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

JUL 22 1983

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: PP3E2872/FAP3H5393: Chlorpyrifos in or on Grapes. Evaluation of analytical methods and residue data.

TO: J. Ellenberger, PM 12
Registration Division (TS-767)

and

Toxicology Branch
Hazard Evaluation Division (TS-769)

THRU: Charles L. Trichilo, Chief
Residue Chemistry Branch
Hazard Evaluation Division (TS-769)

FROM: R. W. Cook
Residue Chemistry Branch
Hazard Evaluation Division (TS-769)

Dow Chemical Co. proposes the establishment of tolerances for combined residues of the insecticide chlorpyrifos (O,O-diethyl O-(3,5,6-trichloro-2-pyridyl)phosphorothioate; tradename Lorsban™ 4E Insecticide) and its metabolite 3,5,6-trichloro-2-pyridinol; abbreviated herein as TCP) in or on the raw agricultural commodity grapes at 1 ppm (of which no more than 0.8 ppm is chlorpyrifos); in raisin waste at 0.8 ppm (of which no more than 0.5 ppm is chlorpyrifos); in raisins at 0.2 ppm; and in grape pomace (wet or dry) at 3 ppm (of which no more than 2.5 ppm is chlorpyrifos).

Tolerances for combined residues of chlorpyrifos and its metabolite TCP in grapes at 0.5 ppm have been established under 40 CFR 180.342, and for residues of chlorpyrifos and its metabolite TCP in dried grape pomace at 2 ppm under 21 CFR 561.98. These tolerances were established in conjunction with PP2E2594/FAP2H5344 (IR-4), to regulate chlorpyrifos residues resulting from soil surface application of 2 quarts of a solution of 2.25 lbs. a.i./100 gallons to an area of 15 square feet around the vine base to control grape root borer. The use is regionally restricted, since the grape root borer occurs east of the Rockies. The grape root borer use thus differs from the foliar application proposed herein.

Tolerances for combined residues of chlorpyrifos and TCP have been established under 40 CFR 180.342 in or on various commodities, ranging from 0.05 to 15 ppm. Food additive tolerances are 1.5 to 10 ppm under 21 CFR 193.85, and feed additive tolerances under 21 CFR 561.98 range from 1 to 15 ppm. Tolerances for combined residues of chlorpyrifos and its metabolite TCP have been established at 0.5 ppm in milk fat (reflecting 0.02 ppm in whole milk); 2 ppm in meat, fat, and meat byproducts of cattle; 1 ppm in meat, fat and meat byproducts of goats, horses, and sheep; 0.5 ppm in meat, fat, and meat byproducts of hogs and poultry (including turkeys); and 0.1 ppm in eggs.

Conclusions:

1. The metabolism of chlorpyrifos in plants and animals is adequately understood. The residue of concern in both plants and animals consists of chlorpyrifos and its metabolite 3,5,6-trichloro-2-pyridinol.

2. Adequate analytical methods are available for enforcement purposes for chlorpyrifos and 3,5,6-trichloro-2-pyridinol.

3a) The residue data reasonably reflect the proposed use. Residues of chlorpyrifos and TCP are not likely to exceed the proposed tolerances of 1 ppm (of which no no more than 0.8 ppm is chlorpyrifos) in or on grapes, and 3 ppm (of which no more than 2.5 ppm is chlorpyrifos) in grape pomace (wet or dry). If and when aerial application is proposed, residue data reflecting such application will be required.

b) We are unable to determine residue levels expected in raisins and raisin waste processed from treated grapes bearing residues at the 1 ppm level. Residue data for the fractions raisins and raisin waste produced from grapes bearing chlorpyrifos residues at or near 1 ppm are needed before we can draw conclusions in this regard. In addition, the petitioner should describe the process used to separate raisins from raisin waste. From this information we may be able to make theoretical calculations of maximum expected residues in raisins and raisin waste. Food/feed additive tolerances will be needed only in those cases where residues in the processed product exceed those in the raw agricultural commodity.

c) In light of the relatively high tolerances established for alfalfa and corn forage, we conclude the existing meat, milk, poultry, and egg tolerances are adequate despite the fact that we are unable to draw no residue conclusions for raisin waste.

4. There are no Mexican or Canadian tolerances for chlorpyrifos in grapes. Codex limits for residues of the parent compound chlorpyrifos in grapes are established at 1 ppm. The

proposed U.S. tolerance is for 1 ppm of combined residues of chlorpyrifos and 3,5,6-trichloro-2-pyridinol (of which no more than 0.8 ppm is chlorpyrifos). We cannot recommend for the Codex limits because the U.S. tolerance is expressed in terms of parent and the metabolite TCP. TCP is included in the U.S. tolerance because it is a significant part of the residue on many treated commodities.

Recommendations:

We recommend against the establishment of the proposed tolerance, for the reason cited in Conclusions 3b.

For a favorable recommendation, the petitioner should be advised that the following information is needed.

1. Residue data for raisins and raisin wastes produced from grapes bearing residues at or near the proposed tolerance level of 1 ppm. A discussion of the procedure used to separate raisins from raisin waste may permit theoretical calculation of maximum expected residues.

3. The petitioner should be advised that residue data reflecting aerial application will be required if and when such use is proposed.

DETAILED CONSIDERATIONS

Formulation:

The formulation proposed for use on grapes is Lorsban™ 4E Insecticide, EPA Reg. No. 464-448, an emulsifiable liquid containing 40.7% of the active ingredient chlorpyrifos and 22.8% of the active ingredient aromatic petroleum derivative solvent. The inert ingredients in this formulation are cleared under 40 CFR 180.1001.

We have previously concluded that no residue problems are expected from the manufacturing impurities (A. Smith, 5/3/74, PP4F1445).

Directions for Use:

For control of variegated and spotted cutworm, orange tortrix, omnivorous leafroller, and grape leaffolder infesting grapes, apply 1 quart/acre/treatment (1 lb. a.i./A) of Lorsban™ 4E Insecticide as a broadcast foliar application in a minimum of 25 gallons of water per acre. Restrictions include: Do not make more than 3 applications per season or apply within 45 days before harvest. Do not use in conjunction with a soil surface spray application for grape root borer control.

We note the statement in Directions for Use-General Information: "Aerial spray equipment may be used where specified."

Accordingly, we consider the use on grapes to be limited to ground equipment. If aerial application is intended, residue data reflecting such application is needed.

Nature of the Residue:

The metabolism of chlorpyrifos in plants and animals has been previously discussed in our reviews of PP3F1306 (corn, beans), PP0F2281 (apples, soybeans), PP1F2575 (citrus), and PP2E2584 (grapes). In view of the TOX conclusion (PP0F2281, W. Dykstra, 10/21/81) that unidentified metabolites found in the apple and soybean studies are not of toxicological significance, we reiterate our previous conclusion that the metabolism of chlorpyrifos in plants is adequately understood and the residue of concern consists of chlorpyrifos and its metabolite 3,5,6-trichloro-2-pyridinol (TCP).

In animal metabolism studies involving rats, cows and goats, the major metabolites were parent chlorpyrifos and TCP (and conjugates of TCP). We consider the metabolism of chlorpyrifos in animals is adequately understood and the residue of concern consists of chlorpyrifos and its metabolite TCP.

Analytical Methods:

The analytical method for chlorpyrifos, entitled "Determination of Residues of O,O-Diethyl O-(3,5,6-Trichloro-2-Pyridyl)Phosphorothioate in Sugar Beets and Solid Process Fractions by Gas Chromatograpy" (J. H. Wetters, Method ACR 73.5) is essentially similar to methods in PAM II. In principle, the method for chlorpyrifos in whole grapes, raisin waste, juice, and wet and dry pomace involves extraction by blending with methanol, transfer to hexane after evaporation of the methanol, and partitioning with acetonitrile. The residue is transferred back to hexane and cleaned-up on a deactivated silica gel column. Quantitation is by gas chromatography using a flame photometric detector.

The analytical method for 3,5,6-trichloro-2-pyridinol is Method VII in PAM II. The TCP is extracted with methanolic sodium hydroxide, to hydrolyze any chlorpyrifos to TCP. An aqueous solution of the hydrolyzate is washed with benzene (discard), and then acidified, and the residue extracted into benzene. After cleanup on acidic alumina oxide column and additional cleanup by partition with sodium bicarbonate, the residue is derivatized with N,O-bis(trimethylsilyl) acetamide to form the trimethylsilyl derivative of pyridinol, which is quantitated by electron capture GC.

Untreated control samples showed 0.00 - 0.02 ppm of TCP in whole grapes. Limits of sensitivity for the specific method for chlorpyrifos per se were reported at 0.01 ppm in grapes and juice, 0.02 ppm in wet pomace and dry pomace, and 0.1 ppm in raisins and raisin waste. Limits of method sensitivity were reported at 0.05 for total residues of TCP (including TCP from the hydrolysis of

chlorpyrifos) in grapes, raisins, raisin waste, juice, wet pomace and dry pomace. Reported recovery values for chlorpyrifos per se in grapes and grape fractions ranged from 76 to 100% at 0.01 to 2.0 ppm fortification levels. Average recoveries were grapes 89%, raisin waste 91%, grape juice 82%, wet pomace 85%, and dry pomace 92%. Reported recovery values for TCP in grapes and grape fractions ranged from 80 to 106% at fortification levels of 0.05 to 1.0 ppm. Average recoveries were grapes 94%, raisins 91%, raisin waste 100%, and grape juice 99%.

We conclude that adequate methods are available for enforcement purposes.

Residue Data:

Residue data are available for 8 trials: 7 in CA, and 1 in NY. According to "Agricultural Statistics, 1981", California produced about 92% of the total U.S. production of grapes for all purposes, and New York produced an additional 3%. The geographical distribution of the residue trials is considered adequate. The trials reflect both high volume (dilute: 190-250 gallons/A) and low volume (concentrate: 25 gallons/A) applications. Applications were made at first bud swell, post bloom (45 days), and midseason (105 days). All applications were made by ground equipment. While use directions for grapes do not mention aerial application, other instructions on the label indicate aerial application is permitted only on crops where specific aerial application directions are given. Thus, we consider the currently proposed use to be limited to ground application equipment. The petitioner should be informed that additional residue data reflecting aerial application will be required, if and when aerial application directions are proposed.

Samples of grapes were collected 44-45 days after last application (149-150 days after first application), while some grapes were field-dried for 21 days. Samples of whole grapes were processed into juice, and wet and dry pomace fractions, while raisin samples were processed into raisins and raisin waste.

All samples were analyzed by the method for total TCP; only those samples showing residues greater than 0.1 ppm were analyzed by the specific method for chlorpyrifos.

In whole grapes, of which there are 32 samples, 19 showed total residues <0.1 ppm and thus were not examined for chlorpyrifos per se by the specific method. Residues of chlorpyrifos in the 8 whole grape samples examined by the specific method showed levels of 0.45 to 0.81 ppm chlorpyrifos. In those samples examined for chlorpyrifos, residues of the metabolite TCP ranged from ND to 0.17 ppm.

We conclude that the residue data reasonably reflect the proposed use and that combined residues of chlorpyrifos and TCP

are not likely to exceed the proposed 1 ppm tolerance (of which no more than 0.8 ppm is chlorpyrifos) in or on grapes.

Processed Commodities:

Raisins:

In two trials (Davis, CA, and Parlier, CA), treated grapes were field dried to raisins for 21 days after harvest of the whole grapes. At the Davis location, whole grapes contained <0.05 to 0.1 ppm of chlorpyrifos, while whole grapes at Parlier contained <0.05 to 0.07 ppm chlorpyrifos. Raisins produced from these grapes showed <0.05 to 0.11 ppm of total TCP (hydrolyzed from chlorpyrifos plus metabolic TCP; chlorpyrifos per se was not determined). Raisin waste fraction derived from Davis samples showed <0.10 to 0.23 ppm of chlorpyrifos plus 0.29 to 0.32 ppm TCP, while at the Parlier location raisin wastes showed 0.12 ppm chlorpyrifos plus 0.07 ppm of TCP. Thus, raisin waste showed about 4X concentration compared to raisins. The petitioner does not, however, describe the procedure for separating raisin waste from raisins, i.e., the composition of the raisin waste samples. If we had such information, it may be possible to make theoretical calculations of maximum expected residues in these fractions.

Since the whole grapes used to make these raisins contained residue levels far lower than the proposed tolerance of 1 ppm in or on whole grapes, we are unable to estimate total residues in raisins produced from grapes bearing residues at or near the proposed tolerance level for whole grapes (1 ppm). Similarly, we are unable to estimate total residues in raisin wastes produced from fresh grapes bearing residues at or near the proposed 1 ppm tolerance level. Residue data for the fractions raisins and raisin waste produced from grapes bearing chlorpyrifos residues at or near the proposed tolerance level of 1 ppm is needed before we can draw a conclusion in this regard. In addition, the petitioner should describe the process used to separate raisin waste from raisins. From this information we may be able to make theoretical calculations of maximum expected residues in raisins and raisin waste.

Juice and Pomace:

In two trials (Hopland, CA, and Knights Valley, CA), treated grapes were processed to juice, wet pomace, and dry pomace fractions. At the Hopland location, whole grapes contained 0.11 to 0.15 ppm of total TCP, while whole grapes at Knights Valley contained 0.45 to 0.70 ppm chlorpyrifos plus 0.07 to 0.17 ppm TCP.

Juice produced from the Hopland grapes showed <0.05 ppm total TCP (hydrolyzed from chlorpyrifos plus metabolic TCP; chlorpyrifos per se was not determined). Juice produced from the Knights Valley ~~grapes~~ showed 0.03 ppm of chlorpyrifos per se and <0.05 ppm TCP. Wet pomace from the Hopland grapes showed 0.25 ppm of chlorpyrifos per se and <0.05 ppm of TCP , while dry pomace contained 0.40 ppm

chlorpyrifos per se and 0.11 ppm TCP. Wet pomace from the Knights Valley grapes showed 1.1 ppm of chlorpyrifos per se and 0.12 ppm TCP, while dry pomace contained 2.1 ppm chlorpyrifos per se and 0.20 ppm TCP . Thus, the concentration factors for total combined residues of chlorpyrifos and TCP in juice, wet pomace and dry pomace fractions can be calculated at 0.3, 1.6, and 3, respectively. Based upon these data, residues in grape juice or wine are not expected to exceed the proposed tolerance of 1 ppm in whole grapes (of which no more than 0.8 ppm is chlorpyrifos). A food additive tolerance for the grape fraction, juice, is not required. Further, the proposed feed additive tolerance of 3 ppm (of which no more than 2.5 ppm is chlorpyrifos) in or on grape pomace (wet or dry) is adequate to cover expected residues.

Meat, Milk, Poultry and Eggs:

The animal feed items of concern herein are cull grapes, raisin waste, and grape pomace. These feed items are used in moderate amounts (maximum of 30%) in the diets of beef cattle, poultry, and lambs, and lesser amounts (20%) in the diets of swine and dairy cattle.

We are unable to determine either the adequacy or the necessity of the proposed tolerances on raisins and/or raisin waste. However, in light of the relatively high tolerances established for alfalfa and corn forage, we conclude the the existing meat and milk tolerances are adequate despite the fact that we are unable to draw no residue conclusions for raisin waste. We are conclude that secondary residues in meat, milk, poultry and eggs will not exceed the established tolerances.

OTHER CONSIDERATIONS:

There are no Mexican or Canadian tolerances for chlorpyrifos in grapes. Codex limits for residues of the parent compound chlorpyrifos in grapes are established at 1 ppm. The proposed U.S. tolerance is for 1 ppm of combined residues of chlorpyrifos and 3,5,6-trichloro-2-pyridinol (of which no more than 0.8 ppm is chlorpyrifos). We cannot recommend for the Codex limits because the U.S. tolerance is expressed in terms of parent and the metabolite TCP. TCP is included in the U.S. tolerance because it is a significant part of the residue on many commodities.

cc: R.F., Circu, Russell W. Cook, FDA, PP#3E2872/FAP3H5393, TOX
EEB, EAB, Robert E. Thompson
RDI:Section Head:RSQuick:Date:7/19/83:RDSchmitt:Date:7/19/83
TS-769:RCB:Reviewer:RWCook:Date:7/18/83:CM#2:RM:810:557-7377

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INTERNATIONAL RESIDUE LIMIT STATUS

F. Suss 6/13/83

CHEMICAL Chlorpyrifos

PETITION NO. 3F2872/FAP3H5393
R. W. Cook

CCPR NO. 17

Codex Status

☐ No Codex Proposal Step 6 or above

Proposed U.S. Tolerances

Residue (if Step 9):

chlorpyrifos only 1/

Crop(s)	Limit (mg/kg)
grapes	1 1/

Residue: Combined residues of chlorpyrifos and 3,5,6-trichloro-2-pyridinol

Crop(s)	Tol. (ppm)	
Grapes	1	(nmt 0.8)
Raisin waste	0.8	(nmt 0.5)
Grape pomace (wet or dry)	3	(nmt 2.5)
Raisins	0.2	

CANADIAN LIMIT

Residue:

Crop	Limit (ppm)
none (on grapes)	

MEXICAN TOLERANCIA

Residue:

Crop	Tolerancia (ppm)
none (on grapes)	

Notes: grapes: 1 ppm (of which no more than 0.8 ppm is chlorpyrifos);
raisin waste: 0.8 ppm (of which no more than 0.5 ppm is chlorpyrifos);
grape pomace: (wet or dry) at 3 ppm (of which no more than 2.5 ppm is chlorpyrifos).

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1/ Aside from numerical considerations, consideration needs to be given as to whether the U.S. definition of residue can be made compatible with that of Codex. Referral to Tox may be useful.

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