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

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OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

Memorandum

SUBJECT: PP#OE2529. Chlorpyrifos on cherries. Evaluation of analytical method and residue data.

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THRU: Charles L. Trichilo, Chief
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Dr. M.E. Burt, Assistant Coordinator, and Dr. R.H. Kupelian, National Director, IR-4, on behalf of the IR-4 Technical Committee and the Agricultural Experiment Stations of Michigan and Ohio propose the establishment of a tolerance of 1.5 ppm for the combined residues of chlorpyrifos [0,0-diethyl-0-(3,5,6-trichloro-2-pyridyl) phosphorothioate] and its metabolite 3,5,6-trichloro-2-pyridinol (TCP) in or on the RAC cherries.

Established tolerances (40 CFR 180.342) range from 15 ppm on peanut hulls to 0.05 ppm for a variety of commodities which include apples and lima and snap beans. Tolerances are also established for the fat, meat and meat byproducts of cattle (1.5 ppm), goats, hogs, horses, and sheep (0.1 ppm) turkeys (0.2 ppm), other poultry (.01 ppm), eggs (0.01 ppm) and milk fat (0.25 ppm, 0.01 ppm in whole milk). Many tolerances are pending.

The Dow Chemical Company has authorized the use of any relevant data from previous petitions that may be needed in support of this petition (letter from R. Bischoff to C. Fletcher, 5/27/81).

Conclusions

1a. The nature of the residue in plants is not adequately understood. TOX has required that certain unidentified metabolites uncovered in soybean and apple radiolabeled studies be further characterized to determine if any are cholinesterase inhibitors.

1b. The nature of the residue in animals is adequately understood. The residue of concern consists of parent plus TCP.

2. The analytical method used to gather residue data is adequate. Methods similar to this are included in PAM II and are considered to be adequate for enforcement purposes in terms of parent compound and TCP. If other metabolites are deemed to be in need of regulation, additional methodology may be needed.

3. The data are too geographically limited to support a national tolerance. We conclude that a tolerance of 2.0 ppm (the proposed tolerance is 1.5 ppm) would be adequate provided this use is limited to the states of Mich., Ohio, Wis., Penn and NY. However, any final conclusion on an appropriate tolerance awaits resolution of the questions raised by TOX concerning plant metabolism (Conclusion 1a).

4. Since cherries are not normally used for animal feed these will be no problem of secondary residues in meat, milk, poultry and eggs.

5. An International Residue Limit Status sheet is attached. There are no Codex proposals for chlorpyrifos on cherries nor are there such tolerances in Mexico or Canada.

Recommendations

For the reasons listed in conclusions 1a and 3 we recommend against the proposed tolerance. We could recommend for a tolerance of 2.0 ppm provided this use is limited to the states of Mich., Ohio, Wis., Penn. and NY. The petitioner should submit revised Sections B and F which incorporate these changes. No final conclusions can be made until questions coverning the metabolism of chlorpyrifos in plants have been resolved.

If and when this tolerance becomes established it should be accompanied in the CFR by a mechanism that defines the geogrphical limitations imposed on this use. See attachment.

DETAILED CONSIDERATIONS

Manufacture and Formulation

Lorsban® 4E is an emulsifiable concentrate containing 41% chlorpyrifos (4 lb a.i./gal). The formulation was discussed in Toxicology's review of PP#3F1306 (memo of W. Park 11/16/72). The manufacturing process was discussed in our review of PP#4F1445 (memo of A. Smith, 5/3/74). The impurities (6%) in the technical material are [redacted] The remainder, the non-volatiles (<0.4% each), consists of at least seven compounds. We do not expect the impurities in Lorsban® to present a residue problem. The inerts are cleared under §180.1001.

MANUFACTURING PROCESS INFORMATION IS NOT INCLUDED

Proposed Use

For control of the Lesser Peachtree Borer Lorsban 4E is to be applied at the rate of 1 1/2 to 3 lbs. a.i. per 100 gallons of water. The application is to be made to the trunk and lower limbs as a coarse low pressure spray. Three applications are to be made. The second is to be made 2 weeks after the first but not within 6 days of harvest. The third application is to be made after harvest. A label restriction prohibits the grazing of meat and dairy animals in treated fields.

Nature of the Residue

Plant

No metabolism studies were submitted with this petition.

The metabolism of radiolabeled chlorpyrifos (^{14}C and ^{36}Cl) has been studied in corn and bean plants (PP#3F1306). These studies show that chlorpyrifos is translocated only to a limited degree from soil or from treated leaves. Chlorpyrifos degrades in UV light in the presence of water by dechlorination to form diols and triols which can undergo ring cleavage. Under prolonged irradiation the products are apparently carbon dioxide, ammonium carbonate and sodium chloride.

Plant metabolism (as indicated by the corn and bean studies) is via hydrolysis to ethyl 3,5,6-trichloro-2-pyridyl phosphate; 3,5,6-trichloro-2-pyridylphosphate; 3,5,6-trichloropyridinol (TCP); and material postulated to be a TCP conjugate. TCP can undergo dechlorination (as observed in UV degradation) to form diols and triols which can be conjugated or incorporated into natural plant constituents.

More recently apple and soybean metabolism studies have been submitted and reviewed (PP#OF2281, memo of 7/7/81, E. Leovey).

In the apple metabolism study chlorpyrifos and TCP were observed as residues at levels of 36.3 and 5.1 - 5.6% respectively. Two metabolites (identified as A-1 and A-2, 4.3 and 4.2% of residue) were postulated to be mono-dechlorinated derivatives of chlorpyrifos from GC/MS data. The aqueous layers contained a metabolite designated B (4.9 to 5.4% of residue) which, upon hydrolysis yielded TCP. The hydrolyzed insoluble material yielded metabolites C (5.2 - 5.7%), D (3.2 to 5.4%) and E (5.5. to 5.7%) which were not characterized due to a lack of sufficient material. The remainder of the radioactivity was located in the hydrolyzed fractions (approximately 20-24%), insoluble material (3.3-4.5%) and aqueous layers (1.4-1.5%). The material in the unidentified hydrolyzed fraction consisted of numerous radiolabelled compounds smeared throughout the HPLC fractions. From 90-95% of the radioactivity could be traced; the remainder was probably lost in sample handling. The ^{14}C residue in soybeans was characterized as 17% incorporated into natural components of the oil; 2.5% chlorpyrifos; 11% TCP; 24% extracted into the aqueous layer and containing at least seven metabolites not hydrolyzable to TCP; 18% solubilized after alkaline hydrolysis and containing a number of products which individulaly constituted at most 3% of the total residues; 11% in the precipitate and deduced to be incorporated into protein and 8% remaining insoluble, according to our calculations. Unidentified metabolites were claimed to be compounds arising from the plant's natural constituents.

Toxicology Branch has recently concluded (Section 18 by the State of Ohio for Chlorpyrifos on soybeans, memo of 8/11/81, A. Mahfouz) that the unidentified metabolites that are water soluble are not of toxicological significance because water soluble metabolites of organophosphate insecticides are usually inactive degradation products. However concern was expressed over other metabolites that weren't identified (oral communication, W. Dykstra, TOX).

Specifically, the undentified organosoluble material from the hydrolyzed fractions in both the soybean and apple studies will be required to be analyzed for cholinesterase inhibition activity. Therefore the metabolism of chlorpyrifos in plants isn't adequately understood.

Analytical Method

The method used to gather residue data determines chlorpyrifos and TCP separately.

Chlorpyrifos

The sample is extracted with acetone. The solution is filtered through celite then deluted to 100 ml with acetone. Twenty-five mLs of the sample are concentrated until all the acetone is gone (several mLs of water remain). Sodium sulfate is added to absorb the water. Ten mLs of 15% methylene chloride in cyclohexane are added and the flask is shaken. The solvent is passed through a filter filled with sodium sulfate.

The volume of the sample is reduced to about 2 mLs. The sample is transfered to a 10 ml volumetric flask. The sample is cleaned up on a gel permeation column. The chlorpyrifos is determined via gas chromatography using a flame photometric detector. Using this method, the recovery of chlorpyrifos form cherries fortified at 0.01-0.05 ppm was 62-112% (avg. 84%).

TCP

The sample is hydrolyzed by adding it to 5 ml 10% NaOH in 40 ml methanol and heating in a 130° oven for 30 minutes. After cooling, the mixture is blended, then filtered through celite. The filtrate is transferred to a 100 ml volumetric flask then diluted to volume with methanol. The sample is cleaned up on an acidic alumina column using ether for elution. The TCP is partitioned into 0.25 M sodium bicarbonate.

The bicarbonate solution is washed with toluene; the toluene is discarded. Six mLs concentrated hydrochloric acid are added to the bicarbonate solution to make the pH less than 1. This solution is extracted with toluene. The toluene solution is injected into a GC using a ^{63}Ni electron capture detector to determine the TCP. Since this method determines total TCP (including that obtained form hydrolyzing the parent) the level of chlorpyrifos must be separately determined; TCP is then calculated by difference.

Using the above method, the recovery of TCP from cherries fortified at 0.05-1.0 ppm was 68-104% (avg. 90%).

Methods similar to the above have been successfully tried out and are adequate for enforcement purposes.

Residue Data

Residue experiments were carried out in Michigan and Washington. Michigan accounts for ca. 76% of the tart cherries grown in this country. Washington accounts for ca. 32% of the sweet cherries.

In the Michigan study cherry trees were treated with 1 1/2 or 3 lbs a.i. in 100 gallons water as per label directions. Samples were taken for residue analysis at 6, 14 and 21 days after a second application. Combined residues as a result of the lower rate (6 day PHI) ranged from 0.06 to 0.6 ppm for sweet cherries and from 0.06 to 1.02 ppm for tart cherries. At the higher rate residues ranged from 0.06-0.61 ppm for sweet cherries and from 0.06 to 0.74 for tart cherries (6 day PHI).

In the Washington study cherry trees were treated with either one or two application of 6 qts. a.i. in 100 gallons of water (2X the proposed rate). Samples were taken for residue analysis 3 weeks after the single application and two weeks after the second of two applications. Residues in sweet cherries as the result of one application were 0.63 ppm; in tart cherries, 0.10 ppm. Residues as the result of two applications were 0.10 ppm (tart) and 0.29 ppm (sweet). The data from Washington is not representative of the proposed use (the rate is exaggerated but so is the PHI) and is therefore not especially useful for determining an appropriate tolerance. Since, in the Michigan studies, the 0.5X rate resulted in residues of up to ca. 1 ppm we conclude that a tolerance of 2.0 ppm for chlorpyrifos on cherries would accommodate expected residues from the proposed use. However since the data is geographically limited we require that this use be limited to the cherry growing states of the north central U.S. (Mich., NY., Ohio, Penn., and Wis.). If use beyond these states is desired additional residue data from the major cherry growing western states will be needed.

Meat, Milk, Poultry and Eggs

Since cherries are not normally considered as an animal feed item, there will be no problem of secondary residues in meat, milk, poultry and eggs.

Other Considerations

If and when this tolerance becomes incorporated into the CFR it should be accomponied by an appropriate mechanism that defines the geographic limitations imposed on this use. See attachement.

INTERNATIONAL RESIDUE LIMIT STATUS

CHEMICAL Chlorpyrifos

CCPR NO. 17

PETITION NO. 1E2529

~~Reviewer: K. Arne~~

Codex Status

/ X / No Codex Proposal Step 6 or above

Residue (if Step 9): Chlorpyrifos

Crop(s)	Limit (mg/kg)
None on this commodity	

Proposed U.S. Tolerances

Residue: 1) 0,0-diethyl 0-(3,5,6-trichloro-2-pyridyl)phosphorothioate
2) 3,5,6-trichloro-2-pyridinol

Crop(s)	Tol. (ppm)
cherries	1.5

CANADIAN LIMIT

Residue:

Crop	Limit (ppm)
None on this commodity	

MEXICAN TOLERANCIA

Residue:

Crop	Tolerancia (ppm)
None on this commodity	

Notes:

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Minor Use Tolerances

Mr. Edwin L. Johnson, Office of Pesticide Programs, Deputy Assistant Administration, has issued a minor use policy dated 9/30/80. One of the issues addressed in the statement is the setting of minor use tolerances based on the submission of residue data from specific geographical areas. A tolerance is normally set on a national basis and is supported by residue data from the major growing areas for the individual crops.

In order to enable users of 40 CFR Section 180. to be able to distinguish these minor use tolerances for specific areas from other tolerances which are supported by the full complement of residue data, we recommend that these tolerances be identified in the CFR.

We suggest a system whereby the minor use tolerances be asterisked in the CFR and be accompanied by an explantory footnote. An appropriate footnote would be, "This minor use tolerance is based on residue data from specific geographical areas. In order to expand the area of usage on this crop, additional residue chemistry data for these areas will need to be submitted."