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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

April 17, 1996

MEMORANDUM

SUBJECT: PP# 8F03672, EPA Reg. No. 524-445. Glyphosate (417300; 103601) in or on Sorghum. Petition Amendment Dated August 14, 1994. MRID Nos. 433420-00, 433420-01, 433420-02. D207119, D207121. Case Nos. 002698, 280708. CB Nos. 14303, 14304.

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TO: Robert Taylor, Product Manager
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and
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Background

Monsanto previously submitted this petition requesting tolerances for residues of the herbicide glyphosate (N-(phosphonomethyl)-glycine) in/on sorghum grain, fodder, forage, and milled fractions (excluding grits) at 5, 20, 20 and 25 ppm, respectively. The petition was initially reviewed by CBTS in 1988 (see 11/18/88 memo of S. Willett), and only a revised section F and grain dust data were needed as of the last review of CBTS (see 9/5/90 review of S. Willett). However, it was subsequently learned that the sorghum residue data were generated by Craven Labs, and therefore its validity was suspect. CBRS determined that new data were needed (see 10/21/91 and 4/26/93 memos of M. Metzger). This submission contains the new data, requests an increased use rate and tolerances only for grain sorghum, fodder and grain sorghum aspirated grain fractions of 15, 40, and 100 ppm, respectively. Tolerances for forage are no longer proposed since in the proposed preharvest use the

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pesticide is applied one week prior to harvest, which is after the forage stage of the sorghum.

Tolerances for glyphosate and its major metabolite AMPA (aminomethyl phosphonic acid), are currently established for numerous commodities, processed foods and feeds under 40 CFR § 180.364, 185.3500 and 86.3500, respectively. The Glyphosate Reregistration Eligibility Decision (RED) document was issued in September 1993. In that document, it was concluded that dietary risk resulting from the (then) established tolerances (≥ 85) and registered uses of pesticide products containing the isopropylamine and sodium salts of glyphosate was minimal.

Conclusions Resulting From Review of This Submission

All residue chemistry residue issues have been adequately addressed with the exception of the following:

- The sorghum field trial residue data are acceptable. However, according to the most recent guidance on the conduct of residue field trials issued in 1994, the data are inadequate in quantity and location since the total trials numbered only eight, with the following regional distribution: IV (1), V (4), VI (1), VII (1), and VIII (1). A minimum of 12 field trials in regions II (1), IV (2), V (4), VI (2), VII (1), and VIII (3) are needed in support of a tolerance on sorghum and its related commodities. Since the field trial data were generated in 1992, prior to the issuance of our June 1994 guidance, CBTS would have no objection to the issuance of a conditional registration until the additional field trials are conducted.

- An individual tolerance for "grain sorghum" aspirated grain fractions is not needed since aspirated grain fractions are normally a composite of more than one grain, typically corn, wheat, sorghum and/or soybeans. If a pesticide is used on several crops, such as is the case with glyphosate, then the RAC with the highest residues in dust will be used to establish the aspirated grain fractions tolerance. Since a 200 ppm tolerance is currently pending as a result of use on corn, and has been determined to be acceptable at least on an interim basis (see 3/16/96 memo of W. Cutchin, PP No. 8F3673), the petitioner should submit a revised Section F deleting the proposed 100 ppm tolerance for sorghum grain aspirated grain fractions.

- Glyphosate residues are expected to be nondetectable in milk, meat, fat and eggs at animal exposure levels of up to 400 ppm (see 3/16/96 memo of W. Cutchin, PP No. 8F3673), and therefore the proposed use on sorghum does not cause concern for the possibility of unacceptable secondary residue levels in these commodities (animal dietary burden ≤ 66 ppm). The

presently established 0.5 ppm glyphosate tolerance for kidney and liver is based on an animal exposure level of up to 40 ppm (see also 3/16/96 memo of W. Cutchin). Although the liver tolerance does not need to be increased for the proposed uses on corn and alfalfa, the kidney tolerance does need to be raised (see W. Cutchin memo, PP No. 8F3673). Glyphosate tolerances for kidney of cattle, goats, hogs, horses, poultry, and sheep are in the process of being raised to 4 ppm as a result of a preharvest use of glyphosate on alfalfa where exposure could be up to 157 ppm (PP No. 4F4312, M. Rodriguez, 1/11/95). The establishment of these higher tolerances for kidney will be necessary before CBTS can recommend for the establishment of the proposed tolerance on grain sorghum.

Recommendations

Upon submission of a revised Section F deleting the proposed tolerance for grain sorghum aspirated grain fractions, and the establishment of the revised tolerance for animal kidney as required in support of pending uses on alfalfa, CBTS could recommend for the establishment of the proposed tolerances on grain sorghum at 15 ppm and sorghum fodder at 40 ppm in connection with a time limited/conditional registration for Roundup herbicide. Additional field trial data as specified in the conclusions section above are needed prior to a full registration.

NOTE TO RCAB: A DRES run can be initiated using 15 ppm as the tolerance for sorghum grain and a 4 ppm tolerance for the kidney of cattle, goats, hogs, horses and sheep.

Detailed Considerations

Since the petition has been pending for over eight years, and the regulatory status and internal policies have changed since the initial filing of the petition, a brief reassessment of all residue chemistry data requirements is appropriate.

Proposed Use

For control of several annual and perennial weeds, ROUNDUPR herbicide (isopropylamine sodium salt; EPA Reg. No. 524-445; 4 lb ai/gallon EUP; 3 lb acid equivalents/gallon EUP) is to be applied at least 7 days prior to harvest of grain sorghum (milo). The maximum application rate is 2 quarts Roundup/acre (2 lb ai/acre; 1.5 lb ae/acre).

This proposed use differs from the initial proposed use. The previously proposed use specified an application rate of 1 quart

of end use product per acre, which was ROUNDUP [EPA Reg No. 524-308AA] containing 3 lb ai/gal. The application rate was therefore 0.75 lb ai/A, to be applied at least 7 days prior to harvest.

Plant and Animal Metabolism

The HED Metabolism Committee has decided that only glyphosate parent is to be regulated in plant and animal commodities, and that AMPA is not of toxicological concern regardless of its level in food (Memo, R. Perfetti 3/17/94).

Analytical Methodology

Adequate enforcement methods are available for analysis of residues of glyphosate in or on plant commodities. These methods include GLC (PAM II; the limit of detection is 0.05 ppm), and HPLC with fluorometric detection. Use of the GLC method is being discouraged due to lengthiness of the procedure. The HPLC method has undergone successful Agency validation and was recommended for inclusion in PAM II; the limit of detection is 0.0005 ppm. A GC/MS method for glyphosate in crops has also been validated by ACL (Memo, G. Kramer 3/21/95). This method has not yet been submitted for publication in PAM-II.

Residue Data
(MRID No. 433420-01)

RoundupR herbicide (41% ai) was applied using ground equipment as a single preharvest treatment at eight locations in Arkansas (1), Kansas (2), Missouri (1), Nebraska (1) Oklahoma (1), South Dakota (1), and Texas (1) in 1992. The application rates were 0.74 (Texas only) to 0.75 (0.5X) lb ai acid equivalents/acre, and 1.48 (Texas only) to 1.50 (1X) lb ae/acre, and the spray volume ranged from 10 to 20 gal/acre. Six to eight days after application of glyphosate, grain and fodder samples were harvested from control, 0.5 X, and 1X plots, and stored frozen until analyzed. The remaining milo stalk and foliage was allowed to field dry to produce milo hay that was then harvested and frozen for analysis. Hay samples were collected 10 to 15 days after the application of glyphosate. All samples were analyzed within 14 months. Storage stability data have been reviewed which shows that glyphosate is stable in a variety of crop matrices for up to 36 months of frozen storage at -18 C (Memo, C. Eiden 11/17/94).

Control and 1X samples were subsequently analyzed to determine residues of glyphosate using an HPLC/fluorescence detection method, which is the preferred method (see also 2/96 memo of G. Kramer). Briefly, the method involves extraction of glyphosate and AMPA with dilute hydrochloric acid (HCl). The extract solution was eluted through a ChelexR 100 (Fe III) resin, and the

retained glyphosate and AMPA iron salts are subsequently eluted with 6N HCl. The isolated glyphosate and AMPA iron salts are then applied to a strong anion exchange resin and eluted with 6N HCl to remove the iron and obtain free acids of glyphosate and AMPA. After concentration to dryness (to remove HCl) the samples are redissolved in a specified volume of water, and analyzed by HPLC using o-phthalaldehyde post column derivation.

To validate the method, control grain samples were fortified with glyphosate at levels ranging from 0.05 to 3.0 ppm and analyzed concurrently with field samples using the methodology described above. Glyphosate recoveries ranged from 68 to 104% (avg 87%). When fodder check samples were fortified over a range of 0.05 to 20 ppm with glyphosate, recoveries ranged from 75 to 101% (avg 84%) for glyphosate. When hay samples were fortified with glyphosate over a range of 0.05 to 10.0 ppm, glyphosate recoveries ranged from 58 to 102% (avg. 84%). Additionally, recoveries from laboratory fortified samples spiked with glyphosate over a range of 0.05 to 3.0 ppm were analyzed concurrently with field treated samples. Average recoveries grain, fodder, and hay were acceptable ($\geq$70%).

Table 1 summarizes the results of the analyses of sorghum grain, fodder, and hay. Results reported here are the averages of the analyses of duplicate samples (see pages 16 to 18 of report).

TABLE 1: MEAN RESIDUE LEVELS OF GLYPHOSATE FOUND IN SORGHUM (MILO) GRAIN, FODDER, AND HAY FOLLOWING PREHARVEST APPLICATION OF ROUNDUP HERBICIDE

LOCATION	PHI GRAIN, FODDER, HAY	PPM GLYPHOSATE GRAIN	PPM GLYPHOSATE FODDER	PPM GLYPHOSATE HAY
ARKANSAS	8, 8, 12	1.7	15.8	17.5
KANSAS-SITE A	6, 6, 11	5.3	33.1	14.7
KANSAS-SITE B	8, 8, 11	12.5	29.3	37.0
MISSOURI	7, 7, 15	6.0	27.9	15.4
NEBRASKA	8, 8, 12	1.8	7.0	4.3
OKLAHOMA	7, 7, 14	6.3	29.5	36.1
SOUTH DAKOTA	7, 7, 10	13.5	2.9	6.4
TEXAS	8, 8, 11	1.4	8.2	3.1

Supporting data (e.g. protocols, storage and handling, chromatograms) were contained in the report. Based on these data, the registrant is proposing a 15 ppm tolerance for sorghum grain, and a 40 ppm tolerance for fodder. Tolerances for forage are no longer proposed since in the proposed preharvest use the

pesticide is applied one week prior to harvest, which is after the forage stage of the sorghum (cf. pending use on corn, PP No. 8F3673). Sorghum hay is not considered to be a raw agricultural commodity.

CBTS concludes that the reported data are acceptable. However, according the most recent guidance on the conduct of residue field trials issued in 1994, the data are inadequate in quantity and location since the total trials numbered only eight, with the following regional distribution: IV (1), V (4), VI (1), VII (1), and VIII (1). A minimum of 12 field trials in regions II (1), IV (2), V (4), VI (2), VII (1), and VIII (3) are needed in support of a tolerance on sorghum and its related commodities. Since the field trial data were generated in 1992, prior to the issuance of our June 1994 guidance, CBTS would have no objection to the issuance of a conditional registration until the additional field trials are conducted.

It is noted that glyphosate tolerances for corn and its related commodities are pending, and tolerances for wheat and its related commodities have already been established. Since sorghum, corn and wheat are all commodities in the cereal grain crop group, and the registered and pending uses all involve a similar preharvest use with application rates of 1 to 3 quarts of various formulations of Roundup, it may be appropriate to pursue a cereal grains crop group tolerance.

Processing Study Data
(MRID No. 433420-22)

Sorghum from test sites in Kansas (A) and Texas (see table 1 above) was processed using simulated industrial practices for dry and wet milling of sorghum. Samples of clean grain, grain dust, bran, grits and flour were analyzed using methodology described above after being stored frozen for 626 days (approximately 21 months) or less. Storage stability data have been reviewed which show that glyphosate is stable in a variety of crop matrices for up to 36 months of frozen storage at -18 C (Memo, C. Eiden 11/17/94).

Average glyphosate residues in grain from the Kansas site were determined to be 4.47 ppm prior to processing, and average glyphosate residues in grain from the Texas site were determined to be 1.08 ppm prior to processing. The average residue levels of glyphosate found in milo bran were 17.8 ppm at the Kansas location, and 6.38 ppm at the Texas location. Therefore, the resulting concentration factors for glyphosate in milo bran were 3.99 and 5.92 for the Kansas and Texas locations, respectively. The average residue levels in glyphosate in milo grain dust were 28.2 ppm at the Kansas location and 3.8 ppm at the Texas location. Therefore the resulting concentration factors for grain dust were 6.31 and 3.52 for the Kansas and Texas locations,

respectively. Glyphosate residues did not concentrate in milo clean grain, flour, germ, starch or grits. Supporting data (e.g. protocols, storage and handling, chromatograms) were contained in the report.Based on these data, the registrant is proposing a 100 ppm feed additive tolerance for grain sorghum aspirated grain fractions. Since no other food and feed items are now associated with grain sorghum, the previously proposed FAT of 25 ppm for sorghum milling fractions is no longer needed and has been deleted from the Section F by the registrant (see Table II 1995).

CBTS concludes that the sorghum processing study is acceptable. Based on an average concentration factor of 5X observed from the processing of incurred residue samples from the Kansas and Texas field trials, and considering the highest residue field trial (HAFT) residue value of 13.5 ppm (see table 1 above), a 100 ppm tolerance for glyphosate in aspirated grain fractions resulting from the proposed use on sorghum would be adequate. However, the petitioner is advised that an individual tolerance for "grain sorghum" aspirated grain fractions is not needed since aspirated grain fractions are normally a composite of more than one grain, typically corn, wheat, sorghum and/or soybeans. If a pesticide is used on several crops, such as is the case with glyphosate, then the RAC with the highest residues in dust will be used to establish the aspirated grain fractions tolerance. Since a 200 ppm tolerance is currently pending as a result of use on corn, and has been determined to be acceptable at least on an interim basis (see 3/16/96 memo of W. Cutchin, PP No. 8F3673), the petitioner should submit a revised Section F deleting the proposed 100 ppm tolerance for sorghum grain aspirated grain fractions.

Secondary Residues in Meat, Milk, Poultry and Eggs

Sorghum grain, fodder and aspirated grain fractions may comprise up to 40%, 25% and 20%, respectively, of the cattle diet. Assuming a worst case diet [55% grain (40% sorghum grain and 15% corn grain), 25% sorghum fodder and 20% aspirated grain fractions] for beef cattle, the maximum exposure to cattle is estimated to be 66 ppm. This is assuming that tolerance levels of 15 ppm and 40 ppm are present in grain and fodder, respectively, and incorporates the pending glyphosate tolerances of 1 ppm and 200 ppm, respectively, on field corn grain and aspirated grain fractions. Sorghum grain may comprise up to 80% of the diet of poultry (dietary burden = 14 ppm), and up to 90% of the diet of swine (dietary burden = 16 ppm).
Glyphosate residues are expected to be nondetectable in milk, meat, fat and eggs at exposure levels of up to 400 ppm (see 3/16/96 memo of W. Cutchin, PP No. 8F3673), and therefore the proposed use on sorghum does not cause concern for the possibility of unacceptable secondary residue levels in these commodities. The presently established 0.5 ppm glyphosate tolerance for kidney and liver is based on an animal exposure

level of up to 40 ppm (see also 3/16/96 memo of W. Cutchin). Glyphosate tolerances for kidney of cattle, goats, hogs, horses, poultry, and sheep are in the process of being raised to 4 ppm as a result of a preharvest use of glyphosate on alfalfa where exposure could be up to 157 ppm (PP No. 4F4312, M. Rodriguez, 1/11/95). Although the liver tolerance does not need to be increased for the proposed uses on corn and alfalfa, the kidney tolerance does need to be raised (see 4/9/96 memo of W. Cutchin, PP No. 8F3673).The establishment of these higher tolerances for kidney will be necessary before CBTS can recommend for the establishment of the proposed tolerance on grain sorghum.

cc: RF, Circ, S. Willett, E. Haeberer, PP No. 8F3672
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