA, no metolachlor uses result in risk quotients exceeding the acute level of concern for terrestrial plants.

No obligate plant-salmonid relationship is known to exist, therefore endangered species RQs for plants have not been calculated (U.S. EPA 2004a).

a. Metolachlor Risk Quotients

Terrestrial plant exposure to metolachlor is discussed in section 4.3.3a and plant toxicity data are summarized in sections 4.1.4a and 4.1.4b. For registered uses of metolachlor, a ground unincorporated spray produces the highest concentration in nearby semi-aquatic areas, from both channelized runoff and spray drift. An aerial treatment produces the highest concentrations in adjacent vegetated areas, from sheet runoff and spray drift. The magnitude of the EECs generated for metolachlor by TerrPlant varies with application rate, so analyses for the corn and the pea scenarios, which have the same application rate, have been grouped.

Table 5.1.5a summarizes the highest RQs estimated for representative crops. For all uses, acute LOCs are exceeded for the terrestrial plants. RQs for monocots are higher than for dicots, and range from 23.3 (cotton, adjacent area, aerial application) to 68.1 (potato, semi-aquatic area, ground unincorporated application). For dicots, RQs range from 1.2 (cotton, adjacent area, aerial application) to 15.1 (potato, semi-aquatic area, ground unincorporated

application).

Table 5.1.5a Terrestrial Plant Acute RQ Values for Metolachlor (Runoff and Spray Drift)						
Use / App. Rate (lbs/acre) / # applications	**Total Loading to Semi-aquatic Areas (lbs/acre)**	**Acute RQ**	**Levels Of Concern Exceeded[1]**	**Total Loading to Adjacent Areas (lbs/acre)**	**Acute RQ**	**Levels Of Concern Exceeded[1]**
Monocot: Ryegrass (*Lolium perenne)* EC_{25}= 0.02 Seedling Emergence						
Corn/2.0/2 Pea/2.0/1	1.02	51.0	Yes	0.16	8.0	Yes
Cotton/1.33/1	0.68	33.9	Yes	0.11	5.3	Yes
Potato/2.67/1	1.36	68.1	Yes	0.21	10.7	Yes
Dicot: Lettuce *(Lactuca sativa)* EC_{25}= 0.09 Seedling Emergence						
Corn/2.0/2 Pea/2.0/1	1.02	11.3	Yes	0.16	1.8	Yes
Cotton/1.33/1	0.68	7.5	Yes	0.11	1.2	Yes
Potato/2.67/1	1.36	15.1	Yes	0.21	2.4	Yes

[1] The acute terrestrial plant level of concern is 1. Because salmonids do not have an obligate relationship to any particular plant species, the non-listed species level of concern for terrestrial plants is used to evaluate the potential for effects to salmonids and critical habitat.

b. Degradate Risk Quotients

Terrestrial plant exposure to metolachlor degradates, ESA and OA, is discussed in section 4.3.3b and toxicity data are summarized in section 4.1.4c. The degradates ESA and OA were only tested at one dose, 0.5 lbs/acre. The only tested plant species to show any effect was rye grass with exposure to the ESA in the seedling emergence study. The effect to rye grass was a 31% reduction in dry weight. Because an EC_{25} value was not available for the ESA the 31% effect level (EC_{31}) was used as a substitute in this instance. Table 5.1.5b presents risk quotients for the ESA.

Table 5.1.5b Metolachlor ESA: Screening-level Risk Quotients for Terrestrial Plants (Runoff)						
Use / App. Rate (lbs/acre)	**Total Loading to Semi-aquatic Areas (lbs/acre)**	**Acute RQ**	**Levels Of Concern Exceeded[1]**	**Total Loading to Adjacent Areas (lbs/acre)**	**Acute RQ**	**Levels Of Concern Exceeded[1]**
Ryegrass (*Lolium perenne)* 31% Effect Level = 0.5 lbs/acre Seedling Emergence						
Corn / (2.0 x 0.12) 0.24 Pea / (2.0 x 0.12) 0.24	0.120	0.24	No	0.012	0.02	No
Cotton / (1.33 x 0.12) 0.16	0.080	0.16	No	0.008	0.02	No
Potato / (2.67 x 0.12) 0.32	0.160	0.32	No	0.016	0.03	No

[1] The acute terrestrial plant level of concern is 1. Because salmonids do not have an obligate relationship to any particular plant species, the non-listed level of concern for terrestrial plants is used to evaluate the potential for effects to salmonids and critical habitat.

Using the EC_{31} all RQs for the ESA are below the acute level of concern for terrestrial plants. Because the EC_{25} would be lower than the EC_{31}, the calculated RQs would increase if the EC_{25} was available. However, the EC_{25} would need to be less than one third the EC_{31} in order to result in an RQ exceeding the level of concern.

For the OA degradate, no effects were noted to tested plant species at 0.5 lbs/acre. The EC_{25} would be higher than 0.5 lbs/acre. The highest predicted exposure for OA was 0.375 lbs/acre. Thus, the risk quotients for the OA would be <0.75, below the level of concern.

5.1.6 Reported Incidents

EPA maintains an incident database system (Ecological Incident Information System or EIIS) to track and evaluate accidental kills associated with pesticide use. The likelihood that a particular pesticide caused the incident is classified as "highly probable", "probable", "possible", or "unlikely", based on the information contained in the incident report. In the years since EPA has maintained the database, a total of 172 incidents associated with racemic metolachlor have been reported. The majority of these incidents (151, or 88%) are for plants, most of which were accidental damage to food crops. The database contains 18 reported aquatic incidents (11% of the total), all of which were fish kills. Six of the 18 incidents were classified as probable and one as highly probable.

The single incident classified as highly probable involved an accidental misuse of the product, killing 2 Northern pike and 5,000 mud minnows in Minnesota. Four of the reported incidents

classified as probable were associated with registered use[19]. One incident was simply reported as a fish kill, and did not include the numbers or species of fish affected. A second reported bluegill and bass as the species affected, but did not include the number of fish. The third incident was a kill of 200 bass and bream in South Carolina, and the fourth was a kill of 3000 largemouth bass and bluegill in Delaware. For one incident classified as probable, it was unknown as to whether the application was in accordance with the label directions. The actual species and number of fish affected was not reported.

No aquatic incidents have been reported for S-metolachlor. Twenty-eight incidents have been reported in total, all associated with accidental plant damage to food crops.

Reports contained in the database must be interpreted with two considerations in mind: 1) not all incidents are expected to be reported 2) in many instances it is difficult to establish a direct cause-effect relationship. Generally, the number and type of incidents associated with the use of a pesticide can be evaluated with the amount of pesticide usage as one approach to evaluate environmental risk. Considering the extensive use of metolachlor on crops during the time it has been registered (approximately 30 years), and the relatively few incident reports regarding fish, it appears likely that the product does not present high acute risks to fish in the environment. In addition, the fact that more incidents are reported on plants is consistent with screening-level risk conclusions on potential risks to plants.

5.2 Risk Description

5.2.1 Potential for Direct Effects to Listed Salmonids

a. Dose Mortality Slope

Based on the assumption of a probit dose-response relationship and the endangered species LOC of 0.05, the probability of an effect on an individual animal can be calculated. These estimations are presented in Table 5.2.1a for fish. Probabilities associated with the upper and lower bounds of the 95% confidence interval of the slope are also included.

[19] Application in accordance with label dictated application rates and timing.

5.2.1a Probability of an Individual Effect Based on Probit Slope										
Test Organism	Compound	LC_{50} (ppm)	Probit p-value	Fit	Slope	Prob.	Lower bound	Prob.	Upper bound	Prob.
Fish										
Bluegill*	S-metolachlor	3.2	1	Y	14.8	1 E-16	2.1	3 E-3	27.5	1 E-16
Sheepshead Minnow*	Racemic metolachlor	9.6	0	N	5.4	2 E-9	-3.2	N/A	13.9	1 E-16
Rainbow Trout[1]*	ESA degradate	48	N/A	N	4.5	2 E-9	N/A	N/A	N/A	N/A

Y=yes, N=no, U= unknown, N/A=not applicable
* denotes values used to derive RQs.
[1]No partial kills in study, does not fit probit assumptions, default slope of 4.5 assumed.

For metolachlor, the probability of an individual effect was calculated for a freshwater fish (bluegill), and an estuarine fish (sheepshead minnow). A probability was also calculated for the metolachlor degradate ESA (rainbow trout). A definitive LC_{50} was not established for the metolachlor degradate OA, thus no probability was calculated. The data from the bluegill study was the only one of the three data sets to fit a probit curve (p=1), this, in addition to the fact that it is the most sensitive endpoint for the fish, make it probably the best estimator for individual effects. Based on the slope (14.8), and the upper bound of the slope (27.5) the probability of an individual effects is estimated at 1×10^{-16}. For the lower bound of the slope (2.1), the probability of an individual effects is estimated at 3×10^{-3}. However, this data set has a wide 95% confidence interval around the slope. Also, it must be recognized that extrapolating the best fit line to the extremes of its range (*i.e.,* LC_{05} or LC_{95}) widens the confidence interval (Newman 1998). The estimate of individual effects contains significant uncertainty but suggests that the potential for any individual salmonid to be affected at a concentration corresponding to the LOC is low. Given that conservatively modeled concentrations were well below concentrations corresponding to the LOC, the probability of an individual being affected is considered to be extremely low.

b. Sublethal Effects

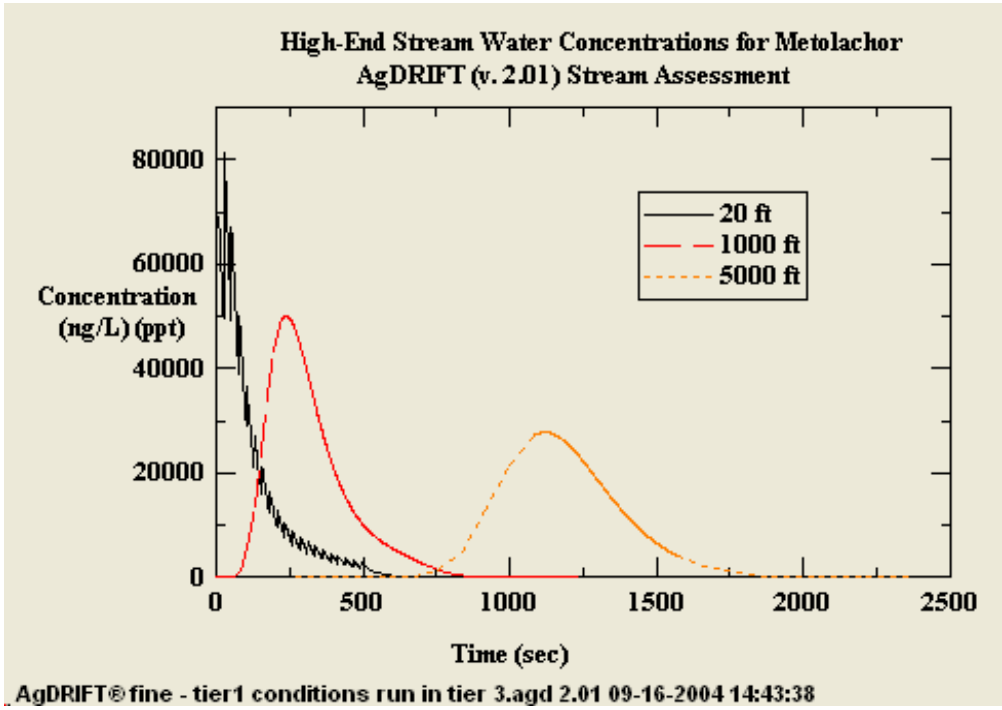
In most of the toxicity studies for fish, sublethal effects, including loss of equilibrium, hypersensitivity, and lethargy were observed in concentrations that later resulted in mortality. For several of the species tested, sublethal effects occurred in concentrations below the calculated LC_{50}. Sublethal effects were noted at 2.1 ppm for the common carp and channel catfish, 3.3 ppm for bluegill sunfish 5.3 ppm for the rainbow trout, and 6.5 ppm for the guppies. Onset of symptoms was 4-6 hours after addition of the metolachlor to the tank. In the wild, effects such as those noted in the tests could be manifested as reduced foraging efficiency, and/or lowered predator avoidance. Alternatively, fish may sense and avoid water containing metolachlor. Extrapolation of these laboratory-observed behaviors to the

assessment endpoints of reduced survival, growth and reproduction of individual fish in the wild is difficult. The methods used in this risk assessment (EPA 2004a) require endpoints used in forming risk conclusions to be clearly linked to survival, growth, or reproduction of the focal species. However, even if a link between the sublethal effects noted above and salmonid growth, survival, or reproduction was identified, no exposure scenario approached the concentration required to affect the most sensitive species (carp and channel catfish, 2.1 ppm) suggesting that no effect would be expected.

c. Potential for Acute Effects Resulting from Spray Drift to Small Streams

Concentrations resulting from spray drift into water are affected by the amount of spray drift as well as the dimensions and flow of the water body. The highest spray drift exposure to salmonids is expected to be to fish in narrow, shallow, slow moving streams directly downwind and adjacent to treatments. Using dimension and flow rates estimated for small streams that could potentially be inhabited by listed salmonids (see 2.6.2) and the stream assessment tool in AgDRIFT (version 2.01), high end stream concentrations and their durations were estimated. The water body used in this stream assessment reflects a highly vulnerable scenario for salmonids, in that, it is a relatively narrow, shallow, and slow moving water body for listed salmonids, and is assumed to be at the downwind edge of the application area with no obstructions between the water and the field. In addition the application scenario used (the 'fine spray/aerial' scenario described in 4.3.4) is expected to reflect a relatively high end spray drift event consistent with an aircraft spraying the highest application rate (2.67 lbs a.i./acre, potatoes) of metolachlor in a fine spray 10 ft above the ground in a 10 mph wind.

Figure 5.2.1. High-end concentrations estimated for a stream that has the potential to support salmonids adjacent to a metolachlor use site. Concentrations are shown for varying distances (20 to 5000 feet) downstream from a metolachlor application. The time, in seconds after the start of application, at which a particular concentration is expected for a given distance downstream is shown on the x-axis. Concentrations, shown on the y-axis, are shown in nanograms per liter (part per trillion). Inputs other than those for the water body were defaults except for the time required for the aircraft to turn around which was set for 20 seconds.



In addition to the conservative aspects of the water body and spray drift scenario, the predicted concentration are expected to be high because they do not account for binding to soil and suspended solids in the stream or dilution resulting from tributaries downstream from the application site.

The highest concentration predicted, 80 ppb, occurs near the application site. As the water moves downstream the pulse is expected to become less concentrated resulting in lower peak concentrations but longer lasting concentrations. The highest concentration predicted is well below the LC_{50} for the most sensitive tested fish (3.8 ppm). In flowing water bodies metolachlor exposure is expected to last for several minutes which is much shorter than the duration used in the LC_{50} study (96 hours). Thus, the potential acute risk resulting from spray drift exposure to salmonids appears to be low.

5.2.2 Potential for Indirect Effects

a. Food Chain Effects

Aquatic Invertebrates

Metolachlor exposure estimates were substantially below LOCs for aquatic invertebrates. Estimated exposure values for metolachlor degradate, OA, was also substantially below the LOC for aquatic invertebrates. Thus, no potential for indirect effects to salmonids through effects on aquatic invertebrates was identified.

Metolachlor exposure estimates are considered conservative in that they were based on model results representing the highest concentrations expected to occur in a ten year period of use at maximum application rates and values are approximately an order of magnitude higher than monitored metolachlor concentrations in the Pacific Northwest and elsewhere. Screening model estimates of metolachlor ESA and OA were also higher than any measured concentration. High-end estimated stream concentrations resulting from spray drift (Figure 5.2.1) are also well below acute toxicity endpoints measured for aquatic invertebrates.

The metolachlor toxicity endpoint for the most sensitive of three aquatic invertebrates was compared to the estimated exposure values. Because only three aquatic invertebrates were tested it is likely that more sensitive aquatic invertebrates exist. However, in order to be impacted at the LOC for the highest exposure scenario, an invertebrate would need to be approximately 50-times more sensitive to metolachlor than the surrogate used.

Toxicity to metolachlor OA was evaluated with one species (*Daphnia magna*), thus if more invertebrates were tested, some could be more sensitive. The toxicity of the OA to daphnids, however, was very low and another invertebrate would need to be more than 200-times more sensitive to the OA to exceed the LOC.

Toxicity to metolachlor ESA was evaluated with one species (*Daphnia magna*), thus if more invertebrates were tested, some could be more sensitive. The toxicity of the ESA to daphnids, however, was very low and another invertebrate would need to be more than 200-times more sensitive to the ESA to exceed the LOC.

Given the magnitude of the difference between concentrations associated with toxic effects to aquatic invertebrates and predicted high-end exposures, it is unlikely that many, if any, aquatic invertebrate species would be directly affected from metolachlor use.

Based on the assumption of a probit dose-response relationship and the endangered species LOC of 0.05, the probability of an effect on an individual organism can be calculated. These estimations are presented in Table 5.2.2a for aquatic invertebrates. Probabilities associated with the upper and lower bounds of the 95% confidence interval of the slope are also included.

5.2.2a Probability of an Individual Effect Based on Probit Slope										
Test Organism	Compound	LC_{50} (ppm)	Probit p-value	Fit	Slope	Prob.	Lower bound	Prob.	Upper bound	Prob.
Midge[1]*	Racemic metolachlor	3.8	ND	U	4.5	2 E-9	ND	ND	ND	ND
Oyster[2]*	Racemic metolachlor	1.6	N/A	N	5	4 E-11	ND	ND	ND	ND
Daphnia	Racemic metolachlor	25.7	0.18	N	5.3	3 E-12	2.8	1 E-4	7.8	1 E-16
Daphnia	S-metolachlor	26	0.97	Y	9.1	1 E-16	5.4	1 E-12	12.8	1 E-16
Daphnia*	OA degradate	15.4	0.68	Y	6.1	1 E-15	3.8	4 E-7	8.4	1 E-16
Mysid	Racemic metolachlor	5.0	0.82	Y	6.1	1 E-15	3.5	3 E-6	8.6	1 E-16

Y=yes, N=no, U= unknown, ND=no data, N/A=not applicable
* denotes values used to derive RQs.
[1] Midge study from Mayer and Ellersieck 1986, no probit slope given, fit unknown and default slope of 4.5 assumed.
[2] Oyster study measures continuous endpoint (shell deposition), slope derived from nonlinear regression in Nuthatch program. For this study, endpoint is EC_{50} rather than LC_{50}.

Two of the studies used to calculate RQs for the invertebrates (midge and oyster) do not fit the probit model, thus the validity of the estimate for individual effects (midge 2×10^{-9}, and oyster, 4×10^{-11}) is questionable. The oyster test is also based on a sublethal endpoint (shell depostion). Although the LC_{50}s are significantly higher, the daphnid (S-metolachlor) and mysid (racemic metolachlor) tests are likely a better estimator for individual effects. For the daphnid, based on a slope of 9.1 (95% CI 5.4-12.8), the probability of individual effects is 1×10^{-16} (95% CI, 2×10^{-12} to 1×10^{-16}). For the mysid, based on a slope of 6.1 (95% CI 3.5-8.6), the probability of individual effects is 1×10^{-15} (95% CI, 3×10^{-6} to 1×10^{-16}). As with the fish, it must be noted that extrapolating the best fit line widens the confidence interval.

Terrestrial Insects

Available information suggests that most terrestrial insects will not be adversely affected by metolachlor use. Using two different methods for estimating insect exposure and registrant-submitted toxicity data for honeybees, it was not possible to rule out potential effects to insects with large surface area to volume ratios (*e.g.* butterflies) present during application. No mortality was observed in the insect toxicity studies, but dosing levels were not as high as estimated exposure to butterflies present with wings open during application, thus effects at higher levels could not be ruled out. Smaller insects are not expected to be impacted in the treatment area.

This risk characterization is based on limited toxicity data (bee toxicity) and a simple direct exposure method which is not expected to be representative of all terrestrial insects. There is no accepted methodology for evaluating the potential exposure of terrestrial insects to pesticides. Refined risk estimates for terrestrial insects would be complicated by the complex and varied life histories of these types of organisms, and a lack of data on exposure pathways. A description of the qualitative risk assessment for terrestrial insects follows below.

The Kenaga nomogram (Fletcher 1994) can be used to estimate residue concentrations on seeds and pods as a surrogate for terrestrial insects. The nomogram estimates residue levels of a pesticide on various types of plants based on a data set of field measurements. As a screening-level estimate, the highest application rate (ID potatoes, 2.67 lb a.i./acre) was used. Estimated residue for pod containing seeds at this application rates is 30 μg a.i./g insect.

An alternate approach to estimating insect exposure to metolachlor is assuming an insect presents a particular surface area toward the depositing spray and has a fixed mass. Dimensions for representative terrestrial insects include 55 cm^2 of surface area and a mass of 0.5 g, consistent with the size and weight of a monarch butterfly with wings spread, or 1 cm^2 and a mass of 0.08 g, consistent with the size and weight of a honey bee. The resulting exposure to insects with these dimensions receiving a direct application of 2.67 lbs a.i./acre (29.7 μg metolachlor/cm^2) would be 3300 μg/g for the butterfly and 371 μg/g for the honey bee.

The available terrestrial insect toxicity data, based on tests with honey bees, suggests that metolachlor poses very low toxicity to insects, with an NOAEL of 110 μg/bee for racemic metolachlor. Using a typical honey bee weight of 0.08 g, this equates to a dose of 1375 μg/g, causing no effects in bees. However, this NOAEL represents the highest dose tested, so while no adverse effects occurred at this dose, it is unknown at what dose effects may actually begin to occur.

Based on estimated exposure from the Kenaga nomogram, the dose is 30 μg a.i./g insect, which does not exceed the NOAEL for honeybees. For insects with a smaller surface area (*i.e.* the honey bee estimate) exposure to direct treatment results in a dose that does not exceed the established NOAEL However, for some insects with greater surface area (*e.g.*, the monarch butterfly) the dose exceeds the established NOAEL. Thus, the potential for risk to some terrestrial insects cannot be excluded in the direct treatment area, but the magnitude or nature of the effects, if any, cannot be accurately assessed given the available data. Overall there is insufficient evidence to suggest that impacts on terrestrial invertebrates may be significant relative to listed salmonids.

Aquatic Plants

LOCs for algae are exceeded by scenarios modeled with PRZM/EXAMS, thus the screening assessment identifies a potential for indirect effects to listed salmonids through aquatic plants. Algae are an important component in many aquatic systems, serving as the base of the food

chain. Significantly reduced primary productivity could affect salmon populations at multiple life stages by reducing the amount of food available in the affected water body. Also, given that the blue-green algae tested (in both registrant-submitted and open literature studies) were significantly less sensitive to the effects of metolachlor than most of the green algae and diatoms tested, the possibility of a shift in phytoplankton or periphyton community structure exists. Herbicides have been documented to affect the species composition of algae in test systems (Hoagland *et al.* 1996). The level of this impact is difficult to gauge, but blue-green algae are considered to be low-quality food source for some plankton feeders (Allen 1995). In extreme cases blue-green algae have also been associated with toxic algae blooms. Vascular aquatic plants are generally more important in aquatic ecosystems as a structural component rather than a food source. Because of the multitude of site-specific factors that influence food chain dynamics, the potential effect is difficult to quantify for the range of conditions within the scope of this risk assessment.

Site specific factors will also influence the potential effects of metolachlor on algae in the water body. In the PRZM/EXAMS scenarios modeled, all but one scenario exceeded the most sensitive algal endpoint, but the level of exceedence was between 1 and 2 times the EC_{50} and the frequency of occurrence was low

Thus, reducing the metolachlor loading into the water body by 50% would decrease the concentration to below the established LOC. Studies evaluating the effect of vegetated buffer strips on metolachlor-laden runoff show that vegetated buffer strips as narrow as 1.5 m can retain from 16% to 100% of metolachlor (Arora *et al.* 1996). A number of studies report similar results (Sadeghi and Isensee 2000, Misra *et al.* 1996, Tingle *et al.* 1998, Mersie *et al.* 1999). However, any channelized runoff that bypassed the buffer would contain higher, unfiltered metolachlor concentrations. It should also be noted that the concentrations used to develop the RQs are based on the 1-in-10 year peak, a relatively rare runoff event. No direct information on the ability of algae to recover from a pulse exposure to metolachlor was available but given the rapid growth rates of algae, algae are expected to rapidly recover from pulsed exposures. Although, modeling identified longer duration exposures exceeding the algal EC_{50} these scenarios (small static waterbody) are not considered to be representative of salmonid habitat. In two scenarios (CA coastal vegetable, OR corn), the 21-day average concentration in the small static water body exceeds the EC_{50}. The 21-day average, and 60 day average concentrations estimated based on all scenarios all exceeded the algal NOAEC by factors of 1.4 to 28.4. Chronic exposure of this magnitude would likely be more important than pulse exposure but given that salmonid habitat is generally compromised of small streams, rivers, large lakes, estuaries and the ocean, chronic exposures like those estimated for the small, static water body are not expected to occur. Estimations of metolachlor concentrations based on spray drift and a representative flowing water body (Section 5.2.1) show concentrations above the algal EC_{50} and NOAEC to be brief (4-17 minutes and 8-17 minutes, respectively).

Metolachlor's effects on aquatic plants is insignificant and discountable. Thus, metolachlor is not likely to adversely affect listed salmonids. The conservative exposure modeling used shows that exposures that could affect aquatic plants occur infrequently, the exposures would

be of short duration, and the plants with the greatest potential to be affected are algae which are expected to recover rapidly.

b. Aquatic Plants as Shelter

Aquatic vascular plants are important sources of shelter for small fish and invertebrates (Cole 1994). Littoral grassbeds are often some of the most productive and diverse areas in lakes and estuaries (Cole 1994, Nybakken 1997). Tidal marshes provide important nursery habitat for salmonids, especially chinook and chum (Groot and Margolis 1991). Reduction in the quantity or density of aquatic vascular plants would be most likely to affect survival of the juvenile salmonids. As with changes in primary productivity, the effects are site-specific and the potential impact on salmonid populations is difficult to predict.

Using the registrant-submitted metolachlor toxicity data for duckweed (EC_{50} = 48 ppb), no application scenarios exceed the LOC for aquatic vascular plants (Table 5.1.4b), thus no effects are expected for vascular aquatic plants. Open literature data on metolachlor's toxicity to aquatic vascular plants (Section 4.1.3b) suggest that the toxicity endpoint used to determine the risk quotient is conservative. EC_{50} levels are identified for 5 of the 6 test species in the open literature for endpoints of biomass or abundance. All the EC_{50} values are higher, less sensitive, than the values derived from registrant-submitted data used to calculate risk quotients. The NOAEL (10 ppb) is identified for one species, *Scirpus olneyi*, which is an emergent, grassy, wetland plant. A comparison of the *S. olneyi* NOAEL to PRZM/EXAMS concentration estimates suggests that effects could occur since peak concentrations can be as much as twice the NOAEL. However, the potential for effect is unlikely after considering that the NOAEL is based on 384 hours of exposure and the PRZM/EXAMS values that exceed the NOAEL are peak concentrations for small, static water bodies which would not be expected to persist more than a few hours in salmonid habitat (section 4.3.2h). Thus, although the no observable adverse effect concentrations for some aquatic plant species may be exceeded, the exceedances are expected to be infrequent and of too short a duration to elicit a measurable effect. Thus, available data suggest that metolachlor is not likely to adversely affect listed salmonids through harming aquatic vegetation used for shelter because its effects are insignificant and discountable.

c. Terrestrial Plants - Riparian Health

Health of the riparian vegetation plays an important part in preservation of salmon habitat (Table 2.6). The screening-level assessment for metolachlor suggests uses have the potential to affect terrestrial plants because RQs exceeded the terrestrial plant LOC of 1. RQs ranged from 1.2 to 10.7 depending on the scenario, application rate of the use evaluated, and whether dicot or monocot toxicity endpoints were used. The lower toxicity and lower expected exposures of non-target terrestrial vegetation to the degradates results in RQs substantially below the LOC.

It is difficult to estimate the magnitude of potential impacts on stream water quality as a result of harming riparian vegetation because riparian areas are highly variable. The riparian

vegetation's level of exposure and the resulting magnitude of effect on vegetation are expected to be highly variable and dependent on many factors. The extent of runoff and/or drift into stream corridor areas is affected by the distance the field is offset from the stream, local geography, weather conditions, and quality of the riparian buffer itself. The sensitivity of the riparian vegetation is likely to be dependent on the susceptibility of the species present to metolachlor and composition of the riparian zone (e.g. vegetation density, species richness, height of vegetation, width of riparian area).

The following subsections discuss the possibility and probability of metolachlor significantly affecting salmonid water quality through effects to riparian zone vegetation. Included is a discussion of instances where the riparian zone consists of row crops agriculture. A closer evaluation of spray drift and runoff risks to terrestrial plants in more typical riparian zones is included to better understand the conditions that could result in adverse effects to riparian vegetation and the types of riparian areas most vulnerable to metolachlor exposure.

Cropped Riparian Zones

Cropping up to the edge of surface water bodies is expected to result in the greatest levels of sediment reaching the water because riparian vegetation reduces the amount of sediment reaching the water. However, the use of metolachlor on fields draining into salmonid occupied waters is not expected to significantly affect erosion from fields and subsequent sediment loading into the waters. Available information suggests that the amount of erosion from agricultural fields, and subsequent sediment loadings, is not related to metolachlor use but rather to soil conservation practices used, or not used. Although some studies have correlated herbicide use with increased sediment loading to salmonid bearing streams, the effect is generally correlated with other land management practices other than the herbicide use (*e.g.* Lopes *et al.* 2001). In row crop agricultural land and soil management practices have been identified as having a large effect on erosion (Green *et al.* 2003, Tebrügge and Düring 1999). Herbicide use, including metolachlor, is commonly an integral part of management practices that result in the lowest erosion levels of row crop agriculture. The practices identified as erosion reducing, some of which employ herbicide use, are consistent with recent U.S. government policies encouraging soil conservation (Uri and Lewis 1998).

In preparing soil for crops, seeding, and controlling pests a number of different practices may be employed that have a large effect on erosion levels and, presumably on subsequent sediment loading to receiving water bodies. Those practices that disturb the soil to a greater extent are correlated with increased erosion and conversely management practices that do not disturb the soil result in lowered erosion levels. The method of tilling employed is strongly correlated with erosion levels (Shiptalo and Edwards 1998). No-till and chisel plow result in relatively low disruption of the soil structure and are associated with significantly reduced erosion levels. These two methods of tillage are commonly referred to as conservation tillage methods for their ability to preserve topsoil. Combining conservation tillage methods with the use of "cover crops" or not removing crop residue after harvest to reduce the surface area of soil directly exposed the impact of rain drops has been shown by numerous researchers to be a good means of conserving soil, significantly reducing erosion under a wide range of

conditions (*e.g.* Williams *et al.* 2000, Jacinthe *et al.* 2004). An integral part of many soil conservation plans includes the use of herbicides (Mickelson *et al.* 2001, Kelly *et al.* 1996). Some soil conservation scenarios require greater use of herbicides relative to conventional tillage to control weeds that would be managed as a result of plowing (Kelly *et al.* 1996). Metolachlor may be used in soil conservation methods reducing erosion or in more traditional farming methods. Thus, metolachlor use may be associated with relatively high or low sediment loadings resulting from upland agricultural erosion.

Spray Drift to Riparian Vegetation

In order to better understand metolachlor risk to terrestrial plants a range of high-end spray drift exposure estimates (section 4.3.4) was compared to metolachlor's toxicity to terrestrial plants (section 4.1.4). By combining model results for spray drift deposition with distance to dose response relationships for plants it is possible to estimate potential effect levels for a range of distances. The potential effect level versus distance, predicted for all terrestrial plants for which toxicity slopes were available, are presented in the figures below.

Figure 5.2.2a. Estimated high-end spray drift effects. Predicted effect levels to **emerging seedlings** and associated downwind distances from **aerial applications using a Fine spray** (American Society of Agricultural Engineers Standard 572 definition). Effect levels shown are for either plant height or plant weight. Distance is truncated at 1000 ft.

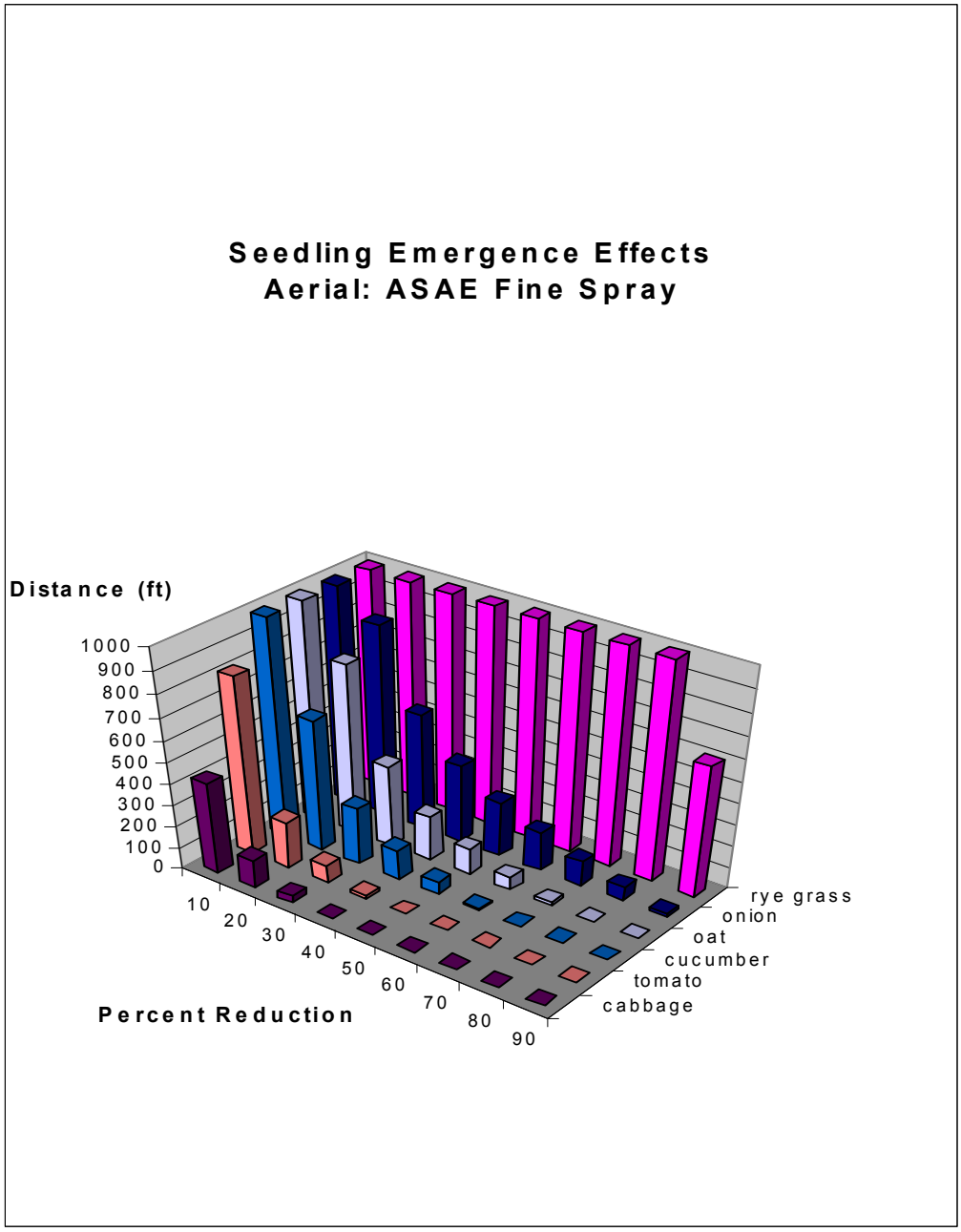


Figure 5.2.2b. Estimated high-end spray drift effects. Predicted effect levels to **emerging seedlings** and associated downwind distances from **aerial applications using a Coarse spray** (American Society of Agricultural Engineers Standard 572 definition). Effect levels shown are for either plant height or plant weight.

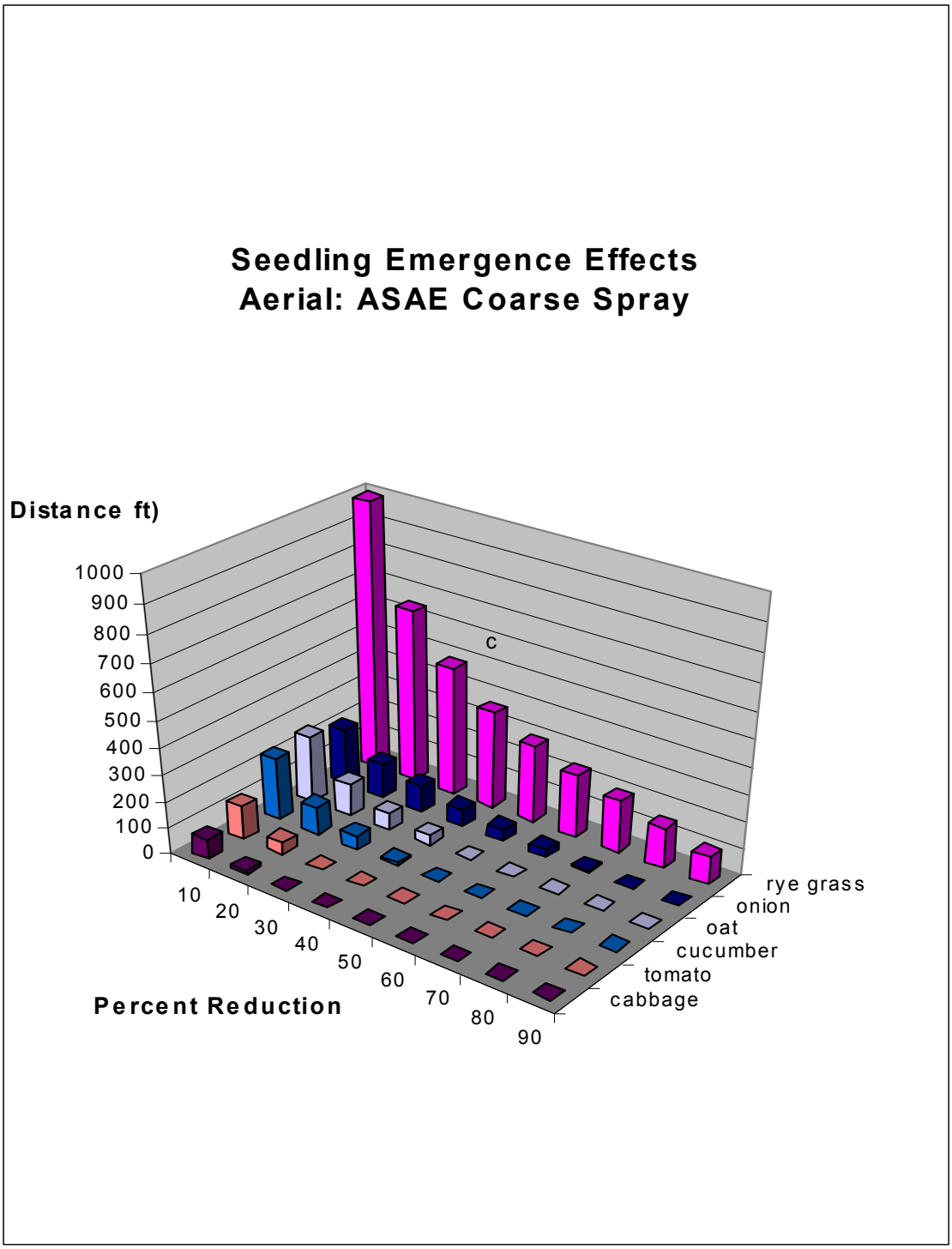


Figure 5.2.2c. Estimated high-end spray drift effects. Predicted effect levels to **emerging seedlings** and associated downwind distances from **ground boom applications using a 4 ft release height and Medium spray** (American Society of Agricultural Engineers Standard 572 definition). Effect levels shown are for either plant height or plant weight.

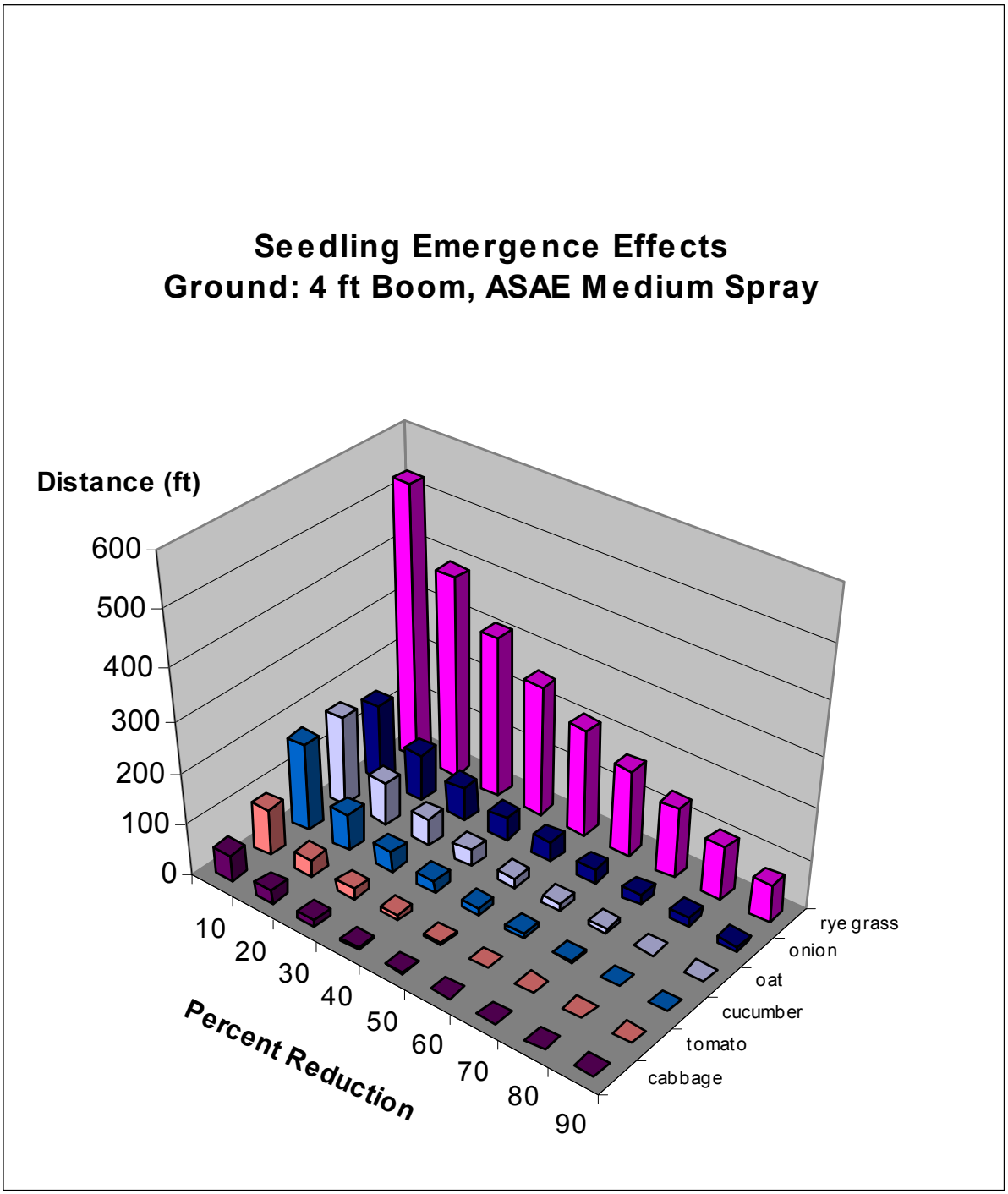
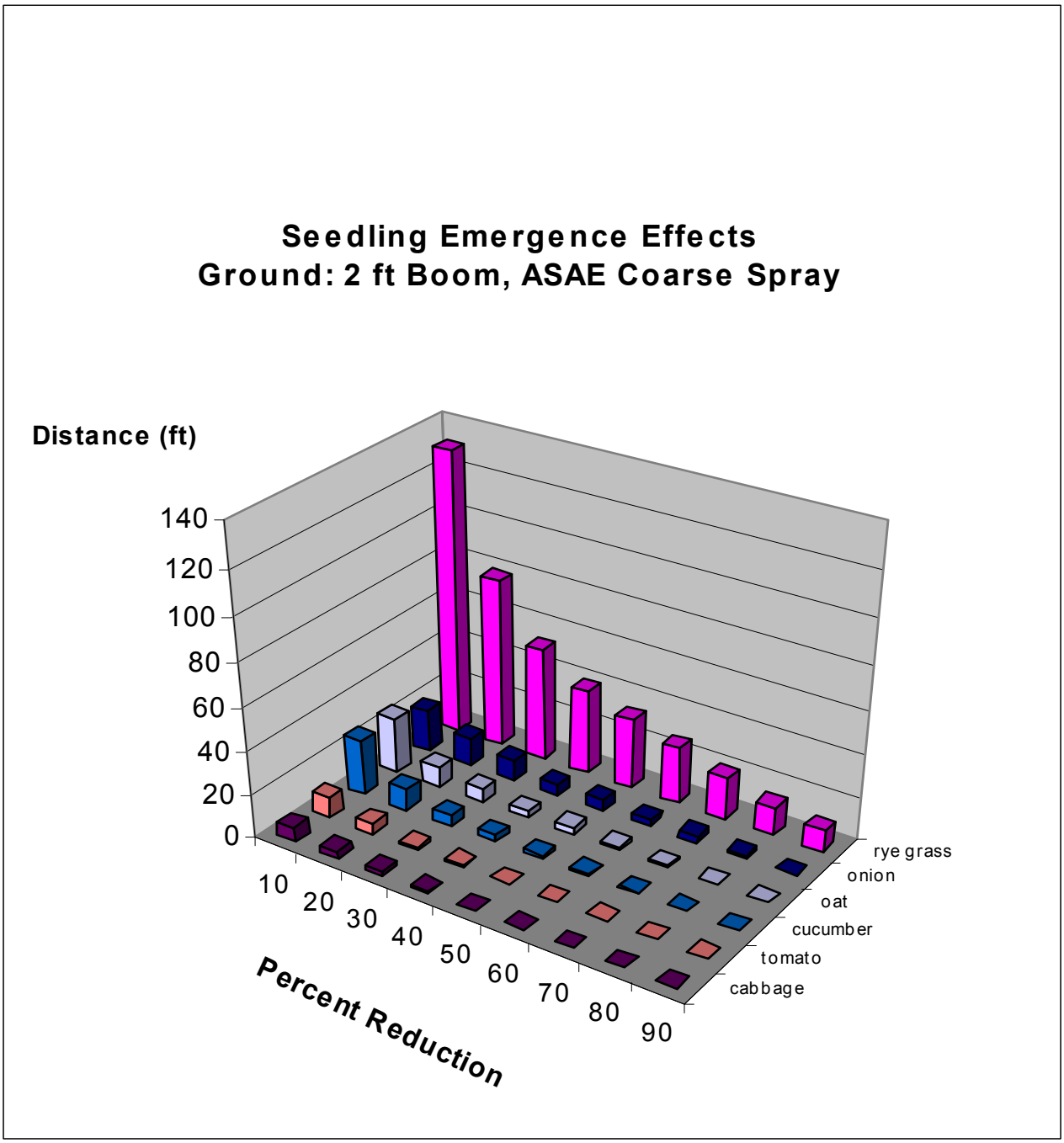


Figure 5.2.2d. Estimated high-end spray drift effects. Predicted effect levels to **emerging seedlings** and associated downwind distances from **ground boom applications using a 2 ft release height and Coarse spray** (American Society of Agricultural Engineers Standard 572 definition). Effect levels shown are for either plant height or plant weight.



The Figures show the downwind distances where spray drift exposure under relatively high drift conditions would be expected to result in 10% to 90% reduction in plant height or weight. A 70% effect level is generally used in efficacy testing on weeds as a measure of acceptable control where weeds are unlikely to recover (Pallet 2003). Thus, plants impacted at the 70% effect level are considered to be killed from herbicide exposure. Figures 5.2.2a-d suggest that under the exposure conditions modeled more sensitive plants (*e.g.* rye grass) could be slightly affected (10% effect level) as far as 530 ft from ground boom applications and beyond 1000 ft from aerial applications. Severe impacts (70% or higher effect level) are only expected at distances less than 140 ft from ground boom applications and at distances of 1000 ft or more downwind from aerial applications. For more typical application conditions (lower drift), less sensitive plants, and lower application rates, effects would be limited to smaller distances.

Registrant-submitted plant toxicity data and data from the open literature suggest grasses, and rye grass in particular, are highly sensitive to metolachlor. In addition, metolachlor is considered to be more toxic to young plants or seedlings; established plants are expected to be less sensitive to metolachlor's effects. A review of wind speed data for representative agricultural areas in the states where listed salmonids are found suggests that the conditions used in spray drift modeling are relatively high end. The median wind speed for all sites examined in the areas where listed salmonids are found were below 10 mph and for most sites the upper 75th percentile was also below 10 mph. The use of the highest application rate, 2.67 lbs a.i./acre for potatoes, also contributes to the conservatism of the assessment. Thus the spray drift risk estimates using rye grass toxicity endpoints appear to represent some of the highest plant risks expected to occur near salmonid habitat.

Curves showing spray drift deposition levels versus distance can be used to estimate the distance at which the most sensitive test plant (rye grass) is expected to experience 25% reduction in plant height or weight. This distance is useful because the 25% effect level of the most sensitive test plant is used to define the terrestrial plant LOC, which in turn is used to determine "no effect" levels for indirect effects. Thus, at a distances where deposition is below the 25% effect level to terrestrial plants, there will be no indirect effects to listed salmonids through harming terrestrial vegetation. High-end distances at which the 25% reduction in weight or height may occur are presented in Table 5.2.2 below.

Table 5.2.2. Downwind distance necessary to reduce spray drift deposition to 25% effect level for rye grass seedling emergence under relatively high drift application conditions.

Application Method	Application Parameters	Downwind Distance to Reach Rye Grass Effect Level (ft)	
		25% reductions	70% reductions
Aerial	Coarse Spray	499	190
Aerial	Fine Spray	3514	1867
Ground Boom	2 ft boom, Coarse Spray	56	16
Ground Boom	4 ft boom, Medium Spray	322	135

Comparing the spray drift risk estimates with the criteria used by Fleming *et al.* (2001) to evaluate riparian zones can provide a means of grading the potential indirect effects of metolachlor to listed salmonids. The parameters used to assess riparian quality that are potentially sensitive to metolachlor are buffer width, vegetation diversity, vegetation cover, structural diversity, and canopy shading (Table 2.6.2b). Buffer width, vegetation cover, and/or canopy shading could be reduced if metolachlor exposure killed plants in the riparian zone. Plant species diversity and structural diversity could be affected if more sensitive plants were impacted (Jobin *et al.* 1997, Kleijn and Snoeijing 1997). Thus, if metolachlor exposure impacted these riparian parameters, salmonid water quality could be affected. Because woody plants are not sensitive to metolachlor levels expected in the environment, effects on shading and structural diversity (height classes) are not expected. The potential for effects is limited to herbaceous (non-woody) plants which are not generally associated with shading or considered to represent vegetation of higher height classes. The most sensitive riparian quality criteria are expected to be plant diversity, vegetation cover, and buffer width because the more sensitive plants (*e.g.* certain young plants and grasses) could be important in maintaining these parameters. A reduction in the quality in any of these parameters may have the potential to reduce water quality and thus adversely affect listed salmonids. The conditions under which the most sensitive riparian health criteria may be affected are discussed below.

Riparian zones can vary greatly in aspects of their size and composition which in turn can affect their ability to maintain adequate water quality for fish. The size and composition of riparian zones are also expected to affect their sensitivity to spray drift from metolachlor applications. Because metolachlor is selective, being more toxic to young plants and grasses, riparian zones that are comprised of many plants species and are wide enough to dissipate edge-of-field spray drift levels are expected to be more tolerant of metolachlor spray drift. Diverse vegetation decreases the likelihood that a significant proportion of the vegetation will be adversely affected and wider riparian zones are more likely to dissipate spray drift levels. In general, riparian zones with size and composition that provide ‘good’ or ‘excellent’ habitat quality (using criteria defined in Fleming *et al.* 2001) are expected to be more resistant to the

impacts from metolachlor drift. Riparian zone widths of greater than 12 m with plant populations consisting of 15 or more species are characteristics associated with good or excellent riparian habitat (Table 2.6.2b). Riparian zones categorized as 'fair' or 'poor' are more likely to be adversely affected by metolachlor spray drift because they may be composed of fewer species and may be narrower. Metolachlor spray drift onto riparian zones comprised mostly of grasses or other sensitive plants could significantly reduce the species diversity of the riparian area and degrade the riparian functions important for salmonids.

The available data suggest that riparian zones that are comprised largely of grasses could be damaged by spray drift from nearby metolachlor use. Bare ground riparian areas could also be adversely affected by spray drift from metolachlor by preventing the growth of grass which can be an important component of riparian vegetation for maintaining water quality. When exposures to riparian plants are below the 25% effect level, the LOC is not exceeded. Using the dissipation distances shown in Table 5.2.2, grass and bare ground riparian areas are not expected to be affected at the 25% level by applications occurring more than 3500 feet from aerial applications and 325 feet from ground boom applications. Severe effects (*i.e.* 70% reduction in height or weight) to grass and bare ground riparian zone would not be expected more than 1900 ft from aerial applications and 135 ft from ground boom applications. Since the 70% effect level is generally equated with plant death, a poor quality riparian zone with low species diversity and composed of highly sensitive plants could be largely degraded if exposed at the rye grass 70% effect level.

The available data also suggest that healthy riparian zones (as described in Table 2.6.2b) would be more resistant to the effects of metolachlor. Trees and woody plants in a healthy riparian area would act to filter spray drift (Koch *et al.* 2003) and push spray drift plumes over the riparian zone (Davis *et al.* 1994) thus reducing exposure to herbaceous plants which tend to be more sensitive. Wider riparian areas offer more distance for metolachlor drift to dissipate reducing deposition onto plants farther from the application site. Higher species diversity reduces the probability of sensitive species forming a critical fraction of the riparian zone plants. Thus, higher quality riparian areas are expected to be less sensitive to impacts from metolachlor. Riparian areas classified as 'excellent' or 'good' could likely tolerate exposure to the rye grass 70% effect level because trees and woody plants would filter and deflect some spray drift and impacts to a relatively small proportion of the plants present would not be expected to significantly reduce the riparian zone functions relative to maintaining water quality. Higher exposures that are expected to cause effects to a wider range of species would increase the risk of impacting riparian functions.

Riparian Vegetation Exposure via Runoff

Plants in riparian areas may be exposed to metolachlor residues carried from application areas via surface water runoff. Metolachlor residues deposited on the soil surface can directly expose seedlings breaking through the soil surface and expose more mature plants through root uptake. Although both seedlings and more mature plants can be exposed to metolachlor residues on the soil, seedlings are understood to be the more sensitive life stage. Rye grass seedlings are the most sensitive tested species to the effects of metolachlor deposited on the

soil surface (Figure 4.1.4a).

Based on metolachlor's solubility, the screening-level model TerrPlant estimates that 5% of metolachlor may run off to adjacent areas during a high-end runoff event. Published runoff studies specific to metolachlor confirm that the 5% value reflects a relatively high loss (Ng and Clegg 1997). For adjacent areas, representative of riparian areas, the TerrPlant model assumes that runoff is deposited over an area equal in size to the source area, *i.e.* a 1:1 ratio of drainage area to receiving area, resulting in an estimated exposure to plants in the riparian area at 5% of the applied rate to the application area. Multiplying 5% (0.05) times the highest application rate (2.67 lbs a.i./acre, potatoes) results in an estimated high-end exposure of riparian plants at approximately 0.1 lbs a.i./acre. Based on toxicity data shown in Figure 4.1.4a the high-end runoff exposure could significantly affect 3 of the 6 tested species (near the 25% effect level) and severely impact rye grass (exceeding the 70% effect level).

The size and composition of riparian zones is likely to affect the sensitivity of riparian areas to metolachlor runoff. The TerrPlant model assumes that pesticide residues are distributed evenly across the receiving area but field data and laboratory data suggest that the types and density of vegetation downslope can greatly affect the distribution of metolachlor runoff. When an area at the downslope edge of a metolachlor use site is absent of vegetation or has a low density of vegetation, sheet flow patterns of runoff which could distribute metolachlor laden runoff over large areas is expected to rapidly become concentrated flow patterns which would expose less riparian area to metolachlor residues. Densely vegetated downslope buffers in riparian zones are used to reduce pesticide losses to adjacent water bodies by increasing infiltration and capturing soil-bound pesticides entrained in runoff (USDA NRCS 2000). Studies conducted on metolachlor show that vegetated buffer strips as narrow as 1.5 m retained from 16% to 100% of the metolachlor in runoff (Arora *et al.* 1996). A number of studies report similar results (Sadeghi and Isensee 2000, Misra *et al.* 1996, Tingle *et al.* 1998, Mersie *et al.* 1999). Riparian zones that minimize concentrated flow patterns of runoff and maximize sheet flow of runoff are most effective in trapping pesticide residues near the edge of the treatment area. Trapping metolachlor residues near the treatment area would be expected to minimize exposure throughout the riparian zone. Degradation of metolachlor in vegetated soils is reported to be faster than in bare ground soil (Mersie *et al.* 1999). Thus, densely vegetated downslope buffers are expected to intercept metolachlor residues, and runoff over less densely vegetated areas would be likely to be in a concentrated flow pattern, reducing the area that would be exposed to metolachlor laden runoff.

Riparian zones which function well for removing sediment and increasing infiltration, characteristics which are consistent with a riparian zone conducive to good water quality for fish, would also be expected to reduce the amount of metolachlor throughout the riparian zone and the amount reaching surface water. The riparian health criteria described in Fleming *et al.* (2000) and the characteristics associated with effective vegetative buffer strips suggest that healthy riparian zones would be less sensitive to the impacts of metolachlor runoff than poor riparian zones. Riparian zones rich in species diversity would be unlikely to consist of a high proportion of very sensitive plants. In addition, established plants in riparian zones which would be exposed through their roots would be expected to be less sensitive to metolachlor.

Wider buffers have more potential to distribute metolachlor residues over a larger area resulting in lower levels. Thus high quality riparian zones would be expected to be less sensitive to metolachlor's effects than riparian zones that are narrow, low in species diversity, and comprised of young plants or unvegetated areas.

Considering the propensity of sheet flow to become concentrated flow over distance and the effectiveness of vegetated buffer strips for reducing downslope metolachlor exposure, seedlings growing downslope within 20 ft of the metolachlor use site were determined to have a significant likelihood of being impacted by metolachlor laden runoff. Beyond 20 ft from the use site, concentrated flow or interception by vegetation would generally be likely to make metolachlor exposure to riparian vegetation insignificant.

Likelihood of Effects to Salmonids Via Damaging Riparian Vegetation

The screening-level assessment indicates that metolachlor use has the potential to adversely affect salmonids through harming riparian vegetation. Further evaluation of toxicity and exposure data suggest that metolachlor could affect nearby riparian vegetation that is downwind or downslope from applications by killing or blocking the growth of sensitive plant species, which are predominately grasses, and killing mature plants of only highly sensitive species. However, further evaluation shows that metolachlor is not likely to adversely affect listed salmonids through harming riparian vegetation.

Metolachlor is most effective in killing and inhibiting the growth of seedlings of grasses and certain broadleaf plants. The recovery of degraded riparian areas that function poorly due to sparse vegetation would be slower if they are exposed to metolachlor because metolachlor deposition (spray drift or runoff) onto bare soil would be expected to inhibit the growth of new vegetation. Metolachlor exposures have the potential to kill new vegetation within approximately 1900 ft of aerial applications and 135 ft of ground boom applications (see Table 5.2.2 and associated discussion). The inhibition of new vegetation growth in spawning and rearing areas where gravels are not already embedded in deposited sediment could result in localized increases in sediment deposition with resulting effects on survival and reproduction. Stream reaches determined by NOAA as being occupied by listed salmonids and potentially containing high quality spawning areas were interpreted in this assessment as potentially containing high quality gravels that are not embedded. The magnitude of increased sediment loading is expected to be relatively small and thus, would not be expected to be significant in low and medium conservation value reaches where high quality spawning gravels are not found or where gravels are already embedded.

Potential effects are limited to reaches abutting sparsely vegetated riparian zones because these are the areas where sediment loading to surface water and the potential for significant deposition onto spawning gravels is expected to be highest. The deposition of sediment following its entry into a flowing water body is a complex process. Key factors in defining the rate and magnitude of particle collection include gravitational settling, the particle size of the sediment, sediment concentration, hydraulic forces, interception, sieving, and the presence of large roughness elements (Everest *et al.* 1996). Fine sediment has very low settling rates

and requires very little hydraulic force to remain suspended and thus can travel rapidly downstream. Larger particle sizes have faster settling rates and require greater hydraulic forces to be carried downstream. Deposition of sediment from a single source onto spawning gravels is expected to be highest near the source of sediment where the concentration of sediment in the water is highest. If the situation existed where metolachlor was used extensively throughout a watershed with denuded riparian zones and good spawning gravel, the deposition of fine particles relatively far from their entry point into surface water might be expected to cause significant degradation of gravel quality. However, this situation is not expected to occur because the limited amount of metolachlor use in any given watershed is not expected to result in a significant cumulative effect and no watershed with a significant amount of denuded streambanks would be expected to contain good spawning gravels.

Sparsely vegetated riparian zones have a significant potential of slowed revegetation as a result of nearby metolachlor use which could result in lowered removal of sediment entrained in runoff over a period of weeks. Because sedimentation can occur rapidly during periods of high runoff, sometimes in less than a week (Soulsby *et al.* 2001), delaying the growth of vegetation for a period of weeks could be significant.

Metolachlor use is not expected to denude riparian zones. The removal of plant structures exposing bare soil in riparian areas could greatly reduce riparian functions for maintaining water quality. However, because most mature plants are expected to be unaffected at expected exposure levels and since the roots, stems, and leaves of sensitive plants killed by metolachlor are not physically removed after a lethal metolachlor exposure, riparian functions are not expected to be immediately degraded. Sediment filtering is largely dependent on the ability of stems and roots to slow overland flow and increase runoff infiltration. Plant structures covering the soil reduce erosion from riparian zones through intercepting rain and reducing the impact of rain drops. Because the roots, stems, and foliage of sensitive vegetation would remain in place after the exposure the erosion reduction and filtering capabilities are not expected to be greatly diminished after exposure to metolachlor. The regeneration of dead and damaged vegetation after metolachlor levels have dissipated and/or replacement by plants more tolerant to metolachlor would retain future riparian function. The expected replacement of herbicide killed plants in riparian areas has been used to argue effects were unlikely to listed salmonids in a biological opinion of the NMFS: "Removal of solid stands of noxious weed vegetation [in riparian areas] by chemical treatment may result in short-term, negligible increases in surface erosion that would diminish as desired vegetation re-occupies the treated site." (NOAA 2003).

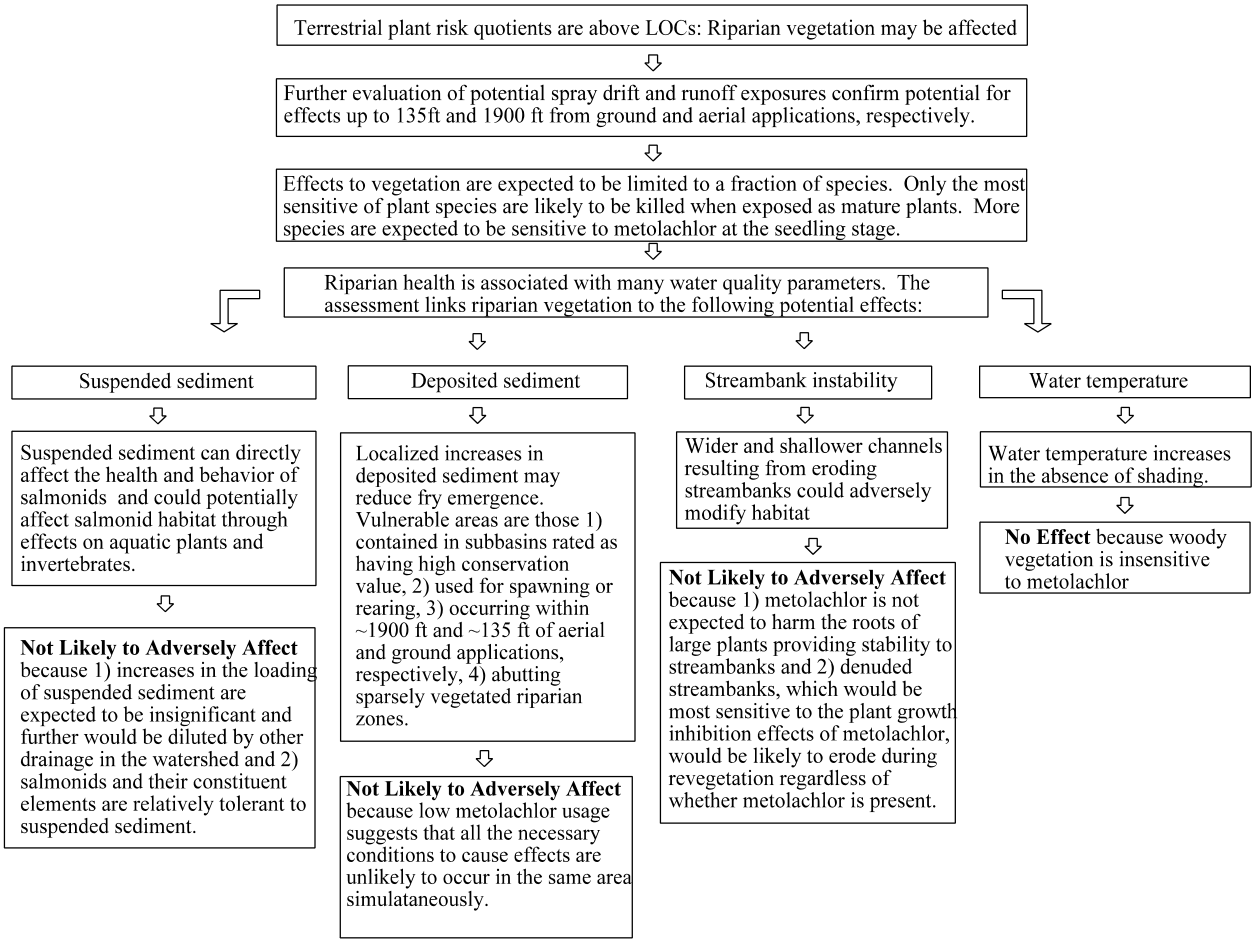
Available phytotoxicity data demonstrate metolachlor's toxicity is selective to certain plant species. Thus, it is expected that metolachlor may cause changes in plant community structure in vegetated areas exposed to metolachlor. Although plant community composition in field margins may change as a result of exposure to spray drift and runoff, there is no information to suggest that more tolerant plants function differently in riparian zones from less tolerant plants. Plants in vegetated buffer strips downslope of treated field are shown to be effective in filtering eroding sediment in addition to reducing metolachlor runoff (see reference in previous subsection). Wetlands plants used in a mesocosm study evaluating the

potential use of constructed wetlands for reducing aquatic metolachlor concentrations also functioned without showing "visual signs of herbicide stress (*e.g.* stunted growth, chlorosis, necrosis)" (Moore *et al.* 2001).

Even if community structure was correlated with riparian function, it may not be possible to discern the effects of metolachlor on species composition separate from other agricultural actions or determine if metolachlor is a significant factor in altering community structure. Plant community composition in agricultural field margins are likely to be modified by many agricultural management practices. Driving over and mowing field margins and off-target movement of fertilizer and herbicides are all likely to cause changes in plant community structure of riparian areas adjacent to agricultural fields (Jobin *et al.* 1997, Kleijn and Snoeijing 1997, Schippers and Joenje 2002). Although herbicides are commonly identified as a contributing factor to changes in plant communities adjacent to agricultural fields, some studies identify fertilizer use as the most important factor affecting plant community structure near agricultural fields (*e.g.* Schippers and Joenje 2002) and community structure is expected to be affected by a number of other factors (de Blois *et al.* 2002). Thus, the effect of metolachlor on riparian community structure would be expected to be one influence complicated by a myriad of other factors.

Considering all of the above information, metolachlor's effects to riparian vegetation are not likely to adversely affect salmonids because increases in suspended sediment levels are expected to be relatively small due to minimal effects on riparian filtering capabilities and increases in suspended sediment would be tempered by dilution as the size of the watershed increases. Mobile salmonid life stages are expected to be tolerant of a small increases in suspended sediment while stages confined to spawning sites (embryos and alevin life stages) are known to be highly sensitive to relatively small increases in sediment deposition. Salmonid embryos and alevins require relatively coarse gravel with good aeration for successful spawning. Deposition of sediment on gravels is well documented to affect early salmonid development. However, for a significant probability of effect to occur, stream reaches would need to have all of the following qualities: 1) contained in subbasins rated as having high conservation value 2) used for spawning 3) occurring within approximately 1900 ft of aerial metolachlor applications and 135 ft of ground boom applications made under relatively high drift or runoff conditions and 4) abutting sparsely vegetated riparian zones. Given the low and declining levels of metolachlor usage in states and counties with listed salmonids (see section 2.4.4 and Appendix D), it is unlikely that all these conditions would occur at the same time and thus lead to the conclusion that these potential effects are discountable and therefore metolachlor use is not likely to adversely affect listed salmonids through harming riparian vegetation.

Figure 5.2.2e. Summary of the assessment process and conclusions related to potential effects due to metolachlor impacts on riparian vegetation.



5.2.3 Conclusions

This assessment has reached the following conclusions regarding metolachlor use and the 26 ESUs of listed salmonids in California and the Pacific Northwest:

1) Metolachlor is expected to have no direct effect on the listed salmonids.
2) Metolachlor is expected to have no appreciable effect on designated critical habitat for the listed salmonids.
3) Metolachlor is expected to have no effect on the listed salmonid prey.
4) Metolachlor is not likely to adversely affect listed salmonids through effects on aquatic plants.
5) Metolachlor is not likely to adversely affect listed salmonids through effects on riparian vegetation.

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References to papers and reports made in this assessment are identified below using standard format.

Studies submitted to EPA are identified using the master record identification number (MRID) are identified below by MRID number.

References identified using the ECOTOX search strategy (e.g. toxicity data provided in Tables and identified by Reference No.) are shown in Appendix C.

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44929502 Vial, A. (1991) Report on the Acute Toxicity Test of CGA-51202 to Common Carp (Cyprinus carpio): Final Report: Lab Project Number: 918151: 407-91. Unpublished study prepared by Ciba-Geigy Limited. 20 p.

44929503 Vial, A. (1991) Report on the Acute Toxicity Test of CGA-51202 on (Daphnia magna Straus 1820): Final Report: Lab Project Number: 918162: 405-91. Unpublished study prepared by Ciba-Geigy Limited. 23 p.

44929513 Schwab, D. (1997) Evaluating the Effects of CGA-51202 on the Emergence and Vegetative Vigor of Non-Target Terrestrial Plants: Final Report: Lab Project Number: 43901: 230-97. Unpublished study prepared by ABC Laboratories, Inc. 69 p.

44929514 Boeri, R.; Magazu, J.; Ward, T. (1997) Acute Toxicity of CGA-51202 to the Duckweed, Lemna Gibba G3: Final Report: Lab Project Number: 1233-NO: 231-97. Unpublished study prepared by T.R. Wilbury Laboratories, Inc. 31 p.

44929515 Vial, A. (1991) Report on the Growth Inhibition Test of CGA-51202 to Green Algae (Scenedesmus subspicatus): Final Report: Lab Project Number: 918152: 408-91. Unpublished study prepared by Ciba-Geigy Limited. 23 p.

44931702 Rufli, H. (1996) Acute Toxicity Test of CGA-354743 (Metabolite of CGA-24705) to Rainbow Trout (Oncorhynchus mykiss) in the Static System: Final Report: Lab Project Number: 961526: 489-96. Unpublished study prepared by Ciba-Geigy Ltd. 46 p.

44931703 Neumann, C. (1996) Acute Toxicity Test of CGA-354743 (Metabolite of CGA-24705) to the Cladoceran (Daphnia magna Straus) Under Static Conditions: Final Report: Lab Project Number: 961528: 488-96. Unpublished study prepared by Ciba-Geigy Ltd. 40 p.

44931718 Schwab, D. (1997) Evaluating the Effects of CGA-354743 on the Emergence and Vegetative Vigor of Non-Target Terrestrial Plants: CGA-354743: Final Report: Lab Project Number: 43900: 229-97. Unpublished study prepared by ABC Labs.,

Inc. 69 p.

44931719 Grade, R. (1997) Growth Inhibition Test of CGA-354743 (Metabolite of CGA-24705) to Green Algae (Selenastrum capricornutum) Under Static Conditions: Lab Project Number: 971645: 784-97. Unpublished study prepared by Ciba-Geigy Ltd. 51 p.

44931720 Ward, T.; Magazu, J.; Boeri, R. (1999) Toxicity of CGA-354743 to the Duckwood, Lemna gibba G3: Final Report: Lab Project Number: 1688-NO: 1145-98. Unpublished study prepared by T.R. Wilbury Labs., Inc. 29 p.

44995902 Lima, W. (1999) S-Metolachlor CGA-77102--Life-Cycle Toxicity Test with Mysid (Mysidopsis bahia): Final Report: Lab Project Number: 106-99: 1781.6575. Unpublished study prepared by Springborn Labs., Inc. 81 p. Relates to L0000473.

44995903 Sousa, J. (1999) S-Metolachlor CGA-77102--Early Life-Stage Toxicity Test with Fathead Minnow (Pimephales promelas): Final Report: Lab Project Number: 108-99: 1781.6576. Unpublished study prepared by Springborn Labs., Inc. 79 p. Relates to L0000473.

Appendix A. Representative PRZM/EXAMS Model Input and Output

```
orswcorn.inp
"Oregon sweet corn Marion County MLRA 2; Metfile: W24232.dvf (old: Met2.met), Kevin
Costello 8/22/01"
*** Record 3:
   0.74    0.15       0      15       1       1
*** Record 6 -- ERFLAG
      4
*** Record 7:
   0.33    1.34       1      10              2       6     354
*** Record 8
      1
*** Record 9
      1    0.25      90     100       1  91  85  87       0     244
*** Record 9a-d
      1      29
0101 1601 0102 1602 0103 1603 0104 0504 1504 1604 2004 0105 1605 0106 1606 0107
.241 .259 .277 .295 .314 .337 .352 .453 .506 .510 .528 .511 .419 .235 .139 .099
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
1607 0108 1608 0109 1009 1509 1609 0110 1610 0111 1611 0112 1612
.099 .100 .101 .256 .306 .377 .390 .396 .384 .378 .383 .395 .405
.014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014 .014
*** Record 10 -- NCPDS, the number of cropping periods
     30
*** Record 11
  100561  210861  100961       1
  100562  210862  100962       1
  100563  210863  100963       1
  100564  210864  100964       1
  100565  210865  100965       1
  100566  210866  100966       1
  100567  210867  100967       1
  100568  210868  100968       1
  100569  210869  100969       1
  100570  210870  100970       1
  100571  210871  100971       1
  100572  210872  100972       1
  100573  210873  100973       1
  100574  210874  100974       1
  100575  210875  100975       1
  100576  210876  100976       1
  100577  210877  100977       1
  100578  210878  100978       1
  100579  210879  100979       1
```

```
 100580  210880  100980      1
 100581  210881  100981      1
 100582  210882  100982      1
 100583  210883  100983      1
 100584  210884  100984      1
 100585  210885  100985      1
 100586  210886  100986      1
 100587  210887  100987      1
 100588  210888  100988      1
 100589  210889  100989      1
 100590  210890  100990      1
*** Record 12 -- PTITLE
Metolachlor - 2 applications @ 2.24 kg/ha
*** Record 13
    60      1      0      0
*** Record 15 -- PSTNAM
Metolachlor
*** Record 16
 010561  0 2  0.0  2.24 0.95 0.05
 300661  0 2  0.0  2.24 0.95 0.05
 010562  0 2  0.0  2.24 0.95 0.05
 300662  0 2  0.0  2.24 0.95 0.05
 010563  0 2  0.0  2.24 0.95 0.05
 300663  0 2  0.0  2.24 0.95 0.05
 010564  0 2  0.0  2.24 0.95 0.05
 300664  0 2  0.0  2.24 0.95 0.05
 010565  0 2  0.0  2.24 0.95 0.05
 300665  0 2  0.0  2.24 0.95 0.05
 010566  0 2  0.0  2.24 0.95 0.05
 300666  0 2  0.0  2.24 0.95 0.05
 010567  0 2  0.0  2.24 0.95 0.05
 300667  0 2  0.0  2.24 0.95 0.05
 010568  0 2  0.0  2.24 0.95 0.05
 300668  0 2  0.0  2.24 0.95 0.05
 010569  0 2  0.0  2.24 0.95 0.05
 300669  0 2  0.0  2.24 0.95 0.05
 010570  0 2  0.0  2.24 0.95 0.05
 300670  0 2  0.0  2.24 0.95 0.05
 010571  0 2  0.0  2.24 0.95 0.05
 300671  0 2  0.0  2.24 0.95 0.05
 010572  0 2  0.0  2.24 0.95 0.05
 300672  0 2  0.0  2.24 0.95 0.05
 010573  0 2  0.0  2.24 0.95 0.05
 300673  0 2  0.0  2.24 0.95 0.05
 010574  0 2  0.0  2.24 0.95 0.05
```

```
 300674  0 2  0.0  2.24 0.95 0.05
 010575  0 2  0.0  2.24 0.95 0.05
 300675  0 2  0.0  2.24 0.95 0.05
 010576  0 2  0.0  2.24 0.95 0.05
 300676  0 2  0.0  2.24 0.95 0.05
 010577  0 2  0.0  2.24 0.95 0.05
 300677  0 2  0.0  2.24 0.95 0.05
 010578  0 2  0.0  2.24 0.95 0.05
 300678  0 2  0.0  2.24 0.95 0.05
 010579  0 2  0.0  2.24 0.95 0.05
 300679  0 2  0.0  2.24 0.95 0.05
 010580  0 2  0.0  2.24 0.95 0.05
 300680  0 2  0.0  2.24 0.95 0.05
 010581  0 2  0.0  2.24 0.95 0.05
 300681  0 2  0.0  2.24 0.95 0.05
 010582  0 2  0.0  2.24 0.95 0.05
 300682  0 2  0.0  2.24 0.95 0.05
 010583  0 2  0.0  2.24 0.95 0.05
 300683  0 2  0.0  2.24 0.95 0.05
 010584  0 2  0.0  2.24 0.95 0.05
 300684  0 2  0.0  2.24 0.95 0.05
 010585  0 2  0.0  2.24 0.95 0.05
 300685  0 2  0.0  2.24 0.95 0.05
 010586  0 2  0.0  2.24 0.95 0.05
 300686  0 2  0.0  2.24 0.95 0.05
 010587  0 2  0.0  2.24 0.95 0.05
 300687  0 2  0.0  2.24 0.95 0.05
 010588  0 2  0.0  2.24 0.95 0.05
 300688  0 2  0.0  2.24 0.95 0.05
 010589  0 2  0.0  2.24 0.95 0.05
 300689  0 2  0.0  2.24 0.95 0.05
 010590  0 2  0.0  2.24 0.95 0.05
 300690  0 2  0.0  2.24 0.95 0.05
*** Record 17
     0      3      0
*** Record 18
     0      0    0.5
*** Record 19 -- STITLE
Woodburn silt loam
*** Record 20
   203          0   0   1   0   0   0   0   0   0
*** Record 26
     0      0      0
*** Record 30
     4    181
```

```
*** Record 33
     7
     1      10    1.44   0.301       0       0       0
      0.0141750.014175       0
          0.1   0.301   0.134    1.86       0
     2      13    1.44   0.301       0       0       0
      0.0141750.014175       0
           1   0.301   0.134    1.86       0
     3      20    1.53    0.35       0       0       0
      0.0141750.014175       0
           2    0.35   0.153    0.56       0
     4      40    1.45   0.388       0       0       0
      0.0141750.014175       0
           2   0.388   0.177     0.3       0
     5      50    1.44   0.394       0       0       0
      0.0141750.014175       0
           5   0.394   0.185   0.112       0
     6      40    1.37   0.418       0       0       0
      0.0141750.014175       0
           5   0.418   0.173    0.07       0
     7      30    1.37   0.404       0       0       0
      0.0141750.014175       0
          10   0.404   0.156    0.06       0
***Record 40
     0
         YEAR      10          YEAR      10          YEAR      10   1
     1
     1  -----
     7    YEAR
   PRCP    TCUM   0   0
   RUNF    TCUM   0   0
   INFL    TCUM   1   1
   ESLS    TCUM   0   0  1.0E3
   RFLX    TCUM   0   0  1.0E5
   EFLX    TCUM   0   0  1.0E5
   RZFX    TCUM   0   0  1.0E5
```

stored as CAcornES.out
Chemical: Metolachlor
PRZM environment: CAcornC.txt modified Satday, 12 October 2002 at 16:32:58

EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 16:33:29
Metfile: w23232.dvf modified Wedday, 3 July 2002 at 09:04:22
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	5.914	5.473	4.289	2.177	1.809	0.8434
1962	38.57	35.18	25.23	14.69	10.78	3.319
1963	10.3	9.308	7.588	4.517	4.001	1.499
1964	5.739	5.03	3.058	1.473	1.757	0.7423
1965	7.89	7.027	5.124	2.719	2.605	0.8279
1966	8.255	7.476	5.976	3.415	2.284	1.077
1967	13.3	12.01	8.3	4.651	4.056	1.166
1968	5.749	5.05	3.073	1.434	1.771	0.6857
1969	10.18	9.021	6.054	3.018	2.819	0.8592
1970	5.759	5.03	3.221	1.541	1.834	0.7738
1971	5.769	5.07	3.163	1.512	1.836	0.5506
1972	5.776	5.1	3.142	1.492	1.831	0.6532
1973	5.741	5.051	3.109	1.444	1.763	0.6451
1974	7.376	6.592	4.299	2.1	2.214	0.6691
1975	5.732	4.982	3.073	1.433	1.729	0.4991
1976	5.875	5.216	4.244	2.171	2.191	0.5801
1977	5.826	5.103	3.049	1.523	1.811	0.7641
1978	6.381	5.74	4.489	2.323	2.398	1.055
1979	5.795	5.089	3.328	1.823	1.919	0.9226
1980	5.792	5.068	3.61	1.745	1.975	0.6769
1981	5.831	5.13	3.362	1.871	1.959	0.983
1982	9.321	8.422	5.779	3.239	3.009	0.9988
1983	6.124	5.397	3.361	2.37	2.442	0.8955
1984	5.741	5.062	3.186	1.522	1.801	0.5886
1985	5.75	5.033	3.195	1.523	1.841	0.7364
1986	6.217	5.569	4.373	2.256	2.328	0.6949
1987	5.775	5.041	3.308	1.609	1.869	0.781
1988	6.172	5.44	3.89	2.761	2.72	0.8339
1989	8.817	7.96	5.39	2.971	2.202	1.096
1990	7.098	6.195	3.744	1.817	2.065	0.6868

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
0.032258064516129	38.57	35.18	25.23	14.69	10.78	3.319
0.0645161290322581	13.3	12.01	8.3	4.651	4.056	1.499
0.0967741935483871	10.3	9.308	7.588	4.517	4.001	1.166
0.129032258064516	10.18	9.021	6.054	3.415	3.009	1.096
0.161290322580645	9.321	8.422	5.976	3.239	2.819	1.077
0.193548387096774	8.817	7.96	5.779	3.018	2.72	1.055
0.225806451612903	8.255	7.476	5.39	2.971	2.605	0.9988

0.258064516129032	7.89	7.027	5.124	2.761	2.442	0.983
0.290322580645161	7.376	6.592	4.489	2.719	2.398	0.9226
0.32258064516129	7.098	6.195	4.373	2.37	2.328	0.8955
0.354838709677419	6.381	5.74	4.299	2.323	2.284	0.8592
0.387096774193548	6.217	5.569	4.289	2.256	2.214	0.8434
0.419354838709677	6.172	5.473	4.244	2.177	2.202	0.8339
0.451612903225806	6.124	5.44	3.89	2.171	2.191	0.8279
0.483870967741936	5.914	5.397	3.744	2.1	2.065	0.781
0.516129032258065	5.875	5.216	3.61	1.871	1.975	0.7738
0.548387096774194	5.831	5.13	3.362	1.823	1.959	0.7641
0.580645161290323	5.826	5.103	3.361	1.817	1.919	0.7423
0.612903225806452	5.795	5.1	3.328	1.745	1.869	0.7364
0.645161290322581	5.792	5.089	3.308	1.609	1.841	0.6949
0.67741935483871	5.776	5.07	3.221	1.541	1.836	0.6868
0.709677419354839	5.775	5.068	3.195	1.523	1.834	0.6857
0.741935483870968	5.769	5.062	3.186	1.523	1.831	0.6769
0.774193548387097	5.759	5.051	3.163	1.522	1.811	0.6691
0.806451612903226	5.75	5.05	3.142	1.512	1.809	0.6532
0.838709677419355	5.749	5.041	3.109	1.492	1.801	0.6451
0.870967741935484	5.741	5.033	3.073	1.473	1.771	0.5886
0.903225806451613	5.741	5.03	3.073	1.444	1.763	0.5801
0.935483870967742	5.739	5.03	3.058	1.434	1.757	0.5506
0.967741935483871	5.732	4.982	3.049	1.433	1.729	0.4991

0.1 10.288 9.2793 7.4346 4.4068 3.9018 1.159

Average of yearly averages: 0.903466666666667

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: CAcornES
Metfile: w23232.dvf
PRZM scenario: CAcornC.txt
EXAMS environment file: pond298.exv
Chemical Name: Metolachlor

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	283.8	g/mol	
Henry's Law Const.	henry	3.7E-5	atm-m^3/mol	
Vapor Pressure	vapr	2.8E-5	torr	
Solubility	sol	4800	mg/L	
Kd	Kd		mg/L	
Koc	Koc	181	mg/L	
Photolysis half-life	kdp	70	days	Half-life
Aerobic Aquatic Metabolism	kbacw	141	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	234	days	Halfife

Aerobic Soil Metabolism		asm	48.9	days	Halfife
Hydrolysis:	pH 5	0	days	Half-life	
Hydrolysis:	pH 7	0	days	Half-life	
Hydrolysis:	pH 9	0	days	Half-life	
Method:	CAM	2	integer	See PRZM manual	
Incorporation Depth:	DEPI	0	cm		
Application Rate:	TAPP	2.24	kg/ha		
Application Efficiency:		APPEFF		0.95	fraction
Spray Drift	DRFT	0.05	fraction of application rate applied to pond		
Application Date	Date	1-4	dd/mm or dd/mmm or dd-mm or dd-mmm		
Interval 1	interval	60	days	Set to 0 or delete line for single app.	
Record 17:	FILTRA				
IPSCND		3			
UPTKF					
Record 18:	PLVKRT				
PLDKRT					
FEXTRC		0.5			
Flag for Index Res. Run		IR	Pond		
Flag for runoff calc.	RUNOFF		none	none, monthly or total(average of entire run)	

Appendix B. Tabular Summaries of Open Literature Toxicity Data

ECOTOX Summary Table for Aquatic Animal Studies

Metolachlor

CAS Number: 51218452
PC Code: 108801
Download Date: 10/8/2004

Freshwater fish

Taxa_Code: FWF

Acute

Ref # 6797
Author: "Mayer, F.L.J., and M.R. Ellersieck"
Year: 1986
Title: Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals
Source: "Resour.Publ.No.160, U.S.Dep.Interior, Fish Wildl.Serv., Washington, DC :505 p. (USGS Data File)"

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Fathead minnow (*Pimephales promelas*)	MOR	MOR	MORT	FW	4 d	A	LC50: 8.4 mg/L Orig: 8.4 mg/L	NR Orig:		100	Lab	S	7.4	40 mg/L CaCO3	NR (NR)

Freshwater arthropods

Taxa_Code: FWAR

Acute

Ref # 6797
Author: "Mayer, F.L.J., and M.R. Ellersieck"
Year: 1986
Title: Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals
Source: "Resour.Publ.No.160, U.S.Dep.Interior, Fish Wildl.Serv., Washington, DC :505 p. (USGS Data File)"

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Midge (*Chironomus plumosus*)	PHY	ITX	IMBL	FW	2 d	A	**EC50: 4.4 mg/L** Orig: 4.4 mg/L	NR Orig:		100	Lab	S	6.9	40 mg/L CaCO3	NR (NR)
Midge (*Chironomus plumosus*)	PHY	ITX	IMBL	FW	2 d	A	**EC50: 3.8 mg/L** Orig: 3.8 mg/L	NR Orig:		100	Lab	S	6.9	40 mg/L CaCO3	NR (NR)

Results in red indicate greater toxicity than most sensitive guideline study submitted by the registrant.

Ref # 6797 **Author:** "Mayer, F.L.J., and M.R. Ellersieck" **Year:** 1986

Title: Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals **Source:** "Resour.Publ.No.160, U.S.Dep.Interior, Fish Wildl.Serv., Washington, DC :505 p. (USGS Data File)"

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Water flea (*Daphnia magna*)	PHY	ITX	IMBL	FW	2 d	A	EC50: 26 mg/L Orig: 26 mg/L	NR Orig:		100	Lab	S	7.2	44 mg/L CaCO3	NR (NR)
Water flea (*Daphnia magna*)	PHY	ITX	IMBL	FW	2 d	A	**EC50: 23.5 mg/L** Orig: 23.5 mg/L	NR Orig:		100	Lab	S	7.2	44 mg/L CaCO3	NR (NR)

Ref # 13689 **Author:** "Ort, M.P., J.F. Fairchild, and S.E. Finger" **Year:** 1994

Title: Acute and Chronic Effects of Four Commercial Herbicide Formulations on Ceriodaphnia dubia **Source:** Arch.Environ.Contam.Toxicol. 27(1):103-106

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Water flea (*Ceriodaphnia dubia*)	MOR	MOR	MORT	FW	2 d	F	**LC50: 15.93 mg/L** Orig: ug/L	NR Orig:	5	100	Lab	S	7.8	283 mg/L CaCO3	NR (NR)

Ref # 67700 **Author:** "Ronco, A., C. Sobrero, V. Grassi, L. Kaminski, L. Massolo, and L. Mina" **Year:** 2000

Title: WaterTox Bioassay Intercalibration Network: Results from Argentina **Source:** Environ.Toxicol. 15(4):287-296

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Water flea (*Daphnia magna*)	PHY	ITX	IMBL	FW	2 d	F	**EC50: 4.25 mg/L** Orig: 4.25 mg/L	NR Orig:		100	Lab	NR		NR	NR (NR)
Water flea (*Daphnia magna*)	PHY	ITX	IMBL	FW	2 d	F	LOAEL: 10 mg/L Orig: 10 mg/L	NR Orig:		100	LAB	NR		NR	NR (NR)

Chronic

Ref # 13689 **Author:** "Ort, M.P., J.F. Fairchild, and S.E. Finger" **Year:** 1994

Title: Acute and Chronic Effects of Four Commercial Herbicide Formulations on Ceriodaphnia dubia **Source:** Arch.Environ.Contam.Toxicol. 27(1):103-106

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Water flea (*Ceriodaphnia dubia*)	REP	REP	GREP	FW	7 d	F	LOEC: 12.5 mg/L Orig: ug/L	NR Orig:	5	100	Lab	R	7.8	283 mg/L CaCO3	NR (NR)
Water flea (*Ceriodaphnia dubia*)	REP	REP	GREP	FW	7 d	F	MATC: 8.84 mg/L Orig: ug/L	NR Orig:	5	100	Lab	R	7.8	283 mg/L CaCO3	NR (NR)
Water flea (*Ceriodaphnia dubia*)	REP	REP	GREP	FW	7 d	F	NOEC: 6.25 mg/L Orig: ug/L	NR Orig:	5	100	Lab	R	7.8	283 mg/L CaCO3	NR (NR)

Other

Ref # 62050 **Author:** "Beauvais, S.L., G.J. Atchison, J.Z. Stenback, and W.G. Crumpton" **Year:** 1999

Title: Use of Cholinesterase Activity to Monitor Exposure of Chironomus riparius (Diptera: Chironomidae) to a Pesticide Mixture in Hypoxic Wetland Mesocosms **Source:** Hydrobiologia 416:163-170

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Midge (*Chironomus riparius*)	BCM	ENZ	CEST	FW	166666 d	F	NOAEL: 0.05 mg/L Orig: 50 ug/L	NR Orig:	1	100	LAB	S		NR	NR (NR)

Ref # 68515 **Author:** "Wolf, M.C., and P.A. Moore" **Year:** 2002

Title: Effects of the Herbicide Metolachlor on the Perception of Chemical Stimuli by Orconectes rusticus **Source:** J.N.Am.Benthol.Soc. 21(3):457-74

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Crayfish (*Orconectes rusticus*)	BEH	BEH	LOCO	FW	4 d	F	LOAEL: 0.025 mg/L Orig: 25 ppb	NR Orig:	3	100	LAB	R		NR	NR (NR)

Acute

Ref # 20274

Author: "Clements, C., S. Ralph, and M. Petras"

Year: 1997

Title: Genotoxicity of Select Herbicides in Rana catesbeiana Tadpoles Using the Alkaline Single-Cell Gel DNA Electrophoresis (Comet) Assay

Source: Environ.Mol.Mutagen. 29(3):277-288

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Bullfrog (Rana catesbeiana)	MOR	MOR	MORT	FW	<=1 d	F	NR-LETH: 17.376 mg/L Orig: 17.376 mg/L	NR Orig:	4	100	Lab	S		NR	NR (NR)

Ref # 66376

Author: "Osano, O., W. Admiraal, and D. Otieno"

Year: 2002

Title: Developmental Disorders in Embryos of the Frog Xenopus laevis Induced by Chloroacetanilide Herbicides and Their Degradation Products

Source: Environ.Toxicol.Chem. 21(2):375-379

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Clawed toad (Xenopus laevis)	MOR	MOR	MORT	FW	4 d	F	LC50: 4744.08 uM Orig: 4792 uM	NR Orig:		99	LAB	R		NR	NR (NR)

Ref # 67700

Author: "Ronco, A., C. Sobrero, V. Grassi, L. Kaminski, L. Massolo, and L. Mina"

Year: 2000

Title: WaterTox Bioassay Intercalibration Network: Results from Argentina

Source: Environ.Toxicol. 15(4):287-296

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Hydra (Hydra attenuata)	MOR	MOR	MORT	FW	2 d	F	LC50: >45 mg/L Orig: >45 mg/L	NR Orig:		100	Lab	NR		NR	NR (NR)
Hydra (Hydra attenuata)	MOR	MOR	MORT	FW	4 d	F	LOAEL: <1 mg/L Orig: <1 mg/L	NR Orig:		100	LAB	NR		NR	NR (NR)

Results in red indicate greater toxicity than most sensitive guideline study submitted by the registrant.

Chronic

Ref # 66376 **Author:** "Osano, O., W. Admiraal, and D. Otieno" **Year:** 2002

Title: Developmental Disorders in Embryos of the Frog Xenopus laevis Induced by Chloroacetanilide Herbicides and Their Degradation Products **Source:** Environ.Toxicol.Chem. 21(2):375-379

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Clawed toad (*Xenopus laevis*)	GRO	DVP	ABNM	FW	4 d	F	EC50: 265.4685 uM Orig: 268.15 uM	NR Orig:	6	99	LAB	R		NR	NR (NR)
Clawed toad (*Xenopus laevis*)	GRO	GRO	LGTH	FW	4 d	F	NOAEL: 34.848 uM Orig: 35.2 uM	NR Orig:	6	99	LAB	R		NR	NR (NR)

Ref # 67700 **Author:** "Ronco, A., C. Sobrero, V. Grassi, L. Kaminski, L. Massolo, and L. Mina" **Year:** 2000

Title: WaterTox Bioassay Intercalibration Network: Results from Argentina **Source:** Environ.Toxicol. 15(4):287-296

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Hydra (*Hydra attenuata*)	GRO	GRO	LGTH	FW	4 d	F	LOAEL: <1 mg/L Orig: <1 mg/L	NR Orig:		100	LAB	NR		NR	NR (NR)
Sour Paste Nematode (*Panagrellus redividus*)	GRO	GRO	COND	FW	4 d	F	LOAEL: 2 mg/L Orig: 2 mg/L	NR Orig:		100	LAB	NR		NR	NR (NR)

Other

Ref # 67700 **Author:** "Ronco, A., C. Sobrero, V. Grassi, L. Kaminski, L. Massolo, and L. Mina" **Year:** 2000

Title: WaterTox Bioassay Intercalibration Network: Results from Argentina **Source:** Environ.Toxicol. 15(4):287-296

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)

Ref # 67700 **Author:** "Ronco, A., C. Sobrero, V. Grassi, L. Kaminski, L. Massolo, and L. Mina" **Year:** 2000

Title: WaterTox Bioassay Intercalibration Network: Results from Argentina **Source:** Environ.Toxicol. 15(4):287-296

Test Species	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Sour Paste Nematode *(Panagrellus redividus)*	GRO	DVP	MATR	FW	4 d	F	LOAEL: 2 mg/L Orig: 2 mg/L	NR Orig:		100	LAB	NR		NR	NR (NR)

ECOTOX Summary Table for Aquatic Plant Studies

Metolachlor

CAS Number: 51218452
PC Code: 108801
Download Date: 10/8/2004

Nonvascular aquatic plants

Taxa_Code: NVAP

Acute

Ref # 13738
Author: "Goncz, A.M., and L. Sencic"
Year: 1994
Title: "Metolachlor and 2,4-Dichlorophenoxyacetic Acid Sensitivity of Salvinia natans"
Source: Bull.Environ.Contam.Toxicol. 53(6):852-855

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Floating moss (*Salvinia natans*)	POP	POP	BMAS	FW	28 d	F	EC50: 0.05 mg/L Orig 50 ug/L	NR Orig	3	100	Lab	S		NR	NR (NR)

Ref # 18093
Author: "Fairchild, J.F., D.S. Ruessler, P.S. Haverland, and A.R. Carlson"
Year: 1997
Title: Comparative Sensitivity of Selenastrum capricornutum and Lemna minor to Sixteen Herbicides
Source: Arch.Environ.Contam.Toxicol. 32:353-357

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae (*Pseudokirchneriella subcapitata*)	POP	POP	BMAS	FW	1 to 4 d	A	LOEC: 0.075 mg/L Orig 75 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
Green algae (*Pseudokirchneriella subcapitata*)	POP	POP	BMAS	FW	1 to 4 d	A	NOEC: 0.038 mg/L Orig 38 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)

Results in red indicate greater toxicity than most sensitive guideline study submitted by the registrant.

Ref # 19186 **Author:** "Day, K.E., and V. Hodge" **Year:** 1996

Title: "The Toxicity of the Herbicide Metolachlor, Some Transformation Products and a Commercial Safener to an Alga (Selenastrum capricornutum), a Cyanophyte" **Source:** Water Qual.Res.J.Can. 31(1):197-214

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Blue-green algae *(Anabaena cylindrica)*	POP	POP	ABND	FW	3 d	F	IC50: >4.965 mg/L Orig >5000 ug/L	NR Orig	6	99.3	LAB	S	7.5	NR	NR (NR)
Green algae *(Pseudokirchneriella subcapitata)*	POP	POP	ABND	FW	3 d	F	IC50: 0.03690981 mg/L Orig 37.17 ug/L	NR Orig	6	99.3	LAB	S	7.5	NR	NR (NR)

Ref # 20116 **Author:** "Kotrikla, A., T. Lekkas, and G. Bletsa" **Year:** 1997

Title: "Toxicity of the Herbicide Atrazine, Two of Its Degradation Products and the Herbicide Metolachlor in Photosynthetic Microorganisms" **Source:** Fresenius Environ.Bull. 6:502-507

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae *(Chlorella fusca)*	POP	POP	BMAS	FW	12 d	F	EC50: 0.10503 mg/L Orig 105.03 ug/L	NR Orig	4	100	Lab	S	6.6	NR	NR (NR)
Green algae *(Chlorella fusca)*	POP	POP	BMAS	FW	12 d	F	EC50: 0.1083 mg/L Orig 108.3 ug/L	NR Orig	4	100	Lab	S	6.6	NR	NR (NR)
Green algae *(Chlorella fusca)*	POP	POP	BMAS	FW	12 d	F	EC50: 0.1073 mg/L Orig 107.3 ug/L	NR Orig	4	100	Lab	S	6.6	NR	NR (NR)
Green algae *(Chlorella fusca)*	POP	POP	BMAS	FW	12 d	F	EC50: 0.10061 mg/L Orig 100.61 ug/L	NR Orig	4	100	Lab	S	6.6	NR	NR (NR)
Green algae *(Chlorella fusca)*	POP	POP	PGRT	FW	12 d	F	EC50: 0.10503 mg/L Orig 105.03 ug/L	NR Orig	4	100	Lab	S	6.6	NR	NR (NR)
Green algae *(Chlorella fusca)*	POP	POP	PGRT	FW	12 d	F	EC50: 0.10061 mg/L Orig 100.61 ug/L	NR Orig	4	100	Lab	S	6.6	NR	NR (NR)

Ref # 20116 **Author:** "Kotrikla, A., T. Lekkas, and G. Bletsa" **Year:** 1997

Title: "Toxicity of the Herbicide Atrazine, Two of Its Degradation Products and the Herbicide Metolachlor in Photosynthetic Microorganisms" **Source:** Fresenius Environ.Bull. 6:502-507

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae (*Chlorella fusca*)	POP	POP	PGRT	FW	12 d	F	EC50: 0.1073 mg/L Orig 107.3 ug/L	NR Orig	4	100	Lab	S	6.6	NR	NR (NR)
Green algae (*Chlorella fusca*)	POP	POP	PGRT	FW	12 d	F	EC50: 0.1083 mg/L Orig 108.3 ug/L	NR Orig	4	100	Lab	S	6.6	NR	NR (NR)

Ref # 45196 **Author:** "St Laurent, D., C. Blaise, P. MacQuarrie, R. Scroggins, and B. Trottier" **Year:** 1992

Title: Comparative Assessment of Herbicide Phytotoxicity to Selenastrum capricornutum Using Microplate and Flask Bioassay Procedures **Source:** Environ.Toxicol.Water Qual. 7:35-48

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae (*Pseudokirchneriella subcapitata*)	POP	POP	ABND	FW	4 d	A	EC50: 0.0555 mg/L Orig 55.5 ug/L	NR Orig	10	100	Lab	S		NR	NR (NR)
Green algae (*Pseudokirchneriella subcapitata*)	POP	POP	ABND	FW	4 d	A	EC50: 0.0509 mg/L Orig 50.9 ug/L	NR Orig	10	100	Lab	S		NR	NR (NR)

Ref # 61984 **Author:** "Ma, J., and W. Liang" **Year:** 2001

Title: Acute Toxicity of 12 Herbicides to the Green Alga Chlorella pyrenoidosa and Scenedesmus obliquus **Source:** Bull.Environ.Contam.Toxicol. 67(3):347-351

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae (*Chlorella pyrenoidosa*)	POP	POP	PGRT	FW	4 d	F	EC50: 6.3586 mg/L Orig 12.7172 mg/L	NR Orig		50	LAB	S		NR	NR (NR)

Ref # 65938 **Author:** "Ma, J., L.. Xu, S. Wang, R. Zheng, S. Jin, S. Huang, and Y. Huang" **Year:** 2002

Title: Toxicity of 40 Herbicides to the Green Alga Chlorella vulgaris **Source:** Ecotoxicol.Environ.Saf. 51(2):128-74

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae *(Chlorella vulgaris)*	POP	POP	PGRT	CUL	4 d	F	EC50: 18.9261 mg/L Orig 18.9261 mg/L	NR Orig		100	Lab	S		NR	NR

Ref # 71458 **Author:** "Ma, J., F. Lin, S. Wang, and L. Xu" **Year:** 2003

Title: Toxicity of 21 Herbicides to the Green Alga Scenedesmus quadricauda **Source:** Bull.Environ.Contam.Toxicol. 71(3):594-74

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae *(Scenedesmus quadricauda)*	POP	POP	PGRT	FW	4 d	F	EC50: 0.3 mg/L Orig 0.6 mg/L	NR Orig		50	Lab	S		NR	NR (NR)

Ref # 73426 **Author:** "Junghans, M., T. Backhaus, M. Faust, M. Scholze, and L.H. Grimme" **Year:** 2003

Title: Predictability of Combined Effects of Eight Chloroacetanilide Herbicides on Algal Reproduction **Source:** Pest Manag.Sci. 59(10):1101-1110

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae *(Scenedesmus sp.)*	POP	POP	ABND	FW	1 d	F	EC50: 0.22504 mg/L Orig 232 ug/L	NR Orig		97	Lab	S		NR	NR (NR)
Green algae *(Scenedesmus sp.)*	POP	POP	ABND	FW	1 d	F	NOEC: 0.116206 mg/L Orig 119.8 ug/L	NR Orig		97	Lab	S		NR	NR (NR)

Other

Ref # 13738 **Author:** "Goncz, A.M., and L. Sencic" **Year:** 1994

Title: "Metolachlor and 2,4-Dichlorophenoxyacetic Acid Sensitivity of Salvinia natans" **Source:** Bull.Environ.Contam.Toxicol. 53(6):852-855

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Floating moss (Salvinia natans)	BCM	BCM	CHLA	FW	28 d	F	EC50: 0.075 mg/L Orig 75 ug/L	NR Orig	3	100	Lab	S		NR	NR (NR)
Floating moss (Salvinia natans)	BCM	BCM	CHLB	FW	28 d	F	EC50: 0.08 mg/L Orig 80 ug/L	NR Orig	3	100	Lab	S		NR	NR (NR)
Floating moss (Salvinia natans)	GRO	GRO	GGRO	FW	28 d	F	EC50: 0.15 mg/L Orig 150 ug/L	NR Orig	3	100	Lab	S		NR	NR (NR)

Ref # 13800 **Author:** "Peterson, H.G., C. Boutin, P.A. Martin, K.E. Freemark, N.J. Ruecker, and M.J. Moody" **Year:** 1994

Title: Aquatic Phyto-Toxicity of 23 Pesticides Applied at Expected Environmental Concentrations **Source:** Aquat.Toxicol. 28(3/4):275-292

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Blue-green algae (Pseudanabaena sp.)	PHY	PHY	PSYN	FW	1 d	F	LOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)
Blue-green algae (Microcystis aeruginosa)	PHY	PHY	PSYN	FW	1 d	F	NOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)
Blue-green algae (Microcystis aeruginosa)	PHY	PHY	PSYN	FW	1 d	F	NOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)
Blue-green algae (Aphanizomenon flos-aquae)	PHY	PHY	PSYN	FW	1 d	F	NOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)
Blue-green algae (Oscillatoria sp.)	PHY	PHY	PSYN	FW	1 d	F	NOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)
Blue-green algae (Anabaena inaequalis)	PHY	PHY	PSYN	FW	1 d	F	NOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)

Ref # 13800 **Author:** "Peterson, H.G., C. Boutin, P.A. Martin, K.E. Freemark, N.J. Ruecker, and M.J. Moody" **Year:** 1994

Title: Aquatic Phyto-Toxicity of 23 Pesticides Applied at Expected Environmental Concentrations **Source:** Aquat.Toxicol. 28(3/4):275-292

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Diatom *(Cyclotella meneghiniana)*	PHY	PHY	PSYN	FW	1 d	F	NOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)
Diatom *(Nitzschia sp.)*	PHY	PHY	PSYN	FW	1 d	F	NOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)
Green algae *(Pseudokirchneriella subcapitata)*	PHY	PHY	PSYN	FW	1 d	F	LOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)
Green algae *(Scenedesmus quadricauda)*	PHY	PHY	PSYN	FW	1 d	F	NOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)

Ref # 18093 **Author:** "Fairchild, J.F., D.S. Ruessler, P.S. Haverland, and A.R. Carlson" **Year:** 1997

Title: Comparative Sensitivity of Selenastrum capricornutum and Lemna minor to Sixteen Herbicides **Source:** Arch.Environ.Contam.Toxicol. 32:353-357

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae *(Pseudokirchneriella subcapitata)*	POP	POP	GPOP	FW	4 d	A	EC50: 0.077 mg/L Orig 77 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)

Ref # 19461 **Author:** "Fairchild, J.F., D.S. Ruessler, and A.R. Carlson" **Year:** 1998

Title: "Comparative Sensitivity of Five Species of Macrophytes and Six Species of Algae to Atrazine, Metribuzin, Alachlor, and Metolachlor" **Source:** Environ.Toxicol.Chem. 17(9):1830-1834

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Blue-green algae *(Anabaena flosaquae)*	POP	POP	CHLO	FW	4 d	A	EC50: >3 mg/L Orig >3000 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)

Ref # 19461 **Author:** "Fairchild, J.F., D.S. Ruessler, and A.R. Carlson" **Year:** 1998

Title: "Comparative Sensitivity of Five Species of Macrophytes and Six Species of Algae to Atrazine, Metribuzin, Alachlor, and Metolachlor" **Source:** Environ.Toxicol.Chem. 17(9):1830-1834

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Blue-green algae *(Microcystis sp.)*	POP	POP	CHLO	FW	4 d	A	EC50: >3 mg/L Orig >3000 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
Green algae *(Chlamydomonas reinhardtii)*	POP	POP	CHLO	FW	4 d	A	EC50: 1.138 mg/L Orig ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
Green algae *(Chlorella vulgaris)*	POP	POP	CHLO	FW	4 d	A	EC50: 0.203 mg/L Orig 203 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
Green algae *(Pseudokirchneriella subcapitata)*	POP	POP	CHLO	FW	4 d	A	EC50: 0.084 mg/L Orig 84 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
Green algae *(Scenedesmus quadricauda)*	POP	POP	CHLO	FW	4 d	A	EC50: >3 mg/L Orig >3000 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)

Ref # 56387 **Author:** "St.Laurant, D., and C. Blaise" **Year:** 1992

Title: Comparative Assessment of Herbicide Phytotoxicity to Selenastrum capricornutum Using Microplate and Flask Bioassay Procedures **Source:** Environ.Toxicol.Water Qual. 7:35-48 (OECDG Data File)

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Green algae *(Pseudokirchneriella subcapitata)*	CEL	HIS	PRLF	FW	4 d	F	EC50: 0.0509 mg/L Orig 50.9 ug/L	NR Orig	10	100	NR	S		NR	NR (NR)
Green algae *(Pseudokirchneriella subcapitata)*	CEL	HIS	PRLF	FW	4 d	F	EC50: 0.0555 mg/L Orig 55.5 ug/L	NR Orig	10	100	NR	S		NR	NR (NR)

Ref # 62097 **Author:** "Juneau, P., D. Dewez, S. Matsui, S.G. Kim, and R. Popovic" **Year:** 2001

Title: Evaluation of Different Algal Species Sensitivity to Mercury and Metolachlor by PAM-Fluorometry **Source:** Chemosphere 45(4/5):589-74

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Blue-green algae (*Microcystis aeruginosa*)	BCM	BCM	FLRS	FW	4 d	F	EC50: 1413 nM Orig 1413 nM	NR Orig		100	LAB	S		NR	NR (NR)
Green algae (*Pseudokirchneriella subcapitata*)	BCM	BCM	FLRS	FW	4 d	F	EC50: 409 nM Orig 409 nM	NR Orig		100	LAB	S		NR	NR (NR)
Green algae (*Ankistrodesmus falcatus*)	BCM	BCM	FLRS	FW	4 d	F	EC50: 276 nM Orig 276 nM	NR Orig	1	100	LAB	S		NR	NR (NR)
Green algae (*Chlorella vulgaris*)	BCM	BCM	FLRS	FW	4 d	F	EC50: 1201 nM Orig 1201 nM	NR Orig		100	LAB	S		NR	NR (NR)
Green algae (*Pediastrum biwae*)	BCM	BCM	FLRS	FW	4 d	F	EC50: 1437 nM Orig 1437 nM	NR Orig		100	LAB	S		NR	NR (NR)

Vascular aquatic plants

Taxa_Code: VAP

Acute

Ref # 13800 **Author:** "Peterson, H.G., C. Boutin, P.A. Martin, K.E. Freemark, N.J. Ruecker, and M.J. Moody" **Year:** 1994

Title: Aquatic Phyto-Toxicity of 23 Pesticides Applied at Expected Environmental Concentrations **Source:** Aquat.Toxicol. 28(3/4):275-292

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
least duckweed (*Lemna minor*)	POP	POP	ABND	FW	7 d	F	LOAEL: 3 mg/L Orig 3 mg/L	NR Orig	1	100	Lab	S		NR	NR (NR)

Ref # 18093 **Author:** "Fairchild, J.F., D.S. Ruessler, P.S. Haverland, and A.R. Carlson" **Year:** 1997

Title: Comparative Sensitivity of Selenastrum capricornutum and Lemna minor to Sixteen Herbicides **Source:** Arch.Environ.Contam.Toxicol. 32:353-357

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
least duckweed (Lemna minor)	POP	POP	BMAS	FW	2 to 4 d	A	LOEC: 0.375 mg/L Orig 375 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
least duckweed (Lemna minor)	POP	POP	BMAS	FW	2 to 4 d	A	NOEC: 0.187 mg/L Orig 187 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)

Ref # 19186 **Author:** "Day, K.E., and V. Hodge" **Year:** 1996

Title: "The Toxicity of the Herbicide Metolachlor, Some Transformation Products and a Commercial Safener to an Alga (Selenastrum capricornutum), a Cyanophyte" **Source:** Water Qual.Res.J.Can. 31(1):197-214

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Inflated duckweed (Lemna gibba)	POP	POP	ABND	FW	7 d	F	IC50: 0.301872 mg/L Orig 304 ug/L	NR Orig	6	99.3	LAB	S	7.5	NR	NR (NR)

Ref # 19461 **Author:** "Fairchild, J.F., D.S. Ruessler, and A.R. Carlson" **Year:** 1998

Title: "Comparative Sensitivity of Five Species of Macrophytes and Six Species of Algae to Atrazine, Metribuzin, Alachlor, and Metolachlor" **Source:** Environ.Toxicol.Chem. 17(9):1830-1834

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
broad waterweed (Elodea canadensis)	POP	POP	BMAS	FW	14 d	A	EC50: 2.355 mg/L Orig ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
common hornwort (Ceratophyllum demersum)	POP	POP	BMAS	FW	14 d	A	EC50: 0.07 mg/L Orig 70 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
least duckweed (Lemna minor)	POP	POP	ABND	FW	4 d	A	EC50: 0.36 mg/L Orig 360 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)

Ref # 19461 **Author:** "Fairchild, J.F., D.S. Ruessler, and A.R. Carlson" **Year:** 1998

Title: "Comparative Sensitivity of Five Species of Macrophytes and Six Species of Algae to Atrazine, Metribuzin, Alachlor, and Metolachlor" **Source:** Environ.Toxicol.Chem. 17(9):1830-1834

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Two-leaf water-milfoil *(Myriophyllum heterophyllum)*	POP	POP	BMAS	FW	14 d	A	EC50: >3 mg/L Orig >3000 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)
waternymph *(Najas sp.)*	POP	POP	BMAS	FW	14 d	A	EC50: 0.242 mg/L Orig 242 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)

Other

Ref # 4057 **Author:** "Walsh, G.E., D.E. Weber, T.L. Simon, L.K. Brashers, and J.C. Moore" **Year:** 1991

Title: Use of Marsh Plants for Toxicity Testing of Water and Sediment **Source:** "In: J.W.Gorsuch, W.R.Lower, W.Wang and M.A.Lewis (Eds.), Plants for Toxicity Assessment, ASTM STP 1

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
Barnyard grass *(Echinochloa crus-galli)*	GRO	GRO	GGRO	FW	10 d	F	LOEC: 0.25 mg/L Orig 0.25 mg/L	NR Orig	6	100	Lab	NR		NR	NR (NR)
Grass *(Echinochloa crusgalli)*	GRO	GRO	GGRO	FW	10 d	F	LOEC: 0.25 mg/L Orig 0.25 mg/L	NR Orig	5	100	Lab	NR		NR	NR (NR)
Smooth cordgrass *(Spartina alterniflora)*	GRO	GRO	GGRO	FW	10 d	F	LOEC: 0.5 mg/L Orig 0.5 mg/L	NR Orig	5	100	Lab	NR		NR	NR (NR)

Ref # 18093 **Author:** "Fairchild, J.F., D.S. Ruessler, P.S. Haverland, and A.R. Carlson" **Year:** 1997

Title: Comparative Sensitivity of Selenastrum capricornutum and Lemna minor to Sixteen Herbicides **Source:** Arch.Environ.Contam.Toxicol. 32:353-357

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)

Ref # 18093 **Author:** "Fairchild, J.F., D.S. Ruessler, P.S. Haverland, and A.R. Carlson" **Year:** 1997

Title: Comparative Sensitivity of Selenastrum capricornutum and Lemna minor to Sixteen Herbicides **Source:** Arch.Environ.Contam.Toxicol. 32:353-357

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
least duckweed (Lemna minor)	POP	POP	GPOP	FW	4 d	A	EC50: 0.343 mg/L Orig 343 ug/L	NR Orig	5	100	Lab	S		NR	NR (NR)

Ref # 61985 **Author:** "Lytle, J.S., and T.F. Lytle" **Year:** 1996

Title: "Responses of the Estuarine Plant Scirpus olneyi to Two Herbicides, Atrazine and Metolachlor" **Source:** "In: D.A.Bengtson and D.S.Henshel (Eds.), Environmental Toxicology and Risk Assessment: Biomarkers a

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
American bulrush (Schoenoplectus americanus)	BCM	ENZ	PODA	SW	16 d	A	LOAEL: 0.1 mg/L Orig 0.1 ppm	NR Orig	3	85.1	LAB	R	7.8	g/L CaCO3	NR (TOC)
American bulrush (Schoenoplectus americanus)	BCM	ENZ	PODA	SW	16 d	A	LOAEL: 0.01 mg/L Orig 0.01 ppm	NR Orig	3	85.1	LAB	R		NR	NR (NR)
American bulrush (Schoenoplectus americanus)	BCM	ENZ	PODA	SW	28 d	A	LOAEL: 1 mg/L Orig 1 ppm	NR Orig	3	85.1	LAB	S	7.8	g/L CaCO3	NR (TOC)
American bulrush (Schoenoplectus americanus)	BCM	ENZ	PODA	SW	28 d	A	LOAEL: 1 mg/L Orig 1 ppm	NR Orig	3	85.1	LAB	S	7.8	g/L CaCO3	NR (TOC)
American bulrush (Schoenoplectus americanus)	BCM	ENZ	PODA	SW	28 d	A	LOAEL: 1 mg/L Orig 1 ppm	NR Orig	3	85.1	LAB	S	7.8	g/L CaCO3	NR (TOC)
American bulrush (Schoenoplectus americanus)	BCM	ENZ	PODA	SW	28 d	A	LOAEL: 1 mg/L Orig 1 ppm	NR Orig	3	85.1	LAB	S	7.8	g/L CaCO3	NR (TOC)
American bulrush (Schoenoplectus americanus)	BCM	ENZ	PODA	SW	28 d	A	LOAEL: 1 mg/L Orig 1 ppm	NR Orig	3	85.1	LAB	S	7.8	g/L CaCO3	NR (TOC)

Ref # 61985 **Author:** "Lytle, J.S., and T.F. Lytle" **Year:** 1996

Title: "Responses of the Estuarine Plant Scirpus olneyi to Two Herbicides, Atrazine and Metolachlor" **Source:** "In: D.A.Bengtson and D.S.Henshel (Eds.), Environmental Toxicology and Risk Assessment: Biomarkers a

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
American bulrush (*Schoenoplectus americanus*)	BCM	ENZ	PODA	SW	16 d	A	LOAEL: 0.1 mg/L Orig 0.1 ppm	NR Orig	3	85.1	LAB	R	7.8	g/L CaCO3	NR (TOC)
American bulrush (*Schoenoplectus americanus*)	BCM	ENZ	PODA	SW	16 d	A	LOAEL: 0.1 mg/L Orig 0.1 ppm	NR Orig	3	85.1	LAB	R	7.8	g/L CaCO3	NR (TOC)
American bulrush (*Schoenoplectus americanus*)	BCM	ENZ	PODA	SW	16 d	A	LOAEL: 0.01 mg/L Orig 0.01 ppm	NR Orig	3	85.1	LAB	R		NR	NR (NR)
American bulrush (*Schoenoplectus americanus*)	BCM	ENZ	PODA	FW	16 d	A	NOAEL: 0.01 mg/L Orig 0.01 ppm	LOAEL: 0.1 mg/L Orig 0.1 ppm	3	85.1	LAB	R		NR	NR (NR)
American bulrush (*Schoenoplectus americanus*)	BCM	ENZ	PODA	SW	16 d	A	NOAEL: 0.1 mg/L Orig 0.1 ppm	LOAEL: 1 mg/L Orig 1 ppm	3	85.1	LAB	R		NR	NR (NR)
American bulrush (*Schoenoplectus americanus*)	GRO	GRO	LGTH	SW	16 d	A	NOAEL: 0.1 mg/L Orig 0.1 ppm	LOAEL: 1 mg/L Orig 1 ppm	3	85.1	LAB	R	7.8	g/L CaCO3	NR (TOC)
American bulrush (*Schoenoplectus americanus*)	GRO	GRO	LGTH	SW	16 d	A	NOAEL: 0.1 mg/L Orig 0.1 ppm	LOAEL: 1 mg/L Orig 1 ppm	3	85.1	LAB	R	7.8	g/L CaCO3	NR (TOC)
American bulrush (*Schoenoplectus americanus*)	GRO	GRO	LGTH	SW	16 d	A	NOAEL: 0.1 mg/L Orig 0.1 ppm	LOAEL: 1 mg/L Orig 1 ppm	3	85.1	LAB	R	7.8	g/L CaCO3	NR (TOC)
American bulrush (*Schoenoplectus americanus*)	GRO	GRO	LGTH	FW	16 d	A	NOAEL: 0.01 mg/L Orig 0.01 ppm	LOAEL: 0.1 mg/L Orig 0.1 ppm	3	85.1	LAB	R		NR	NR (NR)
American bulrush (*Schoenoplectus americanus*)	GRO	GRO	LGTH	SW	16 d	A	NOAEL: 0.01 mg/L Orig 0.01 ppm	LOAEL: 0.1 mg/L Orig 0.1 ppm	3	85.1	LAB	R		NR	NR (NR)
American bulrush (*Schoenoplectus americanus*)	GRO	GRO	LGTH	SW	16 d	A	NOAEL: 0.1 mg/L Orig 0.1 ppm	LOAEL: 1 mg/L Orig 1 ppm	3	85.1	LAB	R		NR	NR (NR)

Ref # 61985 **Author:** "Lytle, J.S., and T.F. Lytle" **Year:** 1996

Title: "Responses of the Estuarine Plant Scirpus olneyi to Two Herbicides, Atrazine and Metolachlor" **Source:** "In: D.A.Bengtson and D.S.Henshel (Eds.), Environmental Toxicology and Risk Assessment: Biomarkers a

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Hardness	Org Matter (Type)
American bulrush *(Schoenoplectus americanus)*	GRO	GRO	LGTH	SW	16 d	A	NOAEL: 1 mg/L Orig 1 ppm	NR Orig	3	85.1	LAB	R		NR	NR (NR)

ECOTOX Summary Table for Terrestrial Plant Studies

Metolachlor

CAS Number: 51218452
PC Code: 108801
Download Date: 10/8/2004

Terrestrial monocots

Taxa_Code: MTP

Acute

Ref # 41129 **Author:** "Hatzios, K.K." **Year:** 1983
Title: Effects of CGA-43089 on Responses of Sorghum to Metolachlor Combined with Ozone or Antioxidants **Source:** Weed Sci. 31:280-284

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	GRO	GRO	WGHT	ART	30 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 3.4788 lb/acre Orig 3.9 ai kg/ha	3	100	Lab	DA		NR
broom-corn (Sorghum bicolor)	GRO	GRO	WGHT	ART	30 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 3.4788 lb/acre Orig 3.9 ai kg/ha	3	100	Lab	DA		NR
broom-corn (Sorghum bicolor)	GRO	GRO	WGHT	ART	30 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 3.4788 lb/acre Orig 3.9 ai kg/ha	3	100	Lab	DA		NR

Ref # 44022 **Author:** "Pillai, P., D.E. Davis, and B. Truelove" **Year:** 1979
Title: "Effects of Metolachlor on Germination, Growth, Leucine Uptake and Protein Synthesis" **Source:** Weed Sci. 27:634-637

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bread wheat (Triticum aestivum)	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR
Bread wheat (Triticum aestivum)	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	3	100	Lab	DA		NR

Results in red indicate greater toxicity than most sensitive guideline study submitted by the registrant.

Ref # 44022 **Author:** "Pillai, P., D.E. Davis, and B. Truelove" **Year:** 1979

Title: "Effects of Metolachlor on Germination, Growth, Leucine Uptake and Protein Synthesis" **Source:** Weed Sci. 27:634-637

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
common barley *(Hordeum vulgare)*	GRO	GRO	HGHT	NAT	15 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	Lab	DA		NR
common barley *(Hordeum vulgare)*	GRO	GRO	HGHT	NAT	15 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	Lab	DA		NR
common barley *(Hordeum vulgare)*	GRO	GRO	HGHT	NAT	15 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	Lab	DA		NR
common barley *(Hordeum vulgare)*	GRO	GRO	HGHT	NAT	15 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	Lab	DA		NR
common barley *(Hordeum vulgare)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR
common barley *(Hordeum vulgare)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR
Common oat *(Avena sativa)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	3	100	Lab	DA		NR
Common oat *(Avena sativa)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR
Corn *(Zea mays)*	GRO	GRO	HGHT	NAT	15 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	Lab	DA		NR
Corn *(Zea mays)*	GRO	GRO	HGHT	NAT	15 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	Lab	DA		NR
Corn *(Zea mays)*	GRO	GRO	HGHT	NAT	15 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	Lab	DA		NR

Ref # 44022 **Author:** "Pillai, P., D.E. Davis, and B. Truelove" **Year:** 1979

Title: "Effects of Metolachlor on Germination, Growth, Leucine Uptake and Protein Synthesis" **Source:** Weed Sci. 27:634-637

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	GRO	GRO	HGHT	NAT	15 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	Lab	DA		NR
Corn *(Zea mays)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
Ryegrass *(Lolium sp.)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR
Ryegrass *(Lolium sp.)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR

Ref # 67700 **Author:** "Ronco, A., C. Sobrero, V. Grassi, L. Kaminski, L. Massolo, and L. Mina" **Year:** 2000

Title: WaterTox Bioassay Intercalibration Network: Results from Argentina **Source:** Environ.Toxicol. 15(4):287-296

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
garden onion *(Allium cepa)*	GRO	GRO	LGTH	NR	3 d	F	LOAEL: <1 ppm Orig <1 mg/L	NR Orig		100	LAB	NR		NR

Ref # 70441 **Author:** "Talbert, R.E., R.A. Wichert, V.F. Carey III, D.H. Johnson, D.F. Ruff, and N.R. Burgos" **Year:** 1993

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1992" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 429:1-29

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
orange day lily *(Hemerocallis fulva)*	PHY	INJ	GINJ	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	2	100	FIELDN	HS	5.6	NR

Ref # 71312 **Author:** "Scarponi, L., P. Perucci, and C. Marucchini" **Year:** 1989

Title: "Effect of Alachlor, Metolachlor, Atrazine and Simazine Residues on Some Enzyme Activities of Maize Tissues" **Source:** Agrochimica 33(6):403-411

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	GRO	GRO	BMAS	NAT	4 d	F	LOAEL: 0.00001 M Orig 0.00001 M	NR Orig	1	100	LAB	DA		NR

Ref # 73228 **Author:** "Yenne, S.P., and K.K. Hatzios" **Year:** 1989

Title: Influence of Oxime Ether Safeners and Metolachlor on Acetate Incorporation into Lipids and on Acetyl-CoA Carboxylase of Grain Sorghum **Source:** Pestic.Biochem.Physiol. 35(2):146-154

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn *(Sorghum bicolor)*	GRO	GRO	LGTH	FLT	2.5 d	F	NOAEL: 10 uM Orig 10 uM	NR Orig	1	100	LAB	DA		NR

Ref # 73229 **Author:** "Wilkinson, R.E." **Year:** 1988

Title: Consequences of Metolachlor Induced Inhibition of Gibberellin Biosynthesis in Sorghum Seedlings **Source:** Pestic.Biochem.Physiol. 32(1):25-37

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn *(Sorghum bicolor)*	GRO	GRO	HGHT	ART	366666 d	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	Lab	GM		NR
broom-corn *(Sorghum bicolor)*	GRO	GRO	HGHT	ART	366666 d	F	LOAEL: 3.6 uM Orig 3.6 uM	NR Orig	1	100	Lab	WA		NR
broom-corn *(Sorghum bicolor)*	GRO	GRO	HGHT	ART	5 d	F	NOAEL: 0.88 uM Orig 0.88 uM	LOAEL: 1.76 uM Orig 1.76 uM	4	100	Lab	GM		NR

Ref # 73229 **Author:** "Wilkinson, R.E." **Year:** 1988

Title: Consequences of Metolachlor Induced Inhibition of Gibberellin Biosynthesis in Sorghum Seedlings **Source:** Pestic.Biochem.Physiol. 32(1):25-37

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	FLT	4 d	F	NOAEL: 0.25 ppm Orig 0.25 ppmw	LOAEL: 0.5 ppm Orig 0.5 ppmw	3	100	Lab	DA		NR

Ref # 73243 **Author:** "Van Biljon, J.J., and P.C. Nel" **Year:** 1988

Title: Effect of Temperature and Soil Moisture on the Selectivity of Metolachlor in Maize **Source:** Appl.Plant Sci. 2(1):1-5

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	GRO	GRO	BMAS	NAT	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	LOAEL: 4 ppm Orig 4 mg/kg	4	100	LAB	DA		0.12 % (C)
Corn (Zea mays)	GRO	GRO	BMAS	NAT	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	LOAEL: 4 ppm Orig 4 mg/kg	4	100	LAB	DA		0.12 % (C)
Corn (Zea mays)	GRO	GRO	BMAS	NAT	14 d	F	NOAEL: 4 ppm Orig 4 mg/kg	LOAEL: 8 ppm Orig 8 mg/kg	4	100	LAB	DA		0.12 % (C)
Corn (Zea mays)	GRO	GRO	BMAS	NAT	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	LOAEL: 4 ppm Orig 4 mg/kg	4	100	LAB	DA		0.12 % (C)
Corn (Zea mays)	GRO	GRO	HGHT	NAT	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	LAB	DA		0.12 % (C)
Corn (Zea mays)	GRO	GRO	HGHT	NAT	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	LOAEL: 4 ppm Orig 4 mg/kg	4	100	LAB	DA		0.12 % (C)
Corn (Zea mays)	GRO	GRO	HGHT	NAT	14 d	F	NOAEL: 4 ppm Orig 4 mg/kg	LOAEL: 8 ppm Orig 8 mg/kg	4	100	LAB	DA		0.12 % (C)

Ref # 73250 **Author:** "Skroch, W.A., C.J. Catanzaro, and M.H. Yonce" **Year:** 1990

Title: Response of Nine Herbaceous Flowering Perennials to Selected Herbicides **Source:** J.Environ.Hortic. 8(1):26-28

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Daylily *(Hemerocallis sp.)*	PHY	INJ	GINJ	NAT	219 d	A	LOAEL: 3 lb/acre Orig 3 lb/acre	NR Orig	1	100	FIELDA	HS	6.5	NR
Redhot poker *(Kniphofia uvaria)*	PHY	INJ	GINJ	NAT	219 d	A	NOAEL: 3 lb/acre Orig 3 lb/acre	NR Orig	1	100	FIELDA	HS	6.5	NR

Ref # 73253 **Author:** "Derr, J.F., and B.L. Appleton" **Year:** 1989

Title: Weed Control with Landscape Fabrics **Source:** J.Environ.Hortic. 7(4):129-133

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
purple crabgrass *(Digitaria sanguinalis)*	GRO	GRO	WGHT	ART	42 d	A	LOAEL: 4.014 lb/acre Orig 4.5 AI kg/ha	NR Orig	1	100	LAB	DA		NR
purple crabgrass *(Digitaria sanguinalis)*	GRO	GRO	WGHT	ART	35 d	A	LOAEL: 4.014 lb/acre Orig 4.5 AI kg/ha	NR Orig	1	100	LAB	DA		NR
purple crabgrass *(Digitaria sanguinalis)*	GRO	GRO	WGHT	ART	28 d	A	LOAEL: 4.014 lb/acre Orig 4.5 AI kg/ha	NR Orig	1	100	LAB	DA		NR
purple crabgrass *(Digitaria sanguinalis)*	GRO	GRO	WGHT	ART	42 d	A	NOAEL: 4.014 lb/acre Orig 4.5 AI kg/ha	NR Orig	1	100	LAB	DA		NR
Yellow nutsedge *(Cyperus esculentus)*	GRO	GRO	WGHT	ART	42 d	A	LOAEL: 4.014 lb/acre Orig 4.5 AI kg/ha	NR Orig	1	100	LAB	DA		NR

Ref # 73254 **Author:** "Whitwell, T., and J. Kelly" **Year:** 1989

Title: Effects of Preemergence Herbicides on Hosta and Daylily **Source:** J.Environ.Hortic. 7(1):29-31

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Daylily (*Hemerocallis sp.*)	GRO	GRO	WGHT	ART	90 d	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	3	100	FIELDN	HS	6.2	NR
Daylily (*Hemerocallis sp.*)	PHY	INJ	GINJ	ART	30 d	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	3	100	FIELDN	HS	6.2	NR
Plantain lily (*Hosta sp.*)	GRO	GRO	WGHT	ART	60 d	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	3	100	FIELDN	HS	6.2	NR
Plantain lily (*Hosta sp.*)	PHY	INJ	GINJ	ART	30 d	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	3	100	FIELDN	HS	6.2	NR

Ref # 73259 **Author:** "Gangwar, K.S., K.P. Niranjan, and O.P. Singh" **Year:** 1991

Title: Weed Management in Sorghum (Sorghum bicolor) + Pigeonpea (Cajanus cajan) Intercropping System in Dryland **Source:** Indian J.Agric.Sci. 61(10):757-759

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (*Sorghum bicolor*)	GRO	GRO	HGHT	NAT	hv	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	2	100	FIELDN	GM	7.35	NR
broom-corn (*Sorghum bicolor*)	GRO	GRO	HGHT	NAT	hv	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	2	100	FIELDN	GM	7.35	NR

Ref # 73272 **Author:** "Farago, S., K. Kreuz, and C. Brunold" **Year:** 1993

Title: Decreased Glutathione Levels Enhance the Susceptibility of Maize Seedlings to Metolachlor **Source:** Pestic.Biochem.Physiol. 47(3):199-205

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73272 **Author:** "Farago, S., K. Kreuz, and C. Brunold" **Year:** 1993

Title: Decreased Glutathione Levels Enhance the Susceptibility of Maize Seedlings to Metolachlor **Source:** Pestic.Biochem.Physiol. 47(3):199-205

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	GRO	GRO	LGTH	HYP	7 d	F	LOAEL: 0.1 mM Orig 0.1 mM	NR Orig	5	100	LAB	GM		NR

Ref # 73275 **Author:** "Berzsenyi, Z., B. Gyorffy, T. Arendas, P. Bonis, and D.Q. Lap" **Year:** 1997

Title: Studies on the Phytotoxicity of Herbicides in Maize (Zea mays L.) as Affected by Temperature and Antidotes **Source:** Acta Agron.Hung. 45(4):443-448

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	INJ	GINJ	NAT	hv	F	LOAEL: 1 L/ha Orig 1 L/ha	NR Orig	5	100	FIELD	GS		3.2 % (OM)

Ref # 73301 **Author:** "Mccarty, L.B., D.W. Porter, D.L. Colvin, D.G. Shilling, and D.W. Hall" **Year:** 1995

Title: St. Augustinegrass Rooting Following Preemergence Herbicide Application **Source:** J.Am.Soc.Hortic.Sci. 120(3):374-378

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
St. Augustine grass *(Stenotaphrum secundatum)*	GRO	GRO	LGTH	ART	36 d	F	LOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	2	100	LAB	HS	6	2.5 % (OM)
St. Augustine grass *(Stenotaphrum secundatum)*	GRO	GRO	LGTH	ART	36 d	F	LOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	2	100	LAB	HS	6	2.5 % (OM)

Ref # 73417 **Author:** "Wilkinson, R.E., R.R. Duncan, S.A. Meredith, and K.K. Hatzios" **Year:** 1993

Title: Growth and Physiological Responses of Sorghum Cultivars Exposed to Excess H+ and the Herbicide Metolachlor **Source:** Can.J.Bot. 71(4):533-540

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	LAB	DA	6	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	LAB	DA	4	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	LAB	DA		NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	LAB	DA	5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	LAB	DA	4	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA	6	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	LAB	DA	4.5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	LAB	DA	4	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	LAB	DA	5.5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	LAB	DA	5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA	5.5	NR

Ref # 73417 **Author:** "Wilkinson, R.E., R.R. Duncan, S.A. Meredith, and K.K. Hatzios" **Year:** 1993

Title: Growth and Physiological Responses of Sorghum Cultivars Exposed to Excess H+ and the Herbicide Metolachlor **Source:** Can.J.Bot. 71(4):533-540

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	LAB	DA	4	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	LAB	DA	5.5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	LAB	DA	6	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	LAB	DA	4.5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	LAB	DA	6	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA	6	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA		NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	LAB	DA		NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	LAB	DA	5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA	4.5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	LAB	DA	6	NR

Ref # 73417 **Author:** "Wilkinson, R.E., R.R. Duncan, S.A. Meredith, and K.K. Hatzios" **Year:** 1993

Title: Growth and Physiological Responses of Sorghum Cultivars Exposed to Excess H+ and the Herbicide Metolachlor **Source:** Can.J.Bot. 71(4):533-540

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	LAB	DA	5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA	4.5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	LAB	DA	5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	LAB	DA	4	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA	4.5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA	5	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	LAB	DA	4	NR
broom-corn (Sorghum bicolor)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	LAB	DA	5.5	NR

Ref # 73424 **Author:** "Talbert, R.E., L.R. Oliver, R.E. Frans, R.A. Wichert, V.F. Carey, D.H. Johnson, and D.F. Ruff" **Year:** 1993

Title: Field Screening of New Chemicals for Herbicidal Activity 1992 **Source:** Ark.Agric.Exp.Stn.Res.Ser. (426):1-22

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73424 **Author:** "Talbert, R.E., L.R. Oliver, R.E. Frans, R.A. Wichert, V.F. Carey, D.H. Johnson, and D.F. Ruff" **Year:** 1993

Title: Field Screening of New Chemicals for Herbicidal Activity 1992 **Source:** Ark.Agric.Exp.Stn.Res.Ser. (426):1-22

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Barnyard grass (*Echinochloa crus-galli*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Bread wheat (*Triticum aestivum*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
broadleaf signalgrass (*Brachiaria platyphylla*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
broom-corn (*Sorghum bicolor*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Common oat (*Avena sativa*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Corn (*Zea mays*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
giant bristlegrass (*Setaria faberi*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Johnsongrass (*Sorghum halepense*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
purple crabgrass (*Digitaria sanguinalis*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Rice (*Oryza sativa*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Rice (*Oryza sativa*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Daylily (*Hemerocallis sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Daylily (*Hemerocallis sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Daylily (*Hemerocallis sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Daylily (*Hemerocallis sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
iris (*Iris sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
iris (*Iris sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
iris (*Iris sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
iris (*Iris sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6	4.3 % (OM)
lily (*Lilium sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
lily (*Lilium sp.*)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Little bluestem (*Schizachyrium scoparium*)	PHY	INJ	GINJ	NAT	hv	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)

Ref # 73736 **Author:** "Calkins, J.B., B.T. Swanson, and D.L. Newman" **Year:** 1996

Title: Weed Control Strategies for Field Grown Herbaceous Perennials **Source:** J.Environ.Hortic. 14(4):221-227

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Little bluestem *(Schizachyrium scoparium)*	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Sheep fescue *(Festuca ovina)*	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Sheep fescue *(Festuca ovina)*	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)

Ref # 73738 **Author:** "Hatzios, K.K." **Year:** 1984

Title: Interactions of Tebuthiuron with Chloroacetanilide Herbicides on Corn (Zea mays L.) Seedlings Safened or Unsafened with the Antidote R-25788 **Source:** Zizaniology 1(3):

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	GRO	GRO	DWGT	ART	30 d	F	NOAEL: 7.99232 lb/acr Orig 8.96 kg/ha	NR Orig	4	100	Lab	HS	nr	NR

Ref # 73786 **Author:** "Ramakrishna, A., C.K. Ong, and S.L.N. Reddy" **Year:** 1991

Title: Studies on Integrated Weed Management in Sorghum **Source:** Trop.Pest Manag. 37(2):159-161

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn *(Sorghum bicolor)*	GRO	GRO	LGTH	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	1	100	FieldN	EN	8.4	NR
broom-corn *(Sorghum bicolor)*	GRO	GRO	LGTH	NAT	hv	A	LOAEL: 0.669 lb/acre Orig 0.75 AI kg/ha	NR Orig	3	100	FieldN	EN	8.4	NR

Ref # 73801 **Author:** "McMullan, P.M., and R.E. Blackshaw" **Year:** 1995

Title: Postemergence Green Foxtail (Setaria viridis) Control in Corn (Zea mays) in Western Canada **Source:** 9(1):37-43

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
Corn (Zea mays)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
Corn (Zea mays)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
Corn (Zea mays)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)

Ref # 73804 **Author:** "Kunkel, D.L., R.R. Bellinder, and J.C. Steffens" **Year:** 1996

Title: Safeners Reduce Corn (Zea mays) Chloroacetanilide and Dicamba Injury Under Different Soil Temperatures **Source:** Weed Technol. 10(1):115-120

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	FieldA	HS	7.5	3.4 % (OM)

Ref # 73804 **Author:** "Kunkel, D.L., R.R. Bellinder, and J.C. Steffens" **Year:** 1996

Title: Safeners Reduce Corn (Zea mays) Chloroacetanilide and Dicamba Injury Under Different Soil Temperatures **Source:** Weed Technol. 10(1):115-120

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	FieldA	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	FieldA	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	FieldA	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	FieldA	HS	7.5	3.4 % (OM)
Corn (Zea mays)	GRO	GRO	LGTH	NAT	21 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	FieldA	HS	7.5	3.4 % (OM)

Ref # 73806 **Author:** "Derr, J.F., R.S. Chandran, and W.D. Ward" **Year:** 1996

Title: Preemergence and Postemergence Yellow Nutsedge (Cyperus esculentus) Control with MON 12000 in Nursery Crops **Source:** Weed Technol. 10(1):95-99

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73806 **Author:** "Derr, J.F., R.S. Chandran, and W.D. Ward" **Year:** 1996

Title: Preemergence and Postemergence Yellow Nutsedge (Cyperus esculentus) Control with MON 12000 in Nursery Crops **Source:** Weed Technol. 10(1):95-99

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge *(Cyperus esculentus)*	GRO	GRO	WGHT	NAT	77 d	F	LOAEL: 1.98024 lb/acre Orig 2.22 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)

Ref # 73809 **Author:** "Mersie, W., T. Mebrahtu, and M. Rangappa" **Year:** 1989

Title: "Ozone-Metolachlor Interactions on Corn (Zea mays), Bean (Phaseolus vulgaris), and Soybean (Glycine max)" **Source:** Weed Technol. 3(4):650-654

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	GRO	GRO	WGHT	ART	21 d	F	NOAEL: 1 ppm Orig 1 ppmw	NR Orig	3	100	Lab	EN		NR

Ref # 73811 **Author:** "Braverman, M.P., T.L. Lavy, and R.E. Talbert" **Year:** 1985

Title: Effects of Metolachlor Residues on Rice (Oryza sativa) **Source:** Weed Sci. 33(6):819-824

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Rice *(Oryza sativa)*	GRO	GRO	HGHT	NAT	21 d	F	LOAEL: 0.2 ppm Orig 0.2 ppmw	NR Orig	2	100	Lab	EN		NR

Ref # 73910 **Author:** "McCarty,L.B.; Porter,D.W.; Colvin,D.L." **Year:** 1995

Title: Sod Regrowth of St. Augustinegrass After Preemergence Herbicide Application **Source:** Agron.J.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73910 **Author:** "McCarty,L.B.; Porter,D.W.; Colvin,D.L." **Year:** 1995

Title: Sod Regrowth of St. Augustinegrass After Preemergence Herbicide Application **Source:** Agron.J.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
St. Augustine grass (*Stenotaphrum secundatum*)	PHY	INJ	GINJ	NAT	14 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	HS	6.4	1.5 % (OM)
St. Augustine grass (*Stenotaphrum secundatum*)	PHY	INJ	GINJ	NAT	14 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	HS	6.2	2.6 % (OM)

Ref # 73915 **Author:** "Talbert,R.E.; Kendig,J.A.; Earnest,L.D.; Guy,C.; Barnes,C.J.; Lavy,T.L.; Frans,R.E.; Oliver,L.R." **Year:** 1989

Title: "Winter Wheat Response to Carryover from Herbicides Used on Corn, Cotton, Grain Sorghum and Soybeans" **Source:** Ark.Agric.Exp.Stn.Res.Ser.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bread wheat (*Triticum aestivum*)	PHY	INJ	GINJ	NAT	~120 d	A	NOAEL: 1.5 lb/acre Orig 1.5 ai lb/acre	NR Orig	1	100	FieldN	DA		1.2 % (OM)
Bread wheat (*Triticum aestivum*)	PHY	INJ	GINJ	NAT	~70 d	A	NOAEL: 0.5 lb/acre Orig 0.5 ai lb/acre	LOAEL: 1 lb/acre Orig 1 ai lb/acre	4	100	FieldN	DA		1.2 % (OM)

Ref # 73923 **Author:** "Johnson III,W.C.; Mullinix,B.G.,Jr." **Year:** 1994

Title: Use of F6285 for Weed Control in Peanut: Efficacy and Crop Injury **Source:** Peanut Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge (*Cyperus esculentus*)	PHY	INJ	GINJ	NAT	30 d	A	LOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	FieldN	GS		0.9 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	PHY	INJ	GINJ	NAT	30 d	A	LOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	FieldN	GS		0.7 % (OM)

Ref # 73939 **Author:** "Ghosheh,H.Z.; Chandler,J.M." **Year:** 1998

Title: Johnsongrass (Sorghum halepense) Control Systems for Field Corn (Zea mays) Utilizing Crop Rotation and Herbicides **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	GRO	GRO	HGHT	NAT	hv	A	LOAEL: 2.24784 lb/acre Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)
Corn (Zea mays)	GRO	GRO	HGHT	NAT	hv	A	NOAEL: 2.24784 lb/acr Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)

Ref # 73949 **Author:** "Kwon,C.S.; Penner,D." **Year:** 1995

Title: The Interaction of Insecticides with Herbicide Activity **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	GRO	GRO	HGHT	ART	21 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	21 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	2	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	21 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	2	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	21 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	2	100	Lab	HS	6.2	NR

Ref # 73959 **Author:** "Rowe,L.; Penner,D." **Year:** 1990

Title: Factors Affecting Chloroacetanilide Injury to Corn (Zea mays) **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73959 **Author:** "Rowe,L.; Penner,D." **Year:** 1990

Title: Factors Affecting Chloroacetanilide Injury to Corn (Zea mays) **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR

Ref # 73959 **Author:** "Rowe,L.; Penner,D." **Year:** 1990

Title: Factors Affecting Chloroacetanilide Injury to Corn (Zea mays) **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	GRO	GRO	HGHT	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR

Ref # 73959 **Author:** "Rowe,L.; Penner,D." **Year:** 1990

Title: Factors Affecting Chloroacetanilide Injury to Corn (Zea mays) **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	4	100	Lab	HS	6.2	NR
Corn (Zea mays)	PHY	INJ	GINJ	ART	10 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	Lab	HS	6.2	NR

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
garden onion (Allium cepa)	GRO	GRO	SIZE	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	GRO	GRO	SIZE	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	GRO	GRO	SIZE	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	GRO	GRO	SIZE	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	GRO	GRO	SIZE	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	GRO	GRO	SIZE	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	PHY	INJ	GINJ	NAT	<60 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	PHY	INJ	GINJ	NAT	<60 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	PHY	INJ	GINJ	NAT	60 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	PHY	INJ	GINJ	NAT	60 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	PHY	INJ	GINJ	NAT	60 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)

Ref # 73961 **Author:** "Keeling,J.W.; Bender,D.A.; Abernathy,J.R." **Year:** 1990

Title: Yellow Nutsedge (Cyperus esculentus) Management in Transplanted Onions (Allium cepa) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
garden onion *(Allium cepa)*	PHY	INJ	GINJ	NAT	60 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)

Ref # 73970 **Author:** "Sharma,V.; Thakur,D.R.; Sharma,J.J." **Year:** 1998

Title: Effect of Metolachlor and Its Combination with Atrazine on Weed Control in Maize (Zea mays) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	GRO	GRO	HGHT	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100		EN	6.7	NR

Ref # 73971 **Author:** Rout D;Satapathy MR; **Year:** 1996

Title: Chemical Weed Control in Rainfed Maize (Zea mays) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	GRO	GRO	WGHT	NAT	hv	F	NOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN		NR
Corn *(Zea mays)*	GRO	GRO	WGHT	NAT	hv	F	NOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73974 **Author:** Berzsenyi Z;Gyorffy B; **Year:** 1989

Title: Comparative Study of the Phytotoxicity of Acetanilide Herbicides on Maize (Zea mays L.) as Affected by Temperature and Antidotes **Source:**

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	PHY	INJ	GINJ	ART	14 d	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	4	100	Lab	HS		NR

Other

Ref # 25746 **Author:** "Mellis, J.M., P. Pillai, D.E. Davis, and B. Truelove" **Year:** 1982

Title: Metolachlor and Alachlor Effects on Membrane Permeability and Lipid Synthesis **Source:** Weed Sci. 30:399-404

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	PHY	PHY	PRET	HYP	4 d	F	LOAEL: 0.00001 M Orig 0.00001 M	NR Orig	2	100	Lab			NR
garden onion *(Allium cepa)*	PHY	PHY	PRET	HYP	3 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	2	100	Lab			NR

Ref # 40621 **Author:** "Vengris, J." **Year:** 1977

Title: Annual Weed Control in Alfalfa New Seedlings **Source:** Proc.Northeast.Weed Sci.Soc. 31:99-103

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Fall panicgrass *(Panicum dichotomiflorum)*	POP	POP	BMAS	NAT	60 d	A	LOAEL: 2 lb/acre Orig 2 ai lb/acre	NR Orig	2	100	FieldN	DA		NR
Fall panicgrass *(Panicum dichotomiflorum)*	POP	POP	BMAS	NAT	60 d	A	LOAEL: 2 lb/acre Orig 2 ai lb/acre	NR Orig	2	100	FieldN	DA		NR

Ref # 40627 **Author:** "Brown, J.F., and H.D. Swingle" **Year:** 1977

Title: Herbicide Evaluation in Vegetable Crops **Source:** P So Wd S S 30:168-175

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses *(NR Poaceae)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5 lb/acre Orig 1.5 lb/acre	NR Orig	2	100	FieldN	DA		NR
grasses *(NR Poaceae)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5 lb/acre Orig 1.5 lb/acre	NR Orig	2	100	FieldN	DA		NR

Ref # 40630 **Author:** "Henne, R.C." **Year:** 1977

Title: New Compounds with Potential for Weed Control in Tomatoes **Source:** Proc.Northeast.Weed Sci.Soc. 31:207-214

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses *(NR Poaceae)*	POP	POP	BMAS	NAT	~90 d	A	NOAEL: 2.676 lb/acre Orig 3 ai kg/ha	NR Orig	2	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)
grasses *(NR Poaceae)*	POP	POP	BMAS	NAT	~30 d	A	NOAEL: 3.0328 lb/acre Orig 3.4 ai kg/ha	NR Orig	1	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)
grasses *(NR Poaceae)*	POP	POP	BMAS	NAT	~30 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	2	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)

Ref # 40869 **Author:** "Vengris, J." **Year:** 1977

Title: Annual Weed Control in Field Corn **Source:** Proc.Northeast.Weed Sci.Soc. 31:1-5

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	120 d	A	NOAEL: 2 lb/acre Orig 2 ai lb/acre	NR Orig	1	100	FieldN	DA		NR

Ref # 40869 **Author:** "Vengris, J." **Year:** 1977

Title: Annual Weed Control in Field Corn **Source:** Proc.Northeast.Weed Sci.Soc. 31:1-5

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses *(NR Poaceae)*	POP	POP	CNTL	NAT	120 d	A	LOAEL: 2 lb/acre Orig 2 ai lb/acre	NR Orig	1	100	FieldN	DA		NR

Ref # 44022 **Author:** "Pillai, P., D.E. Davis, and B. Truelove" **Year:** 1979

Title: "Effects of Metolachlor on Germination, Growth, Leucine Uptake and Protein Synthesis" **Source:** Weed Sci. 27:634-637

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bread wheat *(Triticum aestivum)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
common barley *(Hordeum vulgare)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	3	100	Lab	DA		NR
Common oat *(Avena sativa)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	3	100	Lab	DA		NR
Corn *(Zea mays)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
Ryegrass *(Lolium sp.)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR

Ref # 66126 **Author:** "Foy, C.L., and H.L. Witt" **Year:** 1997

Title: "SAN 582, Alachlor, and Metolachlor Control Triazine-Resistant (TR) Smooth Pigweed (Amaranthus hybridus) in No-Till Corn (Zea mays)" **Source:** Weed Technol. 11(3):623-625

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 66126 **Author:** "Foy, C.L., and H.L. Witt" **Year:** 1997

Title: "SAN 582, Alachlor, and Metolachlor Control Triazine-Resistant (TR) Smooth Pigweed (Amaranthus hybridus) in No-Till Corn (Zea mays)" **Source:** Weed Technol. 11(3):623-625

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	EN	7.3	NR

Ref # 66847 **Author:** "Grichar, W.J., R.G. Lemon, K.D. Brewer, and B.W. Minton" **Year:** 2001

Title: S-Metolachlor Compared with Metolachlor on Yellow Nutsedge (Cyperus esculentus) and Peanut (Arachis hypogaea) **Source:** Weed Technol. 15(1):107-111

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	CNTL	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100		GM	6.9-7.2	NR
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	CNTL	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	CNTL	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	CNTL	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	CNTL	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	CNTL	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR

Ref # 70441 **Author:** "Talbert, R.E., R.A. Wichert, V.F. Carey III, D.H. Johnson, D.F. Ruff, and N.R. Burgos" **Year:** 1993

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1992" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 429:1-29

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Indian goosegrass *(Eleusine indica)*	POP	POP	CNTL	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Indian goosegrass *(Eleusine indica)*	POP	POP	CNTL	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Indian goosegrass *(Eleusine indica)*	POP	POP	CNTL	NAT	42 d	A	NOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	CNTL	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	CNTL	NAT	42 d	A	NOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	CNTL	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR

Ref # 70865 **Author:** "Derr, J.F." **Year:** 1993

Title: Wildflower Tolerance to Metolachlor and Metolachlor Combined with Other Broadleaf Herbicides **Source:** Hortscience 28(10):1023-1026

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	2	100	FIELD	HS		NR
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	2	100	FIELD	HS		NR

Ref # 71312 **Author:** "Scarponi, L., P. Perucci, and C. Marucchini" **Year:** 1989

Title: "Effect of Alachlor, Metolachlor, Atrazine and Simazine Residues on Some Enzyme Activities of Maize Tissues" **Source:** Agrochimica 33(6):403-411

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	BCM	ENZ	ALAD	NAT	4 d	F	LOAEL: 0.00001 M Orig 0.00001 M	NR Orig	1	100	LAB	DA		NR
Corn *(Zea mays)*	BCM	ENZ	ALAD	NAT	4 d	F	NOAEL: 0.00001 M Orig 0.00001 M	NR Orig	1	100	LAB	DA		NR

Ref # 72890 **Author:** "Novosel, K.M., K.A. Renner, J.J. Kells, and E. Spandl" **Year:** 1998

Title: Metolachlor Efficacy as Influenced by Three Acetolactate Synthase-Inhibiting Herbicides **Source:** Weed Technol. 12(2):248-253

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
giant bristlegrass *(Setaria faberi)*	POP	POP	CNTL	NAT	56 d	F	LOAEL: 0.49952 lb/acre Orig 0.56 kg/ha	NR Orig	3	100	FIELDN	NR	6.6-7.1	NR
giant bristlegrass *(Setaria faberi)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.49952 lb/acre Orig 0.56 kg/ha	NR Orig	5	100	FIELDN	NR	7.2-7.8	2.7 % (OM)
giant bristlegrass *(Setaria faberi)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.49952 lb/acre Orig 0.56 kg/ha	NR Orig	3	100	FIELDN	NR	6.6-7.1	NR
giant bristlegrass *(Setaria faberi)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.49952 lb/acre Orig 0.56 kg/ha	NR Orig	5	100	FIELDN	NR	7.2-7.8	3.9 % (OM)

Ref # 73228 **Author:** "Yenne, S.P., and K.K. Hatzios" **Year:** 1989

Title: Influence of Oxime Ether Safeners and Metolachlor on Acetate Incorporation into Lipids and on Acetyl-CoA Carboxylase of Grain Sorghum **Source:** Pestic.Biochem.Physiol. 35(2):146-154

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	BCM	ENZ	ACAC	FLT	2 d	F	NOAEL: 10 uM Orig 10 uM	NR Orig	1	100	LAB	DA		NR
broom-corn (Sorghum bicolor)	BCM	BCM	LIPD	FLT	2 d	F	NOAEL: 10 uM Orig 10 uM	NR Orig	1	100	LAB	DA		NR
broom-corn (Sorghum bicolor)	REP	REP	GERM	FLT	2.5 d	F	NOAEL: 10 uM Orig 10 uM	NR Orig	1	100	LAB	DA		NR

Ref # 73229 **Author:** "Wilkinson, R.E." **Year:** 1988

Title: Consequences of Metolachlor Induced Inhibition of Gibberellin Biosynthesis in Sorghum Seedlings **Source:** Pestic.Biochem.Physiol. 32(1):25-37

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	BCM	ENZ	AMYL	ART	366666 d	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	Lab	GM		NR
broom-corn (Sorghum bicolor)	BCM	ENZ	AMYL	ART	366666 d	F	LOAEL: 3.6 uM Orig 3.6 uM	NR Orig	1	100	Lab	WA		NR
broom-corn (Sorghum bicolor)	BCM	ENZ	ICLY	ART	5 d	F	LOAEL: 0.44 uM Orig 0.44 uM	NR Orig	4	100	Lab	GM		NR

Ref # 73236 **Author:** "Talbert, R.E., M.J. Tierney, V.F. Carey III, and M.J. Kitt" **Year:** 1994

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1993" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 440:1-60

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
annual bluegrass *(Poa annua)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
annual bluegrass *(Poa annua)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
annual bluegrass *(Poa annua)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
annual bluegrass *(Poa annua)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Barnyard grass *(Echinochloa crus-galli)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Barnyard grass *(Echinochloa crus-galli)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Indian goosegrass *(Eleusine indica)*	POP	POP	CNTL	NAT	21 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Indian goosegrass *(Eleusine indica)*	POP	POP	CNTL	NAT	63 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	CNTL	NAT	21 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	CNTL	NAT	63 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)

Ref # 73236 **Author:** "Talbert, R.E., M.J. Tierney, V.F. Carey III, and M.J. Kitt" **Year:** 1994

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1993" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 440:1-60

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	CNTL	NAT	21 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)

Ref # 73246 **Author:** "Gilreath, J.P., J.W. Noling, and B.M. Santos" **Year:** 2004

Title: Methyl Bromide Alternatives for Bell Pepper (Capsicum annuum) and Cucumber (Cucumis sativus) Rotations **Source:** Crop Prot. 23(4):347-351

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
nutgrass (*Cyperus rotundus*)	POP	POP	CNTL	NAT	21 d	F	LOAEL: 2.007 lb/acre Orig 2.25 kg/ha	NR Orig	1	100	FIELDN	HS	7.3	NR

Ref # 73253 **Author:** "Derr, J.F., and B.L. Appleton" **Year:** 1989

Title: Weed Control with Landscape Fabrics **Source:** J.Environ.Hortic. 7(4):129-133

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
purple crabgrass (*Digitaria sanguinalis*)	POP	POP	ABND	ART	28 d	A	NOAEL: 4.014 lb/acre Orig 4.5 AI kg/ha	NR Orig	1	100	LAB	DA		NR
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	ABND	ART	42 d	A	LOAEL: 4.014 lb/acre Orig 4.5 AI kg/ha	NR Orig	1	100	LAB	DA		NR

Ref # 73254 **Author:** "Whitwell, T., and J. Kelly" **Year:** 1989

Title: Effects of Preemergence Herbicides on Hosta and Daylily **Source:** J.Environ.Hortic. 7(1):29-31

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Daylily *(Hemerocallis sp.)*	REP	REP	INFL	ART	90 d	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	3	100	FIELDN	HS	6.2	NR
Plantain lily *(Hosta sp.)*	POP	POP	ABND	ART	16 d	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	3	100	FIELDN	HS	6.2	NR

Ref # 73255 **Author:** "Fleming, A.A., P.A. Banks, and J.G. Legg" **Year:** 1988

Title: Differential Response of Maize Inbreds to Bentazon and Other Herbicides **Source:** Can.J.Plant Sci. 68(2):501-508

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	MOR	MOR	MORT	ART	23 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn *(Zea mays)*	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn *(Zea mays)*	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn *(Zea mays)*	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn *(Zea mays)*	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn *(Zea mays)*	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn *(Zea mays)*	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR

Ref # 73255 **Author:** "Fleming, A.A., P.A. Banks, and J.G. Legg" **Year:** 1988

Title: Differential Response of Maize Inbreds to Bentazon and Other Herbicides **Source:** Can.J.Plant Sci. 68(2):501-508

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR

Ref # 73255 **Author:** "Fleming, A.A., P.A. Banks, and J.G. Legg" **Year:** 1988

Title: Differential Response of Maize Inbreds to Bentazon and Other Herbicides **Source:** Can.J.Plant Sci. 68(2):501-508

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	MOR	MOR	MORT	ART	23 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FIELDN	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR

Ref # 73255 **Author:** "Fleming, A.A., P.A. Banks, and J.G. Legg" **Year:** 1988

Title: Differential Response of Maize Inbreds to Bentazon and Other Herbicides **Source:** Can.J.Plant Sci. 68(2):501-508

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR

Ref # 73255 **Author:** "Fleming, A.A., P.A. Banks, and J.G. Legg" **Year:** 1988

Title: Differential Response of Maize Inbreds to Bentazon and Other Herbicides **Source:** Can.J.Plant Sci. 68(2):501-508

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR

Ref # 73255 **Author:** "Fleming, A.A., P.A. Banks, and J.G. Legg" **Year:** 1988

Title: Differential Response of Maize Inbreds to Bentazon and Other Herbicides **Source:** Can.J.Plant Sci. 68(2):501-508

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR

Ref # 73255 **Author:** "Fleming, A.A., P.A. Banks, and J.G. Legg" **Year:** 1988

Title: Differential Response of Maize Inbreds to Bentazon and Other Herbicides **Source:** Can.J.Plant Sci. 68(2):501-508

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn (Zea mays)	POP	POP	BMAS	ART	16 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	LAB	HS		NR

Ref # 73259 **Author:** "Gangwar, K.S., K.P. Niranjan, and O.P. Singh" **Year:** 1991

Title: Weed Management in Sorghum (Sorghum bicolor) + Pigeonpea (Cajanus cajan) Intercropping System in Dryland **Source:** Indian J.Agric.Sci. 61(10):757-759

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FIELDN	GM	7.35	NR
broom-corn (Sorghum bicolor)	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.0669 lb/acre Orig 0.075 kg/ha	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	2	100	FIELDN	GM	7.35	NR

Ref # 73266 **Author:** "Gilreath, J.P." **Year:** 1987

Title: Chemical Weed Control in Gypsophila **Source:** Hortscience 22(3):446-448

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73266 **Author:** "Gilreath, J.P." **Year:** 1987

Title: Chemical Weed Control in Gypsophila **Source:** Hortscience 22(3):446-448

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses *(NR Poaceae)*	POP	POP	CNTL	NAT	32 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	FieldN	HS	6.4	0.7 % (OM)

Ref # 73275 **Author:** "Berzsenyi, Z., B. Gyorffy, T. Arendas, P. Bonis, and D.Q. Lap" **Year:** 1997

Title: Studies on the Phytotoxicity of Herbicides in Maize (Zea mays L.) as Affected by Temperature and Antidotes **Source:** Acta Agron.Hung. 45(4):443-448

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1 L/ha Orig 1 L/ha	NR Orig	5	100	FIELD	GS		3.2 % (OM)

Ref # 73304 **Author:** "Scarponi, L., M.N. Alla, and L. Martinetti" **Year:** 1992

Title: Metolachlor in Corn (Zea mays) and Soybean (Glycine max): Persistence and Biochemical Signs of Stress During Its Detoxification **Source:** J.Agric.Food Chem. 40(5):884-889

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	BCM	ENZ	GSTR	ART	4 d	A	LOAEL: 2.89008 lb/acre Orig 3.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn *(Zea mays)*	BCM	ENZ	GSTR	ART	4 d	A	LOAEL: 2.89008 lb/acre Orig 3.24 kg/ha	NR Orig	1	100	LAB	HS		NR
Corn *(Zea mays)*	BCM	BCM	PRCO	ART	4 d	A	LOAEL: 2.89008 lb/acre Orig 3.24 kg/ha	NR Orig	1	100	LAB	HS		NR

Ref # 73304 **Author:** "Scarponi, L., M.N. Alla, and L. Martinetti" **Year:** 1992

Title: Metolachlor in Corn (Zea mays) and Soybean (Glycine max): Persistence and Biochemical Signs of Stress During Its Detoxification **Source:** J.Agric.Food Chem. 40(5):884-889

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	BCM	BCM	PRCO	ART	4 d	A	LOAEL: 2.89008 lb/acre Orig 3.24 kg/ha	NR Orig	1	100	LAB	HS		NR

Ref # 73529 **Author:** "Davies, F.T.Jr., and S.A. Duray" **Year:** 1992

Title: Effect of Preemergent Herbicide Application on Rooting and Subsequent Liner Growth of Selected Nursery Crops **Source:** J.Environ.Hortic. 10(3):181-186

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bermudagrass *(Cynodon dactylon)*	POP	POP	BMAS	ART	28 d	F	NOAEL: 0.29882 lb/acr Orig 6.7 kg/ha	NR Orig	3	5		GG	nr	NR
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	BMAS	ART	28 d	F	NOAEL: 0.29882 lb/acr Orig 6.7 kg/ha	NR Orig	3	5		GG	nr	NR

Ref # 73531 **Author:** "Rodrigues, G.S., D. Pimentel, and L.H. Weinstein" **Year:** 1998

Title: In Situ Assessment of Pesticide Genotoxicity in an Integrated Pest Management Program I - Tradescantia Micronucleus Assay **Source:** Mutat.Res. 412(3):235-244

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Spiderwort *(Tradescantia sp.)*	CEL	GEN	BRAK	HYP	1.25 d	F	NOAEL: 10 ppm Orig 10 ppm	LOAEL: 50 ppm Orig 50 ppm	3	100	Lab	HP	nr	NR

Ref # 73786 **Author:** "Ramakrishna, A., C.K. Ong, and S.L.N. Reddy" **Year:** 1991

Title: Studies on Integrated Weed Management in Sorghum **Source:** Trop.Pest Manag. 37(2):159-161

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broom-corn (Sorghum bicolor)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.669 lb/acre Orig 0.75 AI kg/ha	NR Orig	3	100	FieldN	EN	8.4	NR
broom-corn (Sorghum bicolor)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	1	100	FieldN	EN	8.4	NR

Ref # 73787 **Author:** "Ibrahim, A.F., S.A. Shaban, and E.A. El-Metwally" **Year:** 1987

Title: Effect of Some Herbicides on Oil Seed Rape (Brassica napus L.) and Associated Weeds **Source:** J.Agron.Crop Sci. 158(4):236-240

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses (NR Poaceae)	POP	POP	CNTL	NAT	60 d	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
grasses (NR Poaceae)	POP	POP	CNTL	NAT	hv	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
grasses (NR Poaceae)	POP	POP	CNTL	NAT	hv	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
grasses (NR Poaceae)	POP	POP	CNTL	NAT	60 d	A	LOAEL: 0.002136 lb/acr Orig 2.4 AI g/ha	NR Orig	2	50	FieldN	HS		NR

Ref # 73792 **Author:** "Mishra, J.S., and V.M. Bhan" **Year:** 1996

Title: Chemical Control of Carrot Grass (Parthenium hysterophorus) and Associated Weeds in Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 66(9):518-521

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73792 **Author:** "Mishra, J.S., and V.M. Bhan" **Year:** 1996

Title: Chemical Control of Carrot Grass (Parthenium hysterophorus) and Associated Weeds in Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 66(9):518-521

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses *(NR Poaceae)*	POP	POP	ABND	NAT	60 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	6.7	NR
sedges *(NR Cyperaceae)*	POP	POP	ABND	NAT	60 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	6.7	NR

Ref # 73793 **Author:** "Intodia, S.K., L.R. Yadav, and O.P. Tomar" **Year:** 1996

Title: Effect of Herbicides on Weed-Control Efficiency and Yield in Maize (Zea mays)-Soybean (Glycine max) Intercropping System **Source:** Indian J.Agric.Sci. 66(12):730-731

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FieldN	HS	8.3	0.63 % (OC)

Ref # 73794 **Author:** "Mueller-Warrant, G.W., C.W. Young III, and M.E. Mellbye" **Year:** 1994

Title: Influence of Residue Removal Method and Herbicides on Perennial Ryegrass Seed Production: I. Weed control **Source:** Agron.J. 86(4):677-684

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Perennial ryegrass *(Lolium perenne)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.4-5.8	3.5 % (OM)
Perennial ryegrass *(Lolium perenne)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.4-5.8	3.5 % (OM)

Ref # 73794 **Author:** "Mueller-Warrant, G.W., C.W. Young III, and M.E. Mellbye" **Year:** 1994

Title: Influence of Residue Removal Method and Herbicides on Perennial Ryegrass Seed Production: I. Weed control **Source:** Agron.J. 86(4):677-684

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Perennial ryegrass (Lolium perenne)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.4-6.2	2.4 % (OM)
Perennial ryegrass (Lolium perenne)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.4-6.2	2.4 % (OM)

Ref # 73795 **Author:** "Murthy, G.M.A., and J.V.N. Gowda" **Year:** 1993

Title: Evaluation of Herbicides for Weed Control in Tuberose (Polianthes tuberosa Linn.) cv. Double **Source:** Crop Res.(Hisar) 6(1):176-178

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tuberose (Polianthes tuberosa)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	3	100	FieldN	EN		NR

Ref # 73798 **Author:** "Singh, R., R.P. Jangir, and B.L. Poonia" **Year:** 1995

Title: Evaluation of Herbicides for Control of Weeds in Chilli (Capsicum annuum) **Source:** Indian J.Agric.Sci. 65(10):723-726

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses (NR Poaceae)	POP	POP	ABND	NAT	25 d	F	LOAEL: 0.446 lb/acre Orig 0.5 kg/ha	NR Orig	3	100	FieldN	HS	8.1	0.31 % (NR)

Ref # 73801 **Author:** "McMullan, P.M., and R.E. Blackshaw" **Year:** 1995

Title: Postemergence Green Foxtail (Setaria viridis) Control in Corn (Zea mays) in Western Canada **Source:** 9(1):37-43

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (Zea mays)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	7.8	3.6 % (OM)
Corn (Zea mays)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	7.8	3.6 % (OM)
Corn (Zea mays)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	2 % (OM)
Corn (Zea mays)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
Corn (Zea mays)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
Corn (Zea mays)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	2 % (OM)
Corn (Zea mays)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
Corn (Zea mays)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
wild millet (Setaria viridis)	POP	POP	BMAS	NAT	:1 to 28 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
wild millet (Setaria viridis)	POP	POP	BMAS	NAT	:1 to 28 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	7.8	3.6 % (OM)
wild millet (Setaria viridis)	POP	POP	BMAS	NAT	:1 to 28 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)

Ref # 73801 **Author:** "McMullan, P.M., and R.E. Blackshaw" **Year:** 1995

Title: Postemergence Green Foxtail (Setaria viridis) Control in Corn (Zea mays) in Western Canada **Source:** 9(1):37-43

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
wild millet (Setaria viridis)	POP	POP	BMAS	NAT	1 to 28 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
wild millet (Setaria viridis)	POP	POP	BMAS	NAT	1 to 28 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	2 % (OM)
wild millet (Setaria viridis)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	7.8	3.6 % (OM)
wild millet (Setaria viridis)	POP	POP	BMAS	NAT	1 to 28 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	4 % (OM)
wild millet (Setaria viridis)	POP	POP	BMAS	NAT	1 to 28 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	GS	8	2 % (OM)

Ref # 73803 **Author:** "Heatherly, L.G., and C.D. Elmore" **Year:** 1991

Title: Grass Weed Control for Soybean (Glycine max) on Clay Soil **Source:** Weed Technol. 5(1):103-107

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses (NR Poaceae)	POP	POP	CNTL	NAT	hv	A	LOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	HS		NR
grasses (NR Poaceae)	POP	POP	CNTL	NAT	hv	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	HS		NR
grasses (NR Poaceae)	POP	POP	CNTL	NAT	hv	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	HS		NR
grasses (NR Poaceae)	POP	POP	CNTL	NAT	hv	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	HS		NR

Ref # 73806 **Author:** "Derr, J.F., R.S. Chandran, and W.D. Ward" **Year:** 1996

Title: Preemergence and Postemergence Yellow Nutsedge (Cyperus esculentus) Control with MON 12000 in Nursery Crops **Source:** Weed Technol. 10(1):95-99

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge (Cyperus esculentus)	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.98024 lb/acre Orig 2.22 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)

Ref # 73808 **Author:** "Glaze, N.C." **Year:** 1988

Title: "Weed Control in Direct-Seeded Tomato, Lycopersicon esculentum for Transplants" **Source:** Weed Technol. 2(3):333-337

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses (NR Poaceae)	POP	POP	ABND	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	GS		NR
purple crabgrass (Digitaria sanguinalis)	POP	POP	ABND	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	3	100	FieldN	GS		NR
Yellow nutsedge (Cyperus esculentus)	POP	POP	ABND	NAT	hv	F	LOAEL: 0.74928 lb/acre Orig 0.84 kg/ha	NR Orig	3	100	FieldN	GS		NR
Yellow nutsedge (Cyperus esculentus)	POP	POP	ABND	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	GS		NR
Yellow nutsedge (Cyperus esculentus)	POP	POP	ABND	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	3	100	FieldN	GS		NR

Ref # 73811 **Author:** "Braverman, M.P., T.L. Lavy, and R.E. Talbert" **Year:** 1985

Title: Effects of Metolachlor Residues on Rice (Oryza sativa) **Source:** Weed Sci. 33(6):819-824

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73811 **Author:** "Braverman, M.P., T.L. Lavy, and R.E. Talbert" **Year:** 1985

Title: Effects of Metolachlor Residues on Rice (Oryza sativa) **Source:** Weed Sci. 33(6):819-824

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Rice (Oryza sativa)	POP	POP	ABND	NAT	132 d	F	LOAEL: 0.2 ppm Orig 0.2 ppmw	NR Orig	2	100	Lab	EN		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	LOAEL: 0.2 ppm Orig 0.2 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	LOAEL: 0.2 ppm Orig 0.2 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	21 d	F	LOAEL: 0.2 ppm Orig 0.2 ppmw	NR Orig	2	100	Lab	EN		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.8 ppm Orig 0.8 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.4 ppm Orig 0.4 ppmw	LOAEL: 0.6 ppm Orig 0.6 ppmw	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.2 ppm Orig 0.2 ppmw	LOAEL: 0.4 ppm Orig 0.4 ppmw	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.2 ppm Orig 0.2 ppmw	LOAEL: 0.4 ppm Orig 0.4 ppmw	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.2 ppm Orig 0.2 ppmw	LOEC: 0.4 ppm Orig 0.4 ppmw	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.8 ppm Orig 0.8 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.2 ppm Orig 0.2 ppmw	LOAEL: 0.4 ppm Orig 0.4 ppmw	4	100	FieldN	HS		NR

Ref # 73811 **Author:** "Braverman, M.P., T.L. Lavy, and R.E. Talbert" **Year:** 1985

Title: Effects of Metolachlor Residues on Rice (Oryza sativa) **Source:** Weed Sci. 33(6):819-824

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.4 ppm Orig 0.4 ppmw	LOEC: 0.6 ppm Orig 0.6 ppmw	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.8 ppm Orig 0.8 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.8 ppm Orig 0.8 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.2 ppm Orig 0.2 ppmw	LOAEL: 0.4 ppm Orig 0.4 ppmw	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.8 ppm Orig 0.8 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.8 ppm Orig 0.8 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.8 ppm Orig 0.8 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	ABND	NAT	0 to 17 d	F	NOAEL: 0.8 ppm Orig 0.8 ppmw	NR Orig	4	100	FieldN	HS		NR
Rice (Oryza sativa)	POP	POP	BMAS	NAT	0 to 17 d	F	NOAEL: 0.2 ppm Orig 0.2 ppmw	LOAEL: 0.4 ppm Orig 0.4 ppmw	4	100	FieldN	HS		NR

Ref # 73841 **Author:** "Tewari, A.N., K.S. Rathi, and B. Singh" **Year:** 1998

Title: Integrated Weed Management in Garlic (Allium sativum) **Source:** Indian J.Agric.Sci. 68(5):281-283

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73841 **Author:** "Tewari, A.N., K.S. Rathi, and B. Singh" **Year:** 1998

Title: Integrated Weed Management in Garlic (Allium sativum) **Source:** Indian J.Agric.Sci. 68(5):281-283

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Garlic *(Allium sativum)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
Garlic *(Allium sativum)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
littleseed canarygrass *(Phalaris minor)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
littleseed canarygrass *(Phalaris minor)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
nutgrass *(Cyperus rotundus)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR

Ref # 73910 **Author:** "McCarty,L.B.; Porter,D.W.; Colvin,D.L." **Year:** 1995

Title: Sod Regrowth of St. Augustinegrass After Preemergence Herbicide Application **Source:** Agron.J.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
St. Augustine grass *(Stenotaphrum secundatum)*	PHY	PHY	TNST	NAT	420 d	A	LOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	NR Orig	2	100	FieldN	HS	6.4	1.5 % (OM)
St. Augustine grass *(Stenotaphrum secundatum)*	PHY	PHY	TNST	NAT	420 d	A	NOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	NR Orig	2	100	FieldN	HS	6.2	2.6 % (OM)
St. Augustine grass *(Stenotaphrum secundatum)*	POP	POP	BMAS	NAT	420 d	A	NOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	NR Orig	2	100	FieldN	HS	6.2	2.6 % (OM)
St. Augustine grass *(Stenotaphrum secundatum)*	POP	POP	BMAS	NAT	420 d	A	NOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	2	100	FieldN	HS	6.4	1.5 % (OM)

Ref # 73910 **Author:** "McCarty,L.B.; Porter,D.W.; Colvin,D.L." **Year:** 1995

Title: Sod Regrowth of St. Augustinegrass After Preemergence Herbicide Application **Source:** Agron.J.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
St. Augustine grass (*Stenotaphrum secundatum*)	POP	POP	COVR	NAT	120 d	A	LOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	NR Orig	2	100	FieldN	HS	6.2	2.6 % (OM)
St. Augustine grass (*Stenotaphrum secundatum*)	POP	POP	COVR	NAT	420 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	HS	6.4	1.5 % (OM)
St. Augustine grass (*Stenotaphrum secundatum*)	REP	REP	VEGR	NAT	240 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	HS	6.2	2.6 % (OM)
St. Augustine grass (*Stenotaphrum secundatum*)	REP	REP	VEGR	NAT	240 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	HS	6.4	1.5 % (OM)

Ref # 73913 **Author:** "Young,B.G.; Hart,S.E." **Year:** 1997

Title: Giant Foxtail (Setaria faberi) Control in Sethoxydim-Resistant Corn (Zea mays) **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn (*Zea mays*)	POP	POP	BMAS	NAT	hv	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	1	100	FieldN	HS	6.2	4.9 % (OM)
Corn (*Zea mays*)	POP	POP	BMAS	NAT	hv	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	1	100	FieldN	HS	6.1	6 % (OM)
Corn (*Zea mays*)	POP	POP	BMAS	NAT	hv	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	1	100	FieldN	HS	6.1	6 % (OM)
Corn (*Zea mays*)	POP	POP	BMAS	NAT	hv	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	1	100	FieldN	HS	6.2	4.9 % (OM)
giant bristlegrass (*Setaria faberi*)	POP	POP	CNTL	NAT	30 d	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	1	100	FieldN	HS	6.1	6 % (OM)

Ref # 73913 **Author:** "Young,B.G.; Hart,S.E." **Year:** 1997

Title: Giant Foxtail (Setaria faberi) Control in Sethoxydim-Resistant Corn (Zea mays) **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
giant bristlegrass (Setaria faberi)	POP	POP	CNTL	NAT	30 d	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	1	100	FieldN	HS	6.1	6 % (OM)
giant bristlegrass (Setaria faberi)	POP	POP	CNTL	NAT	30 d	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	1	100	FieldN	HS	6.2	4.9 % (OM)
giant bristlegrass (Setaria faberi)	POP	POP	CNTL	NAT	30 d	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	1	100	FieldN	HS	6.2	4.9 % (OM)

Ref # 73914 **Author:** "Mueller,T.C.; Hayes,R.M." **Year:** 1997

Title: Effect of Tillage and Soil-Applied Herbicides on Broadleaf Signalgrass (Brachiaria platyphylla) Control in Corn (Zea mays) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broadleaf signalgrass (Brachiaria platyphylla)	POP	POP	CNTL	NAT	35 d	A	ET80: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	HS	6.3	1.1 % (OM)
broadleaf signalgrass (Brachiaria platyphylla)	POP	POP	CNTL	NAT	33 d	A	ET80: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	HS	6.3	1.1 % (OM)
broadleaf signalgrass (Brachiaria platyphylla)	POP	POP	CNTL	NAT	26 d	A	ET80: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	HS	6.3	1.1 % (OM)
broadleaf signalgrass (Brachiaria platyphylla)	POP	POP	CNTL	NAT	75 d	A	ET80: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	HS	6.3	1.1 % (OM)
Corn (Zea mays)	POP	POP	BMAS	NAT	ma	A	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	HS	6.3	1.1 % (OM)

Ref # 73914 **Author:** "Mueller,T.C.; Hayes,R.M." **Year:** 1997

Title: Effect of Tillage and Soil-Applied Herbicides on Broadleaf Signalgrass (Brachiaria platyphylla) Control in Corn (Zea mays) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	ma	A	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	HS	6.3	1.1 % (OM)
Corn *(Zea mays)*	POP	POP	BMAS	NAT	ma	A	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	HS	6.3	1.1 % (OM)
Corn *(Zea mays)*	POP	POP	BMAS	NAT	ma	A	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	HS	6.3	1.1 % (OM)

Ref # 73915 **Author:** "Talbert,R.E.; Kendig,J.A.; Earnest,L.D.; Guy,C.; Barnes,C.J.; Lavy,T.L.; Frans,R.E.; Oliver,L.R." **Year:** 1989

Title: "Winter Wheat Response to Carryover from Herbicides Used on Corn, Cotton, Grain Sorghum and Soybeans" **Source:** Ark.Agric.Exp.Stn.Res.Ser.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bread wheat *(Triticum aestivum)*	POP	POP	BMAS	NAT	~120 d	A	NOAEL: 1.5 lb/acre Orig 1.5 ai lb/acre	NR Orig	1	100	FieldN	DA		1.2 % (OM)
Bread wheat *(Triticum aestivum)*	POP	POP	BMAS	NAT	~70 d	A	NOAEL: 0.5 lb/acre Orig 0.5 ai lb/acre	LOAEL: 1 lb/acre Orig 1 ai lb/acre	4	100	FieldN	DA		1.2 % (OM)
Bread wheat *(Triticum aestivum)*	POP	POP	BMAS	NAT	~195 d	A	NOAEL: 2 lb/acre Orig 2 ai lb/acre	NR Orig	1	100	FieldN	DA		1.2 % (OM)

Ref # 73916 **Author:** "Talbert,R.E.; Tierney,M.J.; Burgos,N.R.; Strebe,T.A.; Kitt,M.J." **Year:** 1995

Title: "Field Evaluation of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1994" **Source:** Ark.Agric.Exp.Stn.Res.Ser.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
annual bluegrass (*Poa annua*)	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
annual bluegrass (*Poa annua*)	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.74928 lb/acre Orig 0.84 kg/ha	NR Orig	4	100	FieldN	HS	6.9	1 % (OM)
Barnyard grass (*Echinochloa crus-galli*)	POP	POP	CNTL	NAT	7 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Barnyard grass (*Echinochloa crus-galli*)	POP	POP	CNTL	NAT	49 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
purple crabgrass (*Digitaria sanguinalis*)	POP	POP	CNTL	NAT	7 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	CNTL	NAT	21 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	2	100	FieldN	HS	4.7-5.3	2-Jan % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	CNTL	NAT	7 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)

Ref # 73929 **Author:** "Schroeder,J.; Kenney,M.J.; Thomas,S.H.; Murray,L." **Year:** 1994

Title: "Yellow Nutsedge Response to Southern Root-Knot Nematodes, Chile Peppers, and Metolachlor" **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)

Ref # 73929 **Author:** "Schroeder,J.; Kenney,M.J.; Thomas,S.H.; Murray,L." **Year:** 1994

Title: "Yellow Nutsedge Response to Southern Root-Knot Nematodes, Chile Peppers, and Metolachlor" **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)

Ref # 73929 **Author:** "Schroeder,J.; Kenney,M.J.; Thomas,S.H.; Murray,L." **Year:** 1994

Title: "Yellow Nutsedge Response to Southern Root-Knot Nematodes, Chile Peppers, and Metolachlor" **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Yellow nutsedge (*Cyperus esculentus*)	REP	REP	VEGR	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)

Ref # 73934 **Author:** "Grichar,W.J.; Sestak,D.C.; Brewer,K.D.; Besler,B.A.; Stichler,C.R.; Smith,D.T." **Year:** 2001

Title: Sesame (Sesamum indicum L.) Tolerance and Weed Control with Soil-Applied Herbicides **Source:** Crop Prot.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
broadleaf signalgrass (*Brachiaria platyphylla*)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	7.4-7.8	NR
NR (*Urochloa fasciculata*)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	8.2	NR
NR (*Urochloa fasciculata*)	POP	POP	CNTL	NAT	hv	F	LOAEL: 0.5352 lb/acre Orig 0.6 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR

Ref # 73934 **Author:** "Grichar,W.J.; Sestak,D.C.; Brewer,K.D.; Besler,B.A.; Stichler,C.R.; Smith,D.T." **Year:** 2001

Title: Sesame (Sesamum indicum L.) Tolerance and Weed Control with Soil-Applied Herbicides **Source:** Crop Prot.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
smooth crabgrass (Digitaria ciliaris)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	8.2	NR
smooth crabgrass (Digitaria ciliaris)	POP	POP	CNTL	NAT	hv	F	LOAEL: 0.5352 lb/acre Orig 0.6 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR

Ref # 73937 **Author:** "Masters,R.A." **Year:** 1995

Title: Establishment of Big Bluestem and Sand Bluestem Cultivars with Metolachlor and Atrazine **Source:** Agron.J.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Big bluestem (Andropogon gerardii)	POP	POP	ABND	NAT	~365 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (Andropogon gerardii)	POP	POP	ABND	NAT	~365 d	A	NOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (Andropogon gerardii)	POP	POP	ABND	NAT	~365 d	A	NOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (Andropogon gerardii)	POP	POP	ABND	NAT	~365 d	A	NOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (Andropogon gerardii)	POP	POP	ABND	NAT	~365 d	A	NOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (Andropogon gerardii)	POP	POP	ABND	NAT	~365 d	A	NOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (Andropogon gerardii)	POP	POP	ABND	NAT	~365 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	2	100	FieldN	GS		NR

Ref # 73937 **Author:** "Masters,R.A." **Year:** 1995

Title: Establishment of Big Bluestem and Sand Bluestem Cultivars with Metolachlor and Atrazine **Source:** Agron.J.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Big bluestem (*Andropogon gerardii*)	POP	POP	ABND	NAT	~365 d	A	NOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (*Andropogon gerardii*)	POP	POP	BMAS	NAT	~365 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (*Andropogon gerardii*)	POP	POP	BMAS	NAT	~365 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (*Andropogon gerardii*)	POP	POP	BMAS	NAT	~365 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Big bluestem (*Andropogon gerardii*)	POP	POP	BMAS	NAT	~365 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	2	100	FieldN	GS		NR
Sand bluestem (*Andropogon hallii*)	POP	POP	BMAS	NAT	~365 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Sand bluestem (*Andropogon hallii*)	POP	POP	BMAS	NAT	~365 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	2	100	FieldN	GS		NR
Sand bluestem (*Andropogon hallii*)	POP	POP	BMAS	NAT	~365 d	A	NOAEL: 2.9436 lb/acre Orig 3.3 ai kg/ha	NR Orig	2	100	FieldN	GS		NR

Ref # 73939 **Author:** "Ghosheh,H.Z.; Chandler,J.M." **Year:** 1998

Title: Johnsongrass (Sorghum halepense) Control Systems for Field Corn (Zea mays) Utilizing Crop Rotation and Herbicides **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73939 **Author:** "Ghosheh,H.Z.; Chandler,J.M." **Year:** 1998

Title: Johnsongrass (Sorghum halepense) Control Systems for Field Corn (Zea mays) Utilizing Crop Rotation and Herbicides **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.24784 lb/acr Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.24784 lb/acr Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.24784 lb/acr Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.24784 lb/acr Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)
Johnsongrass *(Sorghum halepense)*	POP	POP	ABND	NAT	14 d	A	LOAEL: 2.24784 lb/acre Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)
Johnsongrass *(Sorghum halepense)*	POP	POP	ABND	NAT	14 d	A	LOAEL: 2.24784 lb/acre Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)
Johnsongrass *(Sorghum halepense)*	POP	POP	ABND	NAT	14 d	A	LOAEL: 2.24784 lb/acre Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)
Johnsongrass *(Sorghum halepense)*	POP	POP	ABND	NAT	14 d	A	LOAEL: 2.24784 lb/acre Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)

Ref # 73955 **Author:** "Thakur,D.R." **Year:** 1994

Title: Weed Management in Intercropping Systems Based on Maize (Zea mays) Under Rainfed Mid-hill Conditions **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73955 **Author:** "Thakur,D.R." **Year:** 1994

Title: Weed Management in Intercropping Systems Based on Maize (Zea mays) Under Rainfed Mid-hill Conditions **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FieldN	HS	6.9	NR

Ref # 73960 **Author:** "Glaze,N.C.; Hall,M.R." **Year:** 1990

Title: Cultivation and Herbicides for Weed Control in Sweet Potato (Ipomoea batatas) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	ABND	NAT	42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
purple crabgrass *(Digitaria sanguinalis)*	POP	POP	ABND	NAT	42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	ABND	NAT	<42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
Yellow nutsedge *(Cyperus esculentus)*	POP	POP	ABND	NAT	42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73961 **Author:** "Keeling,J.W.; Bender,D.A.; Abernathy,J.R." **Year:** 1990

Title: Yellow Nutsedge (Cyperus esculentus) Management in Transplanted Onions (Allium cepa) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
garden onion *(Allium cepa)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)

Ref # 73961 **Author:** "Keeling,J.W.; Bender,D.A.; Abernathy,J.R." **Year:** 1990

Title: Yellow Nutsedge (Cyperus esculentus) Management in Transplanted Onions (Allium cepa) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
garden onion (Allium cepa)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
garden onion (Allium cepa)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
Yellow nutsedge (Cyperus esculentus)	POP	POP	CNTL	NAT	30 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
Yellow nutsedge (Cyperus esculentus)	POP	POP	CNTL	NAT	30 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
Yellow nutsedge (Cyperus esculentus)	POP	POP	CNTL	NAT	30 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
Yellow nutsedge (Cyperus esculentus)	POP	POP	CNTL	NAT	<30 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
Yellow nutsedge (Cyperus esculentus)	POP	POP	CNTL	NAT	<30 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)
Yellow nutsedge (Cyperus esculentus)	POP	POP	CNTL	NAT	30 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	7.8	0.9 % (OM)

Ref # 73963 **Author:** "Webber III,C.L." **Year:** 1992

Title: The Influence of Metolachlor and Trifluralin on Kenaf (Hibiscus cannabinus L.) Yield Components **Source:** Ind.Crops Prod.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
grasses *(NR Poaceae)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.49952 lb/acre Orig 0.56 kg/ha	NR Orig	3	100	FieldN	HS		NR
grasses *(NR Poaceae)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.49952 lb/acre Orig 0.56 kg/ha	NR Orig	3	100	FieldN	HS		NR

Ref # 73970 **Author:** "Sharma,V.; Thakur,D.R.; Sharma,J.J." **Year:** 1998

Title: Effect of Metolachlor and Its Combination with Atrazine on Weed Control in Maize (Zea mays) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100		EN	6.7	NR
Corn *(Zea mays)*	REP	REP	SEED	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100		EN	6.7	NR

Ref # 73971 **Author:** Rout D;Satapathy MR; **Year:** 1996

Title: Chemical Weed Control in Rainfed Maize (Zea mays) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN		NR
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73971 **Author:** Rout D;Satapathy MR; **Year:** 1996

Title: Chemical Weed Control in Rainfed Maize (Zea mays) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Corn *(Zea mays)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN		NR

Terrestrial dicots

Taxa_Code: DTP

Acute

Ref # 31621 **Author:** "Teasdale, J.R." **Year:** 1985

Title: "Delayed Application of Metolachlor for Pepper, Tomato, and Cucumber" **Source:** Proc.Northeast.Weed Sci.Soc. 39:131-133

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Bell pepper *(Capsicum annuum)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS		1.4 % (OM)
Bell pepper *(Capsicum annuum)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Bell pepper *(Capsicum annuum)*	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Bell pepper *(Capsicum annuum)*	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Bell pepper *(Capsicum annuum)*	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)

Ref # 31621 **Author:** "Teasdale, J.R." **Year:** 1985

Title: "Delayed Application of Metolachlor for Pepper, Tomato, and Cucumber" **Source:** Proc.Northeast.Weed Sci.Soc. 39:131-133

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Bell pepper *(Capsicum annuum)*	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
garden cucumber *(Cucumis sativus)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
garden cucumber *(Cucumis sativus)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
garden cucumber *(Cucumis sativus)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
garden cucumber *(Cucumis sativus)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
garden cucumber *(Cucumis sativus)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
garden cucumber *(Cucumis sativus)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
garden cucumber *(Cucumis sativus)*	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
garden cucumber *(Cucumis sativus)*	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato *(Lycopersicon esculentum)*	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)

Ref # 31621 **Author:** "Teasdale, J.R." **Year:** 1985

Title: "Delayed Application of Metolachlor for Pepper, Tomato, and Cucumber" **Source:** Proc.Northeast.Weed Sci.Soc. 39:131-133

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato (Lycopersicon esculentum)	GRO	GRO	VGOR	NAT	42 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato (Lycopersicon esculentum)	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato (Lycopersicon esculentum)	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato (Lycopersicon esculentum)	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato (Lycopersicon esculentum)	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	LOAEL: lb/acre Orig	2	100	FIELDN	HS		1.5 % (OM)
Tomato (Lycopersicon esculentum)	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Tomato (Lycopersicon esculentum)	GRO	GRO	VGOR	NAT	42 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	LOAEL: lb/acre Orig	2	100	FIELDN	HS		1.5 % (OM)

Ref # 41050 **Author:** "Waldrop, D.D., and P.A. Banks" **Year:** 1983

Title: Interactions of Herbicides with Insecticides in Soybeans **Source:** Weed Sci. 31:730-734

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	GAIN	NAT	10 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	Lab	HS	6.3	1.2 % (OM)
Soybean (Glycine max)	PHY	INJ	GINJ	NAT	25 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		2.7 % (OM)

Ref # 41050 **Author:** "Waldrop, D.D., and P.A. Banks" **Year:** 1983

Title: Interactions of Herbicides with Insecticides in Soybeans **Source:** Weed Sci. 31:730-734

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	PHY	INJ	GINJ	NAT	22 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		2.7 % (OM)
Soybean *(Glycine max)*	PHY	INJ	GINJ	NAT	10 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	Lab	HS	6.3	1.2 % (OM)

Ref # 44022 **Author:** "Pillai, P., D.E. Davis, and B. Truelove" **Year:** 1979

Title: "Effects of Metolachlor on Germination, Growth, Leucine Uptake and Protein Synthesis" **Source:** Weed Sci. 27:634-637

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
cultivated radish *(Raphanus sativus)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR
garden cucumber *(Cucumis sativus)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR
Lettuce *(Lactuca sativa)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	3	100	Lab	DA		NR
morningglory *(Ipomoea sp.)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	3	100	Lab	DA		NR
Pea *(Pisum sativum)*	GRO	GRO	HGHT	NAT	15 d	F	LOAEL: 3.568 lb/acre Orig 4 kg/ha	NR Orig	1	100	Lab	DA		NR
Pea *(Pisum sativum)*	GRO	GRO	HGHT	NAT	15 d	F	LOAEL: 3.568 lb/acre Orig 4 kg/ha	NR Orig	1	100	Lab	DA		NR
Pea *(Pisum sativum)*	GRO	GRO	HGHT	NAT	15 d	F	LOAEL: 3.568 lb/acre Orig 4 kg/ha	NR Orig	1	100	Lab	DA		NR

Ref # 44022 **Author:** "Pillai, P., D.E. Davis, and B. Truelove" **Year:** 1979

Title: "Effects of Metolachlor on Germination, Growth, Leucine Uptake and Protein Synthesis" **Source:** Weed Sci. 27:634-637

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pea *(Pisum sativum)*	GRO	GRO	HGHT	NAT	15 d	F	NOAEL: 3.568 lb/acre Orig 4 kg/ha	NR Orig	1	100	Lab	DA		NR
Pea *(Pisum sativum)*	GRO	GRO	LGTH	FLT	7 d	F	LOAEL: 0.000001 M Orig 0.000001 M	NR Orig	3	100	Lab	DA		NR
Peanut *(Arachis hypogaea)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR
Sicklepod *(Senna obtusifolia)*	GRO	GRO	LGTH	FLT	7 d	F	LOAEL: 0.000001 M Orig 0.000001 M	NR Orig	3	100	Lab	DA		NR
Soybean *(Glycine max)*	GRO	GRO	LGTH	FLT	7 d	F	NOAEL: 0.000001 M Orig 0.000001 M	LOAEL: 0.00001 M Orig 0.00001 M	3	100	Lab	DA		NR

Ref # 66847 **Author:** "Grichar, W.J., R.G. Lemon, K.D. Brewer, and B.W. Minton" **Year:** 2001

Title: S-Metolachlor Compared with Metolachlor on Yellow Nutsedge (Cyperus esculentus) and Peanut (Arachis hypogaea) **Source:** Weed Technol. 15(1):107-111

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	PHY	INJ	GINJ	NAT	~42-56 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Peanut *(Arachis hypogaea)*	PHY	INJ	GINJ	NAT	~42-56 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	3	100	FIELD	GM	6.9-7.2	NR
Peanut *(Arachis hypogaea)*	PHY	INJ	GINJ	NAT	~42-56 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	3	100	FIELD	GM	6.9-7.2	NR

Ref # 66847 **Author:** "Grichar, W.J., R.G. Lemon, K.D. Brewer, and B.W. Minton" **Year:** 2001

Title: S-Metolachlor Compared with Metolachlor on Yellow Nutsedge (Cyperus esculentus) and Peanut (Arachis hypogaea) **Source:** Weed Technol. 15(1):107-111

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut (Arachis hypogaea)	PHY	INJ	GINJ	NAT	~42-56 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	3	100	FIELD	GM	6.9-7.2	NR
Peanut (Arachis hypogaea)	PHY	INJ	GINJ	NAT	~42-56 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	3	100	FIELD	GM	6.9-7.2	NR
Peanut (Arachis hypogaea)	PHY	INJ	GINJ	NAT	~42-56 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	3	100	FIELD	GM	6.9-7.2	NR

Ref # 67700 **Author:** "Ronco, A., C. Sobrero, V. Grassi, L. Kaminski, L. Massolo, and L. Mina" **Year:** 2000

Title: WaterTox Bioassay Intercalibration Network: Results from Argentina **Source:** Environ.Toxicol. 15(4):287-296

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Lettuce (Lactuca sativa)	GRO	GRO	LGTH	NR	4 d	F	EC50: 9.94 ppm Orig 9.94 mg/L	NR Orig		100	LAB	NR		NR
Lettuce (Lactuca sativa)	GRO	GRO	LGTH	NR	4 d	F	LOAEL: 5 ppm Orig 5 mg/L	NR Orig	6	100	LAB	NR		NR

Ref # 70441 **Author:** "Talbert, R.E., R.A. Wichert, V.F. Carey III, D.H. Johnson, D.F. Ruff, and N.R. Burgos" **Year:** 1993

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1992" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 429:1-29

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
blackeyedsusan (Rudbeckia hirta)	PHY	INJ	GINJ	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	2	100	FIELDN	HS	5.6	NR

Ref # 70441 **Author:** "Talbert, R.E., R.A. Wichert, V.F. Carey III, D.H. Johnson, D.F. Ruff, and N.R. Burgos" **Year:** 1993

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1992" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 429:1-29

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
brambles *(Rubus sp.)*	PHY	INJ	GINJ	NAT	21 d	A	NOAEL: 3.99616 lb/acr Orig 4.48 AI kg/ha	NR Orig	2	100	FIELDN	HS	5.6	NR
Chrysanthemum *(Chrysanthemum sp.)*	PHY	INJ	GINJ	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FieldN	HS	5.6	1 % (OM)
kidney bean *(Phaseolus vulgaris)*	PHY	INJ	GINJ	NAT	42 d	A	NOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)

Ref # 70865 **Author:** "Derr, J.F." **Year:** 1993

Title: Wildflower Tolerance to Metolachlor and Metolachlor Combined with Other Broadleaf Herbicides **Source:** Hortscience 28(10):1023-1026

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Blanketflower *(Gaillardia aristata)*	PHY	INJ	GINJ	NAT	28 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	2	100	FIELD	HS		NR
Blanketflower *(Gaillardia aristata)*	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig 2 kg/ha	2	100	FIELD	HS		NR
Lanceleaf tickseed *(Coreopsis lanceolata)*	PHY	INJ	GINJ	NAT	42 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100	FIELD	HS		NR
Lanceleaf tickseed *(Coreopsis lanceolata)*	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100		HS	5.5	2 % (OM)
Oxeye Daisy *(Leucanthemum vulgare)*	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100		HS		NR
Oxeye Daisy *(Leucanthemum vulgare)*	PHY	INJ	GINJ	NAT	28 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	LOAEL: 8.028 lb/acre Orig 9 kg/ha	2	100	FIELD	HS		NR

Ref # 70865 **Author:** "Derr, J.F." **Year:** 1993

Title: Wildflower Tolerance to Metolachlor and Metolachlor Combined with Other Broadleaf Herbicides **Source:** Hortscience 28(10):1023-1026

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Purple coneflower (*Echinacea purpurea*)	PHY	INJ	GINJ	NAT	28 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	2	100	FIELD	HS		NR
Purple coneflower (*Echinacea purpurea*)	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig 2 kg/ha	2	100	FIELD	HS		NR

Ref # 72762 **Author:** "Harrison, H.F., M.W. Farnham, and J.K. Peterson" **Year:** 1998

Title: Differential Response of Collard and Kale Cultivars to Preemergence Application of Metolachlor **Source:** Crop Prot. 17(4):293-297

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (*Brassica oleracea*)	GRO	GRO	WGHT	NAT	28 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	GRO	GRO	WGHT	NAT	28 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	GRO	GRO	WGHT	NAT	28 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	GRO	GRO	WGHT	NAT	28 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	GRO	GRO	WGHT	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	GRO	GRO	WGHT	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	GRO	GRO	WGHT	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)

Ref # 72762 **Author:** "Harrison, H.F., M.W. Farnham, and J.K. Peterson" **Year:** 1998

Title: Differential Response of Collard and Kale Cultivars to Preemergence Application of Metolachlor **Source:** Crop Prot. 17(4):293-297

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (Brassica oleracea)	GRO	GRO	WGHT	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	GRO	GRO	WGHT	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	GRO	GRO	WGHT	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	GRO	GRO	WGHT	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)

Ref # 73230 **Author:** "Beste, C.E., and J.R. Frank" **Year:** 1990

Title: Influence of Metolachlor on Ilex crenata Thunb. for Control of Yellow Nutsedge **Source:** J.Environ.Hortic. 8(2):58-60

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Japanese holly (Ilex crenata)	PHY	INJ	GINJ	NAT	342 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	4	100	FieldN	HS		5 % (OM)
Japanese holly (Ilex crenata)	PHY	INJ	GINJ	NAT	9 d	F	NOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	LOAEL: 8.028 lb/acre Orig 9 kg/ha	4	100	FieldN	HS		5 % (OM)
Japanese holly (Ilex crenata)	PHY	INJ	GINJ	NAT	6 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	LOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	4	100	FieldN	HS		5 % (OM)
Japanese holly (Ilex crenata)	PHY	INJ	GINJ	NAT	6 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	LOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	4	100	FieldN	HS		5 % (OM)
Japanese holly (Ilex crenata)	PHY	INJ	GINJ	NAT	9 d	F	NOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	LOAEL: 8.028 lb/acre Orig 9 kg/ha	4	100	FieldN	HS		5 % (OM)

Ref # 73231 **Author:** "Frank, J.R., and C.E. Beste" **Year:** 1990

Title: Growth Inhibition of Ericaceous Plants from Metolachlor **Source:** J.Environ.Hortic. 8(4):173-176

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
azaleas (*Rhododendron sp.*)	GRO	GRO	AREA	NAT	121 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	4	100	FieldN	HS		NR
azaleas (*Rhododendron sp.*)	GRO	GRO	AREA	NAT	35 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	LOAEL: 12.042 lb/acre Orig 13.5 kg/ha	4	100	FieldN	HS		NR
azaleas (*Rhododendron sp.*)	PHY	INJ	GINJ	NAT	4 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	LOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	4	100	FieldN	HS		NR
azaleas (*Rhododendron sp.*)	PHY	INJ	GINJ	NAT	37 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	LOAEL: 12.042 lb/acre Orig 13.5 kg/ha	4	100	FieldN	HS		NR

Ref # 73236 **Author:** "Talbert, R.E., M.J. Tierney, V.F. Carey III, and M.J. Kitt" **Year:** 1994

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1993" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 440:1-60

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
kidney bean (*Phaseolus vulgaris*)	PHY	INJ	GINJ	NAT	42 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
kidney bean (*Phaseolus vulgaris*)	PHY	INJ	GINJ	NAT	28 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	14 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	98 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	56 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	28 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	42 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	70 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	161 d	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	2	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	140 d	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	2	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	126 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	28 d	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	49 d	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	70 d	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
Spinach (*Spinacia oleracea*)	PHY	INJ	GINJ	NAT	28 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)

Ref # 73236 **Author:** "Talbert, R.E., M.J. Tierney, V.F. Carey III, and M.J. Kitt" **Year:** 1994

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1993" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 440:1-60

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Spinach (Spinacia oleracea)	PHY	INJ	GINJ	NAT	42 d	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	2	100	FieldN	HS	6.9	1 % (OM)
Spinach (Spinacia oleracea)	PHY	INJ	GINJ	NAT	70 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Spinach (Spinacia oleracea)	PHY	INJ	GINJ	NAT	14 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Spinach (Spinacia oleracea)	PHY	INJ	GINJ	NAT	49 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Winter squash (Cucurbita maxima)	PHY	INJ	GINJ	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Winter squash (Cucurbita maxima)	PHY	INJ	GINJ	NAT	21 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Winter squash (Cucurbita maxima)	PHY	INJ	GINJ	NAT	21 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Winter squash (Cucurbita maxima)	PHY	INJ	GINJ	NAT	42 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)

Ref # 73242 **Author:** "Gabr, M.A., M.A. Shakeeb, F. Fahmy, and H. Abbas" **Year:** 1988

Title: Influence of Metolachlor on Growth and Some Biochemical Activities in Tomato (Lycopersicon esculentum L.) Seedlings **Source:** Egypt J.Bot. 31(1-3):121-132

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73242 **Author:** "Gabr, M.A., M.A. Shakeeb, F. Fahmy, and H. Abbas" **Year:** 1988

Title: Influence of Metolachlor on Growth and Some Biochemical Activities in Tomato (Lycopersicon esculentum L.) Seedlings **Source:** Egypt J.Bot. 31(1-3):121-132

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato *(Lycopersicon esculentum)*	GRO	GRO	LGTH	ART	1 d	F	NOAEL: 3.5 nM Orig 3.5 nM	LOAEL: 7 nM Orig 7 nM	6	100	LAB	DA		NR

Ref # 73245 **Author:** "Ramakrishna, A., C.K. Ong, and S.L.N. Reddy" **Year:** 1991

Title: Integrated Weed Management for Rainfed Groundnut **Source:** J.Plant Prot.Trop. 8(2):111-119

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	GRO	GRO	HGHT	NAT	30 d	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR
Peanut *(Arachis hypogaea)*	GRO	GRO	HGHT	NAT	60 d	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR
Peanut *(Arachis hypogaea)*	GRO	GRO	HGHT	NAT	60 d	A	NOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR
Peanut *(Arachis hypogaea)*	GRO	GRO	HGHT	NAT	60 d	A	NOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR

Ref # 73249 **Author:** "Warren, S.L., and W.A. Skroch" **Year:** 1991

Title: Evaluation of Six Herbicides for Potential Use in Tree Seed Beds **Source:** J.Environ.Hortic. 9(3):160-163

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Eastern redbud *(Cercis canadensis)*	GRO	GRO	HGHT	ART	369 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR

Ref # 73249 **Author:** "Warren, S.L., and W.A. Skroch" **Year:** 1991

Title: Evaluation of Six Herbicides for Potential Use in Tree Seed Beds **Source:** J.Environ.Hortic. 9(3):160-163

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Flowering dogwood (*Cornus florida*)	GRO	GRO	HGHT	ART	549 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR
Pin oak (*Quercus palustris*)	GRO	GRO	HGHT	ART	549 d	A	NOAEL: 4 lb/acre Orig 4 lb/acre	LOAEL: 8 lb/acre Orig 8 lb/acre	2	100	FIELDA	HS		NR
River birch (*Betula nigra*)	GRO	GRO	HGHT	ART	369 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR
Sugar maple (*Acer saccharum*)	GRO	GRO	HGHT	ART	549 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR
Sweetgum (*Liquidambar styraciflua*)	GRO	GRO	HGHT	ART	369 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR
Willow oak (*Quercus phellos*)	GRO	GRO	HGHT	ART	549 d	A	NOAEL: 4 lb/acre Orig 4 lb/acre	LOAEL: 8 lb/acre Orig 8 lb/acre	2	100	FIELDA	HS		NR

Ref # 73250 **Author:** "Skroch, W.A., C.J. Catanzaro, and M.H. Yonce" **Year:** 1990

Title: Response of Nine Herbaceous Flowering Perennials to Selected Herbicides **Source:** J.Environ.Hortic. 8(1):26-28

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Moss phlox (*Phlox sublata*)	PHY	INJ	GINJ	NAT	219 d	A	NOAEL: 3 lb/acre Orig 3 lb/acre	NR Orig	1	100	FIELDA	HS	6.5	NR
Sea lavender (*Limonium sp.*)	GRO	GRO	BMAS	NAT	219 d	A	NOAEL: 3 lb/acre Orig 3 lb/acre	NR Orig	1	100	FIELDA	HS	6.5	NR
Shasta daisy (*Leucanthemum maximum*)	PHY	INJ	GINJ	NAT	219 d	A	NOAEL: 3 lb/acre Orig 3 lb/acre	NR Orig	1	100	FIELDA	HS	6.5	NR

Ref # 73251 **Author:** "Hood, L.R., and J.E. Klett" **Year:** 1992

Title: Preemergent Weed Control in Container-Grown Herbaceous and Woody Plants **Source:** J.Environ.Hortic. 10(1):8-11

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
European white birch (*Betula pendula*)	GRO	GRO	HGHT	ART	2 gs	A	NOAEL: 9.0984 lb/acre Orig 10.2 AI kg/ha	NR Orig	3	100	FIELDA	DA		NR
Tatarian maple (*Acer tataricum*)	GRO	GRO	HGHT	ART	2 gs	A	LOAEL: 3.0328 lb/acre Orig 3.4 AI kg/ha	NR Orig	3	100	FIELDA	DA		NR

Ref # 73252 **Author:** "Staats, D., and J.E. Klett" **Year:** 1993

Title: Evaluation of Weed Control and Phytotoxicity of Preemergence Herbicides Applied to Container-Grown Herbaceous and Woody Plants **Source:** J.Environ.Hortic. 11(2):78-81

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Baby's breath (*Gypsophila pacifica*)	GRO	GRO	HGHT	ART	1 gs	A	NOAEL: 8.1172 lb/acre Orig 9.1 AI kg/ha	NR Orig	2	100	FIELDA	DA		NR
Wooly hedgenettle (*Stachys byzantina*)	GRO	GRO	BMAS	ART	1 gs	A	NOAEL: 8.1172 lb/acre Orig 9.1 AI kg/ha	NR Orig	2	100	FIELDA	DA		NR
Wooly hedgenettle (*Stachys byzantina*)	PHY	INJ	CLRS	ART	1 gs	A	NOAEL: 8.1172 lb/acre Orig 9.1 AI kg/ha	NR Orig	2	100	FIELDA	DA		NR

Ref # 73256 **Author:** "Reddy, K.N., and M. Singh" **Year:** 1993

Title: Response of Citrus (Citrus spp.) Rootstock Seedlings to Soil-Applied Herbicides **Source:** J.Environ.Hortic. 11(1):39-40

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Grapefruit (*Citrus x paradisi*)	GRO	GRO	WGHT	NAT	185 d	A	LOAEL: 0.446 lb/acre Orig 0.5 AI kg/ha	NR Orig	2	100	Lab	DA		NR

Ref # 73256 **Author:** "Reddy, K.N., and M. Singh" **Year:** 1993

Title: Response of Citrus (Citrus spp.) Rootstock Seedlings to Soil-Applied Herbicides **Source:** J.Environ.Hortic. 11(1):39-40

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Mandarin orange (Citrus reticulata)	GRO	GRO	WGHT	NAT	185 d	A	NOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	Lab	DA		NR
Orange (Citrus sinensis)	GRO	GRO	WGHT	NAT	185 d	A	NOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	Lab	DA		NR
Sour orange (Citrus aurantium)	GRO	GRO	WGHT	NAT	185 d	A	NOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	Lab	DA		NR

Ref # 73257 **Author:** "Friesen, G.H., and D.A. Wall" **Year:** 1986

Title: Tolerance of Lentil (Lens culinaris Medik.) to Herbicides **Source:** Can.J.Plant Sci. 66(1):131-140

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Lentil (Lens culinaris)	GRO	GRO	SIZE	NAT	95 d	A	LOAEL: 2.3192 lb/acre Orig 2.6 AI kg/ha	NR Orig	1	100	FIELDN	HS	6.4	NR
Lentil (Lens culinaris)	GRO	GRO	SIZE	NAT	100 d	A	NOAEL: 2.3192 lb/acre Orig 2.6 AI kg/ha	NR Orig	1	100	FIELDN	HS	6.4	NR

Ref # 73259 **Author:** "Gangwar, K.S., K.P. Niranjan, and O.P. Singh" **Year:** 1991

Title: Weed Management in Sorghum (Sorghum bicolor) + Pigeonpea (Cajanus cajan) Intercropping System in Dryland **Source:** Indian J.Agric.Sci. 61(10):757-759

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pigeonpea (Cajanus cajan)	GRO	GRO	HGHT	NAT	hv	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FIELDN	GM	7.35	NR

Ref # 73259 **Author:** "Gangwar, K.S., K.P. Niranjan, and O.P. Singh" **Year:** 1991

Title: Weed Management in Sorghum (Sorghum bicolor) + Pigeonpea (Cajanus cajan) Intercropping System in Dryland **Source:** Indian J.Agric.Sci. 61(10):757-759

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pigeonpea (Cajanus cajan)	GRO	GRO	HGHT	NAT	hv	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FIELDN	GM	7.35	NR

Ref # 73264 **Author:** "Teasdale, J.R." **Year:** 1985

Title: Avoidance of Herbicide Injury by Placement Between Rows of Polyethylene Mulch **Source:** Hortscience 20(5):871-872

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Honeydew (Cucumis melo)	GRO	GRO	VGOR	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS	6.3	NR
Honeydew (Cucumis melo)	GRO	GRO	VGOR	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS	5.4	NR

Ref # 73265 **Author:** "Dusky, J.A." **Year:** 1986

Title: Preemergency Herbicides for Radishes Grown on Organic Soils **Source:** Hortscience 21(1):74-76

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
cultivated radish (Raphanus sativus)	POP	INJ	GINJ	NAT	28 d	A	NOAEL: 2.99712 lb/acr Orig 3.36 AI kg/ha	NR Orig	2	100	FieldN	HS		NR
cultivated radish (Raphanus sativus)	POP	INJ	GINJ	NAT	28 d	A	NOAEL: 2.99712 lb/acr Orig 3.36 AI kg/ha	NR Orig	2	100	FieldN	HS		NR
cultivated radish (Raphanus sativus)	POP	INJ	GINJ	NAT	28 d	A	NOAEL: 2.99712 lb/acr Orig 3.36 AI kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73266 **Author:** "Gilreath, J.P." **Year:** 1987

Title: Chemical Weed Control in Gypsophila **Source:** Hortscience 22(3):446-448

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Baby's breath (*Gypsophila paniculata*)	GRO	GRO	VGOR	NAT	20 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	FieldN	HS	6.4	0.7 % (OM)
Baby's breath (*Gypsophila paniculata*)	GRO	GRO	VGOR	NAT	82 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	FieldN	HS	6.4	0.7 % (OM)

Ref # 73307 **Author:** "Kahn, B.A., and R.J. Schatzer" **Year:** 1992

Title: Economic and Horticultural Evaluation of Chemical and Mechanical Weed Control Strategies for Cowpea **Source:** J.Am.Soc.Hortic.Sci. 117(2):255-259

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Black-eyed pea (*Vigna unguiculata*)	GRO	GRO	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR
Black-eyed pea (*Vigna unguiculata*)	GRO	GRO	BMAS	NAT	hv	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR

Ref # 73334 **Author:** "Nair, S.G., B.M. Patil, and A.P. Karunakar" **Year:** 1999

Title: Effect of Chemical Weed Control on Growth and Yield of Irrigated Mustard (Brassica juncea L.) **Source:** Crop Res. 17(1):116-117

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Brown mustard (*Brassica juncea*)	GRO	GRO	HGHT	NAT	hv	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FieldN	NR	7.8	NR

Ref # 73336 **Author:** "Singh, H., J.S. Kolar, and R.P. Gupta" **Year:** 1995

Title: The Effect of Pre-emergence Applied Herbicides on the Symbiotic Parameters and Seed Yield of Soybean (Glycine max (L.) Merrill) **Source:** Int.J.Trop.Agric. 13(1-4):143-150

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	BMAS	NAT	120 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FIELDN	WA	7.8	NR

Ref # 73345 **Author:** "Van Heerden, H.G., L.L. Hoffmann-Grobler, and B.E. Eisenberg" **Year:** 1991

Title: Effect of Isopropalin and Metolachlor on Flue-Cured Tobacco Transplants **Source:** Appl.Plant Sci. 5(1):18-20

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	LOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	LOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR

Ref # 73345 **Author:** "Van Heerden, H.G., L.L. Hoffmann-Grobler, and B.E. Eisenberg" **Year:** 1991

Title: Effect of Isopropalin and Metolachlor on Flue-Cured Tobacco Transplants **Source:** Appl.Plant Sci. 5(1):18-20

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	HGHT	ART	42 d	A	NOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	NLEF	ART	42 d	A	LOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	NLEF	ART	42 d	A	LOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	NLEF	ART	42 d	A	LOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR
tobacco (Nicotiana sp.)	GRO	GRO	NLEF	ART	42 d	A	LOAEL: 1.869 lb/acre Orig 2100 AI g/ha	NR Orig	1	100	LAB	DA		NR

Ref # 73352 **Author:** "Heuer, B., and A. Carmi" **Year:** 1992

Title: Nitrogen-Enhanced Phytotoxicity to Cucumber of Low Concentrations of EPTC and Metolachlor **Source:** Crop Prot. 11(6):572-576

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
garden cucumber (*Cucumis sativus*)	GRO	GRO	LGTH	CUL	14 d	F	LOAEL: 0.05 ppm Orig 0.05 mg/L	NR Orig	1	100	LAB	GM	6.5	NR
garden cucumber (*Cucumis sativus*)	GRO	GRO	LGTH	CUL	14 d	F	LOAEL: 0.05 ppm Orig 0.05 mg/L	NR Orig	1	100	LAB	GM	6.5-6.8	NR

Ref # 73357 **Author:** "Gabr, M.A., M.A. Shakeeb, F.A. Fahmy, and H. Abbas" **Year:** 1989

Title: "Influence of Metolachlor Foliar Spray on Growth, Carbohydrate Content, Pigmentation and Photosynthetic Activity in Transplanted Tomato Plants (Lycopersicon esculentum L.)" **Source:** Egypt J.Bot. 32(1/2):1-9

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato (*Lycopersicon esculentum*)	GRO	GRO	DWGT	NAT	126 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	SP		NR
Tomato (*Lycopersicon esculentum*)	GRO	GRO	DWGT	NAT	84 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	SP		NR
Tomato (*Lycopersicon esculentum*)	GRO	GRO	LGTH	NAT	126 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	SP		NR
Tomato (*Lycopersicon esculentum*)	GRO	GRO	NODE	NAT	84 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	SP		NR

Ref # 73414 **Author:** "Bochare, P.A., D.K. Shelke, R.H. Bhosle, N.S. Jadhav, and V.D. Salunke" **Year:** 1992

Title: Weed Management in Kharif Sunflower **Source:** J.Maharashtra Agric.Univ. 17(3):502-503

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73414 **Author:** "Bochare, P.A., D.K. Shelke, R.H. Bhosle, N.S. Jadhav, and V.D. Salunke" **Year:** 1992

Title: Weed Management in Kharif Sunflower **Source:** J.Maharashtra Agric.Univ. 17(3):502-503

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Common annual sunflower (*Helianthus annuus*)	GRO	GRO	DWGT	NAT	hv	F	NOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FIELDN	HS		NR

Ref # 73424 **Author:** "Talbert, R.E., L.R. Oliver, R.E. Frans, R.A. Wichert, V.F. Carey, D.H. Johnson, and D.F. Ruff" **Year:** 1993

Title: Field Screening of New Chemicals for Herbicidal Activity 1992 **Source:** Ark.Agric.Exp.Stn.Res.Ser. (426):1-22

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Alfalfa (*Medicago sativa*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
bigpod sesbania (*Sesbania herbacea*)	PHY	INJ	DAMG	ART	35 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Black-eyed pea (*Vigna unguiculata*)	PHY	INJ	DAMG	ART	35 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Common annual sunflower (*Helianthus annuus*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
common beet (*Beta vulgaris*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Common cocklebur (*Xanthium strumarium*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Cotton (*Gossypium hirsutum*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
garden cucumber (*Cucumis sativus*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR

Ref # 73424 **Author:** "Talbert, R.E., L.R. Oliver, R.E. Frans, R.A. Wichert, V.F. Carey, D.H. Johnson, and D.F. Ruff" **Year:** 1993

Title: Field Screening of New Chemicals for Herbicidal Activity 1992 **Source:** Ark.Agric.Exp.Stn.Res.Ser. (426):1-22

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
green pigweed (*Amaranthus hybridus*)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Indian mallow (*Abutilon theophrasti*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Ivyleaf morning-glory (*Ipomoea hederacea*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
kidney bean (*Phaseolus vulgaris*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
moonflower (*Datura stramonium*)	PHY	INJ	DAMG	ART	35 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Peanut (*Arachis hypogaea*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
prickly fanpetals (*Sida spinosa*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Sicklepod (*Senna obtusifolia*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Soybean (*Glycine max*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Tomato (*Lycopersicon esculentum*)	PHY	INJ	DAMG	ART	49 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
white morninglory (*Ipomoea lacunosa*)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR

Ref # 73424 **Author:** "Talbert, R.E., L.R. Oliver, R.E. Frans, R.A. Wichert, V.F. Carey, D.H. Johnson, and D.F. Ruff" **Year:** 1993

Title: Field Screening of New Chemicals for Herbicidal Activity 1992 **Source:** Ark.Agric.Exp.Stn.Res.Ser. (426):1-22

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Winter squash (Cucurbita maxima)	PHY	INJ	DAMG	ART	49 d	A	NOAEL: 1.49856 lb/acr Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Yellow mustard (Brassica hirta)	PHY	INJ	DAMG	ART	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR

Ref # 73736 **Author:** "Calkins, J.B., B.T. Swanson, and D.L. Newman" **Year:** 1996

Title: Weed Control Strategies for Field Grown Herbaceous Perennials **Source:** J.Environ.Hortic. 14(4):221-227

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
peony (Paeonia sp.)	PHY	INJ	GINJ	NAT	hv	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
peony (Paeonia sp.)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Rough blazing star (Liatris spicata)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Rough blazing star (Liatris spicata)	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)

Ref # 73742 **Author:** "Bellinder, R.R., and D.T. Warholic" **Year:** 1988

Title: "Evaluation of Acetanilide Injury and Its Potential for Yield Reduction in Cabbage, Brassica oleracea L." **Source:** Weed Technol. 2(3):350-354

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73742 **Author:** "Bellinder, R.R., and D.T. Warholic" **Year:** 1988

Title: "Evaluation of Acetanilide Injury and Its Potential for Yield Reduction in Cabbage, Brassica oleracea L." **Source:** Weed Technol. 2(3):350-354

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	21 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	49 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	28 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	28 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)

Ref # 73790 **Author:** "Bellinder, R.R., D. Wilcox-Lee, A. Senesac, and D.T. Warholic" **Year:** 1989

Title: Response of Early-Maturing Cabbage Brassica oleracea var capitata to Metolachlor **Source:** Weed Technol. 3(3):463-466

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	8 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	54 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	8 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	10 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	9 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	3	100	FieldN	HS	6.9	3.7 % (OM)

Ref # 73790 **Author:** "Bellinder, R.R., D. Wilcox-Lee, A. Senesac, and D.T. Warholic" **Year:** 1989

Title: Response of Early-Maturing Cabbage Brassica oleracea var capitata to Metolachlor **Source:** Weed Technol. 3(3):463-466

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	54 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	3	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	10 d	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	2	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage (Brassica oleracea)	PHY	INJ	GINJ	NAT	9 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	3	100	FieldN	HS	6.9	3.7 % (OM)

Ref # 73798 **Author:** "Singh, R., R.P. Jangir, and B.L. Poonia" **Year:** 1995

Title: Evaluation of Herbicides for Control of Weeds in Chilli (Capsicum annuum) **Source:** Indian J.Agric.Sci. 65(10):723-726

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper (Capsicum annuum)	GRO	GRO	BMAS	NAT	hv	F	LOAEL: 0.446 lb/acre Orig 0.5 kg/ha	NR Orig	3	100	FieldN	HS	8.1	0.31 % (NR)

Ref # 73799 **Author:** "Jat, L.N., V. Nepalia, and R.N. Kumawat" **Year:** 1999

Title: Effect of Weed Management and Sulphur Fertilization on the Productivity of Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 69(7):521-522

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	HS	8.3	NR
Soybean (Glycine max)	GRO	GRO	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	HS	8.3	NR

Ref # 73806 **Author:** "Derr, J.F., R.S. Chandran, and W.D. Ward" **Year:** 1996

Title: Preemergence and Postemergence Yellow Nutsedge (Cyperus esculentus) Control with MON 12000 in Nursery Crops **Source:** Weed Technol. 10(1):95-99

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
NR (Cotoneaster dammeri)	GRO	GRO	WGHT	NAT	98 d	F	LOAEL: 1.98024 lb/acre Orig 2.22 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)
NR (Cotoneaster dammeri)	GRO	GRO	WGHT	NAT	98 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)
NR (Rhododendron obtusum)	GRO	GRO	WGHT	NAT	98 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)
NR (Rhododendron obtusum)	GRO	GRO	WGHT	NAT	98 d	F	NOAEL: 1.98024 lb/acr Orig 2.22 kg/ha	LOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	2	100	FieldN	HS	5.7	1.8 % (OM)
NR (Cotoneaster dammeri)	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)
NR (Rhododendron obtusum)	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)
NR (Rhododendron obtusum)	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)
NR (Cotoneaster dammeri)	PHY	INJ	GINJ	NAT	63 d	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FieldN	HS	5.7	1.8 % (OM)

Ref # 73808 **Author:** "Glaze, N.C." **Year:** 1988

Title: "Weed Control in Direct-Seeded Tomato, Lycopersicon esculentum for Transplants" **Source:** Weed Technol. 2(3):333-337

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73808 **Author:** "Glaze, N.C." **Year:** 1988

Title: "Weed Control in Direct-Seeded Tomato, Lycopersicon esculentum for Transplants" **Source:** Weed Technol. 2(3):333-337

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato *(Lycopersicon esculentum)*	PHY	INJ	GINJ	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FieldN	GS		NR
Tomato *(Lycopersicon esculentum)*	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	2	100	FieldN	GS		NR
Tomato *(Lycopersicon esculentum)*	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 0.74928 lb/acr Orig 0.84 kg/ha	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	3	100	FieldN	GS		NR

Ref # 73809 **Author:** "Mersie, W., T. Mebrahtu, and M. Rangappa" **Year:** 1989

Title: "Ozone-Metolachlor Interactions on Corn (Zea mays), Bean (Phaseolus vulgaris), and Soybean (Glycine max)" **Source:** Weed Technol. 3(4):650-654

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
kidney bean *(Phaseolus vulgaris)*	GRO	GRO	WGHT	ART	21 d	F	NOAEL: 1 ppm Orig 1 ppmw	NR Orig	3	100	Lab	EN		NR
Soybean *(Glycine max)*	GRO	GRO	WGHT	ART	21 d	F	NOAEL: 1 ppm Orig 1 ppmw	NR Orig	3	100	Lab	EN		NR

Ref # 73911 **Author:** "Grichar,W.J.; Evers,G.W.; Pohler,C.L.; Schubert,A.M." **Year:** 1987

Title: Use of Preemergence Herbicides for Establishment of Clovers **Source:** Tex.Agric.Exp.Stn.Prog.Rep.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Berseem *(Trifolium alexandrinum)*	PHY	INJ	GINJ	NAT	36 d	A	: 1.5 lb/acre Orig 1.5 ai lb/acre	NR Orig	2	100	FieldN	HS	6.8	NR

Ref # 73911 **Author:** "Grichar,W.J.; Evers,G.W.; Pohler,C.L.; Schubert,A.M." **Year:** 1987

Title: Use of Preemergence Herbicides for Establishment of Clovers **Source:** Tex.Agric.Exp.Stn.Prog.Rep.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Rose clover *(Trifolium hirtum)*	PHY	INJ	GINJ	NAT	36 d	A	LOAEL: 1.5 lb/acre Orig 1.5 ai lb/acre	NR Orig	2	100	FieldN	HS	6.8	NR
Subterranean clover *(Trifolium subterraneum)*	PHY	INJ	GINJ	NAT	36 d	A	LOAEL: 1.5 lb/acre Orig 1.5 ai lb/acre	NR Orig	2	100	FieldN	HS	6.8	NR

Ref # 73916 **Author:** "Talbert,R.E.; Tierney,M.J.; Burgos,N.R.; Strebe,T.A.; Kitt,M.J." **Year:** 1995

Title: "Field Evaluation of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1994" **Source:** Ark.Agric.Exp.Stn.Res.Ser.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Black-eyed pea *(Vigna unguiculata)*	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	4.7-5.3	2-Jan % (OM)
Indian blanket *(Gaillardia pulchella)*	PHY	INJ	GINJ	NAT	14 d	F	NOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	LOAEL: 11.596 lb/acre Orig 13 kg/ha	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
kidney bean *(Phaseolus vulgaris)*	PHY	INJ	GINJ	NAT	49 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Spinach *(Spinacia oleracea)*	PHY	INJ	GINJ	NAT	35 d	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	4	100	FieldN	HS	6.9	1 % (OM)
Spinach *(Spinacia oleracea)*	PHY	INJ	GINJ	NAT	112 d	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	NR Orig	1	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Spinach *(Spinacia oleracea)*	PHY	INJ	GINJ	NAT	154 d	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Spinach *(Spinacia oleracea)*	PHY	INJ	GINJ	NAT	77 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)

Ref # 73916 **Author:** "Talbert,R.E.; Tierney,M.J.; Burgos,N.R.; Strebe,T.A.; Kitt,M.J." **Year:** 1995

Title: "Field Evaluation of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1994" **Source:** Ark.Agric.Exp.Stn.Res.Ser.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Spinach *(Spinacia oleracea)*	PHY	INJ	GINJ	NAT	91 d	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
sweet alyssum *(Lobularia maritima)*	PHY	INJ	GINJ	NAT	21 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	LOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	3	100	FieldN	GG	4.7-4.9	2-Jan % (OM)
sweet alyssum *(Lobularia maritima)*	PHY	INJ	GINJ	NAT	7 d	F	NOAEL: 5.9764 lb/acre Orig 6.7 kg/ha	LOAEL: 11.596 lb/acre Orig 13 kg/ha	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Winter squash *(Cucurbita maxima)*	PHY	INJ	GINJ	NAT	84 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Winter squash *(Cucurbita maxima)*	PHY	INJ	GINJ	NAT	hv	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	2	100	FieldN	HS	6.9	1 % (OM)

Ref # 73917 **Author:** "Brar,L.S.; Walia,U.S." **Year:** 1995

Title: Bioefficacy of Herbicides Against Trianthema portulacastrum in Toria (Brassica campestris subsp. Oleifera var Toria) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
turnip rape *(Brassica rapa)*	GRO	GRO	GGRO	NAT	hv	F	LOAEL: 0.446 lb/acre Orig 0.5 kg/ha	NR Orig	2	100	FieldN	EN		NR
turnip rape *(Brassica rapa)*	GRO	GRO	GGRO	NAT	hv	F	NOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FieldN	EN		NR

Ref # 73919 **Author:** "Cardina,J.; Swann,C.W." **Year:** 1988

Title: Metolachlor Effects on Peanut Growth and Development **Source:** Peanut Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	GRO	GRO	WDTH	NAT	56 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	3	100	FieldN	DA	6	NR

Ref # 73923 **Author:** "Johnson III,W.C.; Mullinix,B.G.,Jr." **Year:** 1994

Title: Use of F6285 for Weed Control in Peanut: Efficacy and Crop Injury **Source:** Peanut Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Sicklepod *(Senna obtusifolia)*	PHY	INJ	GINJ	NAT	30 d	A	LOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	FieldN	GS		0.9 % (OM)
Sicklepod *(Senna obtusifolia)*	PHY	INJ	GINJ	NAT	30 d	A	LOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	FieldN	GS		0.7 % (OM)

Ref # 73934 **Author:** "Grichar,W.J.; Sestak,D.C.; Brewer,K.D.; Besler,B.A.; Stichler,C.R.; Smith,D.T." **Year:** 2001

Title: Sesame (Sesamum indicum L.) Tolerance and Weed Control with Soil-Applied Herbicides **Source:** Crop Prot.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Sesame *(Sesamum orientale)*	GRO	GRO	HGHT	NAT	35 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	GRO	GRO	HGHT	NAT	49 d	F	NOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	GRO	GRO	HGHT	NAT	42 d	F	NOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	7.4-7.8	NR

Ref # 73934 **Author:** "Grichar,W.J.; Sestak,D.C.; Brewer,K.D.; Besler,B.A.; Stichler,C.R.; Smith,D.T." **Year:** 2001

Title: Sesame (Sesamum indicum L.) Tolerance and Weed Control with Soil-Applied Herbicides **Source:** Crop Prot.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Sesame *(Sesamum orientale)*	GRO	GRO	HGHT	NAT	35 d	F	NOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	GRO	GRO	HGHT	NAT	42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	GRO	GRO	HGHT	NAT	49 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	GRO	GRO	HGHT	NAT	35 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR

Ref # 73935 **Author:** "Ivany,J.A." **Year:** 2001

Title: Evaluation of Herbicides for Control of Tufted Vetch (Vicia cracca) and Narrow-Leaved Vetch (Vicia angustifolia) **Source:** Crop Prot

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
cow vetch *(Vicia cracca)*	GRO	GRO	WGHT	ART	70 d	A	LOAEL: 1.1748 lb/acre Orig 1320 ai g/ha	NR Orig	3	100	Lab	FS		NR
Narrow leaf vetch *(Vicia augustifolia)*	GRO	GRO	WGHT	ART	70 d	A	LOAEL: 1.1748 lb/acre Orig 1320 ai g/ha	NR Orig	3	100	Lab	FS		NR

Ref # 73944 **Author:** "Ivany,J.A.; McCully,K.V." **Year:** 1994

Title: Evaluation of Herbicides for Sweet White Lupin (Lupinus albus) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73944 **Author:** "Ivany,J.A.; McCully,K.V." **Year:** 1994

Title: Evaluation of Herbicides for Sweet White Lupin (Lupinus albus) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Egyptian lupine *(Lupinus albus)*	PHY	INJ	GINJ	NAT	ma	A	NOAEL: 2.3496 lb/acre Orig 2640 ai g/ha	NR Orig	2	100	FieldN	HS	6.0-6.4	1.8-2.5 ()

Ref # 73947 **Author:** "Osborne,B.T.; Shaw,D.R.; Ratliff,R.L." **Year:** 1995

Title: Response of Selected Soybean (Glycine max) Cultivars to Dimethenamid and Metolachlor in Hydroponic Conditions **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	GRO	GRO	LGTH	HYP	14 d	F	LOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean *(Glycine max)*	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean *(Glycine max)*	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean *(Glycine max)*	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean *(Glycine max)*	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean *(Glycine max)*	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean *(Glycine max)*	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR

Ref # 73947 **Author:** "Osborne,B.T.; Shaw,D.R.; Ratliff,R.L." **Year:** 1995

Title: Response of Selected Soybean (Glycine max) Cultivars to Dimethenamid and Metolachlor in Hydroponic Conditions **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR

Ref # 73947 **Author:** "Osborne,B.T.; Shaw,D.R.; Ratliff,R.L." **Year:** 1995

Title: Response of Selected Soybean (Glycine max) Cultivars to Dimethenamid and Metolachlor in Hydroponic Conditions **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR

Ref # 73947 **Author:** "Osborne,B.T.; Shaw,D.R.; Ratliff,R.L." **Year:** 1995

Title: Response of Selected Soybean (Glycine max) Cultivars to Dimethenamid and Metolachlor in Hydroponic Conditions **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR
Soybean (Glycine max)	GRO	GRO	LGTH	HYP	14 d	F	NOAEL: 0.083 ppm Orig 83 ppb	NR Orig	1	100	Lab	DA		NR

Ref # 73952 **Author:** "Bowman,J.E.; Sinclair,J.B." **Year:** 1989

Title: Effect of Herbicides on Rhizoctonia Seedling Disease of Soybeans in Glasshouse Experiments **Source:** J.Phytopathol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	WGHT	NAT	18 d	A	LOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	Lab	HS		NR
Soybean (Glycine max)	GRO	GRO	WGHT	NAT	18 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	Lab	HS		NR

Ref # 73953 **Author:** "Maheswarappa,H.P.; Nanjappa,H.V." **Year:** 1994

Title: Relative Efficacy of Herbicides in Controlling the Weeds Infesting Pigeonpea (Cajanus cajan) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73953 **Author:** "Maheswarappa,H.P.; Nanjappa,H.V." **Year:** 1994

Title: Relative Efficacy of Herbicides in Controlling the Weeds Infesting Pigeonpea (Cajanus cajan) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pigeonpea (Cajanus cajan)	GRO	GRO	AREA	NAT	hv	A	LOAEL: 0.446 lb/acre Orig 0.5 ai kg/ha	NR Orig	1	100	FieldN	EN		NR
Pigeonpea (Cajanus cajan)	GRO	GRO	AREA	NAT	hv	A	LOAEL: 0.446 lb/acre Orig 0.5 ai kg/ha	NR Orig	1	100	FieldN	EN		NR
Pigeonpea (Cajanus cajan)	GRO	GRO	AREA	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73963 **Author:** "Webber III,C.L." **Year:** 1992

Title: The Influence of Metolachlor and Trifluralin on Kenaf (Hibiscus cannabinus L.) Yield Components **Source:** Ind.Crops Prod.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Deccan hemp (Hibiscus cannabinus)	GRO	GRO	HGHT	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS		NR

Ref # 73964 **Author:** "Callan,E.J.; Kennedy,C.W." **Year:** 1995

Title: Tolerance of Stokes Aster to Selected Herbicides **Source:** Ind.Crops Prod.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Stokes' aster (Stokesia laevis)	GRO	GRO	NLEF	NAT	62 d	A	NOAEL: 2.65816 lb/acr Orig 2.98 ai kg/ha	NR Orig	3	100	Lab	EN		NR

Ref # 73966 **Author:** "Wilkinson,R.E.; Duncan,R.R." **Year:** 1993

Title: Interactions of Metolachlor and Excess Hydrogen (H+) Influences on Sorghum (Sorghum bicolor) Cultivar Roots **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	6	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	5.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	6	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	4.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	6	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	4.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	LOAEL: 0.25 ppm Orig 0.25 mg/kg	NR Orig	4	100	Lab	CM	5.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	Lab	CM	4.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	Lab	CM	4	NR

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	Lab	CM	5.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	Lab	CM	5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	Lab	CM	5.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	Lab	CM	4	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	Lab	CM	4.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	Lab	CM	6	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	Lab	CM	4	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	Lab	CM	4.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	Lab	CM	6	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	Lab	CM	5.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 2 ppm Orig 2 mg/kg	NR Orig	4	100	Lab	CM	5	NR

Ref # 73966 **Author:** "Wilkinson,R.E.; Duncan,R.R." **Year:** 1993

Title: Interactions of Metolachlor and Excess Hydrogen (H+) Influences on Sorghum (Sorghum bicolor) Cultivar Roots **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	Lab	CM	5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	Lab	CM	4	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	Lab	CM	4.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.5 ppm Orig 0.5 mg/kg	LOAEL: 1 ppm Orig 1 mg/kg	4	100	Lab	CM	4	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	Lab	CM	6	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	Lab	CM	5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 0.25 ppm Orig 0.25 mg/kg	LOAEL: 0.5 ppm Orig 0.5 mg/kg	4	100	Lab	CM	5.5	NR
Soybean (Glycine max)	GRO	GRO	LGTH	ART	14 d	F	NOAEL: 1 ppm Orig 1 mg/kg	LOAEL: 2 ppm Orig 2 mg/kg	4	100	Lab	CM	4	NR

Ref # 73968 **Author:** "Singh,V.K.; Bajpai,R.P.; Mishra,R.K.; Purohit,K.K." **Year:** 1991

Title: Chemical Weed Control in Rainfed Soybean (Glycine max) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73968 **Author:** "Singh,V.K.; Bajpai,R.P.; Mishra,R.K.; Purohit,K.K." **Year:** 1991

Title: Chemical Weed Control in Rainfed Soybean (Glycine max) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	WGHT	NAT	hv	A	NOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN	6.2	NR
Soybean (Glycine max)	GRO	GRO	WGHT	NAT	hv	A	NOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN	6.2	NR

Ref # 73972 **Author:** Rout D;Satapathy MR; **Year:** 1998

Title: Chemical Weed Control in Rainfed Cotton (Gossypium hirsutum) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cotton (Gossypium hirsutum)	GRO	GRO	HGHT	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN	5.9	NR
Cotton (Gossypium hirsutum)	GRO	GRO	HGHT	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN	5.9	NR
Cotton (Gossypium hirsutum)	GRO	GRO	HGHT	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN	5.9	NR

Ref # 73977 **Author:** Schroeder J; **Year:** 1992

Title: Pepper (Capsicum annuum) Cultivar Response to Metolachlor in Three New Mexico Soils **Source:** Weed Technol

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper (Capsicum annuum)	GRO	GRO	WGHT	NAT	35 d	A	LOAEL: 0.1115 lb/acre Orig 0.125 ai kg/ha	NR Orig	5	100	Lab	WA	7.6	1.3 % (OM)

Ref # 73977 **Author:** Schroeder J; **Year:** 1992

Title: Pepper (Capsicum annuum) Cultivar Response to Metolachlor in Three New Mexico Soils **Source:** Weed Technol

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	GRO	GRO	WGHT	NAT	35 d	A	NOAEL: 0.1115 lb/acre Orig 0.125 ai kg/ha	LOAEL: 0.223 lb/acre Orig 0.25 ai kg/ha	5	100	Lab	WA	7.7	1.2 % (OM)
Bell pepper *(Capsicum annuum)*	GRO	GRO	WGHT	NAT	35 d	A	NOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	5	100	Lab	WA	7.7	1.45 % (OM)

Ref # 73986 **Author:** Kurtz ME; **Year:** 1996

Title: "The Influence of Preemergence Applied Herbicides on Kenaf Stand, Height, and Yield" **Source:** Ind Crops Prod

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Deccan hemp *(Hibiscus cannabinus)*	GRO	GRO	HGHT	NAT	hv	A	NOAEL: 2.676 lb/acre Orig 3 ai kg/ha	NR Orig	1	100	FieldN	HS	5.7	NR
Deccan hemp *(Hibiscus cannabinus)*	GRO	GRO	HGHT	NAT	hv	A	NOAEL: 2.676 lb/acre Orig 3 ai kg/ha	NR Orig	1	100	FieldN	HS	5.7	NR

Ref # 73990 **Author:** Osborne BT;Shaw DR;Ratliff RL; **Year:** 1995

Title: Soybean (Glycine max) Cultivar Tolerance to SAN 582H and Metolachlor as Influenced by Soil Moisture **Source:** Weed Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean *(Glycine max)*	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)

Ref # 73990 **Author:** Osborne BT;Shaw DR;Ratliff RL; **Year:** 1995

Title: Soybean (Glycine max) Cultivar Tolerance to SAN 582H and Metolachlor as Influenced by Soil Moisture **Source:** Weed Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	14 d	A	NOAEL: 1.5164 lb/acre Orig 1.7 ai kg/ha	LOAEL: 4.46 lb/acre Orig 5 ai kg/ha	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 1.5164 lb/acre Orig 1.7 ai kg/ha	LOAEL: 4.46 lb/acre Orig 5 ai kg/ha	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	GRO	GRO	HGHT	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)

Other

Ref # 25746 **Author:** "Mellis, J.M., P. Pillai, D.E. Davis, and B. Truelove" **Year:** 1982

Title: Metolachlor and Alachlor Effects on Membrane Permeability and Lipid Synthesis **Source:** Weed Sci. 30:399-404

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cotton *(Gossypium hirsutum)*	PHY	PHY	PRET	HYP	2 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	2	100	Lab			NR
garden cucumber *(Cucumis sativus)*	PHY	PHY	PRET	HYP	2 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	2	100	Lab			NR
Soybean *(Glycine max)*	PHY	PHY	PRET	HYP	0.5 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	2	100	Lab			NR

Ref # 31621 **Author:** "Teasdale, J.R." **Year:** 1985

Title: "Delayed Application of Metolachlor for Pepper, Tomato, and Cucumber" **Source:** Proc.Northeast.Weed Sci.Soc. 39:131-133

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	LOAEL: lb/acre Orig	2	100	FIELDN	HS		1.5 % (OM)

Ref # 31621 **Author:** "Teasdale, J.R." **Year:** 1985

Title: "Delayed Application of Metolachlor for Pepper, Tomato, and Cucumber" **Source:** Proc.Northeast.Weed Sci.Soc. 39:131-133

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	LOAEL: lb/acre Orig	2	100	FIELDN	HS		1.4 % (OM)
garden cucumber *(Cucumis sativus)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
garden cucumber *(Cucumis sativus)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
garden cucumber *(Cucumis sativus)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
garden cucumber *(Cucumis sativus)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
garden cucumber *(Cucumis sativus)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	LOAEL: lb/acre Orig	2	100	FIELDN	HS		1.4 % (OM)
garden cucumber *(Cucumis sativus)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
garden cucumber *(Cucumis sativus)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
garden cucumber *(Cucumis sativus)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	LOAEL: lb/acre Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato *(Lycopersicon esculentum)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)

Ref # 31621 **Author:** "Teasdale, J.R." **Year:** 1985

Title: "Delayed Application of Metolachlor for Pepper, Tomato, and Cucumber" **Source:** Proc.Northeast.Weed Sci.Soc. 39:131-133

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato (Lycopersicon esculentum)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	LOAEL: lb/acre Orig	2	100	FIELDN	HS		1.5 % (OM)
Tomato (Lycopersicon esculentum)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	LOAEL: lb/acre Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato (Lycopersicon esculentum)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato (Lycopersicon esculentum)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Tomato (Lycopersicon esculentum)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)
Tomato (Lycopersicon esculentum)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.4 % (OM)
Tomato (Lycopersicon esculentum)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS		1.5 % (OM)

Ref # 40621 **Author:** "Vengris, J." **Year:** 1977

Title: Annual Weed Control in Alfalfa New Seedlings **Source:** Proc.Northeast.Weed Sci.Soc. 31:99-103

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Alfalfa (Medicago sativa)	POP	POP	BMAS	NAT	60 d	A	NOAEL: 2 lb/acre Orig 2 ai lb/acre	LOAEL: 3 lb/acre Orig 3 ai lb/acre	2	100	FieldN	DA		NR
Alfalfa (Medicago sativa)	POP	POP	BMAS	NAT	60 d	A	NOAEL: 2 lb/acre Orig 2 ai lb/acre	LOAEL: 3 lb/acre Orig 3 ai lb/acre	2	100	FieldN	DA		NR

Ref # 40627 **Author:** "Brown, J.F., and H.D. Swingle" **Year:** 1977

Title: Herbicide Evaluation in Vegetable Crops **Source:** P So Wd S S 30:168-175

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pea *(Pisum sativum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 2 lb/acre Orig 2 lb/acre	NR Orig	2	100	FieldN	DA		NR
pigweed *(NR Amaranthaceae)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5 lb/acre Orig 1.5 lb/acre	NR Orig	2	100	FieldN	DA		NR
pigweed *(NR Amaranthaceae)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5 lb/acre Orig 1.5 lb/acre	NR Orig	2	100	FieldN	DA		NR
sieva bean *(Phaseolus lunatus)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 2 lb/acre Orig 2 lb/acre	NR Orig	2	100	FieldN	DA		NR
sieva bean *(Phaseolus lunatus)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 2 lb/acre Orig 2 lb/acre	NR Orig	2	100	FieldN	DA		NR
sieva bean *(Phaseolus lunatus)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.5 lb/acre Orig 1.5 lb/acre	LOAEL: 2 lb/acre Orig 2 lb/acre	2	100	FieldN	DA		NR
wild portulaca *(Portulaca oleracea)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5 lb/acre Orig 1.5 lb/acre	NR Orig	2	100	FieldN	DA		NR
wild portulaca *(Portulaca oleracea)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5 lb/acre Orig 1.5 lb/acre	NR Orig	2	100	FieldN	DA		NR

Ref # 40628 **Author:** "Selleck, G.W., and L.E. Weber" **Year:** 1976

Title: Herbicide Trials for Yellow Nutsedge in Potatoes on Long Island **Source:** Proc.Northeast.Weed Sci.Soc. 30:239-242

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Irish potato *(Solanum tuberosum)*	POP	POP	BMAS	NAT	20-150 d	F	NOAEL: 4 lb/acre Orig 4 lb/acre	NR Orig	3	100	FieldN	GS		NR

Ref # 40628 **Author:** "Selleck, G.W., and L.E. Weber" **Year:** 1976

Title: Herbicide Trials for Yellow Nutsedge in Potatoes on Long Island **Source:** Proc.Northeast.Weed Sci.Soc. 30:239-242

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Irish potato *(Solanum tuberosum)*	POP	POP	BMAS	NAT	20-150 d	F	NOAEL: 4 lb/acre Orig 4 lb/acre	NR Orig	3	100	FieldN	GS		NR

Ref # 40630 **Author:** "Henne, R.C." **Year:** 1977

Title: New Compounds with Potential for Weed Control in Tomatoes **Source:** Proc.Northeast.Weed Sci.Soc. 31:207-214

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
dicotyledons *(NR Magnoliopsida)*	POP	POP	BMAS	NAT	~30 d	A	LOAEL: 1.2488 lb/acre Orig 1.4 ai kg/ha	NR Orig	2	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)
dicotyledons *(NR Magnoliopsida)*	POP	POP	BMAS	NAT	~30 d	A	LOAEL: 3.0328 lb/acre Orig 3.4 ai kg/ha	NR Orig	1	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)
dicotyledons *(NR Magnoliopsida)*	POP	POP	BMAS	NAT	~30 d	A	LOAEL: 1.338 lb/acre Orig 1.5 ai kg/ha	NR Orig	2	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)
Tomato *(Lycopersicon esculentum)*	POP	POP	BMAS	NAT	~90 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	2	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)
Tomato *(Lycopersicon esculentum)*	POP	POP	BMAS	NAT	~90 d	A	NOAEL: 3.0328 lb/acre Orig 3.4 ai kg/ha	NR Orig	1	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)
Tomato *(Lycopersicon esculentum)*	POP	POP	BMAS	NAT	~105 d	A	NOAEL: 2.676 lb/acre Orig 3 ai kg/ha	NR Orig	2	100	FieldN	DA	5.8-6.7	2.2-2.7 % (OM)

Ref # 40869 **Author:** "Vengris, J." **Year:** 1977

Title: Annual Weed Control in Field Corn **Source:** Proc.Northeast.Weed Sci.Soc. 31:1-5

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
dicotyledons *(NR Magnoliopsida)*	POP	POP	CNTL	NAT	120 d	A	LOAEL: 2 lb/acre Orig 2 ai lb/acre	NR Orig	1	100	FieldN	DA		NR

Ref # 41031 **Author:** "Giannopolitis, C.N." **Year:** 1981

Title: "Amaranthus Weed Species in Greece: Dormancy, Germination and Response to Pre-Emergence Herbicides" **Source:** Ann I P Ben 13:80-91

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Green amaranth *(Amaranthus retroflexus)*	MOR	MOR	MORT	ART	15 d	A	LOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	1	50	Lab	SP		50 % (PEAT)
Green amaranth *(Amaranthus retroflexus)*	POP	POP	BMAS	ART	15 d	A	LOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	1	50	Lab	SP		50 % (PEAT)
Prostrate amaranth *(Amaranthus albus)*	MOR	MOR	MORT	ART	15 d	A	LOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	1	50	Lab	SP		50 % (PEAT)
Prostrate amaranth *(Amaranthus albus)*	POP	POP	BMAS	ART	15 d	A	LOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	1	50	Lab	SP		50 % (PEAT)
prostrate pigweed *(Amaranthus blitoides)*	MOR	MOR	MORT	ART	15 d	A	LOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	1	50	Lab	SP		50 % (PEAT)
prostrate pigweed *(Amaranthus blitoides)*	POP	POP	BMAS	ART	15 d	A	LOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	1	50	Lab	SP		50 % (PEAT)

Ref # 41050 **Author:** "Waldrop, D.D., and P.A. Banks" **Year:** 1983

Title: Interactions of Herbicides with Insecticides in Soybeans **Source:** Weed Sci. 31:730-734

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	ABND	NAT	25 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		2.7 % (OM)
Soybean *(Glycine max)*	POP	POP	ABND	NAT	60 hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		2.7 % (OM)

Ref # 41283 **Author:** "Mcnevin, G., and R.G. Harvey" **Year:** 1982

Title: Wild Proso Millet Control in Processing Peas and Soybeans **Source:** Weed Sci. 30:365-368

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	to 165 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 AI kg/ha	NR Orig	3	100	FieldN	GS		1.2 % (OM)

Ref # 41806 **Author:** "Murphy, H.J., and T. Gajewski" **Year:** 1977

Title: "Effect of Several Herbicides Applied Preemergence, at Drag-Off and Layby on Weed Control in White Potatoes" **Source:** Proc.Northeast.Weed Sci.Soc. 31:176-179

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Irish potato *(Solanum tuberosum)*	POP	POP	BMAS	NAT	~135 d	A	NOAEL: 2.23 lb/acre Orig 2.5 ai kg/ha	NR Orig	1	100	FieldN	GS		NR

Ref # 44022 **Author:** "Pillai, P., D.E. Davis, and B. Truelove" **Year:** 1979

Title: "Effects of Metolachlor on Germination, Growth, Leucine Uptake and Protein Synthesis" **Source:** Weed Sci. 27:634-637

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cotton *(Gossypium sp.)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
cultivated radish *(Raphanus sativus)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
garden cucumber *(Cucumis sativus)*	PHY	PHY	PRSY	FLT	1 d	F	LOAEL: 0.00000892 lb/ Orig 0.00001 kg/ha	NR Orig	2	100	Lab	DA		NR
garden cucumber *(Cucumis sativus)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
Lettuce *(Lactuca sativa)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
morningglory *(Ipomoea sp.)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
Pea *(Pisum sativum)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
Peanut *(Arachis hypogaea)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.00001 M Orig 0.00001 M	LOAEL: 0.0001 M Orig 0.0001 M	3	100	Lab	DA		NR
Sicklepod *(Senna obtusifolia)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR
Soybean *(Glycine max)*	REP	REP	GERM	FLT	7 d	F	NOAEL: 0.0001 M Orig 0.0001 M	NR Orig	3	100	Lab	DA		NR

Ref # 44214 **Author:** "Sloan, M.E., and N.D. Camper" **Year:** 1986

Title: Effects of Alachlor and Metolachlor on Cucumber Seedlings **Source:** Environ.Exp.Bot. 26(1):1-7

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
garden cucumber *(Cucumis sativus)*	PHY	PHY	PRSY	NON	~4 d	F	NOAEL: 0.01 M Orig 0.01 M	LOAEL: 0.1 M Orig 0.1 M	4	100	Lab	DA		NR

Ref # 66126 **Author:** "Foy, C.L., and H.L. Witt" **Year:** 1997

Title: "SAN 582, Alachlor, and Metolachlor Control Triazine-Resistant (TR) Smooth Pigweed (Amaranthus hybridus) in No-Till Corn (Zea mays)" **Source:** Weed Technol. 11(3):623-625

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
green pigweed *(Amaranthus hybridus)*	POP	POP	CNTL	NAT	56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	EN	7.3	NR
green pigweed *(Amaranthus hybridus)*	POP	POP	CNTL	NAT	51 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	HS	6.3	NR

Ref # 66847 **Author:** "Grichar, W.J., R.G. Lemon, K.D. Brewer, and B.W. Minton" **Year:** 2001

Title: S-Metolachlor Compared with Metolachlor on Yellow Nutsedge (Cyperus esculentus) and Peanut (Arachis hypogaea) **Source:** Weed Technol. 15(1):107-111

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	POP	POP	ABND	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Peanut *(Arachis hypogaea)*	POP	POP	ABND	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR

Ref # 66847 **Author:** "Grichar, W.J., R.G. Lemon, K.D. Brewer, and B.W. Minton" **Year:** 2001

Title: S-Metolachlor Compared with Metolachlor on Yellow Nutsedge (Cyperus esculentus) and Peanut (Arachis hypogaea) **Source:** Weed Technol. 15(1):107-111

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut (Arachis hypogaea)	POP	POP	ABND	NAT	~42-56 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Peanut (Arachis hypogaea)	POP	POP	ABND	NAT	~42-56 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Peanut (Arachis hypogaea)	POP	POP	ABND	NAT	~42-56 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Peanut (Arachis hypogaea)	POP	POP	ABND	NAT	~42-56 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Peanut (Arachis hypogaea)	POP	POP	ABND	NAT	~42-56 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR
Peanut (Arachis hypogaea)	POP	POP	ABND	NAT	~42-56 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	3	100	FIELD	GM	6.9-7.2	NR

Ref # 70441 **Author:** "Talbert, R.E., R.A. Wichert, V.F. Carey III, D.H. Johnson, D.F. Ruff, and N.R. Burgos" **Year:** 1993

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1992" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 429:1-29

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Amaranth (Amaranthus sp.)	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)
Amaranth (Amaranthus sp.)	POP	POP	CNTL	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Amaranth *(Amaranthus sp.)*	POP	POP	CNTL	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
brambles *(Rubus sp.)*	POP	POP	BMAS	NAT	21 d	A	NOAEL: 3.99616 lb/acr Orig 4.48 AI kg/ha	NR Orig	2	100	FIELDN	HS	5.6	NR
Chrysanthemum *(Chrysanthemum sp.)*	POP	POP	BMAS	NAT	21 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FieldN	HS	5.6	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	35 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	35 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Cutleaf evening primrose *(Oenothera laciniata)*	POP	POP	CNTL	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
Cutleaf evening primrose *(Oenothera laciniata)*	POP	POP	CNTL	NAT	63 d	A	NOAEL: 7.99232 lb/acr Orig 8.96 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.6	NR
kidney bean *(Phaseolus vulgaris)*	POP	POP	BMAS	NAT	63 d	A	NOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)
moonflower *(Datura stramonium)*	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)
Pennsylvania knotweed *(Polygonum pensylvanicum)*	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)
prickly fanpetals *(Sida spinosa)*	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)

Ref # 70441 **Author:** "Talbert, R.E., R.A. Wichert, V.F. Carey III, D.H. Johnson, D.F. Ruff, and N.R. Burgos" **Year:** 1993

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1992" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 429:1-29

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
white morninglory *(Ipomoea lacunosa)*	POP	POP	CNTL	NAT	42 d	A	NOAEL: 1.5164 lb/acre Orig 1.7 AI kg/ha	NR Orig	1	100	FIELDN	HS	5.3	1.5 % (OM)

Ref # 70865 **Author:** "Derr, J.F." **Year:** 1993

Title: Wildflower Tolerance to Metolachlor and Metolachlor Combined with Other Broadleaf Herbicides **Source:** Hortscience 28(10):1023-1026

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Blanketflower *(Gaillardia aristata)*	MOR	MOR	SURV	NAT	399 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100	FIELD	HS		NR
Blanketflower *(Gaillardia aristata)*	MOR	MOR	SURV	NAT	371 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100	FIELD	HS		NR
False daisy *(Eclipta prostrata)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	2	100	FIELD	HS		NR
False daisy *(Eclipta prostrata)*	POP	POP	CNTL	NAT	63 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	LOAEL: 8.028 lb/acre Orig 9 kg/ha	2	100	FIELD	HS		NR
Lanceleaf tickseed *(Coreopsis lanceolata)*	MOR	MOR	SURV	NAT	371 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100	FIELD	HS		NR
Lanceleaf tickseed *(Coreopsis lanceolata)*	MOR	MOR	SURV	NAT	399 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100	FIELD	HS		NR
Oxeye Daisy *(Leucanthemum vulgare)*	MOR	MOR	SURV	NAT	371 d	F	LOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	2	100	FIELD	HS		NR
Oxeye Daisy *(Leucanthemum vulgare)*	MOR	MOR	SURV	NAT	399 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100	FIELD	HS		NR

Ref # 70865 **Author:** "Derr, J.F." **Year:** 1993

Title: Wildflower Tolerance to Metolachlor and Metolachlor Combined with Other Broadleaf Herbicides **Source:** Hortscience 28(10):1023-1026

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Purple coneflower (*Echinacea purpurea*)	MOR	MOR	SURV	NAT	399 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	LOAEL: 8.028 lb/acre Orig 9 kg/ha	2	100	FIELD	HS		NR
Purple coneflower (*Echinacea purpurea*)	MOR	MOR	SURV	NAT	371 d	F	NOAEL: 8.028 lb/acre Orig 9 kg/ha	NR Orig	2	100	FIELD	HS		NR

Ref # 72762 **Author:** "Harrison, H.F., M.W. Farnham, and J.K. Peterson" **Year:** 1998

Title: Differential Response of Collard and Kale Cultivars to Preemergence Application of Metolachlor **Source:** Crop Prot. 17(4):293-297

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 5.352 lb/acre Orig 6 kg/ha	NR Orig	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)

Ref # 72762 **Author:** "Harrison, H.F., M.W. Farnham, and J.K. Peterson" **Year:** 1998

Title: Differential Response of Collard and Kale Cultivars to Preemergence Application of Metolachlor **Source:** Crop Prot. 17(4):293-297

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 2.676 lb/acre Orig 3 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)

Ref # 72762 **Author:** "Harrison, H.F., M.W. Farnham, and J.K. Peterson" **Year:** 1998

Title: Differential Response of Collard and Kale Cultivars to Preemergence Application of Metolachlor **Source:** Crop Prot. 17(4):293-297

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	28 d	F	NOAEL: 2.676 lb/acre Orig 3 kg/ha	LOAEL: 5.352 lb/acre Orig 6 kg/ha	3	100	FieldN	GS		1 % (OM)

Ref # 73232 **Author:** "Eyherabide, J.J." **Year:** 1996

Title: Evaluation of Pre-emergent Herbicides for Weed Control in No Tillage Soybeans **Source:** Ann.Appl.Biol. 128(Suppl.):64-65

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	POP	POP	BMAS	SOI	hv	A	LOAEL: 1.71264 lb/acre Orig 1.92 AI kg/ha	NR Orig	1	100	FIELDN	GS		NR

Ref # 73236 **Author:** "Talbert, R.E., M.J. Tierney, V.F. Carey III, and M.J. Kitt" **Year:** 1994

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1993" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 440:1-60

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Amaranth (Amaranthus sp.)	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Amaranth *(Amaranthus sp.)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	140 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	63 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	98 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	126 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	161 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
common henbit (*Lamium amplexicaule*)	POP	POP	CNTL	NAT	70 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit (*Lamium amplexicaule*)	POP	POP	CNTL	NAT	56 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit (*Lamium amplexicaule*)	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Dogfennel (*Anthemis cotula*)	POP	POP	CNTL	NAT	63 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Dogfennel (*Anthemis cotula*)	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Dogfennel (*Anthemis cotula*)	POP	POP	CNTL	NAT	98 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Dogfennel (*Anthemis cotula*)	POP	POP	CNTL	NAT	126 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Dogfennel (*Anthemis cotula*)	POP	POP	CNTL	NAT	161 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Dogfennel (*Anthemis cotula*)	POP	POP	CNTL	NAT	140 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
kidney bean (*Phaseolus vulgaris*)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Lamb's-quarters (*Chenopodium album*)	POP	POP	CNTL	NAT	42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Lamb's-quarters *(Chenopodium album)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Pennsylvania knotweed *(Polygonum pensylvanicum)*	POP	POP	CNTL	NAT	21 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Pennsylvania knotweed *(Polygonum pensylvanicum)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Pennsylvania knotweed *(Polygonum pensylvanicum)*	POP	POP	CNTL	NAT	63 d	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	2	100	FieldN	HS	5.6	1 % (OM)
Spinach *(Spinacia oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Spinach *(Spinacia oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Spinach *(Spinacia oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
spiny amaranthus *(Amaranthus spinosus)*	POP	POP	CNTL	NAT	21 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
spiny amaranthus *(Amaranthus spinosus)*	POP	POP	CNTL	NAT	63 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
spiny amaranthus *(Amaranthus spinosus)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	140 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	126 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	63 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	70 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	161 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	70 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	98 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)

Ref # 73236 **Author:** "Talbert, R.E., M.J. Tierney, V.F. Carey III, and M.J. Kitt" **Year:** 1994

Title: "Field Evaluations of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1993" **Source:** Ark.Agric.Exp.Stn.Res.Ser. 440:1-60

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Virginia winged rockcress (*Sibara virginica*)	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress (*Sibara virginica*)	POP	POP	CNTL	NAT	70 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress (*Sibara virginica*)	POP	POP	CNTL	NAT	28 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress (*Sibara virginica*)	POP	POP	CNTL	NAT	56 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Winter squash (*Cucurbita maxima*)	POP	POP	ABND	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Winter squash (*Cucurbita maxima*)	POP	POP	ABND	NAT	14 d	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	2	100	FieldN	HS	5.6	1 % (OM)
Winter squash (*Cucurbita maxima*)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)
Winter squash (*Cucurbita maxima*)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	5.6	1 % (OM)

Ref # 73238 **Author:** "Cohen, R., B. Blaier, and J. Katan" **Year:** 1992

Title: Chloroacetamide Herbicides Reduce Incidence of Fusarium Wilt in Melons **Source:** Crop Prot. 11(2):181-185

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Honeydew (*Cucumis melo*)	PHY	IMM	IFCT	NAT	11 d	F	LOAEL: 0.1 ppm Orig 0.1 ug/g	NR Orig	1	100	LAB	DA	7.9	NR

Ref # 73241 **Author:** "Kurmvanshi, S.M., T.R. Sahu, and R.S. Sharma" **Year:** 1995

Title: "Effect of Chemical Weed Control on Crop and Weed Biomass, Productivity Index and Weed Competition Index in Soybean Ecosystem" **Source:** Crop Res. 9(3):390-393

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FIELDN	NR		NR
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FIELDN	NR		NR

Ref # 73242 **Author:** "Gabr, M.A., M.A. Shakeeb, F. Fahmy, and H. Abbas" **Year:** 1988

Title: Influence of Metolachlor on Growth and Some Biochemical Activities in Tomato (Lycopersicon esculentum L.) Seedlings **Source:** Egypt J.Bot. 31(1-3):121-132

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato (Lycopersicon esculentum)	BCM	ENZ	AMYL	ART	5 d	F	LOAEL: 3.5 nM Orig 3.5 nM	NR Orig	6	100	LAB	DA		NR
Tomato (Lycopersicon esculentum)	BCM	BCM	CARC	ART	5 d	F	LOAEL: 3.5 nM Orig 3.5 nM	NR Orig	6	100	LAB	DA		NR
Tomato (Lycopersicon esculentum)	CEL	GEN	RNAC	ART	5 d	F	LOAEL: 3.5 nM Orig 3.5 nM	NR Orig	6	100	LAB	DA		NR
Tomato (Lycopersicon esculentum)	PHY	PHY	PSYN	ART	5 d	F	LOAEL: 3.5 nM Orig 3.5 nM	NR Orig	6	100	LAB	DA		NR

Ref # 73245 **Author:** "Ramakrishna, A., C.K. Ong, and S.L.N. Reddy" **Year:** 1991

Title: Integrated Weed Management for Rainfed Groundnut **Source:** J.Plant Prot.Trop. 8(2):111-119

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR

Ref # 73246 **Author:** "Gilreath, J.P., J.W. Noling, and B.M. Santos" **Year:** 2004

Title: Methyl Bromide Alternatives for Bell Pepper (Capsicum annuum) and Cucumber (Cucumis sativus) Rotations **Source:** Crop Prot. 23(4):347-351

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	21 d	F	LOAEL: 2.007 lb/acre Orig 2.25 kg/ha	NR Orig	1	100	FIELDN	HS	7.3	NR

Ref # 73249 **Author:** "Warren, S.L., and W.A. Skroch" **Year:** 1991

Title: Evaluation of Six Herbicides for Potential Use in Tree Seed Beds **Source:** J.Environ.Hortic. 9(3):160-163

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Eastern redbud *(Cercis canadensis)*	MOR	MOR	SURV	ART	369 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR

Ref # 73249 **Author:** "Warren, S.L., and W.A. Skroch" **Year:** 1991

Title: Evaluation of Six Herbicides for Potential Use in Tree Seed Beds **Source:** J.Environ.Hortic. 9(3):160-163

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Flowering dogwood (*Cornus florida*)	MOR	MOR	SURV	ART	549 d	A	NOAEL: 4 lb/acre Orig 4 lb/acre	LOAEL: 8 lb/acre Orig 8 lb/acre	2	100	FIELDA	HS		NR
NR (*Quercus palustris*)	MOR	MOR	SURV	ART	549 d	A	NOAEL: 4 lb/acre Orig 4 lb/acre	LOAEL: 8 lb/acre Orig 8 lb/acre	2	100	FIELDA	HS		NR
River birch (*Betula nigra*)	MOR	MOR	SURV	ART	369 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR
Sugar maple (*Acer saccharum*)	MOR	MOR	SURV	ART	549 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR
Sweetgum (*Liquidambar styraciflua*)	MOR	MOR	SURV	ART	369 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR
Willow oak (*Quercus phellos*)	MOR	MOR	SURV	ART	549 d	A	NOAEL: 8 lb/acre Orig 8 lb/acre	NR Orig	2	100	FIELDA	HS		NR

Ref # 73250 **Author:** "Skroch, W.A., C.J. Catanzaro, and M.H. Yonce" **Year:** 1990

Title: Response of Nine Herbaceous Flowering Perennials to Selected Herbicides **Source:** J.Environ.Hortic. 8(1):26-28

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bigflower coreopsis (*Coreopsis grandiflora*)	REP	REP	INFL	NAT	219 d	A	NOAEL: 3 lb/acre Orig 3 lb/acre	NR Orig	1	100	FIELDA	HS	6.5	NR
Moss phlox (*Phlox sublata*)	POP	POP	COVR	NAT	219 d	A	NOAEL: 3 lb/acre Orig 3 lb/acre	NR Orig	1	100	FIELDA	HS	6.5	NR
pink (*Dianthus sp.*)	POP	POP	COVR	NAT	219 d	A	LOAEL: 3 lb/acre Orig 3 lb/acre	NR Orig	1	100	FIELDA	HS	6.5	NR

Ref # 73257 **Author:** "Friesen, G.H., and D.A. Wall" **Year:** 1986

Title: Tolerance of Lentil (Lens culinaris Medik.) to Herbicides **Source:** Can.J.Plant Sci. 66(1):131-140

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Lentil (Lens culinaris)	BCM	BCM	PRCO	NAT	95 d	A	LOAEL: 2.3192 lb/acre Orig 2.6 AI kg/ha	NR Orig	1	100	FIELDN	HS	6.4	NR
Lentil (Lens culinaris)	BCM	BCM	PRCO	NAT	100 d	A	NOAEL: 2.3192 lb/acre Orig 2.6 AI kg/ha	NR Orig	1	100	FIELDN	HS	6.4	NR
Lentil (Lens culinaris)	POP	POP	BMAS	NAT	112 d	A	LOAEL: 2.3192 lb/acre Orig 2.6 AI kg/ha	NR Orig	1	100	FIELDN	HS	6.4	NR
Lentil (Lens culinaris)	POP	POP	BMAS	NAT	100 d	A	LOAEL: 2.3192 lb/acre Orig 2.6 AI kg/ha	NR Orig	1	100	FIELDN	HS	6.4	NR
Lentil (Lens culinaris)	POP	POP	BMAS	NAT	95 d	A	LOAEL: 2.3192 lb/acre Orig 2.6 AI kg/ha	NR Orig	1	100	FIELDN	HS	6.4	NR
Lentil (Lens culinaris)	POP	POP	BMAS	NAT	105 d	A	NOAEL: 2.3192 lb/acre Orig 2.6 AI kg/ha	NR Orig	1	100	FIELDN	HS	6.4	NR

Ref # 73258 **Author:** "Tiwari, J.P., and S.P. Kurchania" **Year:** 1993

Title: Chemical Control of Weeds in Indian Mustard (Brassica juncea) **Source:** Indian J.Agric.Sci. 63(5):272-275

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Brown mustard (Brassica juncea)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	GS		NR
Brown mustard (Brassica juncea)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	GS		NR
Brown mustard (Brassica juncea)	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	GS		NR

Ref # 73259 **Author:** "Gangwar, K.S., K.P. Niranjan, and O.P. Singh" **Year:** 1991

Title: Weed Management in Sorghum (Sorghum bicolor) + Pigeonpea (Cajanus cajan) Intercropping System in Dryland **Source:** Indian J.Agric.Sci. 61(10):757-759

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pigeonpea (Cajanus cajan)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FIELDN	GM	7.35	NR
Pigeonpea (Cajanus cajan)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FIELDN	GM	7.35	NR

Ref # 73264 **Author:** "Teasdale, J.R." **Year:** 1985

Title: Avoidance of Herbicide Injury by Placement Between Rows of Polyethylene Mulch **Source:** Hortscience 20(5):871-872

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Honeydew (Cucumis melo)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS	6.3	NR
Honeydew (Cucumis melo)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.99616 lb/acr Orig 4.48 kg/ha	NR Orig	2	100	FIELDN	HS	5.4	NR

Ref # 73265 **Author:** "Dusky, J.A." **Year:** 1986

Title: Preemergency Herbicides for Radishes Grown on Organic Soils **Source:** Hortscience 21(1):74-76

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
cultivated radish (Raphanus sativus)	POP	POP	BMAS	NAT	hv	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	2	100	FieldN	HS		NR
cultivated radish (Raphanus sativus)	POP	POP	BMAS	NAT	hv	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73265 **Author:** "Dusky, J.A." **Year:** 1986

Title: Preemergency Herbicides for Radishes Grown on Organic Soils **Source:** Hortscience 21(1):74-76

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
cultivated radish (*Raphanus sativus*)	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.99712 lb/acr Orig 3.36 AI kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73266 **Author:** "Gilreath, J.P." **Year:** 1987

Title: Chemical Weed Control in Gypsophila **Source:** Hortscience 22(3):446-448

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Amaranth (*Amaranthus sp.*)	POP	POP	CNTL	NAT	32 d	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	FieldN	HS	6.4	0.7 % (OM)
Baby's breath (*Gypsophila paniculata*)	POP	POP	ABND	NAT	hv	F	LOAEL: 1.99808 lb/acre Orig 2.24 kg/ha	NR Orig	1	100	FieldN	HS	6.4	0.7 % (OM)
Baby's breath (*Gypsophila paniculata*)	POP	POP	ABND	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	1	100	FieldN	HS	6.4	0.7 % (OM)

Ref # 73268 **Author:** "Akinyemiju, O.A., and T.N.C. Echendu" **Year:** 1987

Title: Influence of Different Tillage Methods and Pre-emergence Herbicides on Weed Control in Cowpea (Vigna unguiculata (L.) Walp.) **Source:** Crop Prot. 6(5):289-294

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)

Ref # 73268 **Author:** "Akinyemiju, O.A., and T.N.C. Echendu" **Year:** 1987

Title: Influence of Different Tillage Methods and Pre-emergence Herbicides on Weed Control in Cowpea (Vigna unguiculata (L.) Walp.) **Source:** Crop Prot. 6(5):289-294

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)

Ref # 73268 **Author:** "Akinyemiju, O.A., and T.N.C. Echendu" **Year:** 1987

Title: Influence of Different Tillage Methods and Pre-emergence Herbicides on Weed Control in Cowpea (Vigna unguiculata (L.) Walp.) **Source:** Crop Prot. 6(5):289-294

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	GRO	DVP	EMRG	NAT	7 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	MOR	MOR	SURV	NAT	30 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	POP	POP	BMAS	NAT	hv	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	POP	POP	BMAS	NAT	hv	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	POP	POP	BMAS	NAT	hv	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	POP	POP	BMAS	NAT	hv	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea (*Vigna unguiculata*)	POP	POP	BMAS	NAT	hv	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)

Ref # 73268 **Author:** "Akinyemiju, O.A., and T.N.C. Echendu" **Year:** 1987

Title: Influence of Different Tillage Methods and Pre-emergence Herbicides on Weed Control in Cowpea (Vigna unguiculata (L.) Walp.) **Source:** Crop Prot. 6(5):289-294

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)

Ref # 73307 **Author:** "Kahn, B.A., and R.J. Schatzer" **Year:** 1992

Title: Economic and Horticultural Evaluation of Chemical and Mechanical Weed Control Strategies for Cowpea **Source:** J.Am.Soc.Hortic.Sci. 117(2):255-259

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Amaranth (Amaranthus sp.)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR
Amaranth (Amaranthus sp.)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR
Black-eyed pea (Vigna unguiculata)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR
Black-eyed pea (Vigna unguiculata)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR
Black-eyed pea (Vigna unguiculata)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR
Black-eyed pea (Vigna unguiculata)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR
Black-eyed pea (Vigna unguiculata)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR
Black-eyed pea (Vigna unguiculata)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	NR Orig	1	100	FIELD	GS		NR

Ref # 73334 **Author:** "Nair, S.G., B.M. Patil, and A.P. Karunakar" **Year:** 1999

Title: Effect of Chemical Weed Control on Growth and Yield of Irrigated Mustard (Brassica juncea L.) **Source:** Crop Res. 17(1):116-117

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73334 **Author:** "Nair, S.G., B.M. Patil, and A.P. Karunakar" **Year:** 1999

Title: Effect of Chemical Weed Control on Growth and Yield of Irrigated Mustard (Brassica juncea L.) **Source:** Crop Res. 17(1):116-117

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Brown mustard (Brassica juncea)	BCM	BCM	DRYM	NAT	hv	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FieldN	NR	7.8	NR
Brown mustard (Brassica juncea)	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FIELDN	NR	7.8	NR

Ref # 73336 **Author:** "Singh, H., J.S. Kolar, and R.P. Gupta" **Year:** 1995

Title: The Effect of Pre-emergence Applied Herbicides on the Symbiotic Parameters and Seed Yield of Soybean (Glycine max (L.) Merrill) **Source:** Int.J.Trop.Agric. 13(1-4):143-150

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	BCM	BCM	NCON	NAT	hv	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FIELDN	WA	7.8	NR
Soybean (Glycine max)	BCM	ENZ	NITG	NAT	45 d	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FIELDN	WA	7.8	NR
Soybean (Glycine max)	PHY	PHY	NUPT	NAT	hv	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FIELDN	WA	7.8	NR
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FIELDN	WA	7.8	NR

Ref # 73339 **Author:** "Bowman, J.E., J.B. Sinclair, and L.M. Wax" **Year:** 1987

Title: Effect of Herbicides on Soybean Seed Quality **Source:** Fitopatol.Bras. 12(4):334-337

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73339 **Author:** "Bowman, J.E., J.B. Sinclair, and L.M. Wax" **Year:** 1987

Title: Effect of Herbicides on Soybean Seed Quality **Source:** Fitopatol.Bras. 12(4):334-337

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	28 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FIELDN	SP		NR
Soybean *(Glycine max)*	REP	REP	GERM	NAT	28 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FIELDN	SP		NR

Ref # 73349 **Author:** "Gabr, M.A., M.A. Shakeeb, F.A. Fahmy, and H. Abbas" **Year:** 1989

Title: "Influence of Metolachlor Foliar Spray on the Nitrogen Components, Nucleic Acid Content and Enzyme Activities in Transplanted Tomato Plants (Lycopersicon esculentum L.)" **Source:** Egypt J.Bot. 32(1/2):11-20

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato *(Lycopersicon esculentum)*	BCM	ENZ	AMYL	NAT	7 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	BCM	ENZ	AMYL	NAT	70 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	BCM	ENZ	AMYL	NAT	49 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	BCM	ENZ	AMYL	NAT	49 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	BCM	BCM	PRCO	NAT	70 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	BCM	BCM	PRCO	NAT	49 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR

Ref # 73349 **Author:** "Gabr, M.A., M.A. Shakeeb, F.A. Fahmy, and H. Abbas" **Year:** 1989

Title: "Influence of Metolachlor Foliar Spray on the Nitrogen Components, Nucleic Acid Content and Enzyme Activities in Transplanted Tomato Plants (Lycopersicon esculentum L.)" **Source:** Egypt J.Bot. 32(1/2):11-20

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato *(Lycopersicon esculentum)*	BCM	BCM	PRCO	NAT	7 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	BCM	BCM	PRCO	NAT	49 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	CEL	GEN	DNAC	NAT	49 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	CEL	GEN	DNAC	NAT	7 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	CEL	GEN	DNAC	NAT	70 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR
Tomato *(Lycopersicon esculentum)*	CEL	GEN	DNAC	NAT	49 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	HS		NR

Ref # 73352 **Author:** "Heuer, B., and A. Carmi" **Year:** 1992

Title: Nitrogen-Enhanced Phytotoxicity to Cucumber of Low Concentrations of EPTC and Metolachlor **Source:** Crop Prot. 11(6):572-576

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
garden cucumber *(Cucumis sativus)*	BCM	BCM	CACO	CUL	14 d	F	LOAEL: 0.05 ppm Orig 0.05 mg/L	NR Orig	1	100	LAB	GM	6.5	NR
garden cucumber *(Cucumis sativus)*	BCM	BCM	CACO	CUL	14 d	F	LOAEL: 0.05 ppm Orig 0.05 mg/L	NR Orig	1	100	LAB	GM	6.5-6.8	NR

Ref # 73357 **Author:** "Gabr, M.A., M.A. Shakeeb, F.A. Fahmy, and H. Abbas" **Year:** 1989

Title: "Influence of Metolachlor Foliar Spray on Growth, Carbohydrate Content, Pigmentation and Photosynthetic Activity in Transplanted Tomato Plants (Lycopersicon esculentum L.)" **Source:** Egypt J.Bot. 32(1/2):1-9

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Tomato (Lycopersicon esculentum)	BCM	BCM	CARC	NAT	84 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	SP		NR
Tomato (Lycopersicon esculentum)	BCM	BCM	CARC	NAT	126 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	SP		NR
Tomato (Lycopersicon esculentum)	BCM	BCM	CARC	NAT	84 d	F	LOAEL: 35 nM Orig 35 nM	NR Orig	3	100	LAB	SP		NR
Tomato (Lycopersicon esculentum)	BCM	BCM	RSUG	NAT	84 d	F	NOAEL: 35 nM Orig 35 nM	LOAEL: 70 nM Orig 70 nM	3	100	LAB	SP		NR
Tomato (Lycopersicon esculentum)	PHY	PHY	PSYN	NAT	126 d	F	NOAEL: 35 nM Orig 35 nM	LOAEL: 70 nM Orig 70 nM	3	100	LAB	SP		NR
Tomato (Lycopersicon esculentum)	PHY	PHY	PSYN	NAT	84 d	F	NOAEL: 35 nM Orig 35 nM	LOAEL: 70 nM Orig 70 nM	3	100	LAB	SP		NR
Tomato (Lycopersicon esculentum)	PHY	PHY	PSYN	NAT	126 d	F	NOAEL: 35 nM Orig 35 nM	LOAEL: 70 nM Orig 70 nM	3	100	LAB	SP		NR
Tomato (Lycopersicon esculentum)	PHY	PHY	PSYN	NAT	84 d	F	NOAEL: 35 nM Orig 35 nM	LOAEL: 70 nM Orig 70 nM	3	100	LAB	SP		NR

Ref # 73363 **Author:** "Velu, G." **Year:** 1998

Title: Effect of Herbicides and Cultivars on the Ecophysiological Characteristics and Grain Yield of Greengram **Source:** Int.J.Trop.Agric. 16(1-4):147-155

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73363 **Author:** "Velu, G." **Year:** 1998

Title: Effect of Herbicides and Cultivars on the Ecophysiological Characteristics and Grain Yield of Greengram **Source:** Int.J.Trop.Agric. 16(1-4):147-155

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
mung bean (*Vigna radiata*)	POP	POP	BMAS	NAT	105 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	NR		NR
mung bean (*Vigna radiata*)	POP	POP	BMAS	NAT	105 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	NR		NR
mung bean (*Vigna radiata*)	POP	POP	BMAS	NAT	105 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	NR		NR
mung bean (*Vigna radiata*)	POP	POP	BMAS	NAT	105 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	NR		NR
mung bean (*Vigna radiata*)	POP	POP	BMAS	NAT	105 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	NR		NR
mung bean (*Vigna radiata*)	POP	POP	BMAS	NAT	105 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FIELDN	NR		NR

Ref # 73369 **Author:** "Reinhardt, C.F., and P.C. Nel" **Year:** 1989

Title: Use of Prometryn in Combination with Nine Herbicides in Sunflower (Helianthus annuus L.) **Source:** Appl.Plant Sci. 3(2):99-102

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Marigold (*Tagetes minuta*)	POP	POP	BMAS	NAT	73 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	1	100	FIELDN	DA		NR
Pinnate false threadleaf (*Schkuhria pinnata*)	POP	POP	BMAS	NAT	73 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	1	100	FIELDN	DA		NR

Ref # 73369 **Author:** "Reinhardt, C.F., and P.C. Nel" **Year:** 1989

Title: Use of Prometryn in Combination with Nine Herbicides in Sunflower (Helianthus annuus L.) **Source:** Appl.Plant Sci. 3(2):99-102

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Puncture-vine (*Tribulus terrestris*)	POP	POP	BMAS	NAT	73 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	1	100	FIELDN	DA		NR
Thunberg's amaranthus (*Amaranthus thunbergii*)	POP	POP	BMAS	NAT	73 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	1	100	FIELDN	DA		NR

Ref # 73414 **Author:** "Bochare, P.A., D.K. Shelke, R.H. Bhosle, N.S. Jadhav, and V.D. Salunke" **Year:** 1992

Title: Weed Management in Kharif Sunflower **Source:** J.Maharashtra Agric.Univ. 17(3):502-503

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Common annual sunflower (*Helianthus annuus*)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FIELDN	HS		NR

Ref # 73418 **Author:** "Al-Khatib, K., C. Libbey, and S. Kadir" **Year:** 1995

Title: Broadleaf Weed Control and Cabbage Seed Yield Following Herbicide Application **Source:** Hortscience 30(6):1211-1214

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	140 d	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FIELDN	GS	5.9-6.7	NR
Cabbage (*Brassica oleracea*)	POP	POP	BMAS	NAT	140 d	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FIELDN	GS	5.9-6.7	NR
common chickweed (*Stellaria media*)	POP	POP	CNTL	NAT	140 d	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FIELDN	GS	5.9-6.7	NR

Ref # 73418 **Author:** "Al-Khatib, K., C. Libbey, and S. Kadir" **Year:** 1995

Title: Broadleaf Weed Control and Cabbage Seed Yield Following Herbicide Application **Source:** Hortscience 30(6):1211-1214

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Hedge mustard (*Sisymbrium officinale*)	POP	POP	CNTL	NAT	140 d	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FIELDN	GS	5.9-6.7	NR
pineapple weed (*Matricaria discoidea*)	POP	POP	CNTL	NAT	70 d	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FIELDN	GS	5.9-6.7	NR
shepherdspurse (*Capsella bursa-pastoris*)	POP	POP	CNTL	NAT	70 d	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FIELDN	GS	5.9-6.7	NR

Ref # 73421 **Author:** "Bowman, J.B., J.B. Sinclair, and J.T. Yorinori" **Year:** 1986

Title: Effect of Herbicides on Soybean Disease Development and Seed Quality in the State of Parana **Source:** Fitopatol.Bras. 11(1):205-216

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (*Glycine max*)	PHY	IMM	IFCT	NAT	63 d	A	NOAEL: 3.2112 lb/acre Orig 3.6 AI kg/ha	NR Orig		100	FIELDN	HS		NR
Soybean (*Glycine max*)	PHY	IMM	IFCT	NAT	42 d	A	NOAEL: 3.568 lb/acre Orig 4 AI kg/ha	NR Orig		100	FIELDN	HS		NR
Soybean (*Glycine max*)	PHY	IMM	IFCT	NAT	63 d	A	NOAEL: 3.568 lb/acre Orig 4 AI kg/ha	NR Orig		100	FieldN	HS		NR
Soybean (*Glycine max*)	POP	POP	BMAS	NAT	63 d	A	NOAEL: 3.568 lb/acre Orig 4 AI kg/ha	NR Orig		100	FieldN	HS		NR
Soybean (*Glycine max*)	POP	POP	BMAS	NAT	63 d	A	NOAEL: 3.568 lb/acre Orig 4 AI kg/ha	NR Orig		100	FIELDN	HS		NR
Soybean (*Glycine max*)	POP	POP	BMAS	NAT	63 d	A	NOAEL: 2.23 lb/acre Orig 2.5 AI kg/ha	NR Orig		100	FIELDN	HS		NR

Ref # 73421 **Author:** "Bowman, J.B., J.B. Sinclair, and J.T. Yorinori" **Year:** 1986

Title: Effect of Herbicides on Soybean Disease Development and Seed Quality in the State of Parana **Source:** Fitopatol.Bras. 11(1):205-216

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	63 d	A	NOAEL: 3.2112 lb/acre Orig 3.6 AI kg/ha	NR Orig		100	FIELDN	HS		NR
Soybean *(Glycine max)*	REP	REP	GERM	NAT	63 d	A	NOAEL: 3.568 lb/acre Orig 4 AI kg/ha	NR Orig		100	FieldN	HS		NR

Ref # 73529 **Author:** "Davies, F.T.Jr., and S.A. Duray" **Year:** 1992

Title: Effect of Preemergent Herbicide Application on Rooting and Subsequent Liner Growth of Selected Nursery Crops **Source:** J.Environ.Hortic. 10(3):181-186

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Asian jasmine *(Trachelospermum asiaticum)*	REP	REP	VEGR	ART	28 d	F	NOAEL: 0.29882 lb/acr Orig 6.7 kg/ha	NR Orig	3	5		GG	nr	NR
Chinese holly *(Ilex cornuta)*	REP	REP	VEGR	ART	98 d	F	NOAEL: 0.29882 lb/acr Orig 6.7 kg/ha	NR Orig	3	5		GG	nr	NR
largeleaf lantana *(Lantana camara)*	REP	REP	VEGR	ART	28 d	F	NOAEL: 0.29882 lb/acr Orig 6.7 kg/ha	NR Orig	3	5		GG	nr	NR
sheep sorrel *(Oxalis stricta)*	POP	POP	BMAS	ART	28 d	F	NOAEL: 0.29882 lb/acr Orig 6.7 kg/ha	NR Orig	3	5		GG	nr	NR
shoebackplant *(Hibiscus rosa-sinensis)*	REP	REP	VEGR	ART	49 d	F	NOAEL: 0.15164 lb/acr Orig 3.4 kg/ha	LOAEL: 0.29882 lb/acr Orig 6.7 kg/ha	3	5		GG	nr	NR
Small flowered watercress *(Cardamine parvifolia)*	POP	POP	BMAS	ART	28 d	F	NOAEL: 0.29882 lb/acr Orig 6.7 kg/ha	NR Orig	3	5		GG	nr	NR

Ref # 73540 **Author:** "Kucey, R.M.N., P. Chaiwanakupt, T. Arayangkool, P. Snitwongse, C. Siripaibool, P. Wadisirisuk, and **Year:** 1988

Title: Nitrogen Fixation (15N Dilution) with Soybeans Under Thai Field Conditions. II. Effect of Herbicides and Water Application Schedule **Source:** Plant Soil 108(1):87-92

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	BCM	BCM	NCON	NAT	ma	F	LOAEL: 2.75 L/ha Orig 2.75 L/ha	NR Orig	1	100	FieldN	EN	nr	NR
Soybean *(Glycine max)*	BCM	BCM	NCON	NAT	ma	F	LOAEL: 2.75 L/ha Orig 2.75 L/ha	NR Orig	1	100	FieldN	EN	nr	NR
Soybean *(Glycine max)*	PHY	PHY	NFIX	NAT	ma	F	LOAEL: 2.75 L/ha Orig 2.75 L/ha	NR Orig	1	100	FieldN	EN	nr	NR
Soybean *(Glycine max)*	PHY	PHY	NFIX	NAT	ma	F	LOAEL: 2.75 L/ha Orig 2.75 L/ha	NR Orig	1	100	FieldN	EN	nr	NR
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	ma	F	NOAEL: 2.75 L/ha Orig 2.75 L/ha	NR Orig	1	100	FieldN	EN	nr	NR
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	ma	F	NOAEL: 2.75 L/ha Orig 2.75 L/ha	NR Orig	1	100	FieldN	EN	nr	NR

Ref # 73735 **Author:** "Crossan, C.K., C.H. Gilliam, D.J. Eakes, G.J. Keever, G.R. Wehtje, and W.A. Dozier Jr." **Year:** 1996

Title: Weed Control with Herbicide-Coated or -Blended Fertilizer in 'August Beauty' Gardenia **Source:** J.Environ.Hortic. 14(1):5-8

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
spotted spurge *(Chamaesyce maculata)*	POP	POP	CNTL	ART	30 d	F	LOAEL: 2.0516 lb/acre Orig 2.3 kg/ha	NR Orig	4	100	FieldA	HS	nr	NR
spotted spurge *(Chamaesyce maculata)*	POP	POP	CNTL	ART	30 d	F	NOAEL: 4.014 lb/acre Orig 4.5 kg/ha	NR Orig	1	100	FieldA	DA	nr	NR

Ref # 73742 **Author:** "Bellinder, R.R., and D.T. Warholic" **Year:** 1988

Title: "Evaluation of Acetanilide Injury and Its Potential for Yield Reduction in Cabbage, Brassica oleracea L." **Source:** Weed Technol. 2(3):350-354

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Cabbage (Brassica oleracea)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Green amaranth (Amaranthus retroflexus)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Green amaranth (Amaranthus retroflexus)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Lamb's-quarters (Chenopodium album)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)
Lamb's-quarters (Chenopodium album)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.5-6.7	2.7-3.2 % (OM)

Ref # 73787 **Author:** "Ibrahim, A.F., S.A. Shaban, and E.A. El-Metwally" **Year:** 1987

Title: Effect of Some Herbicides on Oil Seed Rape (Brassica napus L.) and Associated Weeds **Source:** J.Agron.Crop Sci. 158(4):236-240

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Colza (Brassica napus)	POP	POP	BMAS	NAT	hv	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR

Ref # 73787 **Author:** "Ibrahim, A.F., S.A. Shaban, and E.A. El-Metwally" **Year:** 1987

Title: Effect of Some Herbicides on Oil Seed Rape (Brassica napus L.) and Associated Weeds **Source:** J.Agron.Crop Sci. 158(4):236-240

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Colza *(Brassica napus)*	POP	POP	BMAS	NAT	hv	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR

Ref # 73790 **Author:** "Bellinder, R.R., D. Wilcox-Lee, A. Senesac, and D.T. Warholic" **Year:** 1989

Title: Response of Early-Maturing Cabbage Brassica oleracea var capitata to Metolachlor **Source:** Weed Technol. 3(3):463-466

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS	5.3	2 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	3	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	2	100	FieldN	HS	6.9	3.7 % (OM)

Ref # 73790 **Author:** "Bellinder, R.R., D. Wilcox-Lee, A. Senesac, and D.T. Warholic" **Year:** 1989

Title: Response of Early-Maturing Cabbage Brassica oleracea var capitata to Metolachlor **Source:** Weed Technol. 3(3):463-466

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS	5.3	2 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	3	100	FieldN	HS	5.3	2 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.9248 lb/acre Orig 4.4 kg/ha	NR Orig	3	100	FieldN	HS	6.9	3.7 % (OM)
Cabbage *(Brassica oleracea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	3	100	FieldN	HS	5.3	2 % (OM)

Ref # 73792 **Author:** "Mishra, J.S., and V.M. Bhan" **Year:** 1996

Title: Chemical Control of Carrot Grass (Parthenium hysterophorus) and Associated Weeds in Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 66(9):518-521

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
ragweed parthenium *(Parthenium hysterophorus)*	POP	POP	ABND	NAT	60 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	6.7	NR
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	60 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	6.7	NR

Ref # 73793 **Author:** "Intodia, S.K., L.R. Yadav, and O.P. Tomar" **Year:** 1996

Title: Effect of Herbicides on Weed-Control Efficiency and Yield in Maize (Zea mays)-Soybean (Glycine max) Intercropping System **Source:** Indian J.Agric.Sci. 66(12):730-731

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FieldN	HS	8.3	0.63 % (OC)

Ref # 73798 **Author:** "Singh, R., R.P. Jangir, and B.L. Poonia" **Year:** 1995

Title: Evaluation of Herbicides for Control of Weeds in Chilli (Capsicum annuum) **Source:** Indian J.Agric.Sci. 65(10):723-726

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
"Pigweed, bla" *(Trianthema portulacastrum)*	POP	POP	ABND	NAT	25 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	3	100	FieldN	HS	8.1	0.31 % (NR)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.669 lb/acre Orig 0.75 kg/ha	LOAEL: 0.892 lb/acre Orig 1 kg/ha	3	100	FieldN	HS	8.1	0.31 % (NR)
gale of the wind *(Phyllanthus niruri)*	POP	POP	ABND	NAT	25 d	F	NOAEL: 0.669 lb/acre Orig 0.75 kg/ha	LOAEL: 0.892 lb/acre Orig 1 kg/ha	3	100	FieldN	HS	8.1	0.31 % (NR)
slender amaranth *(Amaranthus viridis)*	POP	POP	ABND	NAT	25 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	3	100	FieldN	HS	8.1	0.31 % (NR)

Ref # 73799 **Author:** "Jat, L.N., V. Nepalia, and R.N. Kumawat" **Year:** 1999

Title: Effect of Weed Management and Sulphur Fertilization on the Productivity of Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 69(7):521-522

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	BCM	BCM	PRCO	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	HS	8.3	NR

Ref # 73799 **Author:** "Jat, L.N., V. Nepalia, and R.N. Kumawat" **Year:** 1999

Title: Effect of Weed Management and Sulphur Fertilization on the Productivity of Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 69(7):521-522

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	BCM	BCM	PRCO	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	HS	8.3	NR
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	HS	8.3	NR
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	HS	8.3	NR

Ref # 73803 **Author:** "Heatherly, L.G., and C.D. Elmore" **Year:** 1991

Title: Grass Weed Control for Soybean (Glycine max) on Clay Soil **Source:** Weed Technol. 5(1):103-107

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	HS		NR
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	HS		NR
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	HS		NR
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	HS		NR

Ref # 73808 **Author:** "Glaze, N.C." **Year:** 1988

Title: "Weed Control in Direct-Seeded Tomato, Lycopersicon esculentum for Transplants" **Source:** Weed Technol. 2(3):333-337

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
rough Mexican clover (*Richardia scabra*)	POP	POP	ABND	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	GS		NR
rough Mexican clover (*Richardia scabra*)	POP	POP	ABND	NAT	hv	F	LOAEL: 0.74928 lb/acre Orig 0.84 kg/ha	NR Orig	3	100	FieldN	GS		NR
rough Mexican clover (*Richardia scabra*)	POP	POP	ABND	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FieldN	GS		NR
Sicklepod (*Senna obtusifolia*)	POP	POP	ABND	NAT	hv	F	NOAEL: 0.74928 lb/acr Orig 0.84 kg/ha	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	3	100	FieldN	GS		NR
Tomato (*Lycopersicon esculentum*)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	GS		NR
Tomato (*Lycopersicon esculentum*)	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.74928 lb/acr Orig 0.84 kg/ha	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	3	100	FieldN	GS		NR
Tomato (*Lycopersicon esculentum*)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	3	100	FieldN	GS		NR

Ref # 73810 **Author:** "Myers, M.G., and R.G. Harvey" **Year:** 1993

Title: Triazine-Resistant Common Lambsquarters (Chenopodium album L.) Control in Field Corn (Zea mays L.) **Source:** Weed Technol. 7(4):884-889

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Lamb's-quarters (*Chenopodium album*)	POP	POP	ABND	NAT	44 d	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	GS	6.7	2 % (OM)

Ref # 73810 **Author:** "Myers, M.G., and R.G. Harvey" **Year:** 1993

Title: Triazine-Resistant Common Lambsquarters (Chenopodium album L.) Control in Field Corn (Zea mays L.) **Source:** Weed Technol. 7(4):884-889

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Lamb's-quarters *(Chenopodium album)*	POP	POP	ABND	NAT	44 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	GS	6.7	3 % (OM)
Lamb's-quarters *(Chenopodium album)*	POP	POP	ABND	NAT	43 d	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	GS	7.2	2.9 % (OM)

Ref # 73841 **Author:** "Tewari, A.N., K.S. Rathi, and B. Singh" **Year:** 1998

Title: Integrated Weed Management in Garlic (Allium sativum) **Source:** Indian J.Agric.Sci. 68(5):281-283

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Indian Sweet-Clover *(Melilotus indica)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
Lamb's-quarters *(Chenopodium album)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
Lamb's-quarters *(Chenopodium album)*	POP	POP	CNTL	NAT	hv	F	NOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
lesser swinecress *(Coronopus didymus)*	POP	POP	CNTL	NAT	hv	F	NOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
Nettleleaf goosefoot *(Chenopodium murale)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
Pimpernel *(Anagallis arvensis)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR

Ref # 73841 **Author:** "Tewari, A.N., K.S. Rathi, and B. Singh" **Year:** 1998

Title: Integrated Weed Management in Garlic (Allium sativum) **Source:** Indian J.Agric.Sci. 68(5):281-283

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pimpernel *(Anagallis arvensis)*	POP	POP	CNTL	NAT	hv	F	NOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR

Ref # 73912 **Author:** "Grichar,W.J.; Colburn,A.E.; Kearney,N.S." **Year:** 1994

Title: Herbicides for Reduced Tillage Production in Peanut (Arachis hypogaea) in the Southwest **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
blindeyes *(Papaver dubium)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		1 % (OM)
blindeyes *(Papaver dubium)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		1 % (OM)
blindeyes *(Papaver dubium)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		1 % (OM)
blindeyes *(Papaver dubium)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		1 % (OM)
Palmer's amaranth *(Amaranthus palmeri)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		1 % (OM)
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		1 % (OM)
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		1 % (OM)

Ref # 73916 **Author:** "Talbert,R.E.; Tierney,M.J.; Burgos,N.R.; Strebe,T.A.; Kitt,M.J." **Year:** 1995

Title: "Field Evaluation of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1994" **Source:** Ark.Agric.Exp.Stn.Res.Ser.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Amaranth *(Amaranthus sp.)*	POP	POP	CNTL	NAT	7 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Black-eyed pea *(Vigna unguiculata)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	2	100	FieldN	HS	4.7-5.3	2-Jan % (OM)
Carpetweed *(Mollugo verticillata)*	POP	POP	CNTL	NAT	7 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	91 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	1	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
common henbit *(Lamium amplexicaule)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Cutleaf evening primrose *(Oenothera laciniata)*	POP	POP	CNTL	NAT	77 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Dogfennel *(Anthemis cotula)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	1	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Dogfennel *(Anthemis cotula)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Dogfennel *(Anthemis cotula)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)

Ref # 73916 **Author:** "Talbert,R.E.; Tierney,M.J.; Burgos,N.R.; Strebe,T.A.; Kitt,M.J." **Year:** 1995

Title: "Field Evaluation of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1994" **Source:** Ark.Agric.Exp.Stn.Res.Ser.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Dogfennel *(Anthemis cotula)*	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Dogfennel *(Anthemis cotula)*	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.74928 lb/acre Orig 0.84 kg/ha	NR Orig	4	100	FieldN	HS	6.9	1 % (OM)
green pigweed *(Amaranthus hybridus)*	POP	POP	CNTL	NAT	49 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Ivyleaf morning-glory *(Ipomoea hederacea)*	POP	POP	CNTL	NAT	84 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
kidney bean *(Phaseolus vulgaris)*	POP	POP	ABND	NAT	hv	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
Lamb's-quarters *(Chenopodium album)*	POP	POP	CNTL	NAT	49 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	1	100	FieldN	HS	5.3	1.5 % (OM)
prickly fanpetals *(Sida spinosa)*	POP	POP	CNTL	NAT	84 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Spinach *(Spinacia oleracea)*	POP	POP	BMAS	NAT	77 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	4	100	FieldN	HS	6.9	1 % (OM)
Spinach *(Spinacia oleracea)*	POP	POP	BMAS	NAT	77 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Spinach *(Spinacia oleracea)*	POP	POP	BMAS	NAT	154 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Spinach *(Spinacia oleracea)*	POP	POP	BMAS	NAT	154 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)

Ref # 73916 **Author:** "Talbert,R.E.; Tierney,M.J.; Burgos,N.R.; Strebe,T.A.; Kitt,M.J." **Year:** 1995

Title: "Field Evaluation of Herbicides on Small Fruit, Vegetable and Ornamental Crops, 1994" **Source:** Ark.Agric.Exp.Stn.Res.Ser.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Spinach *(Spinacia oleracea)*	POP	POP	BMAS	NAT	112 d	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	NR Orig	1	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.74928 lb/acre Orig 0.84 kg/ha	NR Orig	4	100	FieldN	HS	6.9	1 % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	49 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	91 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	3	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
Virginia winged rockcress *(Sibara virginica)*	POP	POP	CNTL	NAT	42 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	1	100	FieldN	HS	4.7-4.9	2-Jan % (OM)
white morninglory *(Ipomoea lacunosa)*	POP	POP	CNTL	NAT	84 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
wild portulaca *(Portulaca oleracea)*	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
wild portulaca *(Portulaca oleracea)*	POP	POP	CNTL	NAT	35 d	F	LOAEL: 0.74928 lb/acre Orig 0.84 kg/ha	NR Orig	4	100	FieldN	HS	6.9	1 % (OM)
Winter squash *(Cucurbita maxima)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.99904 lb/acre Orig 1.12 kg/ha	NR Orig	2	100	FieldN	HS	6.9	1 % (OM)
Winter squash *(Cucurbita maxima)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.99904 lb/acr Orig 1.12 kg/ha	LOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	2	100	FieldN	HS	6.9	1 % (OM)

Ref # 73917 **Author:** "Brar,L.S.; Walia,U.S." **Year:** 1995

Title: Bioefficacy of Herbicides Against Trianthema portulacastrum in Toria (Brassica campestris subsp. Oleifera var Toria) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
"Pigweed, bla" *(Trianthema portulacastrum)*	POP	POP	BMAS	NAT	45 d	F	LOAEL: 0.446 lb/acre Orig 0.5 kg/ha	NR Orig	2	100	FieldN	EN		NR
"Pigweed, bla" *(Trianthema portulacastrum)*	POP	POP	BMAS	NAT	45 d	F	NOAEL: 0.446 lb/acre Orig 0.5 kg/ha	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	2	100	FieldN	EN		NR
turnip rape *(Brassica rapa)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FieldN	EN		NR

Ref # 73918 **Author:** "Ramamoorthy,K.; Ramasamy,M.; Vairavan,K." **Year:** 1995

Title: Chemical and Cultural Weed Control in Irrigated Soybean (Glycine max) **Source:** Indian J.Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	EN	7.8	NR

Ref # 73919 **Author:** "Cardina,J.; Swann,C.W." **Year:** 1988

Title: Metolachlor Effects on Peanut Growth and Development **Source:** Peanut Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	GRO	DVP	EMRG	NAT	<13 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	3	100	FieldN	DA	6	NR
Peanut *(Arachis hypogaea)*	POP	POP	ABND	NAT	19 d	A	NOAEL: 5.9764 lb/acre Orig 6.7 ai kg/ha	NR Orig	3	100	FieldN	DA	6	NR

Ref # 73922 **Author:** "Gullner,G.; Komives,T.; Rennenberg,H." **Year:** 2001

Title: Enhanced Tolerance of Transgenic Poplar Plants Overexpressing gamma-Glutamylcysteine Synthetase Towards Chloroacetanilide Herbicides **Source:** J.Exp.Bot

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
"Aspen, Cottonwood, Poplar" *(Populus sp.)*	BCM	ENZ	GSTR	UKS	14 d	F	LOAEL: 66 ppm Orig 66 ug/g soil	NR Orig	1	100	Lab	DA		NR
"Aspen, Cottonwood, Poplar" *(Populus sp.)*	BCM	ENZ	GSTR	UKS	14 d	F	LOAEL: 66 ppm Orig 66 ug/g soil	NR Orig	1	100	Lab	DA		NR
"Aspen, Cottonwood, Poplar" *(Populus sp.)*	BCM	ENZ	GSTR	UKS	14 d	F	LOAEL: 66 ppm Orig 66 ug/g soil	NR Orig	1	100	Lab	DA		NR

Ref # 73923 **Author:** "Johnson III,W.C.; Mullinix,B.G.,Jr." **Year:** 1994

Title: Use of F6285 for Weed Control in Peanut: Efficacy and Crop Injury **Source:** Peanut Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	30 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	FieldN	GS		0.9 % (OM)
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	30 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	FieldN	GS		0.7 % (OM)

Ref # 73924 **Author:** "Chandel,A.S.; Saxena,S.C.; Singh,K." **Year:** 1995

Title: Integrated Weed Control and Its Economics in Soybean (Glycine max) Grown in Mollisols of Uttar Pradesh **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73924 **Author:** "Chandel,A.S.; Saxena,S.C.; Singh,K." **Year:** 1995

Title: Integrated Weed Control and Its Economics in Soybean (Glycine max) Grown in Mollisols of Uttar Pradesh **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	NR	7.6	1.82 % (OC)
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	NR	7.6	1.82 % (OC)

Ref # 73925 **Author:** "Hashim,I.B.; Koehler,P.E.; Kvien,C.K." **Year:** 1993

Title: "Fatty Acid Composition, Mineral Content, and Flavor Quality of Southern Runner Peanuts Treated with Herbicides and Fungicides" **Source:** Peanut Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	BCM	BCM	FATL	NAT	135 d	F	LOAEL: 2 lb/acre Orig 2 lb/acre	NR Orig	1	100	FieldN	NR	6.2	NR
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	135 d	F	NOAEL: 2 lb/acre Orig 2 lb/acre	NR Orig	1	100	FieldN	NR	6.2	NR

Ref # 73926 **Author:** "Johnson III,C.W.; Brenneman,T.B.; Mullinix,B.G.,Jr." **Year:** 1994

Title: Chloroacetamide Herbicides and Chlorimuron do not Predispose Peanut (Arachis hypogaea) to Stem Rot (Sclerotium rolfsii) **Source:** Peanut Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	PHY	IMM	IFCT	NAT	85 d	A	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	MU		NR

Ref # 73926 **Author:** "Johnson III,C.W.; Brenneman,T.B.; Mullinix,B.G.,Jr." **Year:** 1994

Title: Chloroacetamide Herbicides and Chlorimuron do not Predispose Peanut (Arachis hypogaea) to Stem Rot (Sclerotium rolfsii) **Source:** Peanut Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut (Arachis hypogaea)	PHY	IMM	IFCT	NAT	131 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		NR
Peanut (Arachis hypogaea)	PHY	IMM	IFCT	NAT	123 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		NR
Peanut (Arachis hypogaea)	PHY	IMM	IFCT	NAT	134 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	MU		NR
Peanut (Arachis hypogaea)	PHY	IMM	IFCT	NAT	131 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	DA		NR
Peanut (Arachis hypogaea)	PHY	IMM	IFCT	NAT	123 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	DA		NR
Peanut (Arachis hypogaea)	PHY	IMM	IFCT	NAT	134 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	DA		NR
Peanut (Arachis hypogaea)	PHY	IMM	IFCT	NAT	134 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		NR
Peanut (Arachis hypogaea)	PHY	IMM	IFCT	NAT	123 d	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	MU		NR
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	MU		NR
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		NR
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	DA		NR

Ref # 73926 **Author:** "Johnson III,C.W.; Brenneman,T.B.; Mullinix,B.G.,Jr." **Year:** 1994

Title: Chloroacetamide Herbicides and Chlorimuron do not Predispose Peanut (Arachis hypogaea) to Stem Rot (Sclerotium rolfsii) **Source:** Peanut Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		NR
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	DA		NR
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	MU		NR
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	MU		NR
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	GS		NR
Peanut (Arachis hypogaea)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	NR Orig	1	100	FieldN	DA		NR

Ref # 73929 **Author:** "Schroeder,J.; Kenney,M.J.; Thomas,S.H.; Murray,L." **Year:** 1994

Title: "Yellow Nutsedge Response to Southern Root-Knot Nematodes, Chile Peppers, and Metolachlor" **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper (Capsicum annuum)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)
Bell pepper (Capsicum annuum)	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)

Ref # 73929 **Author:** "Schroeder,J.; Kenney,M.J.; Thomas,S.H.; Murray,L." **Year:** 1994

Title: "Yellow Nutsedge Response to Southern Root-Knot Nematodes, Chile Peppers, and Metolachlor" **Source:** Weed Sci.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	ART	hv	A	LOAEL: 1.99808 lb/acre Orig 2.24 ai kg/ha	NR Orig	1	100	Lab	EN	7.4	0.4 % (OM)

Ref # 73934 **Author:** "Grichar,W.J.; Sestak,D.C.; Brewer,K.D.; Besler,B.A.; Stichler,C.R.; Smith,D.T." **Year:** 2001

Title: Sesame (Sesamum indicum L.) Tolerance and Weed Control with Soil-Applied Herbicides **Source:** Crop Prot.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Palmer's amaranth *(Amaranthus palmeri)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	8.2	NR
Palmer's amaranth *(Amaranthus palmeri)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR
Palmer's amaranth *(Amaranthus palmeri)*	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	2	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	POP	POP	ABND	NAT	:8 to 42 d	F	NOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	POP	POP	ABND	NAT	:8 to 42 d	F	NOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	POP	POP	ABND	NAT	:8 to 42 d	F	NOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	POP	POP	ABND	NAT	:8 to 42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	POP	POP	ABND	NAT	:8 to 42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR

Ref # 73934 **Author:** "Grichar,W.J.; Sestak,D.C.; Brewer,K.D.; Besler,B.A.; Stichler,C.R.; Smith,D.T." **Year:** 2001

Title: Sesame (Sesamum indicum L.) Tolerance and Weed Control with Soil-Applied Herbicides **Source:** Crop Prot.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Sesame *(Sesamum orientale)*	POP	POP	ABND	NAT	:8 to 42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	4	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.9812 lb/acre Orig 1.1 kg/ha	NR Orig	1	100	FieldN	HS	8.2	NR
Sesame *(Sesamum orientale)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS	7.4-7.8	NR
Sesame *(Sesamum orientale)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	4	100	FieldN	HS	8.2	NR

Ref # 73935 **Author:** "Ivany,J.A." **Year:** 2001

Title: Evaluation of Herbicides for Control of Tufted Vetch (Vicia cracca) and Narrow-Leaved Vetch (Vicia angustifolia) **Source:** Crop Prot

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
cow vetch *(Vicia cracca)*	POP	POP	CNTL	ART	21 d	A	LOAEL: 1.1748 lb/acre Orig 1320 ai g/ha	NR Orig	3	100	Lab	FS		NR
Narrow leaf vetch *(Vicia augustifolia)*	POP	POP	CNTL	ART	21 d	A	LOAEL: 1.1748 lb/acre Orig 1320 ai g/ha	NR Orig	3	100	Lab	FS		NR

Ref # 73939 **Author:** "Ghosheh,H.Z.; Chandler,J.M." **Year:** 1998

Title: Johnsongrass (Sorghum halepense) Control Systems for Field Corn (Zea mays) Utilizing Crop Rotation and Herbicides **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cotton *(Gossypium sp.)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.24784 lb/acr Orig 2.52 ai kg/ha	NR Orig	1	100	FieldN	HS	8.1	1.8 % (OM)

Ref # 73943 **Author:** "Jordan,D.L.; Wilcut,J.W.; Fortner,L.D." **Year:** 1994

Title: Utility of Clomazone for Annual Grass and Broadleaf Weed Control in Peanut (Arachis hypogaea) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Peanut *(Arachis hypogaea)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.9624 lb/acre Orig 2.2 kg/ha	NR Orig	1	100	FieldN	GS	5.5-5.9	0.7-1.7 % (OM)

Ref # 73944 **Author:** "Ivany,J.A.; McCully,K.V." **Year:** 1994

Title: Evaluation of Herbicides for Sweet White Lupin (Lupinus albus) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
bristlestem hempnettle *(Galeopsis tetrahit)*	POP	POP	CNTL	NAT	ma	A	NOAEL: 1.4952 lb/acre Orig 1680 ai g/ha	LOAEL: 2.3496 lb/acre Orig 2640 ai g/ha	2	100	FieldN	HS	6.0-6.4	1.8-2.5 ()
Egyptian lupine *(Lupinus albus)*	POP	POP	BMAS	NAT	ma	A	NOAEL: 2.3496 lb/acre Orig 2640 ai g/ha	NR Orig	2	100	FieldN	HS	6.0-6.4	1.8-2.5 ()
wild radish *(Raphanus raphanistrum)*	POP	POP	CNTL	NAT	ma	A	NOAEL: 2.3496 lb/acre Orig 2640 ai g/ha	NR Orig	2	100	FieldN	HS	6.0-6.4	1.8-2.5 ()

Ref # 73952 **Author:** "Bowman,J.E.; Sinclair,J.B." **Year:** 1989

Title: Effect of Herbicides on Rhizoctonia Seedling Disease of Soybeans in Glasshouse Experiments **Source:** J.Phytopathol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	GRO	DVP	EMRG	NAT	12 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	Lab	HS		NR
Soybean (Glycine max)	GRO	DVP	EMRG	NAT	12 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 ai kg/ha	NR Orig	1	100	Lab	HS		NR

Ref # 73953 **Author:** "Maheswarappa,H.P.; Nanjappa,H.V." **Year:** 1994

Title: Relative Efficacy of Herbicides in Controlling the Weeds Infesting Pigeonpea (Cajanus cajan) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pigeonpea (Cajanus cajan)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN		NR
Pigeonpea (Cajanus cajan)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.446 lb/acre Orig 0.5 ai kg/ha	NR Orig	1	100	FieldN	EN		NR
Pigeonpea (Cajanus cajan)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.446 lb/acre Orig 0.5 ai kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73954 **Author:** "Shivakumar,H.R.; Prathibha,N.C.; Muniyappa,T.V." **Year:** 1994

Title: Effect of Chemical Weed Control on Nutrient Uptake by Common Mulberry (Morus australis) and Associated Weeds **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Korean mulberry (Morus australis)	BCM	BCM	NCON	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73954 **Author:** "Shivakumar,H.R.; Prathibha,N.C.; Muniyappa,T.V." **Year:** 1994

Title: Effect of Chemical Weed Control on Nutrient Uptake by Common Mulberry (Morus australis) and Associated Weeds **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Korean mulberry (Morus australis)	BCM	BCM	NCON	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	2	100	FieldN	HS		NR
Korean mulberry (Morus australis)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	2	100	FieldN	HS		NR
Korean mulberry (Morus australis)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73955 **Author:** "Thakur,D.R." **Year:** 1994

Title: Weed Management in Intercropping Systems Based on Maize (Zea mays) Under Rainfed Mid-hill Conditions **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bean/legume family (NR Fabaceae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FieldN	HS	6.9	NR

Ref # 73956 **Author:** "Sharma,R.K.; Bangar,K.S.; Kanere,G.; Singh,O.P.; Thakur,G.L.; Sharma,S.R." **Year:** 1992

Title: Effect of Weed Control on Yield of Soybean (Glycine max) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	POP	POP	ABND	NAT	50 d	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	NR	7.9	NR

Ref # 73958 **Author:** "Gogoi,A.K.; Pathak,A.K.; Deka,J.; Kalita,H." **Year:** 1991

Title: Pre-emergence Herbicides for Weed Control in Potato (Solanum tubersum) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Irish potato *(Solanum tuberosum)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73960 **Author:** "Glaze,N.C.; Hall,M.R." **Year:** 1990

Title: Cultivation and Herbicides for Weed Control in Sweet Potato (Ipomoea batatas) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
dixie ticktrefoil *(Desmodium tortuosum)*	POP	POP	ABND	NAT	42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
dixie ticktrefoil *(Desmodium tortuosum)*	POP	POP	ABND	NAT	42 d	F	NOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	LOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	2	100	FieldN	HS		NR
rough Mexican clover *(Richardia scabra)*	POP	POP	ABND	NAT	<42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		NR
rough Mexican clover *(Richardia scabra)*	POP	POP	ABND	NAT	42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		NR
rough Mexican clover *(Richardia scabra)*	POP	POP	ABND	NAT	42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
rough Mexican clover *(Richardia scabra)*	POP	POP	ABND	NAT	42 d	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
Sweet potato *(Ipomoea batatas)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		NR
Sweet potato *(Ipomoea batatas)*	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73960 **Author:** "Glaze,N.C.; Hall,M.R." **Year:** 1990

Title: Cultivation and Herbicides for Weed Control in Sweet Potato (Ipomoea batatas) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Sweet potato (Ipomoea batatas)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
Sweet potato (Ipomoea batatas)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
Sweet potato (Ipomoea batatas)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
Sweet potato (Ipomoea batatas)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
Sweet potato (Ipomoea batatas)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR
Sweet potato (Ipomoea batatas)	POP	POP	BMAS	NAT	hv	F	NOAEL: 3.0328 lb/acre Orig 3.4 kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73963 **Author:** "Webber III,C.L." **Year:** 1992

Title: The Influence of Metolachlor and Trifluralin on Kenaf (Hibiscus cannabinus L.) Yield Components **Source:** Ind.Crops Prod.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Deccan hemp (Hibiscus cannabinus)	POP	POP	ABND	NAT	hv	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS		NR
dicotyledons (NR Magnoliopsida)	POP	POP	CNTL	NAT	28 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS		NR
dicotyledons (NR Magnoliopsida)	POP	POP	CNTL	NAT	28 d	F	NOAEL: 1.99808 lb/acr Orig 2.24 kg/ha	NR Orig	3	100	FieldN	HS		NR

Ref # 73964 **Author:** "Callan,E.J.; Kennedy,C.W." **Year:** 1995

Title: Tolerance of Stokes Aster to Selected Herbicides **Source:** Ind.Crops Prod.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Stokes' aster (*Stokesia laevis*)	GRO	DVP	EMRG	NAT	62 d	A	LOAEL: 1.338 lb/acre Orig 1.5 ai kg/ha	NR Orig	3	100	Lab	EN		NR
Stokes' aster (*Stokesia laevis*)	GRO	DVP	EMRG	NAT	62 d	A	NOAEL: 1.99808 lb/acr Orig 2.24 ai kg/ha	NR Orig	3	100	Lab	EN		NR

Ref # 73968 **Author:** "Singh,V.K.; Bajpai,R.P.; Mishra,R.K.; Purohit,K.K." **Year:** 1991

Title: Chemical Weed Control in Rainfed Soybean (Glycine max) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (*Glycine max*)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN	6.2	NR
Soybean (*Glycine max*)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN	6.2	NR
Soybean (*Glycine max*)	REP	REP	SEED	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN	6.2	NR
Soybean (*Glycine max*)	REP	REP	SEED	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN	6.2	NR

Ref # 73969 **Author:** "Gogoi,A.K.; Kalita,H.; Pathak,A.K.; Deka,J." **Year:** 1991

Title: Chemical Control of Weeds in Field Pea (Pisum sativum) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73969 **Author:** "Gogoi,A.K.; Kalita,H.; Pathak,A.K.; Deka,J." **Year:** 1991

Title: Chemical Control of Weeds in Field Pea (Pisum sativum) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Pea *(Pisum sativum)*	POP	POP	BMAS	NAT	114 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 1.784 lb/acre Orig 2 kg/ha	2	100	FieldN	EN	5.8	NR

Ref # 73972 **Author:** Rout D;Satapathy MR; **Year:** 1998

Title: Chemical Weed Control in Rainfed Cotton (Gossypium hirsutum) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Cotton *(Gossypium hirsutum)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN	5.9	NR
Cotton *(Gossypium hirsutum)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN	5.9	NR
Cotton *(Gossypium hirsutum)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN	5.9	NR
Cotton *(Gossypium hirsutum)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	EN	5.9	NR

Ref # 73976 **Author:** Gogoi AK;Kalita H;Pathak AK;Deka J; **Year:** 1991

Title: Integrated Weed Management in Soybean (Glycine max) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	2	100	FieldN	EN	5.9	NR

Ref # 73977 **Author:** Schroeder J; **Year:** 1992

Title: Pepper (Capsicum annuum) Cultivar Response to Metolachlor in Three New Mexico Soils **Source:** Weed Technol

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	POP	POP	ABND	NAT	35 d	A	LOAEL: 0.1115 lb/acre Orig 0.125 ai kg/ha	NR Orig	5	100	Lab	WA	7.7	1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	ABND	NAT	35 d	A	LOAEL: 0.1115 lb/acre Orig 0.125 ai kg/ha	NR Orig	5	100	Lab	WA	7.7	1.2 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	ABND	NAT	35 d	A	NOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	5	100	Lab	WA	7.6	1.3 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	LOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.6	1.3 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	LOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.6	1.3 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)

Ref # 73977 **Author:** Schroeder J; **Year:** 1992

Title: Pepper (Capsicum annuum) Cultivar Response to Metolachlor in Three New Mexico Soils **Source:** Weed Technol

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	LOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	4	100	FieldN	HS	7.7	1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 0.5352 lb/acre Orig 0.6 ai kg/ha	LOAEL: 0.9812 lb/acre Orig 1.1 ai kg/ha	4	100	FieldN	HS	7.7	1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.7	1.2 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	NR Orig	4	100	FieldN	HS	7.7	1.2 % (OM)
Bell pepper *(Capsicum annuum)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.9624 lb/acre Orig 2.2 ai kg/ha	LOAEL: 4.014 lb/acre Orig 4.5 ai kg/ha	4	100	FieldN	HS	7.6-7.7	1.2-1.45 % (OM)

Ref # 73983 **Author:** Gogoi AK;Kalita H;Pathak AK;Deka J; **Year:** 1991

Title: Weed Management in Blackgram (Phaseolus mungo) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Black gram *(Vigna mungo)*	POP	POP	BMAS	NAT	hv	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	2	100	FieldN	NR	5.7	NR

Ref # 73986 **Author:** Kurtz ME; **Year:** 1996

Title: "The Influence of Preemergence Applied Herbicides on Kenaf Stand, Height, and Yield" **Source:** Ind Crops Prod

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Deccan hemp *(Hibiscus cannabinus)*	PHY	PHY	GPHY	NAT	hv	A	NOAEL: 2.676 lb/acre Orig 3 ai kg/ha	NR Orig	1	100	FieldN	HS	5.7	NR
Deccan hemp *(Hibiscus cannabinus)*	PHY	PHY	GPHY	NAT	hv	A	NOAEL: 2.676 lb/acre Orig 3 ai kg/ha	NR Orig	1	100	FieldN	HS	5.7	NR
Deccan hemp *(Hibiscus cannabinus)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.676 lb/acre Orig 3 ai kg/ha	NR Orig	1	100	FieldN	HS	5.7	NR
Deccan hemp *(Hibiscus cannabinus)*	POP	POP	BMAS	NAT	hv	A	NOAEL: 2.676 lb/acre Orig 3 ai kg/ha	NR Orig	1	100	FieldN	HS	5.7	NR

Ref # 73990 **Author:** Osborne BT;Shaw DR;Ratliff RL; **Year:** 1995

Title: Soybean (Glycine max) Cultivar Tolerance to SAN 582H and Metolachlor as Influenced by Soil Moisture **Source:** Weed Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean *(Glycine max)*	POP	POP	ABND	NAT	6 d	A	LOAEL: 1.5164 lb/acre Orig 1.7 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)

Ref # 73990 **Author:** Osborne BT;Shaw DR;Ratliff RL; **Year:** 1995

Title: Soybean (Glycine max) Cultivar Tolerance to SAN 582H and Metolachlor as Influenced by Soil Moisture **Source:** Weed Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	6 d	A	NOAEL: 1.5164 lb/acre Orig 1.7 ai kg/ha	LOAEL: 4.46 lb/acre Orig 5 ai kg/ha	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	ABND	NAT	18 d	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)

Ref # 73990 **Author:** Osborne BT;Shaw DR;Ratliff RL; **Year:** 1995

Title: Soybean (Glycine max) Cultivar Tolerance to SAN 582H and Metolachlor as Influenced by Soil Moisture **Source:** Weed Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)

Ref # 73990 **Author:** Osborne BT;Shaw DR;Ratliff RL; **Year:** 1995

Title: Soybean (Glycine max) Cultivar Tolerance to SAN 582H and Metolachlor as Influenced by Soil Moisture **Source:** Weed Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)

Ref # 73990 **Author:** Osborne BT;Shaw DR;Ratliff RL; **Year:** 1995

Title: Soybean (Glycine max) Cultivar Tolerance to SAN 582H and Metolachlor as Influenced by Soil Moisture **Source:** Weed Sci

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 1.5164 lb/acre Orig 1.7 ai kg/ha	LOAEL: 4.46 lb/acre Orig 5 ai kg/ha	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	hv	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)
Soybean (Glycine max)	POP	POP	BMAS	NAT	lfd	A	NOAEL: 4.46 lb/acre Orig 5 ai kg/ha	NR Orig	2	100	FieldN	HS	6.5	1 % (OM)

Other terrestrial plants

Taxa_Code: OTP

Other

Ref # 72762 **Author:** "Harrison, H.F., M.W. Farnham, and J.K. Peterson" **Year:** 1998

Title: Differential Response of Collard and Kale Cultivars to Preemergence Application of Metolachlor **Source:** Crop Prot. 17(4):293-297

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FieldN	GS		1 % (OM)
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	28 d	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FieldN	GS		1 % (OM)

Ref # 73241 **Author:** "Kurmvanshi, S.M., T.R. Sahu, and R.S. Sharma" **Year:** 1995

Title: "Effect of Chemical Weed Control on Crop and Weed Biomass, Productivity Index and Weed Competition Index in Soybean Ecosystem" **Source:** Crop Res. 9(3):390-393

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FIELDN	NR		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	3	100	FIELDN	NR		NR

Ref # 73245 **Author:** "Ramakrishna, A., C.K. Ong, and S.L.N. Reddy" **Year:** 1991

Title: Integrated Weed Management for Rainfed Groundnut **Source:** J.Plant Prot.Trop. 8(2):111-119

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	30 d	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	30 d	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR

Ref # 73245 **Author:** "Ramakrishna, A., C.K. Ong, and S.L.N. Reddy" **Year:** 1991

Title: Integrated Weed Management for Rainfed Groundnut **Source:** J.Plant Prot.Trop. 8(2):111-119

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	30 d	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	30 d	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	2	100	FIELDN	HS		NR

Ref # 73252 **Author:** "Staats, D., and J.E. Klett" **Year:** 1993

Title: Evaluation of Weed Control and Phytotoxicity of Preemergence Herbicides Applied to Container-Grown Herbaceous and Woody Plants **Source:** J.Environ.Hortic. 11(2):78-81

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	ART	1 gs	A	LOAEL: 4.1032 lb/acre Orig 4.6 AI kg/ha	NR Orig	2	100	FIELDA	DA		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	ART	1 gs	A	LOAEL: 4.1032 lb/acre Orig 4.6 AI kg/ha	NR Orig	2	100	FIELDA	DA		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	ART	1 gs	A	LOAEL: 4.1032 lb/acre Orig 4.6 AI kg/ha	NR Orig	2	100	FIELDA	DA		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	ART	1 gs	A	LOAEL: 4.1032 lb/acre Orig 4.6 AI kg/ha	NR Orig	2	100	FIELDA	DA		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	ART	1 gs	A	NOAEL: 8.1172 lb/acre Orig 9.1 AI kg/ha	NR Orig	2	100	FIELDA	DA		NR

Ref # 73258 **Author:** "Tiwari, J.P., and S.P. Kurchania" **Year:** 1993

Title: Chemical Control of Weeds in Indian Mustard (Brassica juncea) **Source:** Indian J.Agric.Sci. 63(5):272-275

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	GS		NR

Ref # 73259 **Author:** "Gangwar, K.S., K.P. Niranjan, and O.P. Singh" **Year:** 1991

Title: Weed Management in Sorghum (Sorghum bicolor) + Pigeonpea (Cajanus cajan) Intercropping System in Dryland **Source:** Indian J.Agric.Sci. 61(10):757-759

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	NR Orig	2	100	FieldN	GM	7.35	NR

Ref # 73265 **Author:** "Dusky, J.A." **Year:** 1986

Title: Preemergency Herbicides for Radishes Grown on Organic Soils **Source:** Hortscience 21(1):74-76

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	2	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	2	100		HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	2	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73265 **Author:** "Dusky, J.A." **Year:** 1986

Title: Preemergency Herbicides for Radishes Grown on Organic Soils **Source:** Hortscience 21(1):74-76

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	28 d	A	LOAEL: 1.49856 lb/acre Orig 1.68 AI kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73268 **Author:** "Akinyemiju, O.A., and T.N.C. Echendu" **Year:** 1987

Title: Influence of Different Tillage Methods and Pre-emergence Herbicides on Weed Control in Cowpea (Vigna unguiculata (L.) Walp.) **Source:** Crop Prot. 6(5):289-294

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	40 d	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	40 d	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	40 d	A	LOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	40 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	40 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	40 d	A	NOAEL: 3.122 lb/acre Orig 3.5 AI kg/ha	NR Orig	1	100	FieldN	HS	6	2 % (OM)

Ref # 73275 **Author:** "Berzsenyi, Z., B. Gyorffy, T. Arendas, P. Bonis, and D.Q. Lap" **Year:** 1997

Title: Studies on the Phytotoxicity of Herbicides in Maize (Zea mays L.) as Affected by Temperature and Antidotes **Source:** Acta Agron.Hung. 45(4):443-448

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1 L/ha Orig 1 L/ha	NR Orig	5	100	FIELD	GS		3.2 % (OM)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	NOAEL: 16 L/ha Orig 16 L/ha	NR Orig	5	100		GS		3.2 % (OM)
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	30 d	F	NOAEL: 2 L/ha Orig 2 L/ha	LOAEL: 4 L/ha Orig 4 L/ha	5	100		GS		3.2 % (OM)

Ref # 73307 **Author:** "Kahn, B.A., and R.J. Schatzer" **Year:** 1992

Title: Economic and Horticultural Evaluation of Chemical and Mechanical Weed Control Strategies for Cowpea **Source:** J.Am.Soc.Hortic.Sci. 117(2):255-259

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100		GS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100		GS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100		GS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100		GS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100		GS		NR

Ref # 73307 **Author:** "Kahn, B.A., and R.J. Schatzer" **Year:** 1992

Title: Economic and Horticultural Evaluation of Chemical and Mechanical Weed Control Strategies for Cowpea **Source:** J.Am.Soc.Hortic.Sci. 117(2):255-259

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.49856 lb/acre Orig 1.68 kg/ha	NR Orig	1	100		GS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	NR Orig	1	100		GS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.49856 lb/acr Orig 1.68 kg/ha	NR Orig	1	100		GS		NR

Ref # 73339 **Author:** "Bowman, J.E., J.B. Sinclair, and L.M. Wax" **Year:** 1987

Title: Effect of Herbicides on Soybean Seed Quality **Source:** Fitopatol.Bras. 12(4):334-337

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	28 d	A	NOAEL: 2.4976 lb/acre Orig 2.8 AI kg/ha	NR Orig	1	100	FieldN	SP		NR

Ref # 73414 **Author:** "Bochare, P.A., D.K. Shelke, R.H. Bhosle, N.S. Jadhav, and V.D. Salunke" **Year:** 1992

Title: Weed Management in Kharif Sunflower **Source:** J.Maharashtra Agric.Univ. 17(3):502-503

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR

Ref # 73418 **Author:** "Al-Khatib, K., C. Libbey, and S. Kadir" **Year:** 1995

Title: Broadleaf Weed Control and Cabbage Seed Yield Following Herbicide Application **Source:** Hortscience 30(6):1211-1214

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	70 d	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	GS	6.7	NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	140 d	F	NOAEL: 2.99712 lb/acr Orig 3.36 kg/ha	NR Orig	1	100	FieldN	GS	5.9	NR

Ref # 73421 **Author:** "Bowman, J.B., J.B. Sinclair, and J.T. Yorinori" **Year:** 1986

Title: Effect of Herbicides on Soybean Disease Development and Seed Quality in the State of Parana **Source:** Fitopatol.Bras. 11(1):205-216

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	63 d	A	NOAEL: 3.568 lb/acre Orig 4 AI kg/ha	NR Orig		100	FieldN	HS		NR

Ref # 73736 **Author:** "Calkins, J.B., B.T. Swanson, and D.L. Newman" **Year:** 1996

Title: Weed Control Strategies for Field Grown Herbaceous Perennials **Source:** J.Environ.Hortic. 14(4):221-227

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)

Ref # 73736 **Author:** "Calkins, J.B., B.T. Swanson, and D.L. Newman" **Year:** 1996

Title: Weed Control Strategies for Field Grown Herbaceous Perennials **Source:** J.Environ.Hortic. 14(4):221-227

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 2.99712 lb/acre Orig 3.36 kg/ha	NR Orig	1	100	FieldN	NR	6.9	4.3 % (OM)

Ref # 73786 **Author:** "Ramakrishna, A., C.K. Ong, and S.L.N. Reddy" **Year:** 1991

Title: Studies on Integrated Weed Management in Sorghum **Source:** Trop.Pest Manag. 37(2):159-161

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	30 d	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	1	100	FieldN	EN	8.4	NR
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	60 d	A	LOAEL: 0.669 lb/acre Orig 0.75 AI kg/ha	NR Orig	3	100	FieldN	EN	8.4	NR

Ref # 73787 **Author:** "Ibrahim, A.F., S.A. Shaban, and E.A. El-Metwally" **Year:** 1987

Title: Effect of Some Herbicides on Oil Seed Rape (Brassica napus L.) and Associated Weeds **Source:** J.Agron.Crop Sci. 158(4):236-240

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR

Ref # 73787 **Author:** "Ibrahim, A.F., S.A. Shaban, and E.A. El-Metwally" **Year:** 1987

Title: Effect of Some Herbicides on Oil Seed Rape (Brassica napus L.) and Associated Weeds **Source:** J.Agron.Crop Sci. 158(4):236-240

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	60 d	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	60 d	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	60 d	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	60 d	A	LOAEL: 2.1408 lb/acre Orig 2.4 AI kg/ha	NR Orig	2	50	FieldN	HS		NR

Ref # 73788 **Author:** "Das, N., S. Ray, S.N. Jena, and P.K. Mohanty" **Year:** 1998

Title: Effect of Certain Herbicides on Weeds and Population of Root-Knot Nematode (Meloidogyne incognita) in Mustard **Source:** Crop Res.(Hisar) 16(2):156-158

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	hv	A	LOAEL: 0.669 lb/acre Orig 0.75 AI kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73788 **Author:** "Das, N., S. Ray, S.N. Jena, and P.K. Mohanty" **Year:** 1998

Title: Effect of Certain Herbicides on Weeds and Population of Root-Knot Nematode (Meloidogyne incognita) in Mustard **Source:** Crop Res.(Hisar) 16(2):156-158

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	hv	A	LOAEL: 0.669 lb/acre Orig 0.75 AI kg/ha	NR Orig	1	100	FieldN	EN		NR
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	hv	A	LOAEL: 0.669 lb/acre Orig 0.75 AI kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73792 **Author:** "Mishra, J.S., and V.M. Bhan" **Year:** 1996

Title: Chemical Control of Carrot Grass (Parthenium hysterophorus) and Associated Weeds in Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 66(9):518-521

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	60 d	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	6.7	NR
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	60 d	F	NOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN	6.7	NR

Ref # 73793 **Author:** "Intodia, S.K., L.R. Yadav, and O.P. Tomar" **Year:** 1996

Title: Effect of Herbicides on Weed-Control Efficiency and Yield in Maize (Zea mays)-Soybean (Glycine max) Intercropping System **Source:** Indian J.Agric.Sci. 66(12):730-731

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	30 d	F	LOAEL: 0.669 lb/acre Orig 0.75 kg/ha	NR Orig	2	100	FieldN	HS	8.3	0.63 % (OC)

Ref # 73795 **Author:** "Murthy, G.M.A., and J.V.N. Gowda" **Year:** 1993

Title: Evaluation of Herbicides for Weed Control in Tuberose (Polianthes tuberosa Linn.) cv. Double **Source:** Crop Res.(Hisar) 6(1):176-178

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	45 d	A	LOAEL: 0.892 lb/acre Orig 1 AI kg/ha	NR Orig	3	100	FieldN	EN		NR

Ref # 73798 **Author:** "Singh, R., R.P. Jangir, and B.L. Poonia" **Year:** 1995

Title: Evaluation of Herbicides for Control of Weeds in Chilli (Capsicum annuum) **Source:** Indian J.Agric.Sci. 65(10):723-726

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	25 d	F	NOAEL: 0.669 lb/acre Orig 0.75 kg/ha	LOAEL: 0.892 lb/acre Orig 1 kg/ha	3	100	FieldN	HS	8.1	0.31 % (NR)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	90 d	F	LOAEL: 0.446 lb/acre Orig 0.5 kg/ha	NR Orig	3	100	FieldN	HS	8.1	0.31 % (NR)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	90 d	F	LOAEL: 0.446 lb/acre Orig 0.5 kg/ha	NR Orig	3	100	FieldN	HS	8.1	0.31 % (NR)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	90 d	F	NOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	3	100	FieldN	HS	8.1	0.31 % (NR)

Ref # 73799 **Author:** "Jat, L.N., V. Nepalia, and R.N. Kumawat" **Year:** 1999

Title: Effect of Weed Management and Sulphur Fertilization on the Productivity of Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 69(7):521-522

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	HS	8.3	NR

Ref # 73799 **Author:** "Jat, L.N., V. Nepalia, and R.N. Kumawat" **Year:** 1999

Title: Effect of Weed Management and Sulphur Fertilization on the Productivity of Soybean (Glycine max) **Source:** Indian J.Agric.Sci. 69(7):521-522

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	HS	8.3	NR

Ref # 73808 **Author:** "Glaze, N.C." **Year:** 1988

Title: "Weed Control in Direct-Seeded Tomato, Lycopersicon esculentum for Transplants" **Source:** Weed Technol. 2(3):333-337

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	GS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	3	100	FieldN	GS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	hv	F	LOAEL: 0.74928 lb/acre Orig 0.84 kg/ha	NR Orig	3	100	FieldN	GS		NR

Ref # 73841 **Author:** "Tewari, A.N., K.S. Rathi, and B. Singh" **Year:** 1998

Title: Integrated Weed Management in Garlic (Allium sativum) **Source:** Indian J.Agric.Sci. 68(5):281-283

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	1	100	FieldN	HS		NR

Ref # 73911 **Author:** "Grichar,W.J.; Evers,G.W.; Pohler,C.L.; Schubert,A.M." **Year:** 1987

Title: Use of Preemergence Herbicides for Establishment of Clovers **Source:** Tex.Agric.Exp.Stn.Prog.Rep.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom *(NR Plantae)*	POP	POP	CNTL	NAT	36 d	A	LOAEL: 1.5 lb/acre Orig 1.5 ai lb/acre	NR Orig	2	100	FieldN	HS	6.8	NR
Plant kingdom *(NR Plantae)*	POP	POP	CNTL	NAT	36 d	A	LOAEL: 1.5 lb/acre Orig 1.5 ai lb/acre	NR Orig	2	100	FieldN	HS	6.8	NR
Plant kingdom *(NR Plantae)*	POP	POP	CNTL	NAT	36 d	A	LOAEL: 1.5 lb/acre Orig 1.5 ai lb/acre	NR Orig	2	100	FieldN	HS	6.8	NR

Ref # 73918 **Author:** "Ramamoorthy,K.; Ramasamy,M.; Vairavan,K." **Year:** 1995

Title: Chemical and Cultural Weed Control in Irrigated Soybean (Glycine max) **Source:** Indian J.Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom *(NR Plantae)*	POP	POP	BMAS	NAT	30 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	EN	7.8	NR

Ref # 73924 **Author:** "Chandel,A.S.; Saxena,S.C.; Singh,K." **Year:** 1995

Title: Integrated Weed Control and Its Economics in Soybean (Glycine max) Grown in Mollisols of Uttar Pradesh **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom *(NR Plantae)*	POP	POP	ABND	NAT	30 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	NR	7.6	1.82 % (OC)
Plant kingdom *(NR Plantae)*	POP	POP	ABND	NAT	30 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	1	100	FieldN	NR	7.6	1.82 % (OC)

Ref # 73936 **Author:** "Aliyu,L.; Lagoke,S.T.O." **Year:** 1995

Title: "Evaluation of Herbicides for Weed Control in Solanum aethiopicum L. (Scarlet Eggplant) at Samaru, Nigeria" **Source:** Crop Prot.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	COVR	NAT	56 d	A	NOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	1	100	FieldN	HS		0.72 % (OM)
Plant kingdom (NR Plantae)	POP	POP	COVR	NAT	56 d	A	NOAEL: 1.784 lb/acre Orig 2 ai kg/ha	NR Orig	1	100	FieldN	HS		0.66 % (OM)

Ref # 73953 **Author:** "Maheswarappa,H.P.; Nanjappa,H.V." **Year:** 1994

Title: Relative Efficacy of Herbicides in Controlling the Weeds Infesting Pigeonpea (Cajanus cajan) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	A	LOAEL: 0.446 lb/acre Orig 0.5 ai kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73954 **Author:** "Shivakumar,H.R.; Prathibha,N.C.; Muniyappa,T.V." **Year:** 1994

Title: Effect of Chemical Weed Control on Nutrient Uptake by Common Mulberry (Morus australis) and Associated Weeds **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73954 **Author:** "Shivakumar,H.R.; Prathibha,N.C.; Muniyappa,T.V." **Year:** 1994

Title: Effect of Chemical Weed Control on Nutrient Uptake by Common Mulberry (Morus australis) and Associated Weeds **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	BCM	BCM	NCON	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	2	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	BCM	BCM	NCON	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	2	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	2	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	LOAEL: 1.115 lb/acre Orig 1.25 kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73955 **Author:** "Thakur,D.R." **Year:** 1994

Title: Weed Management in Intercropping Systems Based on Maize (Zea mays) Under Rainfed Mid-hill Conditions **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	70 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100	FieldN	HS	6.9	NR

Ref # 73956 **Author:** "Sharma,R.K.; Bangar,K.S.; Kanere,G.; Singh,O.P.; Thakur,G.L.; Sharma,S.R." **Year:** 1992

Title: Effect of Weed Control on Yield of Soybean (Glycine max) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter

Ref # 73956 **Author:** "Sharma,R.K.; Bangar,K.S.; Kanere,G.; Singh,O.P.; Thakur,G.L.; Sharma,S.R." **Year:** 1992

Title: Effect of Weed Control on Yield of Soybean (Glycine max) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	50 d	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	NR	7.9	NR

Ref # 73958 **Author:** "Gogoi,A.K.; Pathak,A.K.; Deka,J.; Kalita,H." **Year:** 1991

Title: Pre-emergence Herbicides for Weed Control in Potato (Solanum tubersum) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	ABND	NAT	hv	F	LOAEL: 1.784 lb/acre Orig 2 kg/ha	NR Orig	1	100	FieldN	EN		NR

Ref # 73960 **Author:** "Glaze,N.C.; Hall,M.R." **Year:** 1990

Title: Cultivation and Herbicides for Weed Control in Sweet Potato (Ipomoea batatas) **Source:** Weed Technol.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	<42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		NR
Plant kingdom (NR Plantae)	POP	POP	CNTL	NAT	42 d	F	LOAEL: 1.5164 lb/acre Orig 1.7 kg/ha	NR Orig	2	100	FieldN	HS		NR

Ref # 73968 **Author:** "Singh,V.K.; Bajpai,R.P.; Mishra,R.K.; Purohit,K.K." **Year:** 1991

Title: Chemical Weed Control in Rainfed Soybean (Glycine max) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom *(NR Plantae)*	POP	POP	BMAS	NAT	100 d	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN	6.2	NR
Plant kingdom *(NR Plantae)*	POP	POP	BMAS	NAT	100 d	A	LOAEL: 0.892 lb/acre Orig 1 ai kg/ha	NR Orig	1	100	FieldN	EN	6.2	NR

Ref # 73969 **Author:** "Gogoi,A.K.; Kalita,H.; Pathak,A.K.; Deka,J." **Year:** 1991

Title: Chemical Control of Weeds in Field Pea (Pisum sativum) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom *(NR Plantae)*	POP	POP	BMAS	NAT	114 d	F	NOAEL: 1.338 lb/acre Orig 1.5 kg/ha	LOAEL: 1.784 lb/acre Orig 2 kg/ha	2	100	FieldN	EN	5.8	NR

Ref # 73970 **Author:** "Sharma,V.; Thakur,D.R.; Sharma,J.J." **Year:** 1998

Title: Effect of Metolachlor and Its Combination with Atrazine on Weed Control in Maize (Zea mays) **Source:** Indian J.Agron.

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom *(NR Plantae)*	POP	POP	ABND	NAT	25 d	F	LOAEL: 0.892 lb/acre Orig 1 kg/ha	NR Orig	2	100		EN	6.7	NR

Ref # 73973 **Author:** Gora DR;Meena NL;Shivran PL;Shivran DR; **Year:** 1996

Title: Dry-Matter Accumulation and Nitrogen Uptake in Cumin (Cuminum cyminum) as Affected by Weed Control and Time of N Application **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	PHY	PHY	NUPT	NAT	hv	F	LOAEL: 0.446 lb/acre Orig 0.5 kg/ha	NR Orig	2	100	FieldN	EN	8.5	0.23 % (OC)
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	hv	F	NOAEL: 1 Orig 1	NR Orig	2	100	FieldN	EN	8.5	0.23 % (OC)

Ref # 73976 **Author:** Gogoi AK;Kalita H;Pathak AK;Deka J; **Year:** 1991

Title: Integrated Weed Management in Soybean (Glycine max) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	65 d	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	2	100	FieldN	EN	5.9	NR

Ref # 73983 **Author:** Gogoi AK;Kalita H;Pathak AK;Deka J; **Year:** 1991

Title: Weed Management in Blackgram (Phaseolus mungo) **Source:** Indian J Agron

Common Name	Effect Group	Effect	Meas	Media	Duration	Type	Results1	Results2	# of Levels	% Purity	Test Loc	Exp Type	pH	Organic Matter
Plant kingdom (NR Plantae)	POP	POP	BMAS	NAT	60 d	F	LOAEL: 2.23 lb/acre Orig 2.5 kg/ha	NR Orig	2	100	FieldN	NR	5.7	NR

Appendix C. References Identified Using the ECOTOX Open Literature Search Method

I. Bibliography of Acceptable ECOTOX Papers

A tabular summary of the toxicity data from these studies for plants, invertebrates, fish, reptiles, and amphibians are included in Appendix B.

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II. Bibliography of ECOTOX Papers that Failed to Meet OPP Acceptance Criteria

The results from the following studies were not generally included in this assessment. The justification for rejecting the papers is noted after each citation.

Rejection codes are:

ABSTRACT- Published as an abstract. Supporting information is not available.

AIR POLLUTION - no specific chemical identified.

BACTERIA- bacteria used as the test organism, including Microtox tests, or other microbial organisms.

BIOLOGICAL TOXICANT- includes venoms, fungal toxins, other plant, animal, or microbial extracts or toxins.

DRUG- testing for drug effects and side-effects.

EFFLUENT- sewage, or polluted runoff.

FATE- studies reporting only what happens to the chemical in abiotic matrices.

FOOD STUDIES- no chemical and effects information reported.

FOReign- published in a foreign language.

HUMAN HEALTH- specific to humans

IN VITRO- including cell cultures and excised tissues.

INCIDENT- reports of animal deaths. Lacks usable concentration or duration or both.

METABOLISM- no usable toxicity data.

METHODS- no usable toxicity data. Reports methods for conducting tests.

MICROBE- Effects only reported non-plant microbial organisms.

MIXTURE- no single chemical tests reported.

MODELING- no new organism toxicity data.

NO CONTROL- no usable toxicity data.

NO ENDPOINT- no usable toxicity data.

NO EFFECT- no usable toxicity data.

NO SPECIES- no organism present or tested or unable to verify species or exposure of dead organism.

NO TOXICANT- no usable toxicity data.

NO TOXicity DATA- publications which are not toxicology studies.

NO CONCentration- no usable dose or concentration reported. Concentrations reported only in log units are not coded.

NO DURATION - no duration reported.

NON-ENGLISH- published in a foreign language.

NUTRIENT studies- in situ chemicals tested as nutrients.

OIL and petroleum products

OTHER AMBIENT CONDITIONS- effects on organisms from changes in conditions other than addition of chemicals.

PUBL AS- results were published in a different format, duplicative of another source.

REVIEW- all toxicity data is reported elsewhere.

SEDIMENT CONcentration- chemical concentrations reported in sediment only.

SURVEY- measuring amounts of chemical present but no usable quantification of exposure,. Lacks either usable concentration or duration or both.

TARGET- efficacy data.

YEAST- yeast is used as the test organism.

Ref #

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Rejection Code: FOREIGN

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Rejection Code: MIXTURE

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Rejection Code: NO ENDPOINT

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Rejection Code: NO CONTROL

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73303 Yenne, S. P., Hatzios, K. K., and Meredith, S. A. (1990) Uptake, Translocation, and Metabolism of Oxabetrinil and CGA-133205 in Grain Sorghum (Sorghum bicolor) and Their Influence on Metolachlor Metabolism. *J.Agric.Food Chem.* 38: 1957-1961.
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73360 Sayed, F. A., Mohamed, S. G., and Abd Elaleem, F. F. (1990) Growth and Nitrogen Metabolism of Rhizoctonia solani as Affected by Some Herbicides and a Fungicide. *Egypt.J.Microbiol.* 25: 269-276.
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Rejection Code: MIXTURE

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73536 Bedmar, F. (1990) Evaluation of Different Pre-emergence Herbicides in Sunflower. *Tests Agrochem.Cultiv.* 11: 62-63.
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III. Bibliography of Papers Excluded from ECOTOX by Rejection Code

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Appendix D. Metolachlor Usage Data by State and County.

The attached data represent the usage of the pesticide active ingredient metolachlor at the state and county level for Idaho, Oregon, and Washington. Major use sites are captured in this usage data summary. However, it is possible that additional sites with pesticide usage exist but are not represented in the attached dataset because they are not covered by data sources currently available to the Biological and Economic Analysis Division (BEAD).

The usage data in the attached summary represent the highest estimated total pounds of a covered active ingredient applied for a site/location combination across all years (1998-2002) and databases. The total pounds applied, as reported in these data, are maximum values, and thus cannot be summed for a national total.

State and county level crop production and pesticide use data were derived using the following data sources spanning the years 1998 to 2002: United States Department of Agriculture's National Agricultural Statistics Service (USDA/NASS) pesticide use databases and Census of Agriculture, and private market research databases.

County level pounds applied data were estimated using county level agricultural production data and state level pesticide usage data. Crop acres grown at the county level were taken from the Census of Agriculture. County pesticide usage was calculated by distributing the above described state level pesticide usage data by the portion of the crop produced at the county level on a per state, crop, and chemical basis. Acres grown data at the county level were, however, in some cases suppressed in source databases to provide for privacy of crop producers. Suppression of data is shown in the dataset with a "-9" and indicates that, even though a crop might be grown in a county, information is not available to estimate the quantity of pesticide usage. As a result, not all estimated pesticide use at the state level will be distributed to the county level.

Summarized pesticide usage data are provided in the table below by state and county. The usage (pound applied) in each county is reported in addition to the number of acres in farms by county reported by USDA's National Agricultural Statistics Service Ag Census (http://www.nass.usda.gov/census/census02/volume1/index2.htm). Dividing the Pounds Applied by the Acres in Farms gives an indication of the county-wide use rate. In counties with higher use rates, any given acre is more likely to be treated than counties with lower use rates. All county-wide use rates are below 0.1 lbs/acre and the average county-wide use rate, excluding zeroes, is 0.007 lbs/acre.

State	County	FIPS	SITE_NAME	Pounds Applied	Acres in Farms	Pounds Applied / Acres in Farms
ID	Ada	16001	All Sites	535	223,388	2.39E-03
ID	Bannock	16005	All Sites	893	357,104	2.50E-03
ID	Benewah	16009	All Sites	-9	137,791	
ID	Bingham	16011	All Sites	14,841	821,163	1.81E-02
ID	Blaine	16013	All Sites	346	225,936	1.53E-03
ID	Bonner	16017	All Sites	1	90,858	1.10E-05
ID	Bonneville	16019	All Sites	7,827	477,784	1.64E-02
ID	Boundary	16021	All Sites	-9	76,506	
ID	Butte	16023	All Sites	395	121,331	3.26E-03
ID	Canyon	16027	All Sites	3,365	271,992	1.24E-02
ID	Caribou	16029	All Sites	1,852	426,973	4.34E-03
ID	Cassia	16031	All Sites	8,015	744,260	1.08E-02
ID	Clearwater	16035	All Sites	34	70,724	4.81E-04
ID	Custer	16037	All Sites	148	131,571	1.12E-03
ID	Elmore	16039	All Sites	3,149	346,034	9.10E-03
ID	Franklin	16041	All Sites	69	243,807	2.83E-04
ID	Fremont	16043	All Sites	7,036	287,494	2.45E-02
ID	Gem	16045	All Sites	121	221,200	5.47E-04
ID	Gooding	16047	All Sites	3,073	194,827	1.58E-02
ID	Idaho	16049	All Sites	30	638,640	4.70E-05
ID	Jefferson	16051	All Sites	9,215	305,305	3.02E-02
ID	Jerome	16053	All Sites	3,636	186,319	1.95E-02
ID	Kootenai	16055	All Sites	1	154,217	6.48E-06
ID	Latah	16057	All Sites	525	340,115	1.54E-03
ID	Lewis	16061	All Sites	199	216,562	9.19E-04
ID	Lincoln	16063	All Sites	571	127,853	4.47E-03
ID	Madison	16065	All Sites	7,900	189,990	4.16E-02
ID	Minidoka	16067	All Sites	8,147	228,459	3.57E-02
ID	Nez Perce	16069	All Sites	720	343,462	2.10E-03
ID	Oneida	16071	All Sites	123	363,152	3.39E-04
ID	Owyhee	16073	All Sites	1,268	571,051	2.22E-03
ID	Payette	16075	All Sites	702	154,562	4.54E-03
ID	Power	16077	All Sites	9,110	425,221	2.14E-02
ID	Teton	16081	All Sites	1,852	124,613	1.49E-02
ID	Twin Falls	16083	All Sites	7,702	441,121	1.75E-02
ID	Washington	16087	All Sites	182	472,465	3.85E-04
ID	State Total	16	All Sites	104,945		
OR	Baker	41001	All Sites	3,604	869,523	4.14E-03
OR	Benton	41003	All Sites	2,629	130,203	2.02E-02
OR	Clackamas	41005	All Sites	108	215,210	5.02E-04
OR	Clatsop	41007	All Sites	1	22,234	4.50E-05
OR	Columbia	41009	All Sites	6	62,398	9.62E-05
OR	Coos	41011	All Sites	-9	144,077	

OR	Crook	41013	All Sites	90	937,628	9.60E-05
OR	Curry	41015	All Sites	-9	70,459	
OR	Deschutes	41017	All Sites	0	138,226	
OR	Douglas	41019	All Sites	51	390,140	1.31E-04
OR	Gilliam	41021	All Sites	52	642,998	8.09E-05
OR	Hood River	41027	All Sites	3	29,064	1.03E-04
OR	Jackson	41029	All Sites	100	252,185	3.97E-04
OR	Jefferson	41031	All Sites	1,509	701,440	2.15E-03
OR	Josephine	41033	All Sites	17	32,370	5.25E-04
OR	Klamath	41035	All Sites	10,428	702,951	1.48E-02
OR	Lane	41039	All Sites	868	234,807	3.70E-03
OR	Lincoln	41041	All Sites	1	32,791	3.05E-05
OR	Linn	41043	All Sites	2,385	385,589	6.19E-03
OR	Malheur	41045	All Sites	16,449	1,175,280	1.40E-02
OR	Marion	41047	All Sites	7,322	341,051	2.15E-02
OR	Morrow	41049	All Sites	22,553	1,124,593	2.01E-02
OR	Multnomah	41051	All Sites	420	34,329	1.22E-02
OR	Polk	41053	All Sites	923	168,881	5.47E-03
OR	Sherman	41055	All Sites	-9	507,705	
OR	Tillamook	41057	All Sites	-9	39,526	
OR	Umatilla	41059	All Sites	23,137	1,330,932	1.74E-02
OR	Union	41061	All Sites	3,394	478,411	7.09E-03
OR	Wallowa	41063	All Sites	549	518,110	1.06E-03
OR	Wasco	41065	All Sites	1	1,086,817	9.20E-07
OR	Washington	41067	All Sites	2,953	130,683	2.26E-02
OR	Yamhill	41071	All Sites	2,211	196,298	1.13E-02
OR	State Total	41	All Sites	108,702		
WA	Adams	53001	All Sites	2,612	1,067,079	2.45E-03
WA	Benton	53005	All Sites	3,346	607,963	5.50E-03
WA	Chelan	53007	All Sites	1	112,023	8.93E-06
WA	Clallam	53009	All Sites	0	22,372	
WA	Clark	53011	All Sites	2	70,694	2.83E-05
WA	Cowlitz	53015	All Sites	23	39,582	5.81E-04
WA	Douglas	53017	All Sites	-9	878,867	
WA	Franklin	53021	All Sites	3,813	664,875	5.73E-03
WA	Grant	53025	All Sites	8,621	1,074,074	8.03E-03
WA	Grays Harbor	53027	All Sites	58	53,594	1.08E-03
WA	Island	53029	All Sites	0	15,018	
WA	King	53033	All Sites	3	41,769	7.18E-05
WA	Kitsap	53035	All Sites	0	16,094	
WA	Kittitas	53037	All Sites	150	230,646	6.50E-04
WA	Klickitat	53039	All Sites	152	606,794	2.50E-04
WA	Lewis	53041	All Sites	38	130,950	2.90E-04
WA	Lincoln	53043	All Sites	404	1,233,377	3.28E-04
WA	Mason	53045	All Sites	2	21,641	9.24E-05
WA	Okanogan	53047	All Sites	0	1,241,316	
WA	Pierce	53053	All Sites	26	57,224	4.54E-04
WA	San Juan	53055	All Sites	-9	17,145	
WA	Skagit	53057	All Sites	822	113,821	7.22E-03
WA	Snohomish	53061	All Sites	-9	68,612	
WA	Spokane	53063	All Sites	-9	643,377	
WA	Stevens	53065	All Sites	-9	528,402	
WA	Thurston	53067	All Sites	2	74,442	2.69E-05

WA	Walla Walla	53071	All Sites	1,224	700,560	1.75E-03
WA	Whatcom	53073	All Sites	236	148,027	1.59E-03
WA	Yakima	53077	All Sites	349	1,678,984	2.08E-04
WA	State Total	53	All Sites	28,139		