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DISULFOTON

TASK 2: ENVIRONMENTAL FATE AND EXPOSURE ASSESSMENT

Contract No. 68-01-6679

Final Report

January 11, 1984

SUBMITTED TO:

Environmental Protection Agency
Arlington, Virginia 22202

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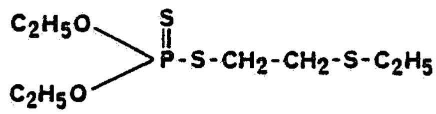
Environmental Fate and Exposure Assessment

Disulfoton

DISULFOTON, ETHYLTHIODEMETON, THIODEMETON, M-74, DI-SYSTON, DITHIODEMETON, DITHIOSYSTOX



O,O-Diethyl S-[2-(ethylthio)ethyl] phosphorodithioate

Disulfoton is a systemic insecticide and acaricide registered for use on various field (including rice), vegetable, orchard, ornamental (including greenhouse), and forestry sites. Approximately 4-7 million pounds of the active ingredient are used annually in the United States. Of the total domestic disulfoton usage, ~35-60% is applied to cotton, 20-45% to sorghum, and 15-25% to wheat. Application rates range from 0.5 to 8 lb ai/A. Disulfoton may be formulated with benefin, chlorobenzilate, demeton, diazinon, dicofol, ethoprop, fensulfothion, pentachloronitrobenzene, etridiazole, trifluralin, and verolate. Single active ingredient formulations of disulfoton consists of 0.25-15% G, 2% P/T, 6 and 8 lb/gal EC, and 95% RTU. These formulations may be applied with ground equipment (air-blast and boom sprayers, planting/drill equipment) or aircraft. Applicators must be certified or under the direct supervision of applicators certified to apply disulfoton to apply G formulations >2%, EC formulations ≥65%, and RTU formulations ≥95%.

Available data are insufficient to fully assess the environmental fate of disulfoton and the exposure of humans and nontarget organisms to disulfoton.

Disulfoton has a low mobility in Hugo sandy loam soil; 28% of the pesticide applied to a 6-inch high soil column was eluted with a total of 110 feet of dilute buffer (00073113). More than 92% of the applied [^{32}P]disulfoton was eluted from 2.5-cm deep soil columns (sandy loam, clay loam, and silty clay loam soils) after the application of ~50 inches of water. Results of alkali treatment of disulfoton indicated that disulfoton sulfoxide and disulfoton sulfone were more mobile in these soils than was the parent compound. Aging [^{32}P]disulfoton prior to elution increased adsorption 10-20 times that of unaged [^{32}]disulfoton. Mobility of disulfoton in soil appears to decrease as organic matter content and CEC increase (00052094, 00052095). Insecticidal disulfoton residues are mobile in a silt loam soil as determined by a mosquito bioassay (00103661). Based on soil TLC tests, disulfoton has low mobility in sand (R_f 0.18), sandy loam (R_f 0.16), silt loam (R_f 0.11 and 0.33), and intermediate mobility in a sandy clay loam soil (R_f 0.39) (00068214). When applied to subirrigated soil columns at 20 lb ai/A, disulfoton exhibited slight upward mobility in a Hagerstown silty clay loam and a Lakeland sandy loam soil (00094227). Disulfoton (6 lb/gal EC) applied at 4 lb ai/A to sloping fields plot (~ 1 inch/foot) of sandy loam, silt loam, and highly organic silt loam soils, was slightly mobile in runoff water. Disulfoton concentrates measured ≤1.6% of applied amounts over a 28-day period in which 1.5-2.5 inches of irrigation was provided (00095651).

Disulfoton (G) dissipates rapidly in field plots of sandy loam soil treated at 2 kg/ha (incorporated to a depth of 10 cm), with a half-life of ~1 week, and 90% loss after 5 weeks. Disulfoton sulfoxide has a half-life of 8-10 weeks while disulfoton sulfone, once formed, remains fairly stable over a 42-week period. Disulfoton sulfone was detected at a depth of 20 cm (00068096). Disulfoton residues dissipate with half-lives of 1-6 months in muck-sand, silt loam, and clay soils treated with disulfoton 10% G or 6 lb/gal EC at 10 ppm. Dissipation (from the upper 6 inches) was enhanced by increasing amounts of rainfall (00036250, 00044919, 00091497).

Disulfoton is likely to be found in runoff water and sediment from treated and cultivated fields. In monitoring studies conducted in 1973 and 1974, disulfoton was found at average concentrations of 13.8 ppb in sediment samples taken from tailwater pits receiving irrigation and rainfall runoff water from cultivated corn silt loam fields. The maximum concentration in sediment samples was 32.7 ppb. The compound was also detected in soil samples from a tailwater pit draining corn and sorghum silt loam fields at an average concentration of 11 ppb. Sediment samples in tailwater pits draining sorghum fields contained disulfoton at a concentration of 117.2 ppb (00079801).

Dermal, ocular, and inhalation exposures to workers may occur during application. The primary potential for exposure from the EC and RTU formulations is during mixing and loading where both dermal and ocular exposure can occur via splashing. Exposure during handling and loading operation involving G and P/T formulations is expected to be mainly dermal. Application from aircraft or use of air-blast sprayers and mist blowers increases the potential for exposure of humans and nontarget organisms to disulfoton due to spray drift and volatilization. Human exposure to disulfoton during handling, mixing, and application operations could be minimized by the use of approved respirators and protective clothing. However, no data are available to assess such exposures. California has established a reentry interval for disulfoton of 2 days for all crops. No federal reentry intervals have been established.

Reported pesticide incidents involving disulfoton alone between 1976 and 1983 include 92 involving human injury (96 individuals involved; 40 individuals received medical attention), 22 involving animals, and 4 involving environmental contamination. Most of the human exposures were the result of dermal or oral exposure.

In summary, disulfoton has a low to intermediate mobility in soils ranging in texture from sand to silty clay. Disulfoton sulfoxide and disulfoton sulfone are more mobile in these soils than the parent compound. Disulfoton is slightly mobile in runoff from treated fields. Mobility of disulfoton in soil appears to decrease as organic matter content and CEC increase. In the field, disulfoton and/or disulfoton residues dissipate from sandy loam, muck, sand, silt loam, and clay soils with half-lives of 1 week to 6 months. Disulfoton sulfoxide has a half-life of 8-10 weeks in a sandy loam, while disulfoton sulfone, once formed, remains fairly stable over a 42 week period.

The following data are required (EPA Data Requirements for Registering Pesticides, 1983) to fully assess the environmental fate and transport of, and the potential exposure to disulfoton: hydrolysis studies; photodegradation studies in water, on soil, and in air; aerobic and anaerobic soil metabolism studies; aerobic and anaerobic aquatic metabolism studies; laboratory and field volatility studies; terrestrial, aquatic, forestry, and possibly long-term field dissipation studies; accumulation studies in rotational crops, irrigated crops, fish and aquatic nontarget organisms; and possibly reentry studies.

Hydrolysis studies: Two studies were reviewed that could not be validated. One study (00095651) could not be validated because raw data were not presented to support the reported half-lives and it was not specified that sterile conditions were maintained. The second study (00095664) could not be validated because the sampling intervals were inadequate to provide data for an accurate assessment of disulfoton. All data are required

Photodegradation studies in water: Two studies were reviewed; one study (00092972) is scientifically invalid because dark controls were not used. The second study (00095664) could not be validated because the sampling intervals were inadequate to accurately assess the photodegradation of disulfoton in water. All data are required.

Photodegradation studies on soil: One study was reviewed (00095664) that could not be validated because the sampling intervals were inadequate to accurately assess the photodegradation of disulfoton on soil. All data are required.

Photodegradation studies in air: No data were submitted, but all data are required.

Aerobic soil metabolism studies: One study was reviewed (00095664) that could not be validated because the sampling intervals were inadequate to provide data for an accurate assessment of disulfoton metabolism in soil. All data are required.

Anaerobic soil metabolism studies: No data were submitted, but all data are required.

Anaerobic aquatic metabolism studies: No data were submitted, but all data are required.

Aerobic aquatic metabolism studies: No data were submitted, but all data are required.

Leaching and adsorption/desorption studies: Nine studies were reviewed, three of which are scientifically invalid. One study could not be validated (00052092) because insufficient information was provided on the procedures and protocols, and there appeared to be an error in the units used to describe the amount of disulfoton adsorbed. The second study is scientifically invalid (00095651) because the experimental design for the column leaching portion of the study was inadequate to accurately assess the mobility of disulfoton in soil, and no data were presented in the adsorption/desorption portion of the study to demonstrate that equilibrium was achieved after 1 hour. The third study is scientifically invalid (00065859) because it was not demonstrated that the bioassays used (fungal and algal) could detect the insecticide disulfoton. Six of the valid studies do not fulfill data requirements because pesticide mobility was not assessed using one of three EPA acceptable protocols and a technical grade or purer product was not used (00095651); the test substance used was uncharacterized, and adsorption constants such as Freundlich K values were not calculated in the adsorption portion of the study (00073113); the column lengths were insufficient (2.5 cm) to fully assess the leaching characteristics of disulfoton in soil (00052904, 00052905); a nonspecific mosquito bioassay was used, disulfoton residues in leachate samples were not quantified, the soil column was not segmented and analyzed for disulfoton following leaching, and complete soil characteristics were not specified (00103661); and the experimental method was not one of the three specified for use in predicting pesticide mobility in soil (00094227). The remaining valid study (00068214) partially fulfills data requirements by providing information on the mobility of disulfoton in sand, sandy loam, sandy clay loam, silt loam, and silty clay soils. A study is needed providing adsorption/desorption data for disulfoton on one aquatic sediment, and mobility data for disulfoton aged in a sandy loam soil.

A decision about the potential for ground water contamination from the use of disulfoton will be made after the receipt of all required leaching and adsorption/desorption data.

Laboratory and field volatility studies: No data were submitted, but all data are required.

Terrestrial field dissipation studies: Six studies were reviewed; one study (00095652) is scientifically invalid because insufficient sampling was performed to allow generation of a decline curve, and no pretreatment soil samples were analyzed. Four of the valid studies do not fulfill data requirements because a nonspecific colorimetric assay was used to determine disulfoton concentrations in soil and the pattern of formation and decline of degradates was not addressed (00036250, 00044919, 00091497); and because the submission of monitoring data is currently not required (~~00079801~~). The remaining valid study (00068096) provides useful information by identifying disulfoton sulfone and disulfoton sulfoxide as degradates of disulfoton. This study does not fulfill data requirements on the decline of disulfoton and formation and decline of degradates for one site because the test site was not shown to be representative of use sites in the United States, preapplication soil samples were not analyzed, the test soil was not fully characterized, and disulfoton was not applied at the highest recommended label rate. All data are required.

Aquatic field dissipation studies: One study was reviewed (00095651) that cannot be validated because the increase in concentration of disulfoton in water during the first 24 hours of incubation was unexplained. All data are required.

Forestry dissipation studies: No data were submitted, but all data are required.

Dissipation studies for combination products and tank mix uses: No data were submitted; however, no data are required because data requirements for combination products and tank mix uses are currently not being imposed for this Standard.

Long-term field dissipation studies: No data were submitted, but all data may be required depending upon the results from the field dissipation/aerobic soil metabolism studies.

Confined accumulation studies on rotational crops: No data were submitted, but all data are required.

Field accumulation studies on rotational crops: No data were submitted, but all data are required.

Accumulated studies on irrigated crops: No data were submitted, but all data are required.

Laboratory studies of pesticide accumulation in fish: No data were submitted, but all data are required.

Field accumulation studies of aquatic nontarget organisms: No data were submitted, but all data are required.

Reentry studies: No data were submitted, but all data are required. See Table A.

Label Restrictions

o Pending the submission of crop rotation data, it is suggested that crops other than those with registered disulfoton uses be restricted from being planted in disulfoton-treated soil.

o Pending the receipt and evaluation of data, a 24 hr. reentry interval is imposed for all uses, unless protective clothing is worn.

References (All Studies Reviewed)

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Mobay Chemical Corporation. 1972. Dasanit - Di-syston: analytical and residue information on tobacco. Includes methods dated Mar. 5, 1964; Mar. 28, 1966; Oct. 27, 1967; and others. Compilation; unpublished study, including published data, received Aug. 21, 1972 under 3125-279; CDL:007221-A. (00094227)

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