(2/8/95)

MEMORANDUM:

SUBJECT: **4F4340**. Clethodim in/on Sugar Beets and Onions (Dry Bulb). Evaluation of Residue Data and Analytical Methodology. CBTS#'s 13703, 13704, and 13705. DP Barcode D203378. MRID#'s 431664-00, 431664-02, 431664-03, 431664-04, 431664-05, 431664-06, and 431664-07.

FROM: José J. Morales, Chemist
Tolerance Petition Section II
Chemistry Branch I -- Tolerance Support
Health Effects Division (7509C)

THROUGH: Edward Zager, Acting Chief
Chemistry Branch I -- Tolerance Support
Health Effects Division (7509C)

TO: Joanne I. Miller/Dan Kenny, PM 23
Fungicide-Herbicide Branch
Registration Division (7505C)

Valent U.S.A. is requesting the establishment of tolerances for the combined residues of the herbicide clethodim [(E)-(±)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] and its metabolites containing the cyclohexen-1-one moiety (calculated as clethodim) in/on sugar beet roots at 0.20 ppm; sugar beet tops at 0.50 ppm; and onions (dry bulb) at 0.50 ppm.

Interim tolerances that expired on 1/31/94 were established for the combined residues of the herbicide clethodim and its metabolites containing the 2-cyclohexen-1-one moiety under 40 CFR §180.458 for the fat, meat, and mbyp of cattle, goats, hogs, horses, poultry, and sheep at 0.20 ppm; milk at 0.05 ppm; eggs at 0.20 ppm; cottonseed at 1.0 ppm; and soybeans at 10.0 ppm.

Interim tolerances that expired on 1/31/94 were established for the combined residues of the herbicide clethodim and its metabolites containing the 2-cyclohexen-1-one moiety under 40 CFR §186.1075 for cottonseed meal at 2.0 ppm; and soybean soapstock at 15.0 ppm.

These interim tolerances have been changed to permanent tolerances as of 2/2/94 [telephone conversation between J. Morales (CBTS) and D. Kenny (RD) on 12/16/94].

CONCLUSIONS

CLETHODI_DOC

1. The manufacturing process of technical grade clethodim has been adequately described. We do not foresee any residue problems from impurities in the technical.

2. CBTS concludes that the registrant has proposed an adequate set of directions for use of Select® 2 EC and Select® on onions, shallots and sugar beets.

3a. CBTS concludes that the nature of the residue in plants is adequately understood for the purposes of the subject petition. Studies have been conducted in a root crop (carrots) and two oilseeds (soybean and cotton). The residue of concern is clethodim and its metabolites containing the 2-cyclohexen-1-one moiety. However, the petitioner should be reminded that for future petitions on crops other than root crops, legumes, or oil seeds additional metabolism data should be provided on a crop such as a leafy vegetable, or fruit crop. Until there are plant metabolism data for clethodim on at least 3 widely different representative commodities; e.g., tree nut, leafy vegetable, small grain, legume, root/tuber crop, oil seed, etc., which reflect a similar metabolism profile, CBTS can not conclude that the nature of the residue is understood in all plants.

3b. CBTS concludes that the nature of the residue in ruminants and poultry is adequately understood for the purposes of the subject petition. The residue of concern is clethodim and its metabolites containing the 2-cyclohexen-1-one moiety.

3c. To be consistent with Codex we recommend that the tolerance expression for clethodim be revised to state the full chemical names of the metabolites. See Conclusions 9 and 10 for the exact wording.

4a. Analytical methods are available for enforcement. Method EPA-RM-26D-2, "Confirmatory Method for the Determination of Clethodim and Clethodim Metabolites in Crops, Animal Tissues, and Milk and Eggs", which distinguishes clethodim residues from residues of the structurally similar herbicide Poast®, and method RM-26B-2 ,"Analytical Method for the Determination of Clethodim Residues", the common moiety method, have undergone successful EPA Method Validation.

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4b. CBTS concludes that adequate validation data have been submitted for clethodim and its metabolites in onions and sugar beet root using the compound specific method EPA-RM-26D-2. An adequate amount of chromatographic data and raw data have been submitted by the petitioner to demonstrate that this method will separate clethodim from sethoxydim in sugar beets and onions.

However, the petitioner should explain the high clethodim equivalents in the blank control samples for sugar beet tops. Also, an explanation should be submitted for the abnormally high recovery values for 5-OH clethodim sulfone in sugar beet tops. Alternatively, the petitioner may submit more validation data for clethodim and its metabolites in sugar beet tops in order to support the subject tolerance petition.

5. Adequate recoveries of clethodim, clethodim sulfoxide, and 5-OH clethodim sulfone have been obtained under FDA's multiresidue protocols (PP#9F3743, M. Nelson's memo of 3/12/90). Included in this petition are the following reports:

> "Testing of RE-45601, RE-45924, and RE-51228 through FDA Multi-Residue Protocols A through E", 8/6/91, J. Fomenko, MRID# 431664-06.
>
> "Testing of RE-45601, RE-45924, and RE-51228 through FDA Multi-Residue Protocol D", 2/5/92, J. Fomenko, MRID# 431664-07.

These reports are being forwarded to FDA for review.

6. CBTS concludes that geographic representation of residue data is adequate for the proposed use on onions and sugar beets.

7a. CBTS concludes that total clethodim residues are stable in onion macerates stored frozen (-20°C) for up to 12 months.

7b. CBTS concludes that total clethodim residues are stable in sugar beet root macerates stored frozen (-20°C) for up to 12 months and 9 months for tops.

8. CBTS concludes that based on the residue data for onions and garlic, the proposed tolerance of 0.50 ppm for clethodim residues in/on onions is inappropriate.

Refer to the Residue Data section of this review for detailed discussion. A tolerance proposal of 0.20 ppm for clethodim residues in/on onions seems more appropriate. The petitioner needs to submit a revised Section F (see Conclusion 9 for exact wording) proposing a tolerance for residues of clethodim and its metabolites in/on onions (dry bulb) at 0.20 ppm in support of the subject tolerance petition. Also, the petitioner should submit an explanation for the variability in the detection limit for the 1989 analyses.

9. The field trials showed that the maximum clethodim residue found in sugar beet root is 0.07 ppm. Based on these field trials a tolerance proposal of 0.10 ppm for clethodim residues in/on sugar beet root would be appropriate. However, to harmonize with the Codex MRL of 0.20 ppm, CBTS recommends for the petitioner's proposed tolerance of 0.20 ppm. For chronic risk assessment purposes, a value of 0.10 ppm can be used. Based on the submitted residue data for sugar beet tops, CBTS concludes that the proposed tolerance of 0.50 ppm for clethodim residues in/on sugar beet tops seems adequate. However, to further harmonize with Codex, the petitioner should submit a revised Section F proposing the subject tolerances as the following:

"Pursuant to Section 408(d)(1) of the Federal Food, Drug, and Cosmetic Act, Valent U.S.A. Corporation proposes to amend 40 CFR part 180 by establishing a tolerance for residues of **clethodim [(E)-(±)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] and its metabolites containing the 5-(2-ethylthiopropyl)cyclohexene-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexene-3-one moieties and their sulphoxides and sulphones, expressed as clethodim**, in or on the following raw agricultural commodities at the indicated levels:

Sugar Beet Roots	0.20 ppm
Sugar Beet Tops	0.50 ppm
Onions (Dry Bulb)	0.20 ppm"

Also, the petitioner should submit an explanation for the variability in the detection limit within the sugar beet samples for the 1989 and 1990 analyses.

10. Although the petitioner stated that no concentration factor could be calculated because no residues were detected in the unprocessed sugar beets, CBTS believes one can be estimated. We estimate that clethodim residues could be found in unprocessed sugar beets in a range from <0.01 ppm to 0.03 ppm (the minimum detection limit for the analytical method). Therefore, dividing the molasses residue level by the average of this range (i.e., 0.02 ppm) gives a concentration factor of about 10X. Applying this concentration factor to the proposed tolerance of 0.20 ppm for sugar beet root results in 2.0 ppm. The petitioner needs to submit a revised Section F proposing the subject tolerances as the following:

"Pursuant to Section 408(d)(1) of the Federal Food, Drug, and Cosmetic Act, Valent U.S.A. Corporation proposes to amend 40 CFR part 186 by establishing a tolerance for residues of **clethodim [(E)-(±)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] and its metabolites containing the 5-(2-ethylthiopropyl)cyclohexene-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexene-3-one moieties and their sulphoxides and sulphones, expressed as clethodim**, in or on the following raw agricultural commodities at the indicated levels:

Sugar Beet Molasses 2.0 ppm"

Also, the petitioner should explain why no residues occurred at the 5X rate on the RAC when residues up to 0.07 ppm resulted in the field trials from the 1X application.

Alternatively, the petitioner may submit a new sugar beet processing study, with measurable residues in the RAC, in order to support the subject tolerance petition.

11. We expect no increase in the dietary burden of ruminants as a result of this use. Therefore, CBTS anticipates that any secondary residues that might result in milk, and meat, fat, and mbyp of cattle, goats, hogs, horses, and sheep would be covered by the established tolerances on these commodities.

12. An international residue limits (IRL) status sheet is attached to this review. There is a Codex tolerance of 0.20 ppm for sugar beets. As noted in Conclusion 9, CBTS has recommended for a tolerance for residues of

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clethodim in sugar beet root at this level. We also recommended that the U.S. tolerance expression be modified to match that of Codex. There are no Canadian or Mexican Limits established for clethodim on sugar beets.

RECOMMENDATION

CBTS recommends against the establishment of the proposed tolerances for reasons given in Conclusions 4b, 8, 9, and 10.

DETAILED CONSIDERATIONS

PRODUCT CHEMISTRY

The manufacturing process for clethodim was submitted in support of PP#9F3743 (MRID#'s 409745-01 thru -05) and discussed in M. Nelson's memo of 3/12/90. There are no toxicological concerns for any of clethodim impurities.

CBTS concludes that the manufacturing process of technical grade clethodim has been adequately described. We do not foresee any residue problems from impurities in the technical.

PROPOSED USE

Two registered formulations of clethodim are proposed for use: Select® 2 EC and Select® Herbicide. Select® 2 EC Herbicide (EPA Reg. No. 59639-3) is an emulsifiable concentrate containing 25% of ai and 75% of inerts. This formulation contains 2 pounds of ai per gallon. Select® Herbicide (EPA Reg. No. 59639-78) contains 12.6% of ai and 87.4% of inerts. The formulation contains 0.94 pounds of ai per gallon.

The registrant proposes use of Select® 2 EC herbicide for postemergence control of annual and perennial grasses such as barnyardgrass, broadleaf signalgrass, bermudagrass, quackgrass in sugar beets, shallots, and onions. To control annual grasses in onions, shallots, and sugar beets apply Select® 2 EC at the rate of 4 fl. ozs./A (0.064 lbs. ai/A) to 16 fl. ozs./A (0.25 lbs. ai/A) by ground application in a minimum of 5 gallons and a maximum of 40 gallons of spray solution per acre. Air application should be made in a minimum of 3 gallons of spray solution per acre. Increase spray volume up to 10 gallons as grass or crop foliage becomes dense. To control perennial grasses in onions and shallots apply at the rate of 6 fl. ozs./A (0.096 lbs. ai/A) to 16 fl. ozs./A (0.25 lbs. ai/A) by ground application in a minimum

of 5 gallons and a maximum of 40 gallons of spray solution per acre. Air application should be made in a minimum of 3 gallons of spray solution per acre. Increase spray volume up to 10 gallons as grass or crop foliage becomes dense. Apply only to actively growing grasses. Always use a crop oil concentrate containing at least 15% emulsifier at 1% v/v to the finished spray volume. Make second application to actively growing grass 2 to 3 weeks after emergence of new growth. The registrant also proposes a spot application treatment using Select® 2 EC and a crop oil concentrate at a 1:2 ratio (fl. oz:fl. oz). If the desired volume of spray is 3 gallons, then add 1 fl. oz of Select® 2 EC and 2 fl. oz of the oil concentrate. The PHI for sugar beets is 100 days. The PHI for onions and shallots is 45 days. Always add a crop oil concentrate to the spray mix. Do not exceed a total of 32 fl. ozs./A (0.50 lbs. ai/A) of Select® 2 EC herbicide per season. Do not tank mix with imazaquin (Scepter®).

The registrant proposes use of Select® herbicide for postemergence control of annual and perennial grasses such as barnyardgrass, broadleaf signalgrass, bermudagrass, quackgrass in sugar beets, shallots, and onions. To control annual grasses in onions, shallots, and sugar beets apply Select® at the rate of 8 fl. ozs./A (0.06 lbs. ai/A) to 34 fl. ozs./A (0.25 lbs. ai/A) by ground application in a minimum of 5 gallons and a maximum of 40 gallons of spray solution per acre. Air application should be made in a minimum of 3 gallons of spray solution per acre. Increase spray volume up to 10 gallons as grass or crop foliage becomes dense. To control perennial grasses in onions and shallots apply at the rate of 13 fl. ozs./A (0.09 lbs. ai/A) to 34 fl. ozs./A (0.25 lbs. ai/A) by ground application in a minimum of 5 gallons and a maximum of 40 gallons of spray solution per acre. Air application should be made in a minimum of 3 gallons of spray solution per acre. Increase spray volume up to 10 gallons as grass or crop foliage becomes dense. Apply only to actively growing grasses. Always use a crop oil concentrate containing at least 15% emulsifier at 1% v/v to the finished spray volume. Make second application to actively growing grass 2 to 3 weeks after emergence of new growth. The registrant also proposes a spot application treatment using Select® and a crop oil concentrate at a 1:2 ratio (fl. oz:fl. oz). If the desired volume of spray is 3 gallons, then add 2 fl. oz of Select® and 4 fl. oz of the oil concentrate. The PHI for sugar beets is 100 days. The PHI for onions and shallots is 45 days. Always add a crop oil concentrate to the spray mix. Do not exceed a total of 68 fl. ozs./A (0.50 lbs. ai/A) of Select® herbicide per season. Do not tank mix with imazaquin (Scepter®).

CBTS concludes that the registrant has proposed an adequate set of directions for use of Select® 2 EC and Select® on onions, shallots and sugar beets.

NATURE OF THE RESIDUE

No new metabolism studies were submitted for clethodim.

Plants

A metabolism study in carrots, soybeans, and cotton was submitted with PP#9F3743 (MRID#410301-37) and discussed in M. Nelson's memo of 3/12/90. Immature plants of carrots, soybeans, and cotton were treated twice at a 14-day interval with a 50:50 tautomeric mixture of ring [6-^{14}C]-clethodim at a rate equivalent to 0.25 lbs. ai/A as a postemergence foliar spray; grown to maturity in a greenhouse; and, harvested with preharvest intervals of 20, 30, and 70 days. The major metabolic pathways of clethodim (C) in plant were initial sulfoxidation to clethodim sulfoxide (CSO) followed by further oxidation to clethodim sulfone (CSO_2), elimination of the chloroallyloxy side chain to give the imine sulfoxide (ISO) and sulfone (ISO_2), and hydroxylation to form the 5-OH sulfoxide (5OH-SO) and sulfone (5OH-SO_2). Clethodim sulfoxide and clethodim sulfone conjugates were also detected as major or minor metabolites, depending on plant species and subfractions. Also present as a minor metabolite was the aromatic sulfone. A study designed to follow the fate of the chloroallyloxy group was done side-by-side with the ^{14}C-ring-labeled clethodim study discussed above. The results showed that the chloroallyloxy moiety cleaved from clethodim underwent extensive metabolism, eliminating the chlorine atom and incorporating the three carbon moieties into natural plant components (with some being evolved as $^{14}CO_2$).

CBTS concludes that the nature of the residue in plants is adequately understood for the purposes of the subject petition. Studies have been conducted in a root crop (carrots) and two oilseeds (soybean and cotton). The residue of concern is clethodim and its metabolites containing the 2-cyclohexen-1-one moiety. However, the petitioner should be reminded that for future petitions on crops other than root crops, legumes, or oil seeds additional metabolism data should be provided on a crop such as a leafy vegetable, or fruit crop. Until there are plant metabolism data for clethodim on at least 3 widely different representative commodities; eg, tree nut, leafy vegetable, small grain, legume, root/tuber crop, oil seed, etc., which reflect a similar metabolism profile, CBTS can not conclude that the nature of the residue is understood in all plants.

Animals

Ruminants

A metabolism study in goats was submitted with PP#9F3743 (MRID#410301-39) and discussed in M. Nelson's memo of 3/12/90.

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Following a one day acclimation period, a lactating goat (39 kg) was dosed with 1.16 mg/kg/day of [propyl-1-^{14}C]-clethodim in gelatin capsules for 4 consecutive days, receiving 3 equal daily doses (14.2 mg/dose) for 3 days and 1 dose (14.2 mg) on the morning of day 4. A control goat received the same number of empty gelatin capsules. Both animals were sacrificed within 4 hours after the final dose. The dominant metabolic process in ruminants (goat) is oxidation of clethodim to clethodim sulfoxide and, to a lesser extent, clethodim sulfone. Clethodim can also be converted to S-methyl, which can be oxidized to S-methyl sulfoxide and S-methyl sulfone. Cleavage of the oxime N-O bond in clethodim produces the imine, which is rapidly oxidized to imine sulfoxide. In a minor process, clethodim can be hydroxylated to 5-OH, which can be oxidized to 5-OH sulfoxide. Alternately, clethodim sulfoxide may be hydroxylated to 5-OH sulfoxide (S-methyl is formed only from clethodim; the literature does not support the formation of S-methyl sulfoxide from clethodim sulfoxide. Thus, the S-methyl metabolites have significance only if animals are exposed to clethodim and this is limited because clethodim is rapidly oxidized to sulfoxides and sulfones in plants).

CBTS concludes that the nature of the residue in ruminants is adequately understood for the purposes of the subject petition. The residue of concern is clethodim and its metabolites containing the 2-cyclohexen-1-one moiety.

Poultry

A metabolism study laying hens was submitted with PP#9F3743 (MRID#410301-40) and discussed in M. Nelson's memo of 3/12/90. Young laying hens were assigned to one of two test groups (8 hens each) or the control group (12 hens). Following a 12-day acclimation period, each hen in the test groups received an oral dose of a 50:50 tautomeric mixture of ring [6-^{14}C]-clethodim:[4-^{14}C]-clethodim (either 2.1 mg/kg/day or 51.3 mg/kg/day) contained in a gelatin gel capsule filled with commercial poultry feed, once daily for 5 consecutive days. Controls received gelatin capsules containing only poultry feed. Clethodim metabolism in hens was not as complex as in goats. The chicken tissues and eggs contained only clethodim (C), clethodim sulfoxide (CSO), and clethodim sulfone (CSO_2). None of the imine analogs, 5-hydroxy analogs, or S-methyl analogs which were identified in the goat were seen in the chicken.

CBTS concludes that the nature of the residue in poultry is adequately understood for the purposes of the subject petition. The residue of concern is clethodim and its metabolites containing the 2-cyclohexen-1-one moiety.

ANALYTICAL METHODOLOGY

The analytical method used to gather the magnitude of the total clethodim residue data on sugar beets, garlic, and onions was Chevron Chemical Method RM-26B-1, "Analytical Method for the Determination of Clethodim Residues". This method is one of 2 methods recommended to enforce the clethodim tolerances. The registrant has revised this method at CBTS's request and designated the revision as Method RM-26B-2 (MRID#413899-01). This revised method has successfully completed a Petition Method Validation (PMV) in EPA Laboratories (M. Nelson's memo of 5/4/90). Briefly, the method involves extraction with aqueous methanol, cleanup by alkaline precipitation and acidic back extraction, oxidation to the pentanedioic acid moieties, derivatization to the corresponding dimethyl esters (DME and/or DME-OH), partition of the dimethyl esters in CH_2Cl_2, and determination by GC-FPD-S. The total residue is expressed as clethodim equivalents. The limit of quantitation is 0.10 ppm. The minimum detection limit for residues measured as the dimethyl esters is 0.01 ppm for milk; 0.05 ppm for other animal commodities including eggs; and 0.05 ppm for crops.

The second method recommended to enforce clethodim tolerances is the compound specific residue analytical method, EPA-RM-26D-2, "Confirmatory Method for the Determination of Clethodim and Clethodim Metabolites in Crops, Animal Tissues, and Milk and Eggs" (MRID#429245-02). This method distinguishes clethodim residues from residues of the structurally similar herbicide Poast®, which contains sethoxydim as the active ingredient. The registrant has revised and rewritten this compound specific method as ACB has suggested and has included additional modifications from current method development. This method has successfully completed a Petition Method Validation (PMV) in EPA Laboratories (F. Griffith's memo of 9/29/93). In summary, a 50 gram sample is extracted with 150-200 mL of methanol/water (1/4, v/v), filtered through Whatman # 42 paper, and precipitated with 2 grams of calcium hydroxide. The solution is partitioned 3 X 100 mL CH_2Cl_2, dried through a bed of anh. Na_2SO_4, and rotary evaporated to just dry. The derivatized solution is base washed with 10 mL of 0.1N NaOH, then methylated with CH_2N_2 with silica gel catalysis before it is oxidized with 2 mL of a 10% solution of m-chloroperbenzoic acid. The solution is quenched with 10% sodium thiosulfate, washed with sat. sodium bicarbonate solution, dried through anh. sodium sulfate, and concentrated with a rotary evaporator. Clean-up is through a 10 gram silica-gel column with the clethodim metabolites eluted off in 200 mL of acetone:methylene chloride (3/7, v/v). Determination is by HPLC using a Hewlett-Packard, model 1090 HPLC, equipped with a Hypersil ODS, 3 um, 15 cm X 4.6 mm column. The mobile phase is a water-ACN gradient at a flow rate of 1 ml per min. The detector is UV at 266 mn with 254 mn as the alternate wavelength.

The petitioner's data shows the limit of quantitation (LOQ) is 0.05 ppm for crops and tissues, and 0.02 ppm for milk. Quantification is by external standards. The minimum detection limit (MDL) is 0.03 ppm for crops and 0.01 ppm for milk. This method has been shown to be suitable to be a quantitative procedure to enforce the total clethodim tolerances in crops and animal tissues. The method is a qualitative confirmatory method for total clethodim tolerances in milk. However, this method is not quantitative for milk and is not suitable for enforcing the total clethodim tolerance in milk. The common moiety method, RM-26B-2, is quantitative for milk and is the enforcement method for milk (F. Griffith's memo of 9/29/93).

As noted in F. Griffith's memo of 11/16/92, company generated method validation data are required for any new total clethodim tolerance (s) on all matrices; ie, the rac (s), food and/or feed processed commodities, and if appropriate for meat, milk, poultry, and eggs, on which tolerances are proposed. These company generated validation data are necessary for both the common moiety method and the compound specific method. Therefore, in support of a tolerance petition for clethodim in/on onions and sugar beets, the petitioner submitted the following reports:

> "Determination of Clethodim Residues in Onions by the Confirmatory Method, EPA-RM-26D-2"; 2/23/94; J. C. Lai; Laboratory Project ID: VP10689; Performing Laboratory was Valent U.S.A. Corporation, Valent Dublin Laboratory, Dublin, CA (MRID# 43164-02).
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> "Determination of Clethodim Residues in Sugarbeet Commodities by the Confirmatory Method, EPA-RM-26D-2"; 2/23/94; J. C. Lai; Laboratory Project ID: VP10699; Performing Laboratory was Valent U.S.A. Corporation, Valent Dublin Laboratory, Dublin, CA (MRID# 431664-03).

Onions were fortified at 0.1 ppm, 0.25 ppm, and 0.50 ppm with both unhydroxylated and hydroxylated clethodim moieties. At the 0.25 ppm level, sethoxydim metabolites (sethoxydim and 5-OH sethoxydim) were concurrently analyzed to demonstrate that these moieties did not interfere with the determination of clethodim residues. The petitioner stated that the limit of quantitation of the method was 0.10 ppm. The limit of detection was claimed to be 0.05 ppm. Three validation runs were performed. The first one, in which no modifications were made to the method, is reported in Table I.

Table I. Clethodim and Sethoxydim Recoveries in Onions

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Using the Unmodified Method EPA-RM-26D-2

Fortification Level (ppm)	Percent Recovery			
	CSO[1]	5-OHCSO$_2$[2]	SS[3]	5-OHSSO$_2$[4]
control (ppm found)	0.003, nd	nd	0.02,0.008	0.07,0.09
0.10	72,70	86,143	--	--
0.25	68,108	99,146	107,130	132,200
0.50	78,116	84,144	--	--

1- Clethodim Sulfoxide
2- 5-Hydroxy Clethodim Sulfone
3- Sethoxydim
4- 5-Hydroxy Sethoxydim Sulfone

The petitioner stated that when using the confirmatory method on onions as written, clethodim recoveries were satisfactory but recovery reproducibility for 5-OH clethodim sulfone was poor. Therefore, two additional runs using decreased sample size (20 g of plant tissue instead of 50 g) were made on onions. Other modifications to the method were: a) increasing the volume of base and water washes to 50 mL (instead of 10 mL); and b) HPLC parameters modifications were made to optimize the chromatography. The recoveries of the second run (using the modified method) are reported in Table II.

Table II. Clethodim Sethoxydim Recoveries in Onions Using the Modified Method EPA-RM-26D-2

Fortification Level (ppm)	Percent Recovery			
	CSO[1]	5-OHCSO$_2$[2]	SS[3]	5-OHSSO$_2$[4]
control (ppm found)	nd	nd	nd	nd
0.10	78,70	68,83	--	--
0.25	88,92	80,82	97,96	68,47
0.50	92,78	100,89	--	--

1- Clethodim Sulfoxide
2- 5-Hydroxy Clethodim Sulfone
3- Sethoxydim
4- 5-Hydroxy Sethoxydim Sulfone

A third run was made, to demonstrate recovery of clethodim, at the 0.25 ppm level with clethodim, 5-OH clethodim sulfone, sethoxydim, and 5-OH sethoxydim sulfone. During this run, the

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gradient was modified slightly and the column was heated to achieve better separation. Results are reported in Table III.

Table III. Clethodim and Sethoxydim Recoveries in Onions Using the Modified Method EPA-RM-26D-2

Fortification Level (ppm)	Percent Recovery			
	CS[1]	5-OHCSO$_2$[2]	SS[3]	5-OHSSO$_2$[4]
control (ppm found)	nd	nd	nd	nd
0.25	69,64	79,85	92,92	71,81

1- Clethodim
2- 5-Hydroxy Clethodim Sulfone
3- Sethoxydim
4- 5-Hydroxy Sethoxydim Sulfone

Sugar beet tops and roots were fortified at 0.1 ppm, 0.25 ppm, and 0.50 ppm with both unhydroxylated and hydroxylated clethodim moieties. At the 0.25 ppm level, sethoxydim metabolites (sethoxydim and 5-OH sethoxydim) were concurrently analyzed to demonstrate that these moieties did not interfere with the determination of clethodim residues. The petitioner also stated that the limit of quantitation of the method for sugar beet roots was 0.10 ppm. The limit of detection was claimed to be 0.05 ppm. The petitioner stated that in the initial trials (run 1) on sugar beet commodities aliquots with 20 g samples were used. The modified base wash partition step was not used. During this initial trial, it was determined that the acetone solution of 5-OH clethodim sulfone had degraded, so the first run results were considered invalid and were not reported.

Two additional validation runs were performed on sugarbeet roots. In the first one, the method used was modified as described above. Results are reported in Table IV.

Table IV. Clethodim and Sethoxydim Recoveries in Sugar Beet Roots Using the Modified Method EPA-RM-26D-2

Fortification Level (ppm)	Percent Recovery			
	CSO[1]	5-OHCSO$_2$[2]	SS[3]	5-OHSSO$_2$[4]
control (ppm found)	nd	nd	nd	0.03,0.04
0.10	71,89	103,96	--	--

0.25	97,100	111,132	98,97	101,118
0.50	94,97	121,113	--	--

1- Clethodim Sulfoxide
2- 5-Hydroxy Clethodim Sulfone
3- Sethoxydim
4- 5-Hydroxy Sethoxydim Sulfone

To demonstrate recovery of clethodim, a second run was conducted at the 0.25 ppm fortification level with clethodim, 5-OH clethodim sulfone, sethoxydim, and 5-OH sethoxydim sulfone. Results are reported in Table V.

Table V. Clethodim and Sethoxydim Recoveries in Sugar Beet Roots Using the Modified Method EPA-RM-26D-2

Fortification Level (ppm)	Percent Recovery			
	CS[1]	5-OHCSO$_2$[2]	SS[3]	5-OHSSO$_2$[4]
control (ppm found)	nd	nd	nd	0.05,0.02
0.25	73,75	82,87	92,101	83,97

1- Clethodim
2- 5-Hydroxy Clethodim Sulfone
3- Sethoxydim
4- 5-Hydroxy Sethoxydim Sulfone

Three additional runs were performed on sugar beet tops. Results for the first run are reported in Table VI.

Table VI. Clethodim and Sethoxydim Recoveries in Sugar Beet Tops Using the Modified Method EPA-RM-26D-2

Fortification Level (ppm)	Percent Recovery			
	CSO[1]	5-OHCSO$_2$[2]	SS[3]	5-OHSSO$_2$[4]
control (ppm found)	0.03,0.02	0.03,0.03	nd	0.04,0.05
0.10	117,92	78,168	--	--
0.25	94,82	127,130	96,110	120,127
0.50	85,87	160,168	--	--

1- Clethodim Sulfoxide
2- 5-Hydroxy Clethodim Sulfone
3- Sethoxydim
4- 5-Hydroxy Sethoxydim Sulfone

The petitioner stated that recoveries of 5-OH clethodim sulfone were high and variable. It was also reported that proper integration was a problem for this moiety. Therefore, another run was made. Results are reported in Table VII.

Table VII. Clethodim and Sethoxydim Recoveries in Sugar Beet Tops Using the Modified Method EPA-RM-26D-2

Fortification Level (ppm)	Percent Recovery			
	CSO[1]	5-OHCSO$_2$[2]	SS[3]	5-OHSSO$_2$[4]
control (ppm found)	0.16,0.17	nd	0.02,0.02	nd
0.10	105,124	174,180	--	--
0.25	61,80	126,133	86,86	80,85
0.50	68,86	100,101	--	--

1- Clethodim Sulfoxide
2- 5-Hydroxy Clethodim Sulfone
3- Sethoxydim
4- 5-Hydroxy Sethoxydim Sulfone

To demonstrate recovery of clethodim, a third run was conducted at the 0.25 ppm fortification level with clethodim, 5-OH clethodim sulfone, sethoxydim, and 5-OH sethoxydim. Results are reported in Table VIII.

Table VIII. Clethodim and Sethoxydim Recoveries in Sugar Beet Tops Using the Modified Method EPA-RM-26D-2

Fortification Level (ppm)	Percent Recovery			
	CS[1]	5-OHCSO$_2$[2]	SS[3]	5-OHSSO$_2$[4]
control (ppm found)	0.01,0.02	nd	0.04,0.05	0.02,0.03
0.25	79,85	117,118	109,113	82,89

1- Clethodim
2- 5-Hydroxy Clethodim Sulfone
3- Sethoxydim
4- 5-Hydroxy Sethoxydim Sulfone

CBTS concludes that adequate validation data have been submitted for clethodim and its metabolites in onions and sugar beet root using the compound specific method EPA-RM-26D-2. An adequate amount of chromatographic data and raw data have been submitted by the petitioner to demonstrate that this method will separate clethodim from sethoxydim in sugar beets and onions.

However, the petitioner should explain the high clethodim equivalents in the blank control samples for sugar beet tops (see Table VII). Also, an explanation should be submitted for the abnormally high recovery values for 5-OH clethodim sulfone in sugar beet tops. Alternatively, the petitioner may submit more validation data for clethodim and its metabolites in sugar beet tops in order to support the subject tolerance petition.

MULTIRESIDUE TESTING

The petitioner has determined recoveries of clethodim, clethodim sulfoxide, and 5-OH clethodim sulfone under FDA's multiresidue protocols (PP#9F3743, M. Nelson's memo of 3/12/90).

Included in this petition are the following reports:

> "Testing of RE-45601, RE-45924, and RE-51228 through FDA Multi-Residue Protocols A through E", 8/6/91, J. Fomenko, MRID# 431664-06.
>
> "Testing of RE-45601, RE-45924, and RE-51228 through FDA Multi-Residue Protocol D", 2/5/92, J. Fomenko, MRID# 431664-07.

These reports are being forwarded to FDA for review.

RESIDUE DATA

Onions

Residue data reflecting the application of clethodim to onions and garlic appear in the following report:

> "Magnitude of Clethodim Residue Study in Dry Onions and Garlic"; J. C. Lai; 2/22/93; Laboratory Project ID No. TSR71207121; Performing Laboratory was Valent U.S.A. Corporation, Valent Dublin Laboratory, Dublin, CA (MRID# 431664-04).

Seven field trials on onions were conducted, five in 1989 and two in 1991. The 1989 field trials were conducted in CA (1),

CO (1), NY (1), OR (1), and TX (1) using Select® 2 EC herbicide. The 1991 field trials were conducted in CA (1) and MI (1) using Select® herbicide. According to Agricultural Statistics, 1988, these states represent nearly 83% of the onion production in the U.S. For garlic, single trials were conducted in CA in 1989 with Select® 2 EC and in 1991 with Select®. According to Agricultural Statistics, 1988, these states represent nearly 89% of the garlic production in the U.S. In all trials, two applications were made, using ground equipment, at the rate of 0.25 lbs. ai/A with PHI's ranging from 30 to 60 days. For one trial, two applications were made at the rate of 0.50 lbs. ai/A. Samples consisting of 12 mature bulbs, with tops removed, were collected from the control and treated plots, frozen, and shipped to Chevron Chemical Company, Residue Chemistry Laboratory, Richmond, California.

CBTS concludes that geographic representation of residue data is adequate for the proposed use on onions.

A freezer storage stability study was conducted using frozen (-20°C) onion macerates fortified with 0.50 ppm clethodim and 0.50 ppm 5-OH clethodim sulfone. Reanalysis of these samples at intervals of 0, 3, 6, 9, and 12 months resulted in clethodim recoveries (as DME) which ranged from 74% to 110%. 5-OH clethodim sulfone recoveries (as DME-OH) ranged from 82% to 112%. Onion samples were analyzed for total clethodim residues up to 12 months after sampling. Maximum interval between extraction and analyses was 8 days. In one field trial (T-7304, NY), samples were analyzed for total clethodim residues up to 20 months after sampling. Garlic samples were analyzed for clethodim residues up to 15 months after sampling. Maximum interval between extraction and analyses was 13 days. No storage stability data were submitted for garlic.

Considering the fact that the majority of the samples were stored for 12 months before analyses and that garlic is a low dietary intake crop; CBTS concludes that total clethodim residues are stable in onion macerates stored frozen (-20°C) for up to 12 months.

Recovery data were obtained from untreated samples of onions, analyzed concurrently with the field trial samples, fortified with clethodim at the level of 0.05 ppm to 0.50 ppm. Overall recoveries of 60% to 155% were obtained. Recovery data for 5-OH clethodim sulfone at fortification levels of 0.05 ppm to 0.50 ppm were 80% to 145%. Submitted chromatograms show well resolved peaks in support of this data.

Recovery data were obtained from untreated samples of garlic, analyzed concurrently with the field trial samples, fortified with clethodim at the level of 0.10 ppm to 0.50 ppm. Overall recoveries of 85% to 132% were obtained. Recovery data

for 5-OH clethodim sulfone at fortification levels of 0.10 ppm to 0.50 ppm were 100% to 109%.

Table IX summarizes the amount of residues on onions resulting from 2 applications of clethodim at the rates of 0.25 lbs. ai/A and 0.50 lbs. ai/A.

Table IX. Clethodim Residues on Onions

Field Trial Location	Formulation	PHI	Clethodim Equivalents (ppm)		
			DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
TX (1989)	2 EC	45	0.12 0.17	<0.01 <0.01	0.12 0.17
CA (1989)	2 EC	30	0.08 <0.05	0.07 <0.05	0.15 <0.05
		45	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05
		60	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05
OR (1989)	2 EC	45	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
CO (1989)	2 EC	45	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
NY (1989)	2 EC	30	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
		45	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
		60	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
MI (1991)	0.94 EC	30	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
		45	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
		60	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10

Field Trial Location	Formulation	PHI	Clethodim Equivalents (ppm)		
			DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
CA (1991)	0.94 EC	45	0.11 0.14	<0.10 <0.10	0.11 0.14
		45[3]	0.12 0.12	<0.10 <0.10	0.12 0.12

1 and 2 - acronyms for the dimethyl esters of 3-[2-(ethylsulfonyl) propyl]pentanedioic acid and 3-[2- (ethylsulfonyl)propyl]-3-hydroxypentanedioic acid, respectively.

3. Applications were made at the rate of 0.50 lbs. ai/A

The petitioner stated that the limit of detection was usually 0.10 ppm but in a few cases the samples were diluted before analyses and therefore the limit of detection decreased to 0.05 ppm. The limit of quantitation was 0.10 ppm. As can be seen from the Table, the maximum residue level found in onions using the 2 EC formulation was 0.17 ppm with a PHI of 45 days. The maximum residue level found in onions using the 0.94 EC formulation was 0.14 ppm with a PHI of 45 days. Control samples showed no detectable clethodim equivalents.

Table X summarizes the amount of residues on garlic resulting from 2 applications of clethodim at the rate of 0.25 lbs. ai/A.

Table X. Clethodim Residues on Garlic

Field Trial Location	Formulation	PHI	Clethodim Equivalents (ppm)		
			DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
CA (1989)	2 EC	45	0.13 0.14	0.24 0.20	0.37 0.34
		60	<0.10 <0.10	0.18 0.20	0.18 0.20
CA (1991)	0.94 EC	45	<0.10 <0.10	<0.10 0.10	<0.10 0.10

1 and 2 - acronyms for the dimethyl esters of 3-[2-(ethylsulfonyl) propyl]pentanedioic acid and 3-[2- (ethylsulfonyl)propyl]-3-hydroxypentanedioic acid, respectively.

The petitioner stated that the DME-OH measurement of garlic was affected by an interference peak, which could not be adequately resolved by gas chromatography and which had a long

retention time. This peak was also found in the control samples at levels from 0.07 ppm to 0.16 ppm. As can be seen from the Table, the maximum combined residue level found in garlic was 0.37 ppm.

CBTS concludes that based on the residue data for onions, the proposed tolerance of 0.50 ppm for clethodim residues in/on onions is inappropriate. The field trials showed that the maximum combined residues calculated as clethodim, found in onions is 0.17 ppm for the 2 EC formulation and 0.14 ppm for the 0.94 EC formulation. Also, the residue data indicate that residues of the 5-hydroxylated moieties are not likely to occur in/on onions. Based on the fact that the interference peak found in garlic was present in both the treated and control samples, and taking into consideration the residue profile in onions showing no detectable residues of the 5-hydroxylated moieties, it is unlikely that the garlic residues reported as 5-OH clethodim moieties are real. A tolerance proposal of 0.20 ppm for clethodim residues in/on onions seems more appropriate. The petitioner needs to submit a revised Section F proposing a tolerance for residues of clethodim and its metabolites in/on onions (dry bulb) at 0.20 ppm in support of the subject tolerance petition. The exact wording of the tolerance expression to harmonize with Codex is specified later in this review (see Sugar Beets section). Also, the petitioner should submit an explanation for the variability in the detection limit for the 1989 analyses.

Sugar Beets

Residue data reflecting the application of clethodim to sugar beets appear in the following report:

> "Magnitude of Clethodim Residues in Sugarbeets - Raw Agricultural Commodities and Processed Parts"; J. C. Lai; 4/2/92; Laboratory Project ID No. TSR5068SGBT; Performing Laboratories were Chevron Chemical Company, Agriculture Chemicals Division, Richmond, CA; and PTRL - West, Richmond, CA (MRID# 431664-05).

Ten field trials on sugar beets were conducted, six in 1989 and four in 1990. The 1989 field trials were conducted in CA (1), ID (1), MI (1), MN (1), NE (1), and ND (1) using Select® 2 EC

herbicide. The 1990 field trials were conducted in CA (1), ID (1), ND (1), and TX (1) using Select® herbicide. According to Agricultural Statistics, 1988, these states represent nearly 86% of the sugar beet production in the U.S. In all trials, two applications were made, using ground and air equipment, at the rate of 0.25 lbs. ai/A with PHI's ranging from 60 to 100 days. Samples consisting of 12 plants (mature sugar beet tops and roots) were collected from the control and treated plots, frozen, and shipped to Chevron Chemical Company, Residue Chemistry Laboratory, Richmond, California. Analyses of the 1989 samples were conducted by PTRL-West laboratories. The 1990 samples were analyzed by Chevron Chemical Company. The processing studies were performed at American Crystal Sugar Co. Research Center, Moorhead, MN.

CBTS concludes that geographic representation of residue data is adequate for the proposed use on sugar beets.

A freezer storage stability study was conducted using frozen (-20°C) macerates of roots and tops fortified with 0.50 ppm clethodim and 0.50 ppm 5-OH clethodim sulfone. Reanalysis of these samples at intervals of 0, 3, 6, 9, and 12 months for sugar beet roots resulted in clethodim recoveries (as DME) which ranged from 76% to 103%. 5-OH clethodim sulfone recoveries (as DME-OH) ranged from 70% to 114%. Reanalysis of these samples at intervals of 0, 4, 6, and 9 months for sugar beet tops resulted in clethodim recoveries (as DME) which ranged from 66% to 106%. 5-OH clethodim sulfone recoveries (as DME-OH) ranged from 68% to 100%. Sugar beet samples were analyzed for total clethodim residues up to 12 months after sampling for roots and 9 months after sampling for tops. Maximum interval between extraction and analyses was 5 days.

CBTS concludes that total clethodim residues are stable in sugar beet root macerates stored frozen (-20°C) for up to 12 months and 9 months for tops.

Recovery data for the 1989 analyses were performed by PTRL-West laboratories. Recovery data for sugar beet roots were obtained from untreated samples analyzed concurrently with the field trial samples, fortified with clethodim sulfoxide and 5-OH clethodim sulfone at the level of 0.50 ppm. Overall recoveries of 74% to 112% were obtained for clethodim sulfoxide. 5-OH clethodim sulfone recoveries ranged from 80% to 111%. Recovery data for sugar beet tops were obtained from untreated samples analyzed concurrently with the field trial samples, fortified with clethodim sulfoxide and 5-OH clethodim sulfone at the level of 0.50 ppm. Overall recoveries of 85% to 105% were obtained for clethodim sulfoxide. 5-OH clethodim sulfone recoveries ranged from 80% to 106%. Submitted chromatograms show well resolved peaks in support of these data.

Recovery data for the 1990 analyses were performed by Chevron Chemical Company, Agricultural Chemicals Division. Recovery data for sugar beet roots were obtained from untreated samples analyzed concurrently with the field trial samples, fortified with clethodim and 5-OH clethodim sulfone at the level of 0.20 ppm and 0.50 ppm. Overall recoveries of 61% to 83% were obtained for clethodim. 5-OH clethodim sulfone recoveries ranged from 64% to 114%. Recovery data for sugar beet tops were obtained from untreated samples analyzed concurrently with the field trial samples, fortified with clethodim and 5-OH clethodim sulfone at the level of 0.20 ppm and 0.50 ppm. Overall recoveries of 65% to 121% were obtained for clethodim sulfoxide. 5-OH clethodim sulfone recoveries ranged from 105% to 117%. Submitted chromatograms show well resolved peaks in support of these data.

Table XI summarizes the amount of residues on sugar beet roots resulting from 2 applications of clethodim at the rate of 0.25 lbs. ai/A.

Table XI. Clethodim Residues on Sugar Beet Roots

Field Trial Location	Formulation	PHI	Clethodim Equivalents (ppm)		
			DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
MN (1989)	2 EC	100	<0.05 <0.05	0.05 <0.05	0.05 <0.05
ID (1989)	2 EC	99	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
ND (1989)	2 EC	61	<0.10 <0.05	<0.10 <0.05	<0.10 <0.05
		79	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05
		100	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
NE (1989)	2 EC	100	<0.05 <0.05 <0.05	<0.05 <0.05 <0.05	<0.05 <0.05 <0.05
CA (1989)	2 EC	60	0.06 <0.05	<0.05 <0.05	0.06 <0.05
		80	0.07 <0.05	<0.05 <0.05	0.07 <0.05

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Field Trial Location	Formulation	PHI	Clethodim Equivalents (ppm)		
			DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
		100	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05
MI (1989)	2 EC	100	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
CA (1990)[4]	0.94 EC	100	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
ID (1990)	0.94 EC	102	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
TX (1990)	0.94 EC	100	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
ND (1990)	0.94 EC	99	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
		99[3]	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10

1 and 2 - acronyms for the dimethyl esters of 3-[2-(ethylsulfonyl) propyl]pentanedioic acid and 3-[2- (ethylsulfonyl)propyl]-3-hydroxypentanedioic acid, respectively.

3 - Applications were made at the rate of 1.25 lbs. ai/A

4 - Two aerial applications were made at the rate of 0.25 lbs. ai/A

Table XII summarizes the amount of residues on sugar beet tops resulting from 2 applications of clethodim at the rate of 0.25 lbs. ai/A.

Table XII. Clethodim Residues on Sugar Beet Tops

Field Trial Location	Formulation	PHI	Clethodim Equivalents (ppm)		
			DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
MN (1989)	2 EC	100	0.05 <0.05	<0.05 <0.05	0.05 <0.05

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Field Trial Location	Formulation	PHI	Clethodim Equivalents (ppm)		
			DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
ID (1989)	2 EC	99	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05
ND (1989)	2 EC	61	0.09 0.10	<0.05 <0.05	0.09 0.10
		79	0.06 <0.05	0.10 <0.05	0.16 <0.05
		100	<0.05 <0.05	<0.05 <0.05	<0.05 <0.05
NE (1989)	2 EC	100	<0.05 <0.05 <0.05	<0.05 <0.05 <0.05	<0.05 <0.05 <0.05
CA (1989)	2 EC	60	<0.10 0.19	<0.10 <0.10	<0.10 0.19
		80	0.13 0.16	<0.10 <0.10	0.13 0.16
		100	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
MI (1989)	2 EC	100	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
CA (1990)[4]	0.94 EC	100	0.23 0.17	<0.10 <0.10	0.23 0.17
ID (1990)	0.94 EC	102	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
TX (1990)	0.94 EC	100	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
ND (1990)	0.94 EC	99	<0.10 <0.10	<0.10 <0.10	<0.10 <0.10
		99[3]	0.24 0.46	<0.10 0.11	0.24 0.57

1 and 2 - acronyms for the dimethyl esters of 3-[2-(ethylsulfonyl) propyl]pentanedioic acid and 3-[2- (ethylsulfonyl)propyl]-3-hydroxypentanedioic acid, respectively.
3 - Applications were made at the rate of 1.25 lbs. ai/A
4 - Two aerial applications were made at the rate of 0.25 lbs. ai/A

The petitioner stated that the limit of detection for the 1990 samples was 0.10 ppm and for the 1989 samples was either 0.05 ppm or 0.10 ppm. The limit of quantitation was 0.10 ppm. As can be seen from Table XI, the maximum residue level found in sugar beet root using the 2 EC formulation was 0.07 ppm with a PHI of 80 days. At a PHI of 100 days the highest residue level found was 0.05 ppm. Non-detectable residues were found using the 0.94 EC formulation. As can be seen from Table XII, the maximum residue level found in sugar beet tops using the 2 EC formulation was 0.19 ppm with a PHI of 60 days. Non-detectable residues were found at samples with a 100 day PHI. The maximum residue found with the 0.94 EC formulation was 0.57 ppm with a 100 day PHI (the application rate for this study was 1.25 lbs. ai/A [5X]). At a PHI of 100 days and a 1X application rate the highest residue found was 0.23 ppm. Control samples showed no detectable clethodim equivalents.

The field trials showed that the maximum clethodim residue found in sugar beet root is 0.07 ppm at a 80 day PHI. At a 100 day PHI the maximum residue found was 0.05 ppm. Based on these field trials a tolerance proposal of 0.10 ppm for clethodim residues in/on sugar beet root would be appropriate. However, to harmonize with the Codex MRL of 0.20 ppm, CBTS recommends for the petitioner's proposed tolerance of 0.20 ppm. For chronic risk assessment purposes, a value of 0.10 ppm can be used. Based on the submitted residue data for sugar beet tops, CBTS concludes that the proposed tolerance of 0.50 ppm for clethodim residues in/on sugar beet tops seems adequate. However, to further harmonize with Codex, the petitioner should submit a revised Section F proposing the subject tolerances as the following:

> "Pursuant to Section 408(d)(1) of the Federal Food, Drug, and Cosmetic Act, Valent U.S.A. Corporation proposes to amend 40 CFR part 180 by establishing a tolerance for residues of **clethodim [(E)-(±)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] and its metabolites containing the 5-(2-ethylthiopropyl)cyclohexene-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexene-3-one moieties and their sulphoxides and sulphones, expressed as clethodim**, in or on the following raw agricultural commodities at the indicated levels:

25

Sugar Beet Roots	0.20 ppm
Sugar Beet Tops	0.50 ppm
Onions (Dry Bulb)	0.20 ppm"

Also, the petitioner should submit an explanation for the variability in the detection limit within the sugar beet samples for the 1989 and 1990 analyses.

PROCESSED COMMODITIES

A report of residues resulting from the processing of sugar beets is included in the following submission:

"Magnitude of Clethodim Residues in Sugarbeets - Raw Agricultural Commodities and Processed Parts"; J. C. Lai; 4/2/92; Laboratory Project ID No. TSR5068SGBT; Performing Laboratories were Chevron Chemical Company, Agriculture Chemicals Division, Richmond, CA; and PTRL - West, Richmond, CA (MRID# 431664-05).

A field trial was conducted during 1990 in ND. Two applications of clethodim were made at the rate of 1.25 lbs. ai/A (5X the label rate). After collection, sugar beet samples were frozen and shipped to American Crystal Sugar Company, Moorhead, MN, where they were processed into sliced roots, dehydrated pulp, molasses, and refined sugar (the complete processing procedure is given on page 903 of the report). The petitioner stated that processed fractions were analyzed within 2 weeks of their generation, so storage stability data are not required. CBTS concurs with the petitioner.

Results are given in Table XIII.

Table XIII. Clethodim Residues Found in Processed Fractions of Sugar Beets

Commodity	DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
Sugar Beet	<0.10	<0.10	<0.10
Sliced Beets	<0.10	<0.10	<0.10

Commodity	DME (ppm)[1]	DME-OH (ppm)[2]	Total (ppm)
Dehydrated Pulp	<0.10	<0.10	<0.10
Refined Sugar	<0.10	<0.10	<0.10
Molasses	0.24	<0.10	0.24

1 and 2 - acronyms for the dimethyl esters of 3-[2-(ethylsulfonyl) propyl]pentanedioic acid and 3-[2- (ethylsulfonyl)propyl]-3-hydroxypentanedioic acid, respectively.

Although the petitioner stated that no concentration factor could be calculated because no residues were detected in the unprocessed sugar beets, CBTS believes one can be estimated. We estimate that clethodim residues could be found in unprocessed sugar beets in a range from <0.01 ppm to 0.03 ppm (the minimum detection limit for the analytical method). Therefore, dividing the molasses concentration by the average of this range (i.e., 0.02 ppm) gives a concentration factor of about 10X. Applying this concentration factor to the proposed tolerance of 0.20 ppm for sugar beet root results in 2.0 ppm. The petitioner needs to submit a revised Section F proposing the subject tolerances as the following:

> "Pursuant to Section 408(d)(1) of the Federal Food, Drug, and Cosmetic Act, Valent U.S.A. Corporation proposes to amend 40 CFR part 186 by establishing a tolerance for residues of **clethodim [(E)-(±)-2-[1-[[(3-chloro-2-propenyl)oxy]imino]propyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one] and its metabolites containing the 5-(2-ethylthiopropyl)cyclohexene-3-one and 5-(2-ethylthiopropyl)-5-hydroxycyclohexene-3-one moieties and their sulphoxides and sulphones, expressed as clethodim**, in or on the following raw agricultural commodities at the indicated levels:
>
> Sugar Beet Molasses 2.0 ppm"

Also, the petitioner should explain why no residues occurred at the 5X rate on the RAC when residues up to 0.07 ppm resulted in the field trials from the 1X application.

Alternatively, the petitioner may submit a new sugar beet processing study, with measurable residues in the RAC, in order to support the subject tolerance petition.

MEAT, MILK, POULTRY AND EGGS

We expect no increase in the dietary burden of ruminants as a result of this use. Therefore, CBTS anticipates that any secondary residues that might result in milk, and meat, fat, and mbyp of cattle, goats, hogs, horses, and sheep would be covered by the established tolerances on these commodities.

OTHER CONSIDERATIONS

An international residue limits (IRL) status sheet is attached to this review. There is a Codex tolerance of 0.20 ppm for sugar beets. As noted in Conclusion 9, CBTS has recommended for a tolerance for residues of clethodim in sugar beet root at this level. We also recommended that the U.S. tolerance expression be modified to match that of Codex. There are no Canadian or Mexican Limits established for clethodim on sugar beets.

Attachment: International Residue Limit Status Sheet

cc: RF, Circu., José J. Morales, E. Haeberer, F. Ives, PP#4F4340
7509C: Reviewer (JJM): CM#2: Rm 804-Q: 305-5010: typist (JJM): 1/31/95
RDI: E. Haeberer (1/31/95): R. Loranger (2/8/95): E. Zager (2/8/95)