UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE: April 5, 1979

SUBJECT: PP# 8F2098: Metolachlor in Sorghum. Evaluation of residue data and analytical method*

FROM: Alfred Smith, Chemist, RCB, HED (TS-769)

TO: R. Mountfort (PM# 23), FHB, RD (TS-767) and TOX, HED (TS-769)

THRU: Acting Chief, RCB

The CIBA-GEIGY Corporation proposes tolerances for combined residues of the herbicide metolachlor, (2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide), and its metabolites (2-(2-ethyl-6-methylphenyl) amino)-1-propanol and 4-(2-ethyl-6-methylphenyl)-2-hydroxy-5-methyl-3-morpholinone, (each expressed as parent metolachlor), in or on sorghum grain at 0.3 ppm and sorghum forage and fodder at 1.5 ppm.

Permanent tolerances are established for metolachlor in soybeans and field corn grain (§180.368) at 0.1 ppm, and eggs, milk, and meat of livestock at 0.02 ppm.

Temporary tolerances are established for soybean hay and forage at 1.25 ppm (PP# 6G1708).

Permanent tolerances are pending for corn forage and fodder at 1.25 ppm; fresh corn, including sweet corn (kernels plus cobs, husks removed) and popcorn grain at 0.1 ppm; and soybean forage and fodder at 2.0 ppm (PP# 8F2081).

Conclusions

1. The nature of the residue is adequately delineated.

2. Adequate analytical methods are available for enforcement.

3a. Residues of metolachlor in or on sorghum grain and its milling fractions (bran, flour, shorts) are not likely to exceed the proposed tolerance. Additionally, residues of atrazine or terbutryn are not likely to exceed the established tolerances for sorghum grain and fodder and forage due to the tank-mix uses.

3b. A tolerance of 2.0 ppm for sorghum forage and fodder would be more appropriate.

4. Residues could occur in eggs, milk, meat, fat, and meat byproducts of

* This petition should be read in conjunction with PP# 8F2081.

livestock (§180.6(a)(2)). However, the established eggs, milk, and meat tolerances (§180.368) are sufficient to cover such residues.

Recommendation

Toxicological considerations permitting, we could recommend for the proposed tolerance if a level of 2.0 ppm is proposed for sorghum forage and fodder.

Detailed Considerations

Proposed Use

Metolachlor, formulated as Dual 8E, an emulsifiable concentrate containing 8 lb act/gal., is proposed for use as a preplant incorporated or preemergence surface-applied treatment for the control of weeds and grasses. Dual 8E may be tank-mixed with atrazine or terbutryn for treatments as above. Bicep 4.5L is a liquid solution containing 2.5 lb metolachlor + 2.0 lb atrazine per gallon. It is also proposed for use on sorghum as above.

Apply metolachlor alone at broadcast rates of 1.5-2.5 lb act/A depending upon the soil type.

Tank-mix: apply 1.5-2.0 lb metolachlor + 1.2-1.6 lb atrazine/A or 1.25-2.0 lb metolachlor/A + 1.2-2.0 lb terbutryn/A depending upon the soil type.

The subject of the sorghum seed treatment use with CGA-43089, (α-cyano-methoximino)-benzacetonitrile), has been considered in the letter of 8/1/77 (P. Chichilo). Therefore, no further comment is considered necessary.

The formulations' inert ingredients are cleared for use under §180.1001.

The manufacturing process and the composition of technical metolachlor is given on the following pages. The impurities are not likely to produce a residue problem.

We have previously considered the question of the possible presence of nitrosoamines (PP# 7F1913). We have indicated that nitrosoamine formation is unlikely.

Atrazine is registered for preplant or preemergence use on sorghum at 4.0 lb act/A. A post-emergence directed spray is permitted at 3 weeks after crop emerges. No grazing of treated areas or feeding of treated forage is permitted for 21 days after treatment.

Atrazine has tolerances established at 0.25 ppm on sorghum grain and 15 ppm on forage and fodder.

Terbutryn is registered for preemergence use on sorghum at a rate of 2.4 lb act/A. No grazing or feeding of forage from treated areas is permitted. Terbutryn has an established tolerance of 0.1 ppm on sorghum grain.

Nature of the Residue

We have considered the metabolism of metolachlor in plants and animals in previous reviews (PP#s 7F1913, 6G1708, 6F1606, 5G1553). Plants (corn, soybeans) absorb, translocate, and metabolize metolachlor. The primary path of plant metabolism involves hydrolysis and conjugation with plant constituents.

Metolachlor is ingested, metabolized, and rapidly eliminated by animals (rats, goats, cattle, chickens) with some deposition of residues in tissues. While the conjugating natural components in animals differ from those in plants, the metabolic components are similar.

The nature of the residue in plants and animals is similar. The significant components of the residue consist of the parent compound and its metabolites: 2-(2-ethyl-6-methylphenyl)amino)-1-propanol; and, 4-(2-ethyl-6-methylphenyl)-2-hydroxy-5-methyl-3-morpholinone). The analytical method determines these components and their conjugates.

The nature of the residue is adequately delineated.

Analytical Methods

Metolachlor: a sample is refluxed overnight with dilute hydrochloric acid. (This procedure converts metolachlor, its metabolites, and conjugates to CGA-37913 and CGA-49751.) The extract is made basic, and the CGA-37913 is extracted into hexane. This extract is cleaned up on an alumina column and concentrated. The CGA-37913 in the concentrate is determined by gas-liquid chromatography (GLC) using an electrolytic conductivity detector which is sensitive to nitrogen. The results are expressed as ppm metolachlor (method AG-265).

For CGA-49751, the initial sample hydrolysis with dilute hydrochloric acid is as above. The acid extract is partitioned with dichloromethane which separates CGA-49751 and CGA-37913. The dichloromethane phase containing CGA-49751 is washed with a dilute sodium carbonate solution, converted to the chloroethanol derivative by reaction with boron trichloride/2-chloroethanol. The derivative is extracted into hexane, and an aliquot of the extract is cleaned up on a silica gel column followed by an alumina column. The eluate is concentrated, and the CGA-49751 is determined as above. The results are expressed as ppm metolachlor (method AG-286).

Untreated (control) samples of sorghum grain, forage, and fodder had no detectable metolachlor equivalent residues (<0.05 ppm). Control samples, fortified at levels of 0.02-0.20 ppm, had recoveries of 52-132%.

The Method AG-286 has been successfully tested with metolachlor and its metabolites on corn grain and meat. We believe the results of the trials can be extended to include sorghum grain and forage and fodder.

Adequate analytical methods are available for enforcement purposes.

Atrazine and its metabolites are extracted by blending with chloroform (green forage) or refluxing with an acetonitrile-water mixture (dry forage). The dry crop, extract is cleaned up by partitioning residues into dichloromethane (Method AG-295). The chloroform or dichloromethane extract is cleaned up by partitioning between acetonitrile and hexane. The acetonitrile extract is cleaned up on an aluminum oxide column. Atrazine, G-30033, and G-28279 are eluted with ethyl ether in carbon tetrachloride, evaporated to dryness, and determined by GLC.

A third atrazine metabolite, G-28273 is determined by Method AG-281. A sample is blended with a methanol/water mixture. The extract is evaporated to dryness, cleaned up by liquid-liquid partition chromatography using a pH 7 buffer as the stationary phase. G-28273 is eluted with ethyl ether and determined by GLC as above.

Terbutryn and its metabolites GS-11355 and GS-26575 are assayed by Method AG-295 as with atrazine. A third metabolite of terbutryn, GS-26831, is assayed with Method AG-281 as with the third atrazine metabolite.

The method for atrazine and terbutryn is similar to the methods tested successfully by FDA on corn, potatoes, and milk (see PP# 7F0534). The method is adequate for residue determinations on sorghum grain and forage.

Residue Data

Samples of sorghum grain, silage stage forage, and harvest fodder and forage were obtained from plots in California, Kansas, Mississippi, Nebraska, Oklahoma, South Dakota, and Texas. The soils had been treated as proposed with metolachlor alone at 1X and 2X the proposed rates and tank-mix rates as proposed.

Metolachlor alone - sorghum grain had <0.05-0.23 ppm metolachlor residues at intervals of 85-169 days after treatment (PHI) due to the proposed rate. Residues in grain due to the 2X rate were <0.05-0.42 ppm at PHIs of 124-145 days.

Sorghum forage and fodder had <0.05-0.99 ppm metolachlor residues due to the proposed rate at PHIs of 55-145 days. (Two aberrant values of 1.85 ppm and 3.19 ppm were also present at a PHI of 145 days.)

Sorghum grain containing a maximum of 0.14 ppm metolachlor residues were processed to bran, flour, and shorts. No concentration of residues is noted in the milling fractions. The bran had <0.08 ppm and the flour and shorts each had no detectable residues (<0.05 ppm). We conclude that residues in sorghum grain milling fractions would be adequately covered by the proposed grain tolerance.

Metolachlor + Atrazine

Soils were treated with tank mixtures of metolachlor + atrazine as proposed and at the maximum proposed rates. Sorghum grain had atrazine residues of <0.1 ppm and metolachlor residues of <0.05 ppm at PHIs of 85-141 days. Sorghum forage and fodder had residues of <0.10-0.17 ppm atrazine plus <0.10-0.25 ppm metolachlor at PHIs of 55-141 days.

The level of metolachlor residues is not increased due to the tank-mix use.

Metolachlor + Terbutryn

Soils were treated with tank-mixtures of metolachlor + terbutryn as proposed and at maximum proposed rates. Sorghum grain had metolachlor residues of <0.05-<0.16 ppm and no detectable terbutryn residues (<0.1 ppm) at PHIs of 116-147 days. Sorghum forage and fodder had metolachlor residues of 0.26-1.07 ppm and no detectable terbutryn residues (<0.1 ppm) at PHIs of 77-147 days.

The level of metolachlor residues is not increased due to the tank-mix use.

We conclude that residues of metolachlor in or on sorghum grain are not likely to exceed the proposed tolerances due to the proposed uses. For sorghum forage and fodder, a level of 2.0 ppm would be more appropriate. The petitioner should be so informed.

Residues of atrazine or terbutryn are not likely to exceed the established tolerances for sorghum grain and fodder and forage.

Meat and Milk

Sorghum grain, sorghum forage and fodder are livestock feed items. The sorghum forage and fodder (1.50 ppm proposed tolerance) is the feed item likely to contribute the major portion of residues to the diet of cattle, goats, and sheep. The sorghum grain is the feed item likely to contribute the major portion of residues to the diet of hogs and poultry.

A permanent tolerance of 0.1 ppm has been established for metolachlor in field corn grain (§180.368). Temporary tolerances are established for soybeans at 0.1 ppm; soybean hay and forage at 1.25 ppm; and, eggs, milk, meat, fat, and meat byproducts of cattle, hogs, horses, poultry, and sheep at 0.02 ppm (PP#6G1708). Permanent tolerances are established for soybeans at 0.1 ppm and eggs, milk, meat, fat, and meat byproducts of livestock at 0.02 ppm (PP# 7F1913).

The proposed and established tolerance levels for metolachlor in eggs, milk, and meat are supported by cattle, goat, and chicken feeding studies (see PP# 7F1913). These studies are sufficient to conclude that metolachlor residues are likely to occur in eggs, milk, and meat of livestock due to the proposed sorghum tolerances in this petition - PP# 8F2098 (§180.6(a)(2)). Moreover, the proposed eggs, milk, and meat tolerances are sufficient to cover residues due to the established and proposed tolerances.

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