MEMORANDUM

DATE: 30-APR-2003

SUBJECT: PP# 8F3673. **GLYPHOSATE.** Review of Proposal to Amend the Roundup Ultra® Label to Permit Directed-Spray Applications Using Drop Nozzles and Over-the-Top Broadcast Applications to Roundup Ready® Corn. MRID#s: 450774-01 & -02. DP Barcode D265967. Chemical#s 103601and 417300. Case# 034794. Submission# S579657.

FROM: William H. Donovan, Ph.D., Chemist
Reregistration Branch 3 (RRB3)
Health Effects Division (HED) (7509C)

THRU: G. Jeffrey Herndon, Branch Senior Scientist
Registration Action Branch 1 (RAB1)/HED (7509C)

TO: Jim Tompkins/Vickie Walters, PM Team 25
Registration Division (RD) (7505C)

Monsanto Company submitted a petition for an amendment to the Roundup Ultra® label to allow directed-spray application using drop nozzles and over-the-top broadcast applications to Roundup Ready® corn. In support of this petition, Monsanto has provided residue chemistry data depicting the magnitude of the residue in Roundup Ready® corn when using the proposed application methods at the maximum proposed rates. In addition, the petitioner conducted side-by-side residue trials using several new lines of Roundup Ready® corn to demonstrate the resulting residue profiles as supplemental information. In addition, on 08-JAN-2002, Monsanto submitted a revised Section F requesting a tolerance levels of 6.0 ppm for "field, corn, forage", and 100 ppm for "aspirated grain fractions".

The directed drop nozzle application technique directs the spray toward the base of corn plants, reducing contact with the upper foliage, thus minimizing the potential risk of crop injury, especially when tank mixing with other herbicide products.

The attached contractor's document (Attachment 1) has been reviewed and revised to reflect current HED policy.

Executive Summary of Chemistry Deficiencies

- Revised Section B.

RECOMMENDATIONS

Provided that Section B (Conclusion 1) is modified as requested, HED concludes there are no residue chemistry data requirements that would preclude increasing the existing permanent tolerance for residues of glyphosate *per se* in/on "corn, field, forage" from 3.0 to 6.0 ppm. The established permanent tolerance levels of 1.0 and 100 ppm for "corn, field, grain" and "corn, field, stover", respectively, are adequate to cover the proposed new use pattern. Also, the request to reduce the "aspirated grain fractions" tolerance from 200 to 100 ppm while deleting the established "soybean, aspirated grain fractions" tolerance of 50 ppm is appropriate. A revised human-health risk assessment is not needed because the increased tolerance level for corn forage does not increase the dietary burden for livestock; thus, glyphosate levels from the new corn use pattern and all registered uses were accounted for by a previous risk assessment (D267588, W. Donovan et. al., 17-AUG-2000).

cc: W. Donovan
RDI: G. Herndon (30-APR-2003), RAB1 Chemists (23-AUG-2001)
W. Donovan:806R:CM#2:(703)-305-7330:MC 7509C

Glyphosate

PC Code 103601

(DP Barcode D265967)

Request for an Amended Registration for application of Glyphosate to Round-up Ready Corn

January 9, 2001

Contract No. 68-W-99-053

Submitted to:
U.S. Environmental Protection Agency
Arlington, VA

Submitted by:
Dynamac Corporation
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GLYPHOSATE

REQUEST FOR AN AMENDED REGISTRATION FOR APPLICATION OF GLYPHOSATE TO ROUND-UP READY CORN

(DP BARCODE D265967)

INTRODUCTION

Monsanto Company has submitted a request for an amended registration for Roundup Ultra® Herbicide (EPA Reg. No. 524-475) to allow for multiple postemergence broadcast applications and/or a directed application using drop nozzles to Roundup Ready® corn.

Tolerances are currently established for the combined residues of glyphosate (N-(phosphonomethyl)glycine) and its metabolite aminomethylphosphonoic acid (AMPA) resulting from the application of the isopropylamine salt of glyphosate and/or the monoammonium salt of glyphosate in or on field corn forage and grain at 1.0 ppm in or on field corn stover at 100 ppm [40 CFR § 180.364(a)(1)]. However, the HED Metabolism Committee (Memo from R. Perfetti, 8/19/92) has determined that AMPA does not need to be regulated, and the Glyphosate RED (9/27/92) has indicated that AMPA will be dropped from the tolerance expression.

Monsanto recently submitted a petition (PP#8F04973) to increase the glyphosate tolerance in/on field corn forage to 3.0 ppm, in conjunction with a request to amend the label for Roundup Ultra® for applications to new strains of Roundup Ready® Corn. This previous label amendment was to allow for a preemergence application at up to 3.75 lb ae/A, followed by up to two broadcast postemergence applications (0.75 lb ae/A/application) to corn up to 30 inches in height, and a preharvest application at 0.75 lb ae/A, no later than 7 days prior to harvest. Residue data to support this petition were generated using a second-generation of Roundup Ready® Corn (line GA21) which has been transformed to express a modified version of the wild-type EPSPS enzyme found in corn, but does not express the gox enzyme. Without the gox degradation gene, the primary residue is parent glyphosate. HED's review of this petition (DP Barcodes D245594 and D245595, W. Donovan, 6/29/00) indicated that the residue data supported the established tolerances for corn grain and stover and the proposed 3.0 ppm tolerance for corn forage.

The field trial data submitted with this label amendment were generated to support the use of a postemergence directed application using drop nozzles in addition to the existing preemergence and broadcast postemergence applications. Data have also been submitted comparing residues resulting from glyphosate applications to the GA21 corn line and to newer Roundup Ready® corn lines (NK series).

CONCLUSIONS/RECOMMENDATIONS

OPPTS GLN 860.1200: Proposed Uses

1. Although the applications in the field trials deviated somewhat from the proposed use directions, the supplemental label use directions for postemergence applications of glyphosate to Roundup Ready® corn are adequate, provided that the registrant changes the rotational crop restriction language to indicate that there is a 30-day minimum plant-back interval for crops on which the use of glyphosate is not registered (Memo, G. Kramer, 12-MAY-1994). **A revised Section B should be submitted.**

OPPTS GLN 860.1340: Residue Analytical Method - Plants

2. The HPLC/fluorescence method is adequate for collecting data on residues of glyphosate and AMPA in/on corn forage, grain, and stover. The validated limit of quantitation (LOQ) for each analyte is 0.05 ppm is each matrix. This method has undergone successful Agency validation and was recommended for inclusion in PAM II.

OPPTS GLN 860.1500: Crop Field Trials

3a. Although the three different treatments used in the field trials deviated slightly from the proposed label directions, the data depicting glyphosate residues in/on corn RACs from Roundup Ready® Corn (line GA21) following a preemergence and multiple postemergence applications totaling 6 lb ae/A/season are adequate. The data support the established tolerances of 1.0 and 100 ppm for corn grain and stover, but do not support the new tolerance of 3.0 ppm for corn forage proposed under PP#8F04973. Of the 44 forage samples from each treatment, glyphosate residues were >3 ppm in/on 3 samples from Treatment #2 (3.2-4.5 ppm), 4 samples from Treatment #3 (3.2-5.6 ppm), and 4 samples from Treatment #4 (4.0-6.7 ppm). Based on the residue data from Treatment #3, which most closely approximates the proposed use pattern, a tolerance level of 6.0 ppm on "corn, field, forage" is supported.

3b. Following a preemergence application of glyphosate at 3.75 lb ae/A, two broadcast foliar applications at 0.75 lb ae/A/application, and a final directed application with drop nozzles at 0.75 lb ae/A (Treatment #2), residues of glyphosate *per se* were <0.04-4.5 ppm in/on forage harvested 25-66 days post-treatment and <0.04-0.51 ppm in/on grain and 0.28-5.8 ppm in/on stover harvested at maturity (46-102 days post-treatment).

3c. Following a preemergence application of glyphosate at 3.0 lb ae/A, two broadcast foliar applications at 0.75 lb ae/A/application, and a final directed application with drop nozzles at 1.50 lb ae/A (Treatment #3), residues of glyphosate *per se* were 0.13-5.6 ppm in/on forage harvested 25-66 days post-treatment and <0.04-0.56 ppm in/on grain and 0.23-5.2 ppm in/on stover harvested at maturity (46-102 days post-treatment).

3d. Following a preemergence application of glyphosate at 3.75 lb ae/A, two broadcast foliar applications at 0.75 and 1.5 lb ae/A (Treatment #4), residues of glyphosate *per se* were 0.18-6.7 ppm in/on forage harvested 33-74 days post-treatment and <0.04-0.96 ppm in/on grain and 0.32-14.8 ppm in/on stover harvested at maturity (54-111 days post-treatment).

3e. For aspirated grain fractions, HED concurs that a tolerance level of 100 ppm is appropriate based on the sorghum residue data. Moreover, the separate tolerance for "soybean, aspirated grain fractions" should be deleted from 40 CFR 180.364.

4. Side-by-side tests at six locations were conducted comparing glyphosate residues in/on corn forage, grain, and stover of the Roundup Ready corn line GA21 (used in the extensive residue field trials) to residues in the new NK series of Roundup Ready® corn (NK522, NK541, NK600 and NK603). The submitted data are adequate and indicate that glyphosate residues in corn RACs from the GA21 line are representative of the residues in corn RACs from the newer NK series of Roundup Ready® corn lines, which contain the same gene for conferring glyphosate tolerance.

OPPTS GLN 860.1480: Meat, Milk, Poultry and Eggs

5. Increasing the tolerance for glyphosate residues in/on field corn forage from 3.0 to 6.0 ppm is expected to have no impact on the maximum theoretical dietary burden for livestock and will therefore not effect the established tolerances on livestock commodities.

DETAILED CONSIDERATIONS

OPPTS GLN 860.1200: Directions for Use

Monsanto Company submitted supplemental labeling for Roundup® Ultra Herbicide (EPA Reg. No. 524-475) allowing postemergence broadcast and/or directed-spray applications using drop nozzles to corn with the Roundup Ready® gene.

The supplemental label allows for a preemergence application to Roundup Ready® Corn at up to 3.75 lb ae/A followed by multiple postemergence applications. For postemergence applications, either broadcast or directed spray applications may be used from crop emergence through the V8 stage or until corn reaches 30 inches in height. For corn 30-48 inches in height, apply only as a directed application using drop nozzles. The maximum single application rate for postemergence applications is 0.75 lb ae/A for broadcast applications and 1.5 lb ae/A for directed applications. All postemergence applications should not exceed a total of 2.25 lb ae/A, and the maximum total seasonal application rate is 6 lb ae/A. Broadcast applications may be made with ground or aerial equipment using a minimum application volume of 5 and 3 gallons/A, respectively. A minimum retreatment interval of 10 days is specified for postemergence application, along with a preharvest interval of 50 days for corn forage and grain. There are no rotational crop restrictions following applications of this glyphosate product.

Conclusions: Although the applications in the field trials deviated somewhat from the proposed use directions, the supplemental label use directions for postemergence applications of glyphosate to Roundup Ready® corn are adequate, provided that the registrant changes the rotational crop restriction language to indicate that there is a 30-day minimum plant-back interval for crops on which the use of glyphosate is not registered (Memo, G. Kramer, 12-MAY-1994). **A revised Section B should be submitted.**

OPPTS GLN 860.1300: Nature of the Residue - Plants & Livestock

Plants

The qualitative nature of the residue in plants is adequately understood. Studies with a variety of plants including corn, cotton, soybeans, and wheat indicate that the uptake of glyphosate or its metabolite, aminomethylphosphonic acid (AMPA), from soil is limited. The material which is taken up is readily translocated. Foliarly applied glyphosate is readily absorbed and translocated throughout the trees of vines to the fruit of apples, coffee, dwarf citrus (calamondin), pears and grapes. Metabolism via N-methylation yields N-methylated glycines and phosphonic acids. For the most part, the ratio of glyphosate to AMPA is 9 to 1 but can approach 1 to 1 in a few cases (e.g., soybeans and carrots). Much of the residue data for crops reflects a detectable residue of parent (0.05 - 0.15 ppm) along with residues below the level of detection (<0.05 ppm) of AMPA (Memo, R. Perfetti, 27-OCT-1992). In a meeting of the HED Metabolism Committee held 19-AUG-1992, the Committee determined that AMPA need not be regulated and should be dropped

from the tolerance expression (Memo, R. Perfetti, 19-OCT-1992). Furthermore, in a meeting of the HED Metabolism Committee held 17-MAR-1994, the Committee discussed whether uses that result in significantly higher residues of AMPA in plants and livestock commodities in the future would require that AMPA be reintroduced into the tolerance expression of glyphosate. The Committee determined that, based on toxicological considerations, AMPA need not be regulated regardless of levels observed in foods or feeds (Memo, R. Perfetti, 17-MAR-1994). Thus, the terminal residue to be regulated in plants is glyphosate *per se*.

Livestock

The qualitative nature of the residue in livestock is adequately understood. Studies with lactating goats and laying hens fed a mixture of glyphosate and AMPA indicate that the primary route of elimination was by excretion (urine and feces). These results are consistent with metabolism studies in rats, rabbits, and cows. The terminal residues in eggs, milk, and animal tissues are glyphosate and its metabolite AMPA; there was no evidence of further metabolism (Memo, R. Perfetti, 27-OCT-1992). The conclusions of the HED Metabolism Committee on 19-AUG-1992 and 17-MAR-1994 apply to plant and livestock commodities. Thus, the terminal residue to be regulated in livestock is glyphosate *per se*.

OPPTS GLN 860.1340: Residue Analytical Method - Plants

In conjunction with the crop field trials (1999; MRID 45077401 and 45077402), the petitioner submitted method descriptions and concurrent recovery data for a high performance liquid chromatography (HPLC) method using fluorometric detection to determine residues of glyphosate and its metabolite AMPA in/on corn. This method has undergone successful Agency validation and was recommended for inclusion in PAM II (Memo, R. Perfetti, 10/27/92).

Briefly, residues of glyphosate and AMPA are extracted using chloroform or methylene chloride and 0.1 N HCl (1:3, v:v), filtered, concentrated to an aqueous remainder, and purified using a column of Chelex® 100 resin in the Fe(III) form. Residues are eluted from the resin with HCl and the iron is removed using an anion exchange resin. The residues are then concentrated to dryness to remove the HCl and analyzed using a two-column-switching HPLC equipped with an o-phthalaldehyde post-column reactor and a fluorescence detector (excitation at 340 nm, emission at 455 nm).

The validated LOQ for residues of each analyte is 0.05 ppm for all plant matrices. For method validation, control samples of representative corn matrices were fortified with glyphosate and AMPA at 0.05-20.0 ppm. Concurrent recoveries were 68-120% for parent and 62-123% for AMPA from corn forage, 61-110% for parent and 67-114% for AMPA from corn grain, and 61-125% for parent and 64-124% for AMPA from corn stover (Table 1). Adequate representative chromatograms and sample calculations were provided.

Conclusions: The HPLC/fluorometric method is adequate for collecting data on residues of glyphosate and AMPA in/on corn forage, grain and stover. The validated LOQ for residues of each analyte is 0.05 ppm for all plant matrices. This method has undergone successful Agency validation and was recommended for inclusion in PAM II (Memo, R. Perfetti, 10/27/92).

Table 1. Concurrent method recoveries from control samples of various corn lines fortified with glyphosate and AMPA using an HPLC with fluorometric detection method.

MRID	Matrix	Fortification level (ppm)	# of Samples	% Recovery of glyphosate		% Recovery of AMPA	
				Range [a]	Avg ± SD	Range [a]	Avg ± SD
45077401	Forage	0.05	4	74-91	83 ± 9	62-106 (2)	84 ± 26
		0.10	5	75-93	84 ± 8	78-123 (1)	99 ± 20
		0.50	3	82-120	97 ± 21	86-118	100 ± 16
		2.50	3	78-87	83 ± 5	75-85	81 ± 6
		3.59	1	96	NA [b]	98	NA
		5.00	5	84-98	89 ± 7	81-97	88 ± 7
		10.0	2	87-104	95 ± 13	86-100	93 ± 11
	Grain	0.05	6	62-104 (2)	88 ± 20	67-113 (1)	92 ± 22
		0.10	4	80-99	87 ± 10	71-91 [c]	82 ± 12
		0.25	1	113	NA	125	NA
		0.50	4	61-110 (1)	92 ± 23	73-112	94 ± 17
		1.00	1	90	NA	101	NA
		2.50	4	82-103	89 ± 11	81-97	89 ± 7
		5.00	4	82-86	84 ± 2	83-95	91 ± 6
	Stover	0.05	5	82-110	98 ± 11	88-119	100 ± 15
		0.10	5	80-103	93 ± 11	81-101	92 ± 9
		0.50	4	92-104	96 ± 5	87-102	93 ± 7
		2.50	4	87-114	98 ± 12	84-114	97 ± 14
		5.00	4	75-126 (1)	95 ± 24	70-124 (1)	93 ± 26
		20.0	1	79	NA	81	NA
45077402	Forage	0.05-10.0	7	68-101 (1)	83 ± 15	63-96 (1)	80 ± 14
	Grain	0.05-5.0	6	73-114	89 ± 16	74-114	96 ± 18
	Stover	0.10-5.0	7	61-114 (2)	87 ± 23	64-100 (1)	89 ± 16

[a] Values in parentheses represent the number of samples with recoveries outside the acceptable range (70-120%).

[b] NA = not applicable.

[c] Excluding an outlier with a 0% recovery that was the result of an interfering peak.

OPPTS GLN 860.1360: Multiresidue Method

The Pestrak database (1990) indicate that recoveries are not likely for glyphosate under FDA Multiresidue Methods. No further data regarding multiresidue methods are required for this proposed use.

OPPTS GLN 860.1500: Crop Field Trials

To support an amended use allowing a postemergence directed application of glyphosate to Roundup Ready® corn with drop nozzles, Monsanto Company has submitted data (citation below) from 22 corn field trials (66 tests) conducted during 1998 in GA, IA (4), IL (3), IN, MI (2), MN (2), NC, NE (2), OH, PA, SD, TX, and WI (2) depicting residues of glyphosate and AMPA in/on corn forage, grain and stover.

> 45077401 Culkin, J. (1999) Magnitude of Glyphosate Residues in Roundup Ready® Corn Raw Agricultural Commodities Following Drop Nozzle Application of Roundup® Ultra Herbicide: Lab Project Number: MSL-15334: 98-63-R-4. Unpublished study prepared by Monsanto Company. 642 p. {860.1500}

The Roundup Ready® corn line used in each test, GA21, expresses a modified version of the wild-type EPSPS enzyme and does not contain the gox enzyme or any other enzyme that modifies the metabolic pathway of glyphosate. The IPA salt of glyphosate (EPA Reg. No. 524-475; 4 lb/gal SC/L, equivalent to 3 lb ae/gal) was applied to corn plots at each test site using three different treatment regimes (Table 2). Each treatment included a preemergence application of glyphosate at 3-3.75 lb ae/A followed by two or three postemergence applications totaling 2.25-3 lb ae/A. Two postemergence broadcast applications were made at 0.75 and/or 1.5 lb ae/A/application followed, in two treatments, by a final postemergence directed application at 0.75 or 1.5 lb ae/A using drop nozzles. All applications were made using ground equipment in 10-20 gallons of water/A, with a nonionic surfactant (0.5% v/v) added to all applications and ammonium sulfate (17 lb/100 gallons of spray solution) added to all the postemergence applications.

Table 2. Treatment regimes for glyphosate-IPA (3 lb ae/gal) application to Roundup Ready® corn.

Treatment number	Preemergence Application	Postemergence over-the-top at V4-V6 stage	Postemergence over-the-top at V8 stage	Postemergence directed drop nozzle
2	3.75 lb/A [a] (5 qt./A)	0.75 lb/A (1 qt./A)	0.75 lb/A (1 qt./A)	0.75 lb/A (1 qt./A)
3	3.0 lb/A (4 qt./A)	0.75 lb/A (1 qt./A)	0.75 lb/A (1 qt./A)	1.50 lb/A (2 qt./A)
4	3.75 lb/A (5 qt./A)	0.75 lb/A (1 qt./A)	1.50 lb/A (2 qt./A)	Not applicable

[a] Application rates are expressed in lb ae/A and in quarts/A of Roundup Ultra Herbicide (EPA Reg. No. 524-475).

HED notes that the treatments used in the field trials deviated somewhat from the proposed use directions. Although all treatment patterns (#s 2, 3, and 4) matched the combined total per year rate of 8 quarts per acre (6 lbs ae/A) as specified on the supplemental label, none completely followed the likely worse-case scenario allowed by the label language. Based upon the proposed use directions, the actual worse-case scenario would be a preemergence application at 3.75 lb ae/A, followed by a postemergence broadcast application at 0.75 lb ae/A and a final postemergence directed application at 1.5 lb ae/A. Treatment #2 followed the proposed use directions for preemergence application, but the final directed application was not applied at the maximum of 1.5 lb ae/A allowed by the label. Treatment #3 included two postemergence broadcast applications at the allowed maximum of 0.75 lb ae/A/application followed by a single directed application at the allowed maximum of 1.5 lb ae/A; however, the total amount of glyphosate applied postemergence (3.0 lb ae/A), exceeded the maximum postemergence amount proposed on the label (2.25 lb ae/A). Treatment #4 included two broadcast applications totaling 2.25 lb ae/A, the maximum allowed for all postemergence applications, but the second broadcast application was applied at 1.5 lb ae/A, which is 2x higher than the amount allowed on the label for this type of application. Of the treatments used in the current field trials, Treatment #3 would most closely approximate the worse-case use, although this use pattern may reasonably be expected to give residue levels slightly higher than expected from the worse-case scenario allowed by the label directions.

In the present field trails, one control and duplicate treated samples of corn forage, grain and stover were collected at normal harvest time (25-74 days post-treatment for corn forage and 46-111 days post-treatment for corn grain and stover) from each test. Samples were placed in frozen storage (<-1 C) within 4 hours and then shipped frozen within 28 days by freezer truck to Monsanto Company (St. Louis, MO), where samples were stored at <-10 C. The maximum frozen storage intervals from collection to analysis were 107 days for forage, 253 days for grain, and 254 days for stover. These storage intervals are adequately supported by the available storage stability data (MRID 41472002), which indicate glyphosate residues are stable in frozen crop samples for at least 2.5 years.

All samples were analyzed using HPLC/fluorometric detection described above. Although the validated LOQ for each analyte in each matrix is 0.05 ppm, the reported LOQs in corn forage, grain, and stover were 0.04, 0.04, and 0.06 ppm, respectively, for parent, and 003, 0.05, and 0.06 ppm, respectively, for AMPA. Apparent residues of glyphosate and AMPA were <0.03 in/on 21 of 22 untreated samples of corn forage (one sample had AMPA residues of 0.08 ppm), <0.04 in/on 21 of 22 untreated samples of corn grain (one sample was 0.09 ppm for parent and 0.10 ppm for AMPA), and <0.06 in/on 21 of 22 untreated samples of corn stover (one sample was 0.10 ppm for parent).

Residues of glyphosate and AMPA in/on treated corn forage, grain and stover from each test are presented in Table 3, and the results for each treatment are summarized in Table 4.

Treatment #4 resulted in both the maximum residue values observed for each commodity and in the highest overall residue values in each test. In at least 16 of the 22 trials, Treatment #4 produced the highest residues in each commodity. For Treatment #4, residues of glyphosate *per se* were 0.18-6.7 ppm in/on forage harvested 33-74 days post-treatment and <0.04-0.96 ppm in/on grain and 0.32-14.8 ppm in/on stover harvested at maturity (54-111 days post-treatment). Corn commodities from Treatment #3, which most closely approximates the proposed use directions, generally had the next highest levels of glyphosate residues. For Treatment #3, residues of glyphosate *per se* were 0.13-5.6 ppm in/on forage harvested 25-66 days post-treatment and <0.04-0.56 ppm in/on grain and 0.23-5.2 ppm in/on stover harvested at maturity (46-102 days post-treatment). For Treatment #2, in which residues were generally lowest, residues of glyphosate *per se* were <0.04-4.5 ppm in/on forage harvested 25-66 days post-treatment and <0.04-0.51 ppm in/on grain and 0.28-5.8 ppm in/on stover harvested at maturity (46-102 days post-treatment).

Residues of AMPA were a minor component of the total residues. Regardless of the treatment, the majority of forage samples (92 out of 132) had AMPA residues <0.05 ppm; another 38 forage samples had AMPA residues of 0.05-0.18 ppm and 2 samples residues of 0.95 and 0.98 ppm. AMPA residues were <0.05 ppm in/on corn grain, with the exception of two samples with residues at 0.051 and 0.079 ppm, and were <0.06 ppm in/on corn stover, with the exceptions of four samples with residues at 0.063-0.11 ppm.

The number and geographical distribution of corn field trials is adequate. The petitioner submitted data from 22 trials in Region 1 (1), Region 2 (2), Region 5 (18), and Region 6 (1); while the OPPTS Residue Chemistry Test Guidelines (860.1500) suggest 20 trials from Region 1 (1), Region 2 (1), Region 5 (17), and Region 6 (1) for field corn.

Aspirated Grain Fractions (AGFs)
Monsanto observed that among corn, wheat, sorghum, and soybean, the highest average glyphosate residue level might be expected from sorghum. Applying the sorghum AGF concentration factor of 5x to the highest average field trial (HAFT) value of 13.5 ppm in sorghum grain would product a theoretical residue of 68 ppm for sorghum AGF. Thus, a tolerance level of 100 ppm for aspirated grain fractions is supported.

Conclusions: Although the three treatments used in the field trials deviated slightly from the proposed label directions, the data depicting glyphosate residues in/on corn RACs from Roundup Ready® Corn (line GA21) following preemergence and multiple postemergence applications totaling 6 lb ae/A/season are adequate. The data support the established tolerances of 1.0 and 100 ppm for corn grain and stover, but do not support the new tolerance of 3.0 ppm for corn forage proposed under PP#8F04973. Of the 44 forage samples from each treatment, glyphosate residues were >3 ppm in/on 3 samples from Treatment #2 (3.2-4.5 ppm), 4 samples from Treatment #3 (3.2-5.6 ppm), and 4 samples from Treatment #4 (4.0-6.7 ppm). Based on the residue data from Treatment #3, which most closely approximates the proposed postemergence use, a tolerance level of 6.0 ppm on "corn, field, forage" is supported.

For aspirated grain fractions, HED concurs that a tolerance level of 100 ppm is appropriate based on the sorghum residue data. Moreover, the separate tolerance for "soybean, aspirated grain fractions" should be deleted from 40 CFR 180.364.

Table 3. Residues of glyphosate and AMPA in/on corn forage, grain and stover harvested following three or four applications of glyphosate totaling ~6 lb ae/A/season to Roundup Ready® Corn line GA21.

Trial Location/ EPA Region	Application Data				Residues (ppm) [b]		
	Treatment Regime [a]	# of Appl.	Total Appl. (lb ae/A/season)	PHI (days)	Glyphosate	AMPA	Combined [c]
Corn Forage							
Tift, GA/2	2	4	6.13	34	1.0, 0.88	0.038, <0.03	1.1 <0.92
	3	4	6.10	34	1.3, 1.3	0.041, 0.039	1.4, 1.4
	4	3	6.15	40	2.6, 2.6	0.053, 0.056	2.7, 2.7
Jefferson, IA/5	2	4	5.97	56	0.55, 0.78	0.046, 0.065	0.62, 0.88
	3	4	6.12	56	0.47, 0.46	0.038, 0.051	0.53, 0.54
	4	3	6.08	64	0.28, 0.36	<0.03, 0.034	<0.33, 0.41
Hamilton, IA/5	2	4	5.97	42	0.98, 0.88	<0.03, <0.03	<1.0, <0.93
	3	4	5.94	42	1.3, 1.2	0.030, 0.069	1.3, 1.3
	4	3	6.05	51	1.7, 2.0	0.034, 0.038	1.7, 2.1
Guthrie, IA/5	2	4	6.10	65	0.56, 0.53	0.035, <0.03	0.63, <0.58
	3	4	6.07	65	0.58, 0.64, 0.37, 0.38	<0.03,<0.03, <0.03, <0.03	<0.63, <0.69, <0.42, <0.43
	4	3	6.12	74	0.88, 0.82	<0.03, <0.03	<0.93, <0.87
Boone, IA/5	2	4	6.12	64	0.25, 0.28	<0.03, <0.03	<0.30, <0.33
	3	4	6.01	64	0.94, 0.97, 1.9, 2.1	<0.03, 0.04, <0.03, <0.03	<1.0, 1.0, <1.9, <2.1
	4	3	6.09	74	0.95, 0.88	<0.03, <0.03	<1.0, <0.93
Jersey, IL/5	2	4	6.00	40	0.71, 0.72	0.052, 0.056	0.79, 0.80
	3	4	6.03	40	1.1, 1.4	0.071, 0.083	1.2, 1.5
	4	3	6.04	47	1.6, 1.8	0.035, 0.040	1.6, 1.9
Clinton, IL/5	2	4	6.01	43	0.55, 0.57	0.040, 0.036	0.61, 0.63
	3	4	5.99	43	0.81, 0.83	0.040, 0.053	0.87, 0.90
	4	3	6.03	52	1.2, 0.97	0.043, 0.036	1.2, 1.0
Stark, IL/5	2	4	5.99	50	0.41, 0.35	0.048, 0.040	0.48, 0.41
	3	4	6.01	50	0.42, 0.41	0.046, 0.058	0.49, 0.50
	4	3	5.97	57	0.82, 0.76	<0.03, <0.03	<0.87, <0.81
Hamilton, IN/5	2	4	6.02	59	0.58, 0.47	<0.03, <0.03	<0.63, <0.52
	3	4	6.04	59	1.4, 1.2	0.050, 0.037	1.5, 1.2

Trial Location/ EPA Region	Application Data				Residues (ppm) [b]		
	Treatment Regime [a]	# of Appl.	Total Appl. (lb ae/A/season)	PHI (days)	Glyphosate	AMPA	Combined [c]
	4	3	6.00	70	0.75, 0.89	<0.03, <0.03	<0.80, <0.94
Corn Forage (continued)							
Ingham, MI/5	2	4	5.90	50	0.57, 0.52	<0.03, <0.03	<0.62, <0.57
	3	4	5.96	50	0.23, 0.36	<0.03, <0.03	<0.28, <0.41
	4	3	6.00	60	0.21, 0.18	<0.03, <0.03	<0.26, <0.23
Ottowa, MI/5	2	4	6.01	49	0.61, 1.0	0.045, 0.067	0.68, 1.1
	3	4	6.00	49	1.1, 0.89	0.12, 0.066	1.3, 0.99
	4	3	5.99	59	1.3, 1.3	0.065, 0.061	1.4, 1.4
Wilkin, MN/5	2	4	6.09	54	0.24, 0.29	<0.03, <0.03	<0.29, <0.35
	3	4	6.04	54	0.23, 0.30	<0.03, <0.03	<0.28, <0.35
	4	3	6.03	65	0.39, 0.61	<0.03, <0.03	<0.44, <0.66
Freeborn, MN/5	2	4	5.81	52	0.77, 0.58	0.039, 0.032	0.83, 0.63
	3	4	5.97	45	0.21, 0.21	<0.03, <0.03	<0.26, <0.26
	4	3	5.91	63	1.2, 1.2	0.040, 0.042	1.3, 1.3
Sampson, NC/2	2	4	5.90	39	1.3, 1.7	0.042, 0.059	1.4, 1.8
	3	4	5.88	39	2.1, 1.7	0.062, 0.055	2.2, 1.8
	4	3	5.87	43	2.5, 2.0	0.16, 0.066	2.7, 2.1
York, NE/5	2	4	5.98	54	0.54, 0.50	<0.03, <0.03	<0.59, <0.55
	3	4	5.99	54	0.51, 0.55	<0.03, 0.033	<0.56, 0.60
	4	3	5.96	60	0.93, 0.82	<0.03, <0.03	<0.98, <0.87
Polk, NE/5	2	4	5.97	44	0.48, 0.52	<0.03, <0.03	<0.53, <0.57
	3	4	5.98	44	0.49, 0.51	<0.03, <0.03	<0.54, <0.56
	4	3	5.95	52	0.99, 0.84	0.036, 0.038	1.0, 0.89
Fayette, OH/2	2	4	5.91	54	3.2, 2.5	0.062, 0.045	3.3, 2.6
	3	4	6.02	54	2.4, 2.4	0.051, 0.063	2.5, 2.5
	4	3	6.03	58	4.2, 4.8	0.071, 0.087	4.3, 4.9
Lehigh, PA/1	2	4	6.18	66	4.5, 4.0	0.10, 0.078	4.7, 4.1
	3	4	6.14	66	4.7, 5.6	0.10, 0.12	4.9, 5.8
	4	3	6.16	74	4.3, 6.7	0.091, 0.061	4.4, 6.8
Marshall, SD/5	2	4	5.93	56	<0.04, 0.11	0.036, 0.033	<0.09, 0.16
	3	4	5.93	56	0.17, 0.13	0.037, <0.03	0.23, <0.18
	4	3	5.92	61	0.36, 0.24	0.034, 0.034	0.41, 0.29
Corn Forage (continued)							
Clay, TX/6	2	4	6.10	25	2.7, 2.1	0.18, 0.12	3.0, 2.3

Trial Location/ EPA Region	Application Data				Residues (ppm) [b]		
	Treatment Regime [a]	# of Appl.	Total Appl. (lb ae/A/season)	PHI (days)	Glyphosate	AMPA	Combined [c]
	3	4	6.11	25	2.4, 2.4, 2.0, 3.2, 2.8, 4.1	0.13, 0.041, 0.048, 0.95, <0.03, 0.98	2.6, 2.5, 2.1, 4.6, <2.8, 5.6
	4	3	6.08	33	2.3, 2.8	0.10, 0.15	2.5, 3.0
Dane, WI/5	2	4	6.09	56	0.51, 0.46	0.031, <0.03	0.56, <0.51
	3	4	5.77	56	0.59, 0.72	0.039, 0.035	0.64, 0.77
	4	3	6.05	68	0.76, 0.70	<0.03, <0.03	<0.81, <0.75
Walworth, WI/5	2	4	6.04	54	0.68, 0.63	<0.03, <0.03	<0.73, <0.68
	3	4	6.02	54	0.71, 0.63	0.041, 0.034	0.77, 0.68
	4	3	5.86	62	1.1, 1.2	0.046, 0.040	1.2, 1.3
Corn Grain							
Tift, GA/2	2	4	6.13	68	0.082, 0.090	<0.05, <0.05	<0.16, <0.13
	3	4	6.10	68	0.12, 0.10	<0.05, <0.05	<0.20, <0.18
	4	3	6.15	74	0.28, 0.28	<0.05, <0.05	<0.36, <0.36
Jefferson, IA/5	2	4	5.97	77	0.040, 0.059	<0.05, <0.05	<0.12, <0.14
	3	4	6.12	77	0.056, 0.061	<0.05, <0.05	<0.14, <0.14
	4	3	6.08	85	0.054, 0.044	<0.05, <0.05	<0.13, <0.12
Hamilton, IA/5	2	4	5.97	98	0.077, 0.071	<0.05, <0.05	<0.15, <0.15
	3	4	5.94	98	0.062, 0.073	<0.05, <0.05	<0.14, <0.15
	4	3	6.05	107	0.13, 0.11	<0.05, <0.05	<0.21, <0.19
Guthrie, IA/5	2	4	6.10	96	0.052, 0.065	<0.05, <0.05	<0.13, <0.14
	3	4	6.07	96	0.081, 0.075	<0.05, <0.05	<0.16, <0.15
	4	3	6.12	105	0.14, 0.14	<0.05, <0.05	<0.21, <0.21
Boone, IA/5	2	4	6.12	93	<0.04, <0.04	<0.05, <0.05	<0.12, <0.12
	3	4	6.01	93	0.093, 0.071	<0.05, <0.05	<0.17, <0.15
	4	3	6.09	103	0.042, 0.042	<0.05, <0.05	<0.12, <0.12
Jersey, IL/5	2	4	6.00	77	0.046, <0.04	<0.05, <0.05	<0.12, <0.12
	3	4	6.03	77	0.29, 0.22	<0.05, <0.05	<0.37, <0.30
	4	3	6.04	84	0.20, 0.17	<0.05, <0.05	<0.28, <0.25
Clinton, IL/5	2	4	6.05	84	<0.04, <0.04	<0.05, <0.05	<0.12, <0.12
	3	4	5.99	84	0.11, 0.092	<0.05, <0.05	<0.19, <0.17
	4	3	6.03	93	<0.04, <0.04	<0.05, <0.05	<0.12, <0.12
Corn Grain (continued)							
Stark, IL/5	2	4	5.99	101	<0.04, 0.055	<0.05, <0.05	<0.12, <0.13
	3	4	6.01	101	0.043, 0.042	<0.05, <0.05	<0.12, <0.12

Trial Location/ EPA Region	Application Data				Residues (ppm) [b]		
	Treatment Regime [a]	# of Appl.	Total Appl. (lb ae/A/season)	PHI (days)	Glyphosate	AMPA	Combined [c]
	4	3	5.97	108	0.062, 0.051	<0.05, <0.05	<0.14, <0.13
Hamilton, IN/5	2	4	6.02	91	<0.04, <0.04	<0.05, <0.05	<0.12, <0.12
	3	4	6.04	91	<0.04, <0.04	<0.05, <0.05	<0.12, <0.12
	4	3	6.00	102	0.12, 0.067	<0.05, <0.05	<0.20, <0.14
Ingham, MI/5	2	4	5.90	88	<0.04, 0.043	<0.05, <0.05	<0.12, <0.12
	3	4	5.96	88	<0.04, <0.04	<0.05, <0.05	<0.12, <0.12
	4	3	6.00	98	<0.04, <0.04	<0.05, <0.05	<0.12, <0.12
Ottowa, MI/5	2	4	6.01	94	0.069, 0.077	<0.05, <0.05	<0.15, <0.15
	3	4	6.00	94	0.094, 0.14	<0.05, <0.05	<0.17, <0.22
	4	3	5.99	104	0.15, 0.14	<0.05, <0.05	<0.23, <0.22
Wilkin, MN/5	2	4	6.09	75	0.074, 0.064	<0.05, <0.05	<0.15, <0.14
	3	4	6.04	75	0.067, 0.079	<0.05, <0.05	<0.14, <0.15
	4	3	6.03	86	0.085, 0.058	<0.05, <0.05	<0.16, <0.13
Freeborn, MN/5	2	4	5.81	91	0.20, 0.18	<0.05, <0.05	<0.28, <0.26
	3	4	5.97	85	0.068, 0.062	<0.05, <0.05	<0.15, <0.14
	4	3	5.91	102	0.23, 0.22	<0.05, <0.05	<0.31, <0.30
Sampson, NC/2	2	4	5.90	67	0.24, 0.31	<0.05, <0.05	<0.32, <0.39
	3	4	5.88	67	0.25, 0.25	<0.05, <0.05	<0.33, <0.33
	4	3	5.87	71	0.29, 0.37	<0.05, <0.05	<0.37, <0.45
York, NE/5	2	4	5.98	75	0.053, 0.057, 0.059, 0.050	<0.05, <0.05 <0.05, <0.05	<0.13, <0.13 <0.14, <0.13
	3	4	5.99	75	0.078, 0.065, 0.078, 0.067	<0.05,<0.05, <0.05, <0.05	<0.16, <0.15 <0.16, <0.15
	4	3	5.96	81	0.083, 0.083	<0.05, <0.05	<0.16, <0.16
Polk, NE/5	2	4	5.97	70	<0.04, 0.050, 0.054, 0.047	<0.05, <0.05, <0.05, <0.05	<0.12, <0.13, <0.13, <0.12
	3	4	5.98	70	0.058, 0.049, 0.053, 0.042	<0.05, <0.05, <0.05, <0.05	<0.14, <0.13, <0.13, <0.12
	4	3	5.95	78	0.13, 0.096	<0.05, <0.05	<0.21, <0.17
Fayette, OH/2	2	4	5.91	84	0.19, 0.19	<0.05, <0.05	<0.27, <0.27
	3	4	6.02	84	0.17, 0.21	<0.05, <0.05	<0.25, <0.29
	4	3	6.03	88	0.43, 0.41	<0.05, <0.05	<0.51, <0.49
Corn Grain (continued)							
Lehigh, PA/1	2	4	6.18	102	0.098, 0.068	<0.05, 0.079	<0.18, 0.19
	3	4	6.14	102	0.077, 0.094	0.051, <0.05	0.15, <0.17

Trial Location/ EPA Region	Application Data				Residues (ppm) [b]		
	Treatment Regime [a]	# of Appl.	Total Appl. (lb ae/A/season)	PHI (days)	Glyphosate	AMPA	Combined [c]
	4	3	6.16	110	0.15, 0.081	<0.05, <0.05	<0.23, <0.16
Marshall, SD/5	2	4	5.93	101	0.085, 0.070	<0.05, <0.05	<0.16, <0.15
	3	4	5.93	101	0.10, 0.084	<0.05, <0.05	<0.18, <0.16
	4	3	5.92	106	0.11, 0.10	<0.05, <0.05	<0.19, <0.18
Clay, TX/6	2	4	6.10	46	0.51, 0.47	<0.05, <0.05	<0.59, <0.53
	3	4	6.11	46	0.48, 0.56	<0.05, <0.05	<0.56, <0.64
	4	3	6.08	54	0.96, 0.70	<0.05, <0.05	<1.0, <0.78
Dane, WI/5	2	4	6.09	99	0.077, 0.067	<0.05, <0.05	<0.15, <0.15
	3	4	5.77	99	0.061, 0.065	<0.05, <0.05	<0.14, <0.14
	4	3	6.05	111	0.074, 0.074	<0.05, <0.05	<0.15, <0.15
Walworth, WI/5	2	4	6.04	102	0.098, 0.098	<0.05, <0.05	<0.17, <0.17
	3	4	6.02	102	0.094, 0.082	<0.05, <0.05	<0.17, <0.16
	4	3	5.86	110	0.094, 0.14	<0.05, <0.05	<0.17, <0.22
Corn Stover							
Tift, GA/2	2	4	6.13	68	1.6, 1.6	<0.06, <0.06	<1.7, <1.7
	3	4	6.10	68	2.9, 2.3	<0.06, <0.06	<3.0, <2.4
	4	3	6.15	74	6.5, 4.9	<0.06, <0.06	<6.6, <5.0
Jefferson, IA/5	2	4	5.97	77	0.79, 0.95	<0.06, <0.06	<0.87, <1.0
	3	4	6.12	77	0.82, 0.80	<0.06, <0.06	<0.91, <0.89
	4	3	6.08	85	0.51, 0.36	<0.06, <0.06	<0.60, <0.45
Hamilton, IA/5	2	4	5.97	98	1.4, 1.3	<0.06, <0.06	<1.5, <1.4
	3	4	5.94	98	1.3, 1.5	<0.06, <0.06	<1.4, <1.6
	4	3	6.05	107	2.4, 2.2	<0.06, <0.06	<2.5, <2.3
Guthrie, IA/5	2	4	6.10	96	0.86, 0.93	<0.06, <0.06	<0.95, <1.0
	3	4	6.07	96	1.0, 0.95	<0.06, <0.06	<1.1, <1.0
	4	3	6.12	105	2.0, 2.0	<0.06, <0.06	<2.1, <2.1
Boone, IA/5	2	4	6.12	93	0.49, 0.47	<0.06, <0.06	<0.58, <0.56
	3	4	6.01	93	1.9, 1.8	<0.06, <0.06	<2.0, <1.9
	4	3	6.09	103	0.49, 0.48	<0.06, <0.06	<0.58, <0.57
Jersey, IL/5	2	4	6.00	77	1.1, 1.2	<0.06, <0.06	<1.2, <1.3
	3	4	6.03	77	2.2, 2.3	<0.06, <0.06	<2.3, <2.4
	4	3	6.04	84	2.6, 2.5	<0.06, <0.06	<2.7, <2.6
Corn Stover (continued)							
Clinton, IL/5	2	4	6.01	84	0.91, 0.66	<0.06, <0.06	<1.0, <0.75

Trial Location/ EPA Region	Application Data				Residues (ppm) [b]		
	Treatment Regime [a]	# of Appl.	Total Appl. (lb ae/A/season)	PHI (days)	Glyphosate	AMPA	Combined [c]
	3	4	5.99	84	1.5, 1.5	<0.06, <0.06	<1.6, <1.6
	4	3	6.03	93	1.6, 2.1	<0.06, <0.06	<1.7, <2.2
Stark, IL/5	2	4	5.99	101	0.84, 0.85	<0.06, <0.06	<0.93, <0.94
	3	4	6.01	101	0.83, 0.85	<0.06, <0.06	<0.92, <0.94
	4	3	5.97	108	1.1, 1.2	<0.06, <0.06	<1.2, <1.3
Hamilton, IN/5	2	4	6.02	91	0.29, 0.28	<0.06, <0.06	<0.38, <0.37
	3	4	6.04	91	0.36, 0.40	<0.06, <0.06	<0.45, <0.49
	4	3	6.00	102	1.4, 1.3	<0.06, <0.06	<1.5, <1.4
Ingham, MI/5	2	4	5.90	88	0.85, 0.81	<0.06, <0.06	<0.94, <0.90
	3	4	5.96	88	0.60, 0.55	<0.06, <0.06	<0.69, <0.64
	4	3	6.00	98	0.41, 0.32	<0.06, <0.06	<0.50, <0.41
Ottowa, MI/5	2	4	6.01	94	1.0, 0.86	<0.06, <0.06	<1.1, <0.95
	3	4	6.00	94	1.1, 1.3	<0.06, <0.06	<1.2, <1.4
	4	3	5.99	104	2.0, 2.0	<0.06, <0.06	<2.1, <2.1
Wilkin, MN/5	2	4	6.09	75	0.58, 0.58	<0.06, <0.06	<0.67, <0.67
	3	4	6.04	75	0.63, 0.63	<0.06, <0.06	<0.72, <0.72
	4	3	6.03	86	1.1, 0.90	<0.06, <0.06	<1.2, <0.99
Freeborn, MN/5	2	4	5.81	91	1.7, 1.2	<0.06, <0.06	<1.8, <1.3
	3	4	5.97	85	0.27, 0.23	<0.06, <0.06	<0.36, <0.32
	4	3	5.91	102	3.0, 2.9	<0.06, <0.06	<3.1, <3.0
Sampson, NC/2	2	4	5.90	67	4.8, 3.1	<0.06, <0.06	<4.9, <3.2
	3	4	5.88	67	3.2, 4.8	<0.06, <0.06	<3.3, <4.9
	4	3	5.87	71	5.5, 5.0	<0.06, <0.06	<5.6, <5.1
York, NE/5	2	4	5.98	75	0.89, 0.72	<0.06, <0.06	<0.98, <0.81
	3	4	5.99	75	0.79, 0.78	<0.06, <0.06	<0.88, <0.83
	4	3	5.96	81	1.3, 1.4	<0.06, <0.06	<1.4, <1.5
Polk, NE/5	2	4	5.97	70	0.82, 0.82	<0.06, <0.06	<0.94, <0.94
	3	4	5.98	70	0.84, 0.68	<0.06, <0.06	<0.93, <0.77
	4	3	5.95	78	2.1, 2.0	<0.06, <0.06	<2.2, <2.1
Fayette, OH/2	2	4	5.91	84	3.8, 4.9	<0.06, <0.06	<3.9, <5.0
	3	4	6.02	84	5.0, 5.2	<0.06, <0.06	<5.1, <5.3
	4	3	6.03	88	12.9, 14.8	0.067, 0.11	13.0, 15.0
Corn Stover (continued)							
Lehigh, PA/1	2	4	6.18	102	1.2, 1.0	<0.06, <0.06	<1.3, <1.1

Trial Location/ EPA Region	Application Data				Residues (ppm) [b]		
	Treatment Regime [a]	# of Appl.	Total Appl. (lb ae/A/season)	PHI (days)	Glyphosate	AMPA	Combined [c]
	3	4	6.14	102	1.6, 1.3	<0.06, <0.06	<1.7, <1.4
	4	3	6.16	110	2.1, 2.5	<0.06, <0.06	<2.2, <2.6
Marshall, SD/5	2	4	5.93	101	0.67, 0.61	<0.06, <0.06	<0.76, <0.70
	3	4	5.93	101	1.2, 1.0	<0.06, <0.06	<1.3, <1.1
	4	3	5.92	106	1.4, 1.0	<0.06, <0.06	<1.5, <1.1
Clay, TX/6	2	4	6.10	46	5.1, 5.8	0.063, 0.072	<5.2, 5.9
	3	4	6.11	46	4.5, 4.7	<0.06, <0.06	<4.6, <4.8
	4	3	6.08	54	5.9, 6.0	<0.06, 0.069	<6.0, <6.1
Dane, WI/5	2	4	6.09	99	0.70, 0.81	<0.06, <0.06	<0.79, <0.90
	3	4	5.77	99	1.1, 0.74	<0.06, <0.06	<1.2, <0.83
	4	3	6.05	111	0.89, 1.0	<0.06, <0.06	<0.98, <1.1
Walworth, WI/5	2	4	6.04	102	1.0, 1.0	<0.06, <0.06	<1.1, <1.1
	3	4	6.02	102	1.2, 0.87	<0.06, <0.06	<1.3, <0.96
	4	3	5.86	110	1.1, 1.8	<0.06, <0.06	<1.2, <1.9

[a] The various treatment regimes are described in Table 2 above.

[b] Data are not corrected for concurrent recoveries. The reported LOD/LOQ for corn forage, grain, and stover was 0.04, 0.04, and 0.06 ppm, respectively, for parent glyphosate and 0.03, 0.05, and 0.06 ppm, respectively, for AMPA.

[c] Combined residue are expressed in terms of glyphosate; calculated as glyphosate residues + (AMPA residues x 1.523), where 1.523 is the ratio of molecular weights of glyphosate to AMPA (169.07/111.04).

Table 4 Summary of residues of glyphosate and AMPA in/on corn forage, grain and stover harvested following three or four applications of glyphosate totaling ~6 lb ae/A/season.

Commodity	Treatment [a]	# of Appl.	PHIs (days)	No. of samples	Residues (ppm)		
					Glyphosate	AMPA	Combined [b]
Corn forage	2	4	25-66	44	<0.04-4.5	<0.03-0.18	<0.09-4.7
	3	4	25-66	44	0.13-5.6	<0.03-0.98	<0.18-5.8
	4	3	33-74	44	0.18-6.7	<0.03-0.16	<0.23-6.8
Corn grain	2	4	46-102	44	<0.04-0.51	<0.05	<0.12-<0.59
	3	4	46-102	44	<0.04-0.56	<0.05-0.051	<0.12-<0.64
	4	3	54-111	44	<0.04-0.96	<0.05	<0.12-<1.0
Corn stover	2	4	46-102	44	0.28–5.8	<0.06-0.072	<0.37-<5.9
	3	4	46-102	44	0.23-5.2	<0.06	<0.32-<5.3
	4	3	54-111	44	0.32-14.8	<0.06-0.11	<0.41-15.0

[a] The various treatment regimes are described in Table 2 above.
[b] Combined residue are expressed in terms of glyphosate.

Comparison of residues in different lines of Roundup Ready Corn

Monsanto Company also submitted supplemental data (cited below) from 6 corn field trials conducted during 1998 in IA (3), IL, IN, and KS depicting residues of glyphosate and AMPA in/on forage, grain and stover from 5 different glyphosate-tolerant corn lines.

> 45077402 Bleeke, M; Culkin, J. (1999) Comparison of Glyphosate Residues in Different Roundup Ready® Corn Lines Following Topical Application of Roundup® Ultra Herbicide: Lab Project Number: MSL-16382: 98-63-R-3. Unpublished study prepared by Stewart Agricultural Research Services, Inc. in conjunction with Monsanto Company. 294 p. {860.1500}

At each test site, five different corn lines (GA21, NK522, NK541, NK600 and NK603) were treated with glyphosate. Each of these lines express a modified version of the wild-type EPSPS enzyme and do not contain the gox enzyme or any other enzyme that modifies the metabolic pathway of glyphosate. The IPA salt of glyphosate (4 lb/gal SC/L, equivalent to 3 lb ae/gal) was applied to the corn plots as a combination of a 3.75 lb ae/A preemergence application followed by two a 0.75 lb ae/A postemergence applications at the V4-V6 and V8 stages, for a total of 5.25 lb ae/A/season. Applications were made using ground equipment in 10-20 gallons of water/A, with a nonionic surfactant (0.5% v/v) and ammonium sulfate (17 lb/100 gallons of spray solution) added to all applications.

In each test, one control and duplicate treated samples of corn forage, grain and stover were collected at normal harvest time (PHIs of 51-67 days for corn forage and 69-115 days for corn grain and stover) and placed in frozen storage (<24 F) within 4 hours, except the KS grain which was dried indoors for 52 days at ambient temperature before freezing due to a high moisture content. Samples were shipped frozen by freezer truck to Monsanto Company (St. Louis, MO) within 37 days, and stored frozen (<-10 C) from collection to analysis for a maximum of 223 days for forage, 78 days for grain, and 177 days for stover.

All samples were analyzed using the HPLC/fluorescence detection method described above. The reported LOQ was 0.05 ppm for each analyte in/on corn forage, grain, and stover; no method LOD was reported, but values below 0.05 ppm were reported for both analytes. Apparent residues of glyphosate were <0.05 ppm in/on 5 control samples of forage and in/on 6 control samples each of grain and stover; one control sample of forage had apparent glyphosate residues of 0.068 ppm. Apparent residues of AMPA were <0.05 ppm in/on 5 control forage samples, 4 control samples of grain, and 6 control samples of stover; apparent residues of AMPA were 0.13 ppm in/on one control sample of forage, and 0.19 and 0.79 ppm in/on 2 control samples of gain.

For all five corn lines, residues of glyphosate *per se* were <0.05-2.2 ppm in/on 60 treated forage samples harvested 51-64 days post-treatment (Table 5) and were <0.05-0.24 ppm in/on 60 treated corn grain samples and 0.16-2.7 ppm in/on 60 treated corn stover samples harvested at maturity, 69-115 days post-treatment.

A summary of the residues in Table 6 indicates that residues of glyphosate and AMPA in each RAC were similar for the five different glyphosate-tolerant corn lines.

Conclusions: The side-by-side tests comparing glyphosate residues in the GA21 corn line (used in the extensive residue field trials) to residues in the new NK series corn lines (NK522, NK541, NK600 and NK603) are adequate and indicate that glyphosate residues in corn RACs from the GA21 line are representative of the residues in corn RACs from the newer NK series corn lines, which contain the same gene for conferring glyphosate tolerance.

Table 5. Residues of glyphosate and AMPA in/on corn forage, grain and stover harvested following three applications of glyphosate (3 lb ae/gal SC/L) totaling 5.25 lb ae/A/season.

Trial Location/ EPA Region	Corn Line	PHI (days)	Residues (ppm) [a]		
			Glyphosate	AMPA	Combined [b]
Corn Forage					
Jefferson, IA/5	NK522	64	0.99, 0.95	0.05, *0.03*	1.07, 1.00
	NK541		0.80, 0.89	*0.02, 0.02*	0.83, 0.92
	NK600		0.65, 0.65	*0.02, 0.02*	0.68, 0.68
	NK603		0.47, 0.53	0.06, *0.02*	0.56, 0.56
	GA21		0.53, 0.48	*0.02, 0.01*	0.56, 0.50
Hamilton, IA/5	NK522	63	1.6, 1.5	*0.02, 0.02*	1.6, 1.5
	NK541		1.1, 0.99	*0.01, 0.01*	1.1, 1.0
	NK600		0.61, 0.65	*0.01, 0.01*	0.63, 0.68
	NK603		1.0, 1.1	*0.02, 0.01*	1.0, 1.1
	GA21		0.63, 0.75	*0.02, 0.02*	0.66, 0.78
Greene, IA/5	NK522	64	0.12, 0.14	*<0.01, <0.01*	0.14, 0.16
	NK541		0.22, 0.23	*<0.01, <0.01*	<0.24, <0.25
	NK600		0.43, 0.38	*<0.01, <0.01*	<0.45, <0.40
	NK603		*0.03, 0.02*	*<0.01, <0.01*	<0.05, <0.04
	GA21		0.62, 0.69	*<0.01, <0.01*	<0.64, <0.71
Clinton, IL/5	NK522	52	0.69, 0.71	0.05, 0.05	0.77, 0.79
	NK541		0.72, 0.84	0.05, 0.05	0.80, 0.92
	NK600		1.1, 1.1	0.14, 0.13	1.3, 1.3
	NK603		0.88, 0.91	0.05, 0.08	0.96, 1.0
	GA21		1.1, 1.0	0.13, 0.12	1.3, 1.2
Hamilton, IN/5	NK522	67	0.49, 0.40	*0.01, 0.01*	0.51, 0.42
	NK541		0.21, 0.28	*<0.01, <0.01*	<0.23, <0.30
	NK600		0.34, 0.39	*<0.01, <0.01*	<0.36, <0.41
	NK603		0.21, 0.25	*<0.01, <0.01*	<0.23, <0.27
	GA21		0.14, 0.14	*0.02, <0.01*	0.17, <0.16
Sedgwick, KS/5	NK522	51	1.4, 1.6	0.14, 0.23	1.6, 2.0
	NK541		1.7, 2.2	0.12, 0.14	1.9, 2.4
	NK600		2.2, 1.5	0.11, 0.06	2.4, 1.6
	NK603		1.9, 1.4	0.14, 0.08	2.1, 1.5
	GA21		1.0, 1.1	0.15, 0.07	1.2, 1.2
Corn Grain					
Jefferson, IA/5	NK522	105	0.11, 0.090	*0.02, 0.03*	0.14, 0.13
	NK541		0.10, 0.090	*0.03, 0.04*	0.14, 0.15

Trial Location/ EPA Region	Corn Line	PHI (days)	Residues (ppm) [a]		
			Glyphosate	AMPA	Combined [b]
	NK600		0.080, *0.046*	*0.03, <0.01*	0.13, <0.07
	NK603		*0.044*, 0.054	*<0.01, <0.01*	<0.06, <0.07
	GA21		0.085, 0.064	*0.02, <0.01*	0.12, <0.08
Hamilton, IA/5	NK522	106	0.11, 0.10	*0.04, 0.03*	0.17, 0.15
	NK541		*0.035*, 0.061	*<0.01, 0.02*	0.06, 0.09
	NK600		*0.044*, 0.062	*0.03, 0.03*	0.08, 0.10
	NK603		0.066, 0.080	*0.03, 0.04*	0.11, 0.14
	GA21		0.056, 0.073	*0.03, 0.03*	0.11, 0.12
Greene, IA/5	NK522	115	*0.02, 0.02*	*<0.01, <0.01*	<0.04, <0.04
	NK541		*0.04, 0.03*	*<0.01, <0.01*	<0.06, <0.05
	NK600		0.058, 0.063	*<0.01, <0.01*	<0.08, <0.08
	NK603		0.057, 0.083	*<0.01, <0.01*	<0.08, <0.10
	GA21		0.071, 0.10	*<0.01, <0.01*	<0.09, <0.12
Clinton, IL/5	NK522	95	0.062, 0.095	0.14, 0.14	0.27, 0.30
	NK541		0.066, 0.082	0.096, 0.091	0.22, 0.22
	NK600		0.11, 0.13	0.16, 0.15	0.35, 0.36
	NK603		0.15, 0.12	0.17, 0.13	0.41, 0.32
	GA21		0.13, 0.15	0.24, 0.30	0.49, 0.61
Hamilton, IN/5	NK522	91	0.059, 0.072	*0.02*, 0.09	0.09, 0.21
	NK541		0.053, 0.055	*0.05, 0.02*	0.13, 0.08
	NK600		0.063, 0.067	*0.04, 0.02*	0.12, 0.10
	NK603		0.092, 0.095	*0.03, 0.03*	0.14, 0.14
	GA21		0.089, 0.091	*0.03*, 0.05	0.12, 0.17
Sedgwick, KS/5 [c]	NK522	69	0.14, 0.13	0.94, 1.0	1.6, 1.7
	NK541		0.17, 0.16	0.70, 0.66	1.2, 1.2
	NK600		0.22, 0.23	1.2, 1.2	2.0, 2.0
	NK603		0.24, 0.21	1.0, 0.99	1.7, 1.7
	GA21		0.19, 0.19	0.58, 0.64	1.1, 1.2
Corn Stover					
Jefferson, IA/5	NK522	105	0.86, 0.96	*<0.01, <0.01*	<0.88, <0.98
	NK541		0.92, 0.91	*<0.01, 0.03*	<0.94, 0.96
	NK600		0.66, 0.51	*<0.01, 0.03*	<0.68, 0.56
	NK603		0.45, 0.46	0.05, *<0.01*	0.53, <0.48
	GA21		0.61, 0.47	*<0.01, <0.01*	<0.63, <0.49
Hamilton, IA/5	NK522	106	2.3, 1.6	0.05, *0.03*	2.4, 1.7
	NK541		1.3, 1.5	*0.03, 0.04*	1.4, 1.6
	NK600		1.7, 1.6	*0.04, 0.04*	1.8, 1.7

Trial Location/ EPA Region	Corn Line	PHI (days)	Residues (ppm) [a]		
			Glyphosate	AMPA	Combined [b]
	NK603		1.8, 1.6	*0.04, 0.03*	1.9, 1.7
	GA21		1.4, 1.7	*0.04*, 0.05	1.5, 1.8
Greene, IA/5	NK522	115	0.16, 0.24	0.02, 0.063	0.19, 0.34
	NK541		0.68, 0.64	0.04, 0.04	0.74, 0.70
	NK600		1.5, 1.4	0.05, 0.01	1.6, 1.4
	NK603		1.2, 1.9	0.02, 0.03	1.2, 2.0
	GA21		1.6, 1.3	0.04, 0.06	1.7, 1.4
Clinton, IL/5	NK522	95	0.64, 0.94	0.06, *<0.01*	0.73, <0.96
	NK541		1.1, 1.0	*<0.01, <0.01*	1.1, 1.0
	NK600		1.4, 1.6	*<0.01, <0.01*	1.4, 1.6
	NK603		1.8, 1.1	*0.04, 0.01*	1.9, 1.1
	GA21		1.7, 1.6	*<0.01, <0.01*	1.7, 1.6
Hamilton, IN/5	NK522	91	1.9, 1.5	*0.03, 0.02*	1.9, 1.5
	NK541		0.75, 0.74	*0.01, 0.02*	0.77, 0.77
	NK600		1.1, 1.2	*0.04, 0.02*	1.2, 1.2
	NK603		0.57, 0.53	*0.01, 0.01*	0.60, 0.55
	GA21		0.37, 0.55	*0.01, 0.02*	0.39, 0.58
Sedgwick, KS/5	NK522	69	1.6, 1.9	*<0.01, <0.01*	1.6, 1.9
	NK541		2.3, 2.0	*<0.01, <0.01*	2.3, 2.0
	NK600		2.7, 2.2	*<0.01, <0.01*	2.7, 2.2
	NK603		1.7, 1.9	*0.01, 0.01*	1.7, 1.9
	GA21		1.3, 1.2	*<0.01, <0.01*	1.3, 1.2

[a] Data are not corrected for concurrent recoveries. The LOQ for both analytes was 0.05 ppm; values reported in italics are below the LOQ. No LOD for the method was reported.

[b] Combined residue are expressed in terms of glyphosate; calculated as glyphosate residues + (AMPA residues x 1.523), where 1.523 is the ratio of molecular weights of glyphosate to AMPA (169.07/111.04).

[c] High AMPA values observed in corn grain from the Sedgwick, KS site were probably due to interference or contamination as the control sample from this site also had high residues of AMPA (0.790 ppm).

Table 6. Summary of residues of glyphosate and AMPA in/on corn forage, grain and stover harvested following three applications of glyphosate totaling 5.25 lb ae/A/season.

Commodity	Corn Line	Average residues ± S.D. (ppm) [a]		
		Glyphosate	AMPA	Combined [b]
Corn forage	NK522	0.89 ± 0.58	0.05 ± 0.07	0.96 ± 0.65
	NK541	0.85 ± 0.64	0.04 ± 0.05	0.90 ± 0.71
	NK600	0.83 ± 0.56	0.04 ± 0.06	0.89 ± 0.63
	NK603	0.73 ± 0.61	0.04 ± 0.04	0.79 ± 0.67
	GA21	0.69 ± 0.35	0.05 ± 0.06	0.76 ± 0.43
Corn grain	NK522	0.08 ± 0.04	0.20 ± 0.38	0.39 ± 0.61
	NK541	0.08 ± 0.05	0.14 ± 0.27	0.29 ± 0.49
	NK600	0.10 ± 0.07	0.24 ± 0.47	0.46 ± 0.78
	NK603	0.11 ± 0.06	0.20 ± 0.40	0.42 ± 0.66
	GA21	0.11 ± 0.05	0.16 ± 0.24	0.35 ± 0.41
Corn stover	NK522	1.22 ± 0.68	0.02 ± 0.02	1.25 ± 0.68
	NK541	1.16 ± 0.56	0.02 ± 0.02	1.19 ± 0.55
	NK600	1.46 ± 0.61	0.02 ± 0.02	1.49 ± 0.60
	NK603	1.26 ± 0.60	0.02 ± 0.01	1.29 ± 0.61
	GA21	1.14 ± 0.51	0.02 ± 0.02	1.17 ± 0.53

[a] Data are not corrected for concurrent recoveries.
[b] Combined residues are expressed as in glyphosate equivalents.

OPPTS GLN 860.1480: Residues in Meat, Milk, Poultry and Eggs

The impact of glyphosate residues on livestock diets was recently addressed in conjunction with a petition for increasing use rates on alfalfa (PP#9F05096, DP Barcodes D256740 and D256741, W. Donovan, 6/9/00). In the alfalfa petition, the dietary burden was estimated to be 210 and 220 ppm for dairy and beef cattle, respectively, using alfalfa hay (proposed 400 ppm tolerance) as the roughage component of the diet. No corn commodities were used in the calculated diets. Consequently, increasing the tolerance for field corn forage from 3.0 to 6.0 ppm would be expected to have no impact on the maximum theoretical dietary burden for cattle. In addition, no impact is expected on the dietary burden for poultry or hogs since corn forage is not a feed item for these livestock.

Agency Memoranda Cited

DP Barcodes:	D256740 and D256741
Subject:	PP# 9F05096. Review of Proposal to Increase the Glyphosate Pre-harvest Use Application Rate on Alfalfa Hay and Forage.
From:	W. Donovan
To:	J. Tompkins/V. Walters
Date:	6/9/00
MRID(s):	None

DP Barcodes:	D245594 and D245595
Subject:	PP# 8F04973. Review of Proposal to Increase the Tolerance on Field Corn Forage Based on Residues From a New Strain of Roundup Ready® Corn.
From:	W. Donovan
To:	J. Tompkins/V. Walters
Date:	6/29/00
MRID(s):	44531301