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DYNAMAC
CORPORATION

FONOFOS

Task 2: Environmental Fate and Exposure Assessment

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Final Report

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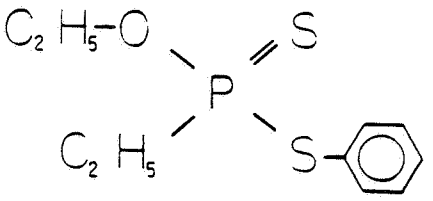
Environmental Fate and Exposure Assessment

Fonofos

FONOFOS, DYFONATE, N-2788



O-Ethyl-S-phenylethylphosphonodithioate

Fonofos is a nonsystemic soil insecticide registered for use on various field and vegetable crops, lawns, and turf. Approximately 11 million pounds of active incredient are used annually in the United States. Of the total domestic fonofos use, ~95% is applied to corn in the Midwest. Application rates range from 0.75 to 10 lb ai/A. Fonofos may be formulated in combination with pebulate and thiram. Single active ingredient formulations of fonofos consist of 2, 5, 10, 15, and 20% G and 4 lb/gal EC. These formulations may be broadcast prior to or at planting and then incorporated into the soil, applied as a soil drench, or applied post-emergence as a band or broadcast foliar spray. The latter use may be applied by ground or air equipment. Applicators must be certified or under the direct supervision of applicators certified to apply the EC formulation of fonofos. Certification is not required for use of the G formulations.

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

Under aerobic conditions, fonofos at 10 ppm was degraded at a moderate rate with half-lives ranging from 3 to >16 weeks in soils ranging in texture from loamy sand to clay loam to peat (00090831, 00052058, 00092024, 00073059). Fonofos was degraded at a slower rate with a half-life of >24 weeks in sterile soils (00073059). The major degradate identified was O-ethylethane phosphonothioic acid, other degradates identified included fonofos oxon, O-ethylethane phosphonic acid, O-ethyl

O-methylethyl phosphonate, diphenyl disulfide, methylphenyl sulfoxide, and methylphenyl sulfone (00052058, 00092024). The soil fungus Rhizopus japonicus degraded [^{14}C]fonofos to yield dyfoxon, thiophenol, ethylethoxy phosphonic acid, and methylphenyl sulfoxide (00090866).

Fonofos is relatively immobile in a silt loam and sandy loam soil and mobile in quartz sand. After 7-12 inches of water were added to 7-inch soil columns, ~2-9% of the applied [^{14}C]fonofos dose leached from the treated soil layer in Plano silt loam and Fox fine sandy loam columns. When a quartz sand was leached with 7 inches of water, ~50% of the applied radioactivity was detected in the leachate. Dyfoxon, a fonofos degradate, and two unidentified compounds were found in the leachate of the silt loam soil (00052059).

Fonofos does not have a great propensity to be mobile in runoff water. After 30 days, only 0.54-1.2% of the applied [^{14}C]fonofos was recovered in runoff water from drenching a Sorrento loam soil on an inclined plant at a 15° slope. Fonofos accounted for most of the recovered radioactivity which was primarily adsorbed to the silt fraction (00052058).

Fonofos does not volatilize from soil but is fairly volatile from water. Within 24 hours after application, 15-16% of the [^{14}C]fonofos applied volatilized from soil water (a suspension of fine sand in tap water) and tap water while only 1% volatilized from a silt loam soil. [^{14}C]Fonofos volatilized from soil water with a half-life of ~5 days; 80% of the applied radioactivity was volatilized at the end of 10 days (00090826).

In the field, fonofos dissipated with a half-life of ~28-40 days when the 10% G and 4 lb/gal EC formulations were applied at 4.8-10 lb ai/A to a sandy loam and two silt loam soils (00090827, 00041235, 00090871). Using a root maggot bioassay, toxic fonofos residues in a sandy loam field soil were detected up to 17 weeks after the 10% G formulation was applied at 2-5 lb ai/A. Residues were detected up to 28 weeks after treatment when the same soil was maintained in a greenhouse (00090869).

Fonofos has been found in tailwater pit sediment and water samples. Monitoring studies conducted in 1973 and 1974 in Haskell County, Kansas, showed that the

highest concentrations found were 770 ppb for sediment and 5.9 ppb for water during 1974. Mean peak concentrations were highest in June and July (00079801).

Radioactive residues accumulate in the edible portion of bluegill sunfish, reaching a maximum of 0.25 mg/kg after 21 days' exposure to [^{14}C]fonofos at 0.0017 mg/l. By the end of the 35-day accumulation period, seven times more ^{14}C was accumulated in visceral tissue than in muscle. Accumulated ^{14}C residues were depurated rapidly from edible tissue; after 3 days in untreated water, ~80% of the accumulated [^{14}C]fonofos residues were eliminated (Bionomics, No MRID).

Application by aircraft increases the potential for exposure of humans and nontarget organisms to fonofos due to spray drift and volatilization of fonofos. Human exposure to fonofos during application and soil incorporation operations could be minimized by the use of approved respirators and protective clothing. Exposure during reentry operations is thought to be minimal when fonofos is incorporated into soil, but reentry exposure would be greater when fonofos is applied as a postemergence foliar spray. However, data are not available to fully assess such exposures.

Dermal and ocular exposure due to splashing may occur during mixing and handling operations involving the EC formulation when closed-transfer systems are not utilized. Exposure during application is expected to be mainly dermal, although use of aircraft may increase the potential for inhalation exposures. Exposure from the G formulations is expected to be mainly dermal. Such exposure could be greatly minimized by the use of gloves and protective clothing during handling and application.

Reported pesticide incidents involving fonofos include 21 involving human injury; there have been two reported fatalities. In addition, numerous reports of cattle, dog, raccoon, and fish deaths are on record. All of the above incidents were the result of accidents and careless use of fonofos and/or containers that once held fonofos.

In summary, fonofos degrades in aerobic soils with half-lives of >3-16 weeks. Fonofos is relatively immobile in silt and sandy loam soils but mobile in pure

sand. Fonofos is not mobile in runoff water from a loam soil, does not volatilize from soil but is fairly volatile from water. In the field, fonofos dissipated with half-lives of ~4-7 weeks. Fonofos has been found in tailwater pit sediment and water samples at ≤770 and ≤6 ppb, respectively. [^{14}C]Fonofos is accumulated in bluegill sunfish with a bioconcentration factor of 150 X in edible tissue, but 80% of the accumulated ^{14}C residues were depurated within 3 days.

The following data are required (EPA Data Requirements for Registering Pesticides, 1983) to fully assess the environmental fate, transport of, and the potential exposure to fonofos: hydrolysis studies; photodegradation studies in water and air, and on soil; anaerobic soil metabolism studies; leaching and volatility studies on rotational crops and fish; and reentry and exposure studies. These requirements are detailed below:

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

Photodegradation studies in water: One study was reviewed (00052058) that is scientifically invalid because photolysis was studied in nonsterile tap water. All data are required.

Photodegradation studies on soil: One study was reviewed (00052058) that is scientifically invalid; because ^{14}C activity was not determined in the aqueous phase of soil:water slurries, all data are required.

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

Aerobic soil metabolism studies: Five studies were reviewed and all are scientifically valid. Two studies do not fulfill data requirements because a formulated product was used (00090831) or because there are currently no requirements for studies using pure cultures of microorganisms (00090866). The other three studies each partially fulfill data requirements by providing half-life data of fonofos in a sandy loam and organic soil (00073059), by providing half-life data, and by identifying two fonofos degradates in a sandy loam soil (00092024). Taken together, these three studies completely fulfill data requirements, no further data are required.

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

Anaerobic and aerobic aquatic metabolism studies: No data were submitted, however, these studies are not required because fonofos does not have a forestry, aquatic, or aquatic impact use.

Leaching and adsorption/desorption studies: Three studies were reviewed; one study (00090870) is scientifically invalid because leachates from untreated soil column controls were not included to verify that toxicity observed in treated leachates was due to fonofos residues. The other two studies are scientifically valid, but do not fulfill data requirements because the leaching columns were too short (only 7 inches) and an insufficient amount of water (11.5 inches over 105 days) was used (00052059), or because there are currently no requirements for the submission of runoff data (00052058). All data are required. If the 2% G product remains registered for domestic use, an adsorption/desorption study will be required.

Laboratory volatility studies: One study was reviewed (00090826) that is scientifically valid but does not fulfill data requirements because the test substance was not a typical end-use product. All data are required.

Field volatility studies: No data were submitted, but all data are required.

Terrestrial field dissipation studies: Four studies were reviewed and all are scientifically valid. One study (00090869) does not fulfill data requirements because a root maggot bioassay was used. The other three studies each partially fulfill data requirements by providing dissipation data of the 4 lb/gal EC formulation in a sandy loam soil (00090827) and in a silt loam soil (0041235), and by providing dissipation data of the 10% G formulation in a silt loam soil (0009-0871). Data are needed for the dissipation of a representative G formulation at a site in the cornbelt.

Aquatic field dissipation studies: No data are required because fonofos does not have an aquatic or aquatic impact use. One monitoring study was reviewed (00079801) that is scientifically valid, but doe not fulfill data requirements. Currently there are no requirements for the submission of monitoring data.

Forestry dissipation studies: No data were submitted; however, no data are required because fonofos does not have a forestry use.

Dissipation studies for combination products and tank mix uses: There is currently no requirement for these studies.

Long-term field dissipation studies: No data were submitted, and no data are required because more than one-half of the application dissipates before another recommended application is applied.

Confined accumulation studies on rotational crops: One study was reviewed (00052058) that is scientifically invalid because extractable residues were removed from the soil before crops were planted in the treated soil. All data are required.

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

Accumulation studies on irrigated crops: No data were submitted; however, no data are required because crops are not expected to be irrigated with fonofos-contaminated water.

Laboratory studies of pesticide accumulation in fish: One study was reviewed (Bionomics, No MRID) that is scientifically valid and partially fulfils data requirements by providing information on the accumulation and depuration of [^{14}C]fonofos in the edible portion of bluegill sunfish tissue. A study is needed to provide data on residues in visceral tissue and whole fish throughout the experiment, and to identify degradates.

Field accumulation studies of aquatic nontarget organisms: No data were submitted, and no data are required because fonofos has no aquatic noncrop, forestry, or aquatic impact uses.

Reentry and exposure studies: No data were submitted, but all data are required.

Label Restrictions

Fonofos may not be rotated with carrots. There is currently no other label restriction for the application of fonofos to field crops or vegetables.

References (All Studies Reviewed)

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