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To: R. Mountfort
Product Manager #23
Registration Division (TS-767C)

From: Paul Mastradone, Acting Chief *PM*
Environmental Chemistry Review Section #1
Exposure Assessment Branch/HED (TS-769C)

Through: Paul F. Schuda, Chief
Exposure Assessment Branch/HED (TS-769C)

Paul F. Schuda

Attached, please find the EAB review of . . .

Reg./File # : 239-1246
Chemical Name : Captan
Type Product : Fungicide
Product Name : Orthocide
Company Name : Chevron Chemical Company
Purpose : Addendum to a Standard

Date Received: 6/29/88 Action Code: 660
Date Completed: 8/3/88 EAB # (s): 80862
Monitoring Study Requested: _____ Total Reviewing time: 4 days
Monitoring Study Volunteered: _____

Deferrals to: _____ Ecological Effects Branch
_____ Residue Chemistry Branch
_____ Toxicology Branch

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1. CHEMICAL: Common name:

Captan

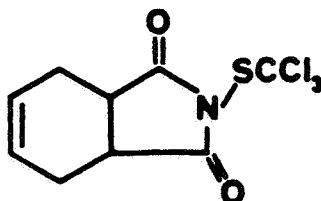
Chemical name:

cis-N-Trichloromethylthio-4-cyclohexene-1,2-dicarboximide.

Trade name(s):

Orthocide, Captanex, Captaf, Merpan, Vondcaptan.

Structure:



Formulations:

Dust, flowables, and wettable powder.

Physical/Chemical properties:

Molecular formula: $C_9H_8Cl_3NO_2S$.

Molecular weight: 300.6.

Physical state: Colorless to beige amorphous solid (technical), colorless crystals (analytical).

Melting point: 175 C (analytical grade).

Vapor pressure: <1.3 mPa at 25 C.

Solubility: <5 mg/L in water at room temperature; insoluble in petroleum oils; at 25 C, 70 g/kg in chloroform, 20 g/kg in acetone, 20 g/kg in cyclohexanone, 20 g/kg in xylene, and 1 g/kg in 2-propanol.

2. TEST MATERIAL:

Trichloromethyl-labeled [^{14}C]captan, analytical grade - Studies 2, 3, and 4.

Tetrahydrophthalamide-labeled [^{14}C]captan, analytical grade - Study 1.
[^{14}C]Captan. label position not specified - Study 5.

3. STUDY/ACTION TYPE:

Addendum to a Standard.

4. STUDY IDENTIFICATION:

Pack, D.E. 1977. Soil mobility of captan, folpet, and captafol as determined by soil thin-layer chromatography. File No:722.0. Prepared and submitted by Chevron Chemical Company, Richmond, CA. (40658011)

Pack, D.E. 1987. Estimation of soil adsorption coefficient of captan from TLC data. Laboratory Project ID MEF-0073/8726836. Prepared and submitted by Chevron Chemical Company, Richmond, CA. (40658011)

Pack, D.E. and I.S. Verrips. 1988a. Aerobic soil metabolism of [trichloromethyl-¹⁴C]captan. Laboratory Project ID MEF-0060/8809887. Prepared and submitted by Chevron Chemical Company, Richmond, CA. (40658007)

Pack, D.E. and I.S. Verrips. 1988b. Anaerobic soil metabolism of [trichloromethyl-¹⁴C]captan. Laboratory Project ID MEF-0061/8809887. Prepared and submitted by Chevron Chemical Company, Richmond, CA. (40658008)

Ruzo, L.O., A.L. Kesterson, S.B. Jackson, and L.J. Lawrence. 1988a. Soil surface photolysis of [¹⁴C]captan in natural sunlight. Laboratory Project ID ORTHO:MEF-0068. PTRL Report No. 1142. PTRL Project No. 232. Prepared by Pharmacology and Toxicology Research Laboratory (PTRL), Lexington, KY, and submitted by Chevron Chemical Company, Richmond, CA. (40658010)

Ruzo, L.O., A.L. Kesterson, S.B. Jackson, and L.J. Lawrence. 1988b. Soil surface photolysis of [¹⁴C-trichloromethyl]captan in natural sunlight. Laboratory Project ID ORTHO:MEF-0075. PTRL Report No. 231-2. PTRL Project No. 231. Prepared by Pharmacology and Toxicology Research Laboratory (PTRL), Lexington, KY, and submitted by Chevron Chemical Company, Richmond, CA. (40658009)

5. REVIEWED BY:

L. Lewis
Environmental Scientist
EAB/HED/OPP
Review Section #1

Signature: *L. Lewis*

Date: AUG 8 1988

6. APPROVED BY:

Paul Mastradone
Supervisory Chemist
EAB/HED/OPP
Review Section #1

Signature: *Paul J. Mastradone*

Date: AUG 8 1988

7. CONCLUSIONS

Five studies were submitted and reviewed. Two studies (Photodegradation on Soil; MRID 40658010 and 40658009) were considered unacceptable because the text did not adequately and clearly explain the experimental design and the source of some data. One study was conducted using tetrahydrophthalamide-labeled [¹⁴C]captan, and the second study using trichloromethyl-labeled [¹⁴C]captan. If these studies are resubmitted with additional information (see individual DERs for details), they may fulfill data requirements.

The remaining three studies (MRID 40658007, 40658008, and 40658011) are acceptable and partially fulfill data requirements for aerobic and anaerobic soil metabolism studies, and leaching and adsorption/desorption studies.

The following lists the current status of the captan data requirements as per the EAB files:

Hydrolysis (161-1):

One study was reviewed (MRID 00096974) that partially fulfilled data requirements by providing information on the hydrolysis of the tetrahydrophthalamide portion of the captan molecule at pHs ranging from 2 to 9. A second study (MRID 40208101) provided acceptable information on the hydrolysis of trichloromethyl-labeled [¹⁴C]captan at pH 9. Data are still needed on the hydrolysis of trichloromethyl-labeled [¹⁴C]captan at pH 5 and 7.

Photodegradation in Water (161-2):

Existing data (MRID 40208102) will be accepted upon receipt of acceptable data on the hydrolysis of captan at pH 5.

Photodegradation on Soil (161-3):

Data were provided on both the trichloromethyl and tetrahydrophthalamide portions of the captan molecule (MRID 40658010 and 40658009, respectively). Additional information is needed for both studies as detailed in the DERs.

Photodegradation in Air (161-4):

Based on acceptable data showing that the volatility of captan from soil under laboratory conditions is low, EAB has recommended waiving the photodegradation in air data requirement in a review dated July 28, 1988.

Metabolism - Aerobic Soil (162-1):

One study was reviewed (MRID 00070414) that partially fulfilled data requirements by providing information on the aerobic soil metabolism of the tetrahydrophthalamide portion of the captan molecule. A second study

(MRID 40658007) provided acceptable information on the aerobic soil metabolism of trichloromethyl-labeled [¹⁴C]captan. Taken together, these two studies completely fulfill the requirement for aerobic soil metabolism data for captan.

Metabolism - Anaerobic Soil (162-2):

One study was reviewed (MRID 00098881) that partially fulfilled data requirements by providing information on the anaerobic soil metabolism of the tetrahydrophthalamide portion of the captan molecule. A second study (MRID 40658008) provided acceptable information on the anaerobic soil metabolism of trichloromethyl-labeled [¹⁴C]captan. Taken together, these two studies completely fulfill the requirement for anaerobic soil metabolism data for captan.

Metabolism - Anaerobic Aquatic (162-3):

No acceptable data have been submitted, but all data are required.

Metabolism - Aerobic Aquatic (162-4):

No acceptable data have been submitted, but all data are required.

Mobility - Leaching and Adsorption/Desorption (163-1):

One study was reviewed (MRID 00096972) that partially fulfilled data requirements by providing information on the leaching and adsorption/desorption characteristics of the parent captan molecule in clay and clay loam soils only. A second study (MRID 40658011) provided acceptable information on the mobility (soil TLC) of unaged [¹⁴C]captan in sandy loam, silty clay loam, two clay loam, and clay soils. Taken together, these two studies provide complete information on the mobility of the parent captan molecule in a variety of soil types.

Additional information was requested on the mobility of the THPI and TCMT degradates of captan. The registrant provided acceptable mobility data for THPI by submitting a study on the leaching characteristics of captafol (see attached review). Since the aerobic soil metabolism data using trichloromethyl-labeled [¹⁴C]captan shows rapid degradation to CO₂, no further mobility data for captan are required.

Mobility - Laboratory Volatility (163-2):

One study was reviewed (MRID 40231901) that fulfills the data requirement for a laboratory volatility study for captan.

Mobility - Field Volatility (163-3):

No data have been submitted; however, based on acceptable data showing that the volatility of captan from soil under laboratory conditions is low, EAB recommended waiving the requirement for a field volatility study

for captan in a review dated July 8, 1988.

Field Dissipation (164-1):

No acceptable data have been submitted, but all data are required.

Aquatic Dissipation (164-2):

No acceptable data have been submitted, but all data are required.

Forestry Dissipation (164-3):

No data are required for captan based on its use pattern.

Combination Product and Tank Mixes (164-4):

Requirements for combination product and tank mix data are currently not being imposed.

Long-term Field Dissipation (164-5):

Data are reserved pending results of the field dissipation study.

Accumulation - Confined and Field Rotational Crops (165-1, -2):

No acceptable data have been submitted, but all data are required.

Accumulation - Irrigated Crops (165-3):

No acceptable data have been submitted, but all data are required.

Accumulation - Laboratory Fish (165-4):

No acceptable data have been submitted, but all data are required.

Accumulation - Aquatic Non-target Organisms (165-5):

Data are reserved pending results of the laboratory fish accumulation study.

8. RECOMMENDATIONS:

According to information in the EAB files, the following data requirements are satisfied:

- Metabolism - Aerobic Soil
- Metabolism - Anaerobic Soil
- Mobility - Leaching and Adsorption/Desorption
- Mobility - Laboratory Volatility

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As per the EAB files, the following data requirements can be satisfied provided that additional information is submitted:

Hydrolysis
Photodegradation in Water
Photodegradation on Soil

According to information in the EAB files, the following data requirements are not satisfied:

Metabolism - Aerobic and Anaerobic Aquatic
Field Dissipation
Aquatic Dissipation
Long-term Field Dissipation
Accumulation - Confined and Field Rotational Crops
Accumulation - Irrigated Crops
Accumulation - Laboratory Fish
Accumulation - Aquatic Non-target Organisms

9. BACKGROUND:

A. Introduction

These studies were submitted by Chevron Chemical Company on behalf of the Captan Task Force in response to data requirements listed in the Captan Registration Standard.

B. Directions for Use

Captan is a protectant-eradicator fungicide used to control scab, black rot, botrytis, sooty blotch, fly speck, and summer rots on apples; brown rot and leaf spots on stone fruits and almonds; dead arm, downy mildew, and black rot on grapes; and a wide variety of fungus diseases on small fruits, berries ornamentals, and vegetables. It is compatible with most commonly used insecticides and fungicides.

C. Summary of Acceptable Studies

Captan undergoes hydrolysis in water with a maximum half-life of 710 minutes (00096979). Over the pH range 2 to 6, the reaction is pH independent; above pH 7 breakdown accelerates with increasing pH (half-life of <10 minutes at pH 9). The major identified hydrolysis products are tetrahydrophthalamide (THPI) and tetrahydrophthalamic acid (THPAM). The fate and rates of breakdown of the trichloromethanethiol side chain over a range of pHs is not fully addressed; however, in pH 9 buffer solution, trichloromethyl-labeled [¹⁴C]captan hydrolyzed rapidly, with a calculated half-life of 3.6 minutes. ¹⁴CO₂ accounted for up to 86% of the applied radioactivity during the test period. Three additional products were found at >10% of the applied, but were not positively identified (40208101).

Trichloromethyl-labeled [¹⁴C]captan is not photodegraded in water; the half-life for captan in sterile buffer solution (pH 5) was calculated to be approximately 10 hours in both irradiated and dark control samples (40208102).

[¹⁴C]Residues did not volatilize appreciably from sand soil treated with ring-labeled [¹⁴C]captan (50% wettable powder) at 1 lb ai/A, with approximately 0.003% of the applied radioactivity volatilized over a 9 day period (40231901). Slightly greater amounts of radioactivity volatilized from trichloromethyl-labeled [¹⁴C]captan treated soil (3.9% of the applied), indicating the presence of volatile degradates. TLC results showed that none of the volatile radioactivity from this label was parent captan.

Preliminary data on the aerobic soil metabolism of captan (tetrahydrophthalamide-labeled [¹⁴C]captan), identified the major products as THPI and THPAM. The reported rate of breakdown varies. Half-lives determined by chemical techniques ranged from 3 to 7 days and are reported to be related to soil type and organic matter content (00098833). The rate of dissipation of captan from aerobic soils is slower and more variable when determined by bioassay. Half-lives ranging from 3 days to several months were reported using this technique (00098833).

Trichloromethyl-labeled [¹⁴C]captan, at 6.1 ppm, degraded with a half-life of <1 day in aerobic sandy loam soil (40658008). After 1 day of aerobic incubation, an average of 19.5% of the applied radioactivity was undegraded captan, 46.0% had been evolved as CO₂, 0.6% had been evolved as organic compounds (not further characterized), and 16.7% was unextractable. No nonvolatile degradates were detected.

Tetrahydrophthalamide-labeled [¹⁴C]captan, applied at 10 ppm to a sandy loam soil had a half-life of 3 days and was 99% dissipated at 365 days (0070414). In a New York loam, captan applied at 10 and 100 ppm had a half-life of 3-4 days. Captan degraded more rapidly in moist soils (17.5% water) than in dry soils (1.7% water) maintained at 29 C (05001486).

The anaerobic soil metabolism of captan reportedly results in the formation of four major breakdown products: cis-4-cyclohexene-1,2-dicarboxylic acid (THPAI), cis-6-cyano-3-cyclohexenecarboxylic acid (THCY), THPI, and THPAM (00098881).

After 1 day of aerobic incubation plus 29 days of anaerobic (N₂ gas) incubation, an average of 4.0% of the radioactivity applied to a sandy loam soil was undegraded captan, 85.6% had been evolved as CO₂, 0.8% had been evolved as organic compounds (not further characterized), and 16.6% was unextractable (40658008). Approximately 80% of the parent captan had degraded during the 1-day aerobic incubation period.

Handwritten notes on the left margin: "None are 70% of ...", "THPI", "THPAM", "THCY", "Diol".

Handwritten note on the left margin: "Captan residues?"

THPI, a major degradate of both aerobic and anaerobic soil metabolism, was degraded with half-lives of <7 days and 40 days under aerobic and anaerobic conditions, respectively (00070414).

Captan was found to be moderately mobile in five soil types ranging from clay to loam (00096972). Using bioassay techniques, captan residues (parent plus degradates) were found to leach readily through an Oakley sandy loam. Residues leached less readily through a soil mixture classified as a loam, or when German plant moss was added to a soil column. The two major degradation products THPI and THPAM are considered to be moderately mobile (00096972).

Using soil TLC methods, [¹⁴C]captan was determined to be slightly mobile (Helling's mobility class 2) in Crowley clay loam soil (R_f 0.21), Macksbury silty clay loam soil (R_f 0.15), and Nicollet clay loam soil (R_f 0.14), and immobile (Helling's mobility class 1) in Oakley sandy loam (R_f 0.09) and Stockton adobe clay (R_f 0.08) sieved through a 500 μm sieve (40658011).

[¹⁴C]Captan was taken up by tobacco plants grown in soils which were drenched with captan. The solution was 0.6 g in 200 mL of a soil drench applied 6 weeks prior to harvest. The maximum level found in the plant was 4.81 ppm (00098831). Soybeans in which captan was applied as a seed coating showed only detection level trace quantities of ¹⁴C in foliage at pod set (00083100).

10. DISCUSSION OF INDIVIDUAL TESTS OR STUDIES:

See attached reviews of individual studies.

11. COMPLETION OF ONE-LINER:

See attached one-liner.

12. CBI APPENDIX:

N/A