PMSD/ISB

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

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OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Permethrin. Anticipated Residue. No MRID #. No DEB #.

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THRU: Richard D. Schmitt, PhD, Chief
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TO: James Kariya, Acting Section Head
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Dietary Exposure Branch (DEB) has been requested to provide anticipated residue estimates to DRES for the purpose of assessing the dietary exposure to permethrin residues in foods.

Tolerances are established for permethrin in/on numerous raw agricultural commodities (rac's) [40CFR180.378]. The rac's listed below are of special interest because of frequency and amount of consumption, high tolerance levels, and/or importance as animal feeds: alfalfa hay 55 ppm, apples 0.05 ppm, broccoli 1 ppm, Brussels sprouts 1 ppm, cabbage 6 ppm, cantaloupes 3 ppm, celery 5 ppm, cauliflower 1 ppm, cherries 3 ppm, corn grain 0.05 ppm, corn forage/fodder 60 ppm, leafy vegetables (except Brassica) 20 ppm, lettuce 20 ppm, mushrooms 6 ppm, peaches 5 ppm, pears 3 ppm, pepper 1 ppm, potatoes 0.05 ppm, pumpkins 2 ppm, soybeans 0.05 ppm, spinach 20 ppm, vegetables (cucurbit) 3 ppm, and tomatoes 2 ppm. Tolerances on the above rac's include residues of the parent compound and the sum of its metabolites 3-(2,2-dichloroethenyl)-2,2-dimethylcyclopropane carboxylic acid (DCVA) and 3-phenoxybenzyl alcohol (PBA).

Tolerances are also established in/on animal commodities at 0.05 ppm in poultry meat, 0.15 ppm in poultry fat, 0.25 ppm in poultry meat byproducts, 1 ppm in eggs, 0.25 ppm in cattle meat, 2 ppm in meat byproducts, 3 ppm in cattle fat, and 0.25 ppm in

whole milk. Tolerances on the animal commodities include residues of the parent compound, DCVA, 3-phenoxybenzyl alcohol, and 3-phenoxybenzoic acid (PBAcid).

No food/feed additive tolerances are established.

Permethrin has been registered for use for many years. It can be analyzed by one of the FDA multiresidue methods. Since the FDA monitoring data reflect various sampling districts and various sampling times, and include several varieties of certain foods such as tomatoes, peppers and apples, DEB concludes that the FDA monitoring data are adequately representative for dietary exposure assessment.

DEB received monitoring data for permethrin residues for the years 1985 to 1989 from FDA (E. Gunderson, 6/29/89). For most commodities, residues were not detectable. Finite levels of the parent compound (cis and trans isomers) were found in several leafy vegetables, however. The lowest level of permethrin which was reported in the monitoring data printouts was 0.01 ppm per isomer. On this basis, DEB estimated the detection limit to be 0.01 ppm and assigned nondetectable residues (ND) to be 0.01 ppm for the sum of 2 isomers.

For estimating dietary exposure of permethrin residues due to plant commodities, DEB has calculated anticipated residue values derived solely from domestic surveillance data except for tomatoes and peppers for which import surveillance data were also considered because of the numbers of samples collected. The total number of samples analyzed, residue range, total number of positive findings or "hits", and the anticipated residues for each crop are tabulated below.

Table 1

crop	total # samples	max residue in ppm	total # "hits"	anticipated residue (ppm)*
apples	1363	ND-0.03	1	0.01
artichokes	69	ND	0	0.01
avocados	11	ND	0	0.01
Brussels sprouts	76	ND	0	0.01
broccoli	663	ND-0.15	3	0.01
cauliflower	463	ND-0.03	1	0.01
cantaloupe	281	ND	0	0.01
cabbage	592	ND-3.84	29	0.03
cherries	283	ND	0	0.01
collards	166	ND-4.6	12	0.15
celery	385	ND-1.0	58	0.04
cottonseed	2	ND	0	0.01

cucumber	291	ND	0	0.01
field corn	155	ND	0	0.01
dandelion	18	ND-0.84	2	0.07
endive/ chicory	167	ND-2.42	14	0.07
lettuce	2661	ND-8.5	727	0.23
mushroom	145	ND-0.65	2	0.01
peppers	369	ND-0.2	1	0.01
peppers (imp)	3173	ND-2.12	152	0.02
pears	307	ND	0	0.01
peaches	404	ND-0.31	2	0.01
parsley	104	ND-1.17	1	0.02
potatoes	1298	ND	0	0.01
rhubarb	13	ND	0	0.01
squash	408	ND	0	0.01
sweet corn	280	ND-0.01	4	0.01
spinach	368	ND-4.8	74	0.21
swiss chard	49	ND-1.4	4	0.07
tomatoes**	820	ND	0	0.01
tomatoes (imp)	2538	ND-1.5	162	0.01
turnip green	126	ND-12.9	14	0.15
turnip root	96	ND	0	0.01
watermelon	233	ND	0	0.01
wheat grain	453	ND	0	0.01

* values of 0.01 ppm reflect the limit of detection of the FDA multiresidue method for cis and trans permethrin

** for fresh market only

Meat and Milk

Several of the registered crops or their plant parts or both are feed items and may be fed to livestock. A typical dairy cattle diet may consist of 30% corn grain, 25% corn silage, and 25% alfalfa hay; for beef cattle a typical diet may consist of 70% corn silage, 11% corn grain and 16% alfalfa hay (Forages, 4th edition, 1985, Chapter 58). According to BEAD, less than 10% of the field corn and less than 10% of the alfalfa were treated with permethrin in 1987 and 1988 (memo of J. Faulkner, 3/6/90).

Livestock feeding studies were discussed in PP8F2034 and PP8F2099. Cows were fed permethrin at 0.2, 1, 10 and 50 ppm for 28-31 days. At the 0.2 ppm and 1 ppm feeding levels, residues in milk were nondetectable (<0.01 ppm). At the 10 ppm and 50 ppm feed level, residues ranged from 0.02-0.06 ppm and 0.06-0.19 ppm, respectively. The individual milk analysis results (in ppm) for the 10 ppm and 50 ppm feeding dose are tabulated below.

	10 ppm	50 ppm
day 5	0.02 (2), 0.03	0.19, 0.07, 0.20
day 9	0.02 (2), 0.04	0.12, 0.15, 0.09
day 10	0.02 (2), 0.05	0.16, 0.10, 0.09
day 11	0.02, 0.04, 0.02	0.13, 0.04, 0.15
day 14	0.02 (2), 0.06	0.08, 0.06, 0.14

DEB calculated average milk residues of 0.03 ppm from the 10 ppm feeding level and 0.118 ppm from the 50 ppm feeding level.

Analyses for permethrin residues were also conducted for liver, kidney, muscle and fat. At the 0.2 ppm and 1 ppm feeding levels, residues were predominantly <0.01 ppm and ranged ≤ 0.01-0.04 ppm in liver, kidney, muscle and fat. Individual residue levels (in ppm) resulting from the 10 ppm and 50 ppm feeding levels are tabulated below:

	10 ppm	50 ppm
liver	<0.01 (3)	<0.01 (3)
kidney	<0.01, 0.01 (2)	0.02 (2), 0.06
muscle	<0.01, 0.01 (4) 0.02 (3), 0.03	0.02 (2), 0.03, 0.05, 0.06 (3), 0.07, 0.1
fat	<0.01, 0.02 0.04, 0.09, 0.11, 0.25	0.10, 0.14, 0.42 0.46, 0.49, 1.09

DEB calculated the following average values from the 10 ppm and 50 ppm feeding studies: 0.01 ppm and 0.033 ppm for kidney, 0.016 ppm and 0.052 ppm for muscle, and 0.086 ppm and 0.45 ppm for fat.

For the 50 ppm feeding level, permethrin metabolites were also analyzed (in ppm):

	DCVA	3-PBA	PBAcid
milk	not found	not found	not found
liver	0.01-0.04	0.05-0.1	0.1
kidney	0.07-0.09	0.01-0.09	0.03-0.04
muscle	<0.01-0.02	<0.01	<0.01
fat	not found	not found	not found

For the determination of the dietary burden in cattle, DEB estimated the anticipated residue values for the feed items on the basis of field trial data for field corn grain, corn silage and alfalfa hay. For corn, numerous residue data are available.

Residue data discussed in connection with PP2F2624 and PP1F2476 reflect field trials conducted in CO, GA, TX, NM, KS, NB, OK, SD, AR and LA. Following 3-5 x 0.2 lb ai/A and PHI's of 4-44 days, permethrin residues in corn grain ranged from ND-0.03 ppm. In addition, field trials data from IL, NJ, CO, and NE were collected at 1 x 2 lbs ai/A treatments (PP1F2476, 10x the registered rate), and residues of permethrin were nondetectable (<0.01 ppm) in corn grain. DEB estimated an anticipated residue of 0.005 ppm in corn grain.

For corn forage/fodder, permethrin residues reflecting PHI's of 28 days were used since there is a label restriction of "do not cut for silage or graze livestock within 30 days of application." These residue values were: 0.68, 0.05, 1.9 and 0.96 ppm (PP2F2624 submission) following 2-5 x 0.2 lb ai/A (2-5 times the registered rate). DEB calculated an anticipated residue of 0.23 ppm after normalizing to the 1x use rate.

For alfalfa hay residue data (PP0F2389) reflecting registered use were used in the calculation of anticipated residue. Residues (data representing AZ, CA, WA, CO and NV) following 1 x 0.1 lb ai/A (PHI=0 day) ranged from 4.9-39.9 ppm permethrin with a calculated average of 16.3 ppm; residues resulting from 1 x 0.2 lb ai/A (PHI=7 days) ranged from 1.8-56.4 ppm with a calculated average of 19.6 ppm. Data from trials conducted in NY, WI and KS were also reviewed in 1987. Residues ranged from 1-31.5 ppm (0.1 lb ai/A) with an average of 15.6 ppm and ranged from 1-11.4 ppm (0.2 lb ai/A) with an average of 5.32 ppm. This resulted in an anticipated residue of 14.2 ppm.

The dietary burden for dairy cattle would then be 3.78 ppm (30% corn grain or 0.0015 ppm + 25% corn silage or 0.23 ppm on a dry weight basis after corrected for 75% moisture content in corn silage + 25% alfalfa hay or 3.55 ppm). Extrapolating from the feeding study data (10 ppm or 50 ppm), DEB estimated permethrin residues in milk to be 0.009-0.01 ppm. Percents of crop treated have not been included in the estimation.

The dietary burden for beef cattle would be 2.91 ppm (70% corn silage or 0.64 ppm on a dry weight basis + 11% corn grain or 0.0006 ppm + 16% alfalfa hay or 2.27 ppm). Extrapolating from the feeding study data (50 ppm), DEB estimated anticipated permethrin residues of 0.003 ppm in muscle (including liver), 0.002 ppm in kidney, and 0.026 ppm in fat. Again, percents of crop treated have not been included in the estimation.

The poultry feeding study was reviewed in connection with PP8F2044. Chickens were fed permethrin at levels of 0.4, 3.4 and 33 ppm in their diet for either 21 or 28 days. Egg samples were taken throughout the entire study. Residues in the liver samples at all feeding levels were <0.01 ppm. Residues in the muscle (with skin and fat included) were <0.01 ppm at the 0.4 ppm and 3.4 ppm

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feeding level. At the 33 ppm feeding level, residues in the muscle ranged up to 0.08 ppm.

Residues in the whites at all feeding levels and at all sampling intervals were <0.02 ppm. Residues in the yolks at the 0.4 ppm feeding levels were also all <0.02 ppm. At the 3.4 ppm feeding level, residues in the yolks ranged up to 0.05 ppm. At the 33 ppm feeding level, residues in the yolks ranged up to 0.64 ppm.

The permethrin dietary burden for poultry would be around 0.004 ppm (75% corn grain x 0.005 ppm). At this level of animal exposure, DEB estimated transfer of permethrin residues to poultry meat and eggs to be <0.0001 ppm.

For assessing dietary exposure to meat and milk, DEB recommends the following permethrin residues be used (percents of crop treated have been included):

Table 2

0.0003 ppm	meat and meat byproducts (except kidney)
0.0003 ppm	beef liver
0.0002 ppm	beef kidney
0.003 ppm	beef fat
0.001 ppm	milk
0.00001 ppm	eggs
0.000005 ppm	poultry (skin + muscle, kidney, and liver)

CONCLUSIONS AND RECOMMENDATION

1) Only the parent compound was analyzed in the FDA monitoring program. DEB has determined anticipated residues for various crops based on the 1985-1989 FDA monitoring data. This is justified since plant metabolism studies have shown that the parent compound is an important and significant residue on plants treated with permethrin. For example, 30-42 day after foliar treatment, residues on cabbage leaves consist of 64-92% parent, hydroxylated parent and/or conjugates; metabolites occupy only a small percentage of the total residues (3% DCVA and 9% 3-PBA). For at least 2 weeks, 60 percent of the residues on apples treated with permethrin consist of the parent, hydroxylated parent and/or conjugates. Permethrin has also been observed to degrade relatively slowly on apples, beans, cabbage and cotton (comprising 60% of the residues in cotton bolls 28 days after treatment).

2) The meat and milk estimates are for parent compound only. As seen from the above discussion in Table 2, DCVA, 3-PBA and PBAcid metabolites form most of the residues in liver and kidney. Liver and kidney metabolite residues of permethrin amount to approximately 4x the levels of the parent compound. If these levels are significant and it is deemed necessary to include these metabolites in the dietary exposure assessment, then DEB would provide more accurate estimate.

DEB recommends that the anticipated residue values listed for the various plant and animal commodities in Tables 1 and 2 be used in the permethrin dietary exposure assessment.

cc:Circ, RF, SF, Cheng, PMSD/ISB
RDI:FSuhre:3/12/9:EZager:3/12/9
H7509C:DEB:CM#2:Rm810:Cheng:3/8/90:1:3/12/90