Shaugh. No. 081301-4

EAB Log Out Date: JAN 13 1987

Init.: _____

To: H. Jacoby
Product Manager 21
Registration Division (TS-767)

From: Carolyn K. Offutt
Chief, Environmental Processes and Guidelines Section
Exposure Assessment Branch, HED (TS-769)

Attached, please find the environmental fate review of:

Reg./File No.: 476-2099

Chemical: Captan

Type Product: F

Product Name: Captan

Company Name: Stauffer Chemical Company

Submission Purposes: Evaluate reentry data for Captan Registration Standard - Use on strawberries and apples

Action Code: 660

Date In: 6/4/86

EAB#: 6691

Date Completed: 1/12/87

TAIS (Level II)	Days
101	2

Deferrals To:

_____ Ecological Effects Branch

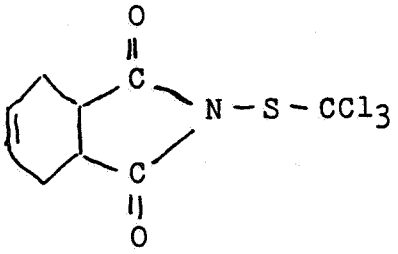
_____ Residue Chemistry Branch

_____ Toxicology Branch

EVALUATION OF CAPTAN REENTRY DATA

1. CHEMICAL:

Chemical name: cis-N-((Trichloromethyl)thio)-4-cyclohexene-1,2-dicarboximide
Common name: Captan
Structure:



2. TEST MATERIAL:

All studies used a 50% wettable powder formulation.

3. STUDY/ACTION TYPE:

Review of reentry data submitted for the Captan Registration Standard.

4. STUDY IDENTIFICATION:

1. "A Breakdown Study of Captan (Orthocide) on Strawberry Foliate and Fruit in Ventura County, California April, 1977", K.T. Maddy, C.S. Kahn, L. Riddle, and J. Alexander; Agricultural Chemicals and Feed, CDFA, 1220 N Street, Sacremento, California 95814

2. "A Study of the Decay of Captan on the Foliage and Fruit of Strawberries in Santa Cruz County California May, 1977", K.T. Maddy, S. Edmiston, C.S. Kahn, and T. Jackson; Agricultural Chemicals and Feed, CDFA, 1220 N Street, Sacremento, California 95814

3. "Harvester Exposure to Captan During Apple-Picking: Preliminary Evaluation of Pennsylvania State University Data", R.D. Knapp, Environmental Services Department, Penn State U, February 8, 1982

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Submitted by: Stauffer Chemical Company
1200 South 47th Street
Richmond, California 94804
Issue Date: 6/9/86
Identifying No: 476-2099
Accession No: 252447

5. REVIEWED BY:

Matthew N. Lorber, Agricultural Engineer Date 1/12/87
Environmental Processes and Guidelines Section/EAB/HED

6. APPROVED BY:

Carolyn E. Offutt, Chief Date 1/12/87
Environmental Processes and Guidelines Section/EAB/HED

7. CONCLUSIONS:

The three studies fulfill data requirements stated in the Captan Registration Standard for strawberries and apples for determination of reentry intervals. The registrant could have proposed reentry intervals based on these data, but since none was proposed by the registrant, recommendations for reentry intervals on strawberries and apples are listed below. Included in this data submission are also 4 studies which address applicator exposure, a dermal adsorption study, and a captan metabolism study in rats. These studies were not evaluated and should be rerouted to the appropriate reviewers.

8. RECOMMENDATIONS:

The registrant should amend the label for captan application to strawberries and apples to include the following reentry intervals:

Strawberries:	12 days
Apples:	3 days

9. BACKGROUND:

On May 8, 1986, EPA met with representatives of three companies, Chevron Chemical Company, Makhteshim-Agan(America) Inc., and Stauffer Chemical Company, to address the requirements of the Captan Registration Standard. Several reentry studies had been submitted, but were not mentioned or referenced. Stauffer sent in this package to be rereviewed and the Registration Standard requirements reevaluated.

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10. DISCUSSION

Prior to determining a reentry interval from data presented in the submitted studies, an Allowable Exposure Level (AEL) was determined using the the Captan one-liner supplied by the Toxicology Branch. The limiting toxic result from this one-liner was given as a teratological dietary exposure ADI of 0.2 mg/kg/day for humans. Several other teratological NOELs listed include: 50 mg/kg/day for hamsters, 25 mg/kg/day for rabbits, and 12.5 mg/kg/day for monkeys. Also given by the one-liner was a maximum dermal adsorption rate on rats of 1.3%/hr. Assuming a 50-kg woman in the first trimester of pregnancy, an Allowable Exposure Level is determined as:

$$AEL = \frac{(0.2 \text{ mg/kg/day}) * (50 \text{ kg/person})}{(8 \text{ hr/day}) * (0.013/\text{hr}) * (8 \text{ hr})}$$

$$= 12 \text{ mg/hr}$$

Each study will now be evaluated seperately:

1) "A Breakdown Study of Captan (Orthocide) on Strawberry Foliage and Fruit in Ventura County, California"

In this study, 3 pounds per acre of Captan were applied to strawberry fields in the form of Orthocide 50 wettable. The application was on a 20-acre site in Ventura County, CA, and was on April 4, 1977. Duplicate samples were taken on days 1, 2, 3, 7, and 9 following application, and each sample was a composite of 100 leaf discs of 2.5 cm in diameter. Weather records kept during the study showed a maximum and minimun temperature of 68.4 and 47.0 °F, and no rainfall or irrigation.

This study did not fulfill requirements for a dislodgeable residue dissipation study because the results were not expressed in terms of mass per unit area, but rather in parts per million. However, a conversion factor of 40 cm^2/gm for both sides of a leaf, or 20 cm^2/gm for one side of the leaf, will be assumed for strawberry leaves for the purpose of calculating a reentry interval (personnal communication, J. Adams). Whole body dose rates in ug/hr are estimated using dislodgeable residue levels, an assumption of 20 cm^2/gm to convert ppm to ng/cm^2 for one side of a leaf, and Popendorf's correlation as amended with EAB data (note: this correlation is based on one side of a leaf). This correlation is attached to the review. Table 1 lists: the number of days following application, the dislodgeable residue results expressed in ppm, the conversion to ng/cm^2, and the whole body dose rate.

As can be seen, the AEL of 12 mg/hr is not reached during the nine-day study, as the estimated dose rate on the ninth day is 28 mg/hr. However, this data can be extrapolated by estimating the foliar dislodgeable residue half-life based on the data, and then determining the date at which dislodgeable residues would

Table 1.

# days	dislodgeable residues, ppm	dislodgeable residues, ng/cm^2	whole body dose rate, ug/hr
1	118	$5.90 * 10^3$	$9.0 * 10^4$
2	86	4.30 "	8.0 "
3	80	4.00 "	7.0 "
7	41	2.04 "	3.6 "
9	35	1.76 "	2.8 "

lead to a dose rate at or below 12 mg/hr. Assuming the residue at day 1 is the concentration at time 0, and dissipation follows first-order kinetics, half-lives calculated after days 2, 3, 7, and 9, range from 2.2-4.6 days. Assuming a dislodgeable residue half-life of 3.5 days, a dose rate of 12 mg/hr is reached after 11.9 days. Therefore, a 12-day reentry interval is calculated for strawberries based on this data and assumptions listed above.

2) "A Study of the Decay of Captan on the Foliage and Fruit of Strawberries in Santa Cruz County, California May 1977"

In this study, 2 pounds per acre of Captan were applied to strawberry fields in the form of Orthocide 50 wettable. The application was on a 2-acre site in Santa Cruz County, CA, and was on May 2, 1977. Duplicate samples were taken on days 0, 1, 2, 3, and 7 following application, and each sample was a composite of 100 leaf discs of 2.5 cm in diameter. Weather records kept during the study showed a maximum and minimun temperature of 61.8 and 43.9 °F, and 0.22 and 0.31 inches of rainfall fell on days 6 and 7, respectively.

This study did not fulfill requirements for a dislodgeable residue dissipation study because the results were not expressed in terms of mass per unit area, but rather in parts per million. However, a conversion factor of 20 cm^2/gm will be assumed for one side of strawberry leaves for the purpose of calculating a reentry interval (see explanation for this assumption in the review of the previous study). Whole body dose rates in ug/hr are estimated using dislodgeable residue levels and Poppendorf's correlation, as amended with EAB data. Table 2 lists: the number of days following application, the dislodgeable residue results expressed in ppm, the conversion to ng/cm^2, and the whole body dose rate.

As can be seen, the AEL of 12 mg/hr is not reached until the second day following application. Therefore, a 2-day reentry interval is calculated from this data.

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Table 2.

# days	dislodgeable residues, ppm	dislodgeable residues, ng/cm^2	whole body dose rate, ug/hr
0	66.4	3.32 * 10^3	5.8 * 10^4
1	95.5	4.78 "	8.9 "
2	8.8	0.44 "	0.5 "
3	5.0	0.26 "	0.3 "
7	11.2	0.56 "	0.8 "

Justification for 12-day reentry interval for strawberries:

Despite the fact that one of the two studies reviewed imply a 2-day reentry interval, a 12-day interval for strawberries is recommended. A primary justification for this recommendation is making the conservative choice between the two studies. Secondly, a 12-day reentry interval for strawberries is also implied for another literature study on worker exposure to captan on strawberries. In that study by Zweig, et al (Zweig, G., R. Gao, and W. Popendorf. 1983. J. Agric. Food Chem., Vol. 31: 1109-1113), 4 lb of captan (formulation unspecified) were applied to strawberries on May 15, 1982. Ten workers were measured for dermal exposure for a 2-hr period on May 19. The following table lists comparable results from the three studies, including rate of application, dermal exposure at approximately the same time following application, and dislodgeable foliar residue.

Table 3.

Application lb ai/ac	Days After Application	Dermal Exposure mg/hr	Dislodgeable Residues ug/cm^2
2.0	3	3.0	0.26
3.0	3	70.0	4.00
4.0	4	39.0	4.55

It is noted that the dermal exposure and dislodgeable residues for the 2- and 3-lb rates were estimated based on an assumption of a 20 gm/cm^2 conversion factor (since results were reported in ppm). Since this is a conservative assumption, in all likelihood, the dermal exposure and dislodgeable residue results for the 2- and 3-lb rates would be lower. As well, the method of application of captan for the 4.0 lb rate was described by Zweig, et al as: "...the latest application prior to the study took place on May 15, 1982 (4 days prior to the study) and consisted of the following given as active ingredient (a.i.): 1.5 gal of EC dicofol (2.4 lb of a.i.); 1 lb of benomyl; 4 lb of captan." This would imply

that the captan was applied as an EC for the 4-lb rate, in comparison to a w.p. formulation for the 2- and 3-lb rate. Given that an E.C. dissipates more rapidly than a w.p. formulation, if the 4-lb rate had been applied as a w.p., then dermal exposure and dislodgeable residues would be higher than listed above.

With these two qualifiers, one can attempt to estimate a reentry interval based on Zweig's study. Again assuming a dislodgeable residue half-life of 3.5 days, a residue level of 4.55 ug/cm^2 after 4 days, and Popendorf's correlation amended with EAB data, a reentry interval of 12.5 days can be calculated. On this basis, a 12-day reentry interval over all application rates and methods is felt justifiable for captan applications to strawberries.

3) "Harvester Exposure to Captan During Apple-Picking: Preliminary Evaluation of Pennsylvania State University Data"

This study directly measured exposure of apple-pickers to Captan during an apple-picking operation. Dermal and inhalation exposure was measured for a crew of five on days 1, 3, 7, and 14 following application of a maximum label rate of 6 lb of 50% W per acre of captan. All five pickers practiced standard methods of apple picking and the study was conducted on a commercial farm. Dermal exposure was estimated with multi-layered gauze pads on several parts of the body, both on the outside and inside of a single layer of clothing. Inhalation exposure was measured with air samplers drawing 2 L/min of air through 37 mm-diameter quartz-fiber filter mounted in a conventional closed-faced cassette attached to the worker's lapel. Specific procedures for exposure measurement determined from the methodology of Durham and Wolfe. This study was evaluated for applicability to Guideline Requirements 133-3 and 133-4.

The study was found to fulfill the requirements of these guidelines despite some problems. One major problem was that exposure to hands was estimated with an ethanol rinse, rather than with the use of cotton gloves as recommended in the guidelines. A second problem was that application was in late August, whereas standard practices for that area (p. 4-5 of the study) call for 3-4 applications during bloom period in mid-May and 1-2 applications during the pre-harvest period in late September. By applying during August when the temperatures got to 90 °F and higher (p. 5), it is expected that the Captan would dissipate more rapidly as compared to the cooler application periods of late September or mid-May. As well, bloom period applications are at a maximum rate of 6 lb ai/ac and pre-harvest rates are at 3 lb ai/ac. Therefore, this pre-harvest application was not standard practice both in terms of time and rate of application. Finally, the calculations of body area in this study are higher than given in the guidelines. However, this problem would tend to overestimate, rather than underestimate, exposure as compared to the guideline requirements.

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Total foliage and apple residues were also measured for these days. However, dislodgeable foliar residues were not calculated, and hence this data was found not to fulfill guideline requirement 132-2. Foliar dislodgeable residues could be estimated if a ratio of apple leaf surface area to volume were available. However, since exposure is directly measured by this study, this estimate was not sought.

All analytical methodology, quality control results, and individual results for each worker were included as appendices to this report. These are available in RD files if they are needed for further intepretation.

Results of this study are given in Table 3 below. As seen, exposure levels at or below 12 mg/hr were not reached until the third day. On this basis, a 3-day reentry interval is recommended for apples.

Table 3.

Days Post-Application	Man-Days Sampled	Measured Mean Hourly Exposure, mg/hr			Crop Residues ppm	
		Skin	Respired	Total	Apples	Foliage
1	5	12.2	0.06	12.3	3.4	128
3	5	10.6	0.09	10.7	2.9	85
7	5	9.7	0.05	9.8	2.4	37
14	5	6.0	0.06	6.1	2.4	39