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

12 MAY 1994

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

DP Barcode: D182158, D186408, D165691, D170529, D170534, D165005, D175638, D175632, D169871, D195745, D183233, D164920
PC Code: 100601

MEMORANDUM:

Subject: Fenamiphos RED Chapter, Section 18, Registration Actions.

To: Lois Rossi, Branch Chief
Reregistration Branch
Special Review and Reregistration Division (7508W)

Everett Byington, Branch Chief
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (7507C)

From: Henry Jacoby, Branch Chief
Environmental Fate and Ground Water Branch
Environmental Fate and Effects Division (7507C)

Based on EFGWB's review and evaluation of available environmental fate, ground and surface water data, fenamiphos exceeds certain levels of concern for ground water and has potential concerns for surface water. Because of these concerns, 1) EFGWB recommended in 1992 that a prospective ground water monitoring study be conducted for fenamiphos and its degradates (the study is expected to begin in 1994 primarily to satisfy the State of Florida requirements), 2) EFGWB now recommends that several other prospective ground water monitoring studies be conducted, and 3) in addition, the registrant should be requested to propose mitigation activities that will eliminate or reduce the contamination of ground water by fenamiphos residues, and that voluntary cancellation of this chemical in the United States be considered if contamination continues. Because of potential concerns for surface water source drinking water, it is recommended that reregistration of fenamiphos be contingent upon the registrants agreeing to fund monitoring programs for fenamiphos and its sulfoxide and sulfone degradates in surface source water supply systems which drain watersheds which typically receive high fenamiphos applications.

Although three guideline data requirements remain unfulfilled at present, there are sufficient data for comprehensive qualitaive and quantitative environmental fate, ground and surface water assessments for the emulsifiable concentrate (Nemacur 3EC). However, additional field dissipation studies are necessary using granular formulations (Nemacur 15% G) to determine the dissipation routes and half-life, the formation and decline of degradates, and the potential for leaching. Fenamiphos dissipation in terrestrial environments appears to be primarily by microbial metabolism (aerobic soil metabolism half-life was 15.7 days, anaerobic soil metabolism half-life was 87.9 days) together with or followed by leaching of degradates and further degradation. Laboratory data indicates that fenamiphos is moderately resistant to degradation when incorporated into the soil and has the potential to be highly mobile (K_{ads} ranging from 0.95 to 3.4) in different soils. The degradates fenamiphos sulfoxide and fenamiphos sulfone appear to be more mobile than parent fenamiphos. In upgradeable field dissipation studies parent fenamiphos (Nemacur 3EC) was not detected below the 0-6 inch soil horizon; however, fenamiphos sulfoxide was detected as far as the 30-36 inch soil horizon and fenamiphos sulfone was detected as far as the 18-24 inch soil horizon.

The hydrolysis and anaerobic soil metabolism half-lives for parent fenamiphos indicate that it will persist once it reaches ground water. Thus fenamiphos use is likely to have a significant impact on ground water quality. Leaching of fenamiphos was confirmed by detections in ground water in Florida during a small scale retospective monitoring study. Concentrations of parent fenamiphos in ground water ranged up to 22.5 ppb, or approximately 1100 percent of the lifetime Health Advisory. The sulfoxide and sulfone degradate concentrations ranged up to 204 ppb and 19.9 ppb respectively. For this reason, the Agency required that the registrant conduct a prospective ground-water monitoring study in 1992 and also requested a label advisory at that time.

Three guidelines are not fulfilled at this time: the unaged portion of the leaching/adsorption/desorption (163-1), terrestrial field dissipation (164-1), and prospective ground water monitoring (166-1). Field dissipation studies using the granular formulations (Nemacur 15% G) are necessary to determine the formation and decline of degradates and the half-life, the dissipation routes, and the potential for leaching under actual use conditions. Prospective ground water monitoring studies are needed to establish the extent of fenamiphos leaching into ground water and to identify appropriate follow-up regulatory actions. Specific recommendations are included in this RED package.

Date Out: 12 MAY 1994 Chemical Code:100601

DP Barcode: D182158, D186408, D165691, D170529, D170534, D165005, D175638, D175632, D169871, D195745, D183233, D164920

ENVIRONMENTAL FATE AND GROUND WATER BRANCH

Review Action

To: Larry Schnaubelt, PM # 72
Special Review and
Reregistration Division (7508W)

Cynthia Giles-Parker, PM # 22
Registration Division (7505C)

Rebecca Cool, PM #41
Emergency Response Section
Registration Division (7505C)

From: Henry Jacoby, Chief
Environmental Fate & Ground Water Branch
Environmental Fate and Effects Division (7507C)

Attached, please find the EFGWB review of...

Common Name:	Fenamiphos	**Trade name:**	Nemacur 3EC, Nemacur 15% G
Company Name:	Miles, Incorporated		
ID #:	100601, 94CA0002, 003125-00283, 003125-00236		
Purpose:	Review environmental fate studies for reregistration; review applications for amended registration; reissuance of a Section 18 in California; review status of ground-water monitoring for Reregistration Eligibility Document.		

Type Product:	Action Code:	Review Time:
Insecticide/Nematicide	331, 606, 301, 305, 320, 330, 510	40 days

STATUS OF STUDIES IN THIS PACKAGE:

Guideline #	MRID	Status[1]
161-1	42149302	A
161-3	40608001	A
162-1	421493	A
	41064302,405 24601	C
162-2	41286901	A
163-1	40547502, 40547501	A
	40774808, 40774807	U
163-2	40774810	A
164-1	42149301, 42216201	U

STATUS OF DATA REQUIREMENTS ADDRESSED IN THIS PACKAGE:

Guideline #	Status[2]
161-1	S
161-3	S
162-1	S
162-2	S
163-1	P
163-2	S
164-1	N

[1]Study Status Codes: A=Acceptable U=Upgradeable C=Ancillary I=Invalid
[2]Data Requirement Status Codes: S=Satisfied P=Partially satisfied N=Not satisfied R=Reserved W=Waived.

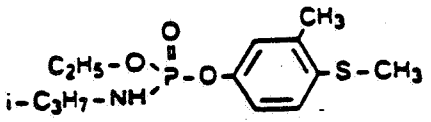
1.0 CHEMICAL:

Common name: Fenamiphos

Chemical name: Ethyl 3-methyl-4-(methylthio)phenyl (1-methylethyl) phosphoramidate

Trade Name: Nemacur

Chemical Structure:



fenamiphos

2.0 TEST MATERIAL: See Individual DER's

3.0 STUDY/ACTION TYPE: Review of environmental fate and groundwater data to support registration, new uses, section 18, and reregistration.

4.0 STUDY IDENTIFICATION:

Mulford, D.J. 1987. Stability of NEMACUR in Sterile Aqueous Buffer Solutions. Study performed and submitted by Mobay Corporation, Kansas City, MO. MRID No. 421493-02.

Hanlon, C.M. 1988. Photodegradation of Fenamiphos on Soil. Study performed and submitted by Mobay Corporation, Stilwell, Kansas. MRID No. 406080-01.

Spiteller, M. 1989. Degradation of Fenamiphos, Nemacur in Aerobic Sandy Loam. Study performed by Bayer Ag, Leverkusen-Bayerwerk, FRG. Project No. M1250256-1. MRID No. 421493-03.

Simon, L., A. Haisch, and P. Wallnofer. 1988. Metabolism of Fenamiphos in Soils of Different Geographic Origin under Aerobic Conditions. Study performed by Bayer AG Institute of Metabolism Research, FRG and submitted by Mobay Corporation, Stilwell, Kansas. MRID No. 409337-01 (Duplicate MRID No. 410643-02).

Spiteller, M. 1989. Degradation of Fenamiphos, Nemacur, in Anaerobic Sandy Loam. Study performed by Bayer AG, Institute for Metabolism Research, Leverkusen-Bayerwerk, FRG for Mobay Corporation, Stilwell, Kansas. MRID No. 412869-01.

Hanna, G.R. 1980. The Metabolism of NEMACUR in Sandy Loam Soil. Study performed and submitted by Mobay Corporation, Stilwell, Kansas. MRID No. 405246-01.

Mulford, D.J. 1987. Leaching Characteristics of Aged Soil Residues of NEMACUR. Study performed and submitted by Mobay Corporation, Stilwell, Kansas. MRID No. 405475-02.

Spiteller, M. 1987. Leaching Characteristics of Fenamiphos (NEMACUR) Aged in Soil. Study performed by Bayer AG, Institute of Metabolism Research, Federal Republic of Germany and submitted by Mobay Corporation, Stilwell, Kansas. MRID No. 405475-01.

Daly, D. 1988. Soil Adsorption/Desorption with ^{14}C-Nemacur Sulfoxide. Study performed by Analytical Bio-Chemistry Laboratories, Inc., Columbia, Missouri for Mobay Corporation, Stilwell, Kansas. MRID No. 407748-07.

Daly, D. 1988. Soil Adsorption/Desorption with ^{14}C-Nemacur. Study performed by Analytical Bio-Chemistry Laboratories, Inc., Columbia, Missouri. MRID No. 407748-08.

Detra, R.L. 1988. Volatility of Fenamiphos from the Surface of Sandy Loam. Study performed and submitted by Mobay Corporation, Stilwell, Kansas. MRID No. 407748-10.

Grace, T.J., K.S. Cain, and J.L. Delk. 1990. Dissipation of Fenamiphos in California Soils. Study performed by Plant Sciences, Inc., Watsonville, CA., Siemer and Associates, Inc., Fresno, CA., and Pharmacology and Toxicology Research Laboratory-East, Lexington, Kentucky, for Mobay Corporation, Kansas City, Mo. MRID No. 421493-01.

Appendix 1. Jacobsen, K.A., and S.K. Forrest. 1990. Fenamiphos-(NEMACUR 3 EC) Field Dissipation for Terrestrial Use Multiple Application Plot. Plant Sciences, Inc., Watsonville, CA.

Appenmdix 2. Hicks, S.C. 1990. NEMACUR 3 Turf Nematicide-California Soil Dissipation Study. Siemer & Associates, Inc., Fresno, CA.

Appendix 3. Moore, P., and J. Howard. 1990. Nemacur (Fenamiphos) Soil Dissipation Study: Validation and Sample Analyses of Soil. Study performed by PTRL East, Inc., Richmond, Kentucky, for Mobay Corporation, Stilwell, Kansas.

Carey, R. 1990. Subsurface Soil Incorporation Report, Mobay Corporation, Fresno Site No.2. Study performed by Kleinfelder, Inc., Fresno, CA., for Mobay Corporation, Kansas City, Missouri. MRID No. 422162-01. (Report of analytical results of soil samples from the Fresno location).

5.0 REVIEWED BY:

George Tompkins
Entomologist, Review Section 1
EFGWB/EFED/OPP

Signature: George Tompkins
Date: 12 MAY 1994

Estella Waldman
Hydrologist, GWTS
EFGWB/EFED/OPP

Signature: Estella Waldman
Date: 5/16/94

6.0 APPROVED BY:

Paul Mastradone
Section Chief, Review Section 1
EFGWB/EFED/OPP

Signature: Paul J Mastradone
Date: 12 MAY 1994

Elizabeth Behl
Section Chief, GWTS
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Signature: E Behl
Date: 5/16/94

Henry Nelson
Section Chief, SWS
EFGWB/EFED/OPP

Signature: H Nelson
Date: 5/13/94

7.0 CONCLUSIONS:

Major Routes of Dissipation

Although the environmental fate data base is not complete, the information from acceptable and upgradeable environmental fate data from the 1987 Registration Standard to present indicate that the major routes of dissipation for fenamiphos incorporated into the soil appear to be by microbial metabolism (aerobic half-life was 15.7 days at 20°C; anaerobic half-life was 87.9 days at 20°C) together with or followed by leaching of degradates and further degradation. The Freundlich K_{ad} values of fenamiphos ranged from 0.95 (sandy loam soil) to 3.4 (silt loam soil) indicating that fenamiphos has the potential to be highly mobile to mobile in the soils tested. The degradates fenamiphos sulfoxide and fenamiphos sulfone appear to be more mobile than parent fenamiphos. In the field studies (Nemacur 3 EC) fenamiphos was not detected below the 0-6 inch soil horizon. Fenamiphos sulfoxide was detected as far as the 30-36 inch soil horizon in one study and fenamiphos sulfone was detected as far as the 18-24 inch soil horizon in the same study site. If fenamiphos were on the soil surface or in the water then photolysis appears to be rapid (aqueous photolysis half-life was 2-4 hours under artificial light; soil photolysis half-life = 2.7 hours under natural sunlight). Fenamiphos is relatively stable to hydrolysis (half-life = 245 days at pH 5.0, 301 days at pH 7.0, and 235 days at pH 9.0).

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Laboratory and Field Half-lives

EFGWB concludes that the following studies submitted for the reregistration of fenamiphos for Terrestrial Food Crop, Terrestrial Food + Feed Crop, and Terrestrial Non-Food Crop uses are acceptable and satisfy the data requirements.

a) Hydrolysis (161-1), MRID No. 42149302. Fenamiphos was stable to hydrolysis with reported half-lives of 245 days at pH 5.0, 301 days at pH 7.0, and 235 days at pH 9.0. The major degradate at all pH's tested was fenamiphos sulfoxide, which by day 31 accounted for 9.9% of the radioactivity in the pH 5.0 samples, 8.1% in the pH 7.0 samples, and 4.1% in the pH 9.0 samples. In the pH 9.0 samples fenamiphos phenol was also found (5.2% of radioactivity by day 31).

b) Photodegradation on Soil (161-3), MRID No. 40608001. Fenamiphos had a reported half-life of 2.7 hours when exposed to natural sunlight. After 4 hr exposure, the major degradate was fenamiphos sulfoxide (64.4% of applied radiocarbon) and 33.8% of the radiocarbon was parent fenamiphos.

c) Aerobic Soil Metabolism (162-1), MRID No. 42149303 (two additional ancillary studies were also submitted, MRID No. 41064302, and 40524601). Fenamiphos applied at a rate of 13.7 ppm to a sandy loam soil degraded with a reported half-life of 15.7 days at 20°C. The major metabolite was fenamiphos sulfoxide (maximum of 51.4% of the applied radioactivity at day 14 and decreased to 1.0% by day 365). Other identified degradates were fenamiphos sulfone (maximum of 3.5% of applied radioactivity at day 14), fenamiphos phenol (<0.1% at all sampling intervals), fenamiphos sulfoxide phenol (maximum of 5.4% at day 31), fenamiphos sulfone phenol (maximum of 24.3% at day 63 and decreasing to 6.6% by day 365), and fenamiphos sulfone anisole (steadily increased to a maximum of 4.4% by day 365). By day 365 of the study 34.2% of the applied was quantitated as $^{14}CO_2$. The proposed metabolic pathway indicates that fenamiphos transformed to the corresponding sulfoxide metabolite and further degraded to fenamiphos sulfoxide phenol and fenamiphos sulfone phenol. CO_2 appeared to be produced from the degradation of fenamiphos sulfoxide phenol and fenamiphos sulfone phenol and possibly from the degradation of fenamiphos phenol. In an ancillary study (MRID No. 40933701) it was demonstrated that fenamiphos degraded more rapidly in the soil at 22°C than at 16°C in three temperate climatic zone soils, and also more rapidly at 28°C than at 22°C in two tropic climatic zone soils.

d) Anaerobic Soil Metabolism (162-2), MRID No. 41286901, 40524601. Fenamiphos degraded with a reported half-life of 87.9 days when applied at a rate of 13.3 ppm to a sandy loam soil incubated at 20±1°C under anaerobic conditions after an initial 6 day aerobic incubation period. The major degradate was fenamiphos sulfoxide (maximum of 46.5% of applied radioactivity and decreasing to 14.3% by day 66). Other reported degradates were fenamiphos sulfone

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(maximum of 0.5% on days 46 and 60), fenamiphos phenol (maximum of 4.2±1.2% on day 52), fenamiphos sulfoxide phenol (maximum of 3.2% on day 36), and fenamiphos sulfone phenol (maximum of 8.7% on day 66). Fenamiphos sulfone anisole was detected only on day 66 at levels below 1% of applied radioactivity. In a second ancillary study (MRID No. 40524601) the anaerobic half-life of fenamiphos after 30 days aerobic incubation was reported at 280 days. The major degradates reported were fenamiphos sulfoxide (55.6% of applied radioactivity) and fenamiphos sulfone (5.4%). Other reported degradates were fenamiphos sulfoxide phenol (2.1%) and fenamiphos sulfone phenol (1.5%).

e) Laboratory Volatility (163-2), MRID No. 40774810. Fenamiphos did not volatilize very rapidly when applied at a rate of 12 lbs ai/A to a sandy loam soil. After 7 days, with a linear flow of air at 20 cm/min, less than 0.1% fenamiphos volatilized. This indicated that volatilization was not a major route of dissipation for fenamiphos when applied to soil.

f) Aged Leaching and Adsorption/Desorption (163-1), MRID No. 40547502, 40547501. Fenamiphos and its metabolites were mobile in the Indiana sand soil in which 63.8% of applied radioactivity was found in the leachate. Fenamiphos was somewhat less mobile in the California sandy loam soil (47.2% of applied radioactivity found in the leachate fraction) and in the Kansas sandy loam soil (16.2% of the radioactivity found in the leachate fraction). The majority of the radioactivity in the leachates was identified as fenamiphos sulfoxide (86.4% of radioactivity in the leachate fraction from the California sandy loam soil column was fenamiphos sulfoxide, 76.5% from the Indiana sand soil leachate, and 90.12% in the leachate from the Kansas sandy loam soil columns). The results indicated that fenamiphos sulfoxide was the most highly mobile metabolite, followed by fenamiphos sulfone. The majority of parent fenamiphos did not leach through the columns (no parent fenamiphos found in the leachate fractions of Kansas sandy loam soil).

EFGWB concludes that the following studies submitted for the reregistration of fenamiphos are upgradeable and require further information from the registrant (See 10.0-Discussion of Individual Studies).

a) Unaged Leaching and Adsorption/Desorption (163-1), MRID No. 40774808, 40774807. In batch equilibrium studies using four different soils unaged fenamiphos was shown to range from being mobile in a sandy loam soil (Freundlich K_{ad} of 0.95) to moderately mobile in a silt loam soil (K_{ad} of 3.4). The K_{oc} values ranged from 171.0 in the clay loam soil to 543.4 in the sand soil. These results indicated that fenamiphos has the potential to be highly mobile to mobile in the soils tested.

b) Terrestrial Field Dissipation (164-1), MRID No. 42149301, 42216201. Fenamiphos (Nemacur 3) was surface sprayed onto established turf plots at a rate of 10 lb ai/A to two sites located at Chualar and Fresno, California. The reported half-life of fenamiphos was 16.2 days in the sandy loam soil at Chualar and 17.0 days in a sandy loam soil at the Fresno site. Parent fenamiphos was not detected (detection limits 0.01 ppm) below the 0-6 inch soil horizon at either of the two sites at any sampling interval. Fenamiphos sulfoxide was detected as far as the 24-30 inch soil horizon at the Chualar site and as far as the 30-36 inch soil horizon at the Fresno site. Fenamiphos sulfone was detected no further than the 6-12 inch soil horizon at the Chualar site and down to the 18-24 inch soil horizon at the Fresno site. The cumulative rainfall/irrigation was 79.85 inches at the Chualar location and 36.80 inches at the Fresno site.

At the Chualar site the maximum concentration of fenamiphos was 0.211 ppm on day 0 of the first application and decreased continually. The maximum concentration of fenamiphos sulfoxide was 0.983 ppm at 28 days posttreatment, and fenamiphos sulfone was also a maximum (0.324 ppm) at this sampling interval. At the Fresno site the maximum concentration of fenamiphos for the first application was reported on day 0 (2.668 ppm). The maximum concentration of fenamiphos sulfoxide was also on the day of application (1.394 ppm). The maximum concentration of fenamiphos sulfone was 60 days posttreatment (0.521 ppm). It appears that fenamiphos dissipates by microbial degradation to fenamiphos sulfoxide and fenamiphos sulfone followed by leaching into the soil and eventual further degradation as proposed in the aerobic soil metabolism study (MRID No. 42149303, Appendix 18).

Additional Field Dissipation Studies using granular formulations (Nemacur 15%G) are necessary to determine the dissipation routes and half-life, the formation and decline of degradates, and the potential for leaching.

Ground Water

As explained above, fenamiphos and its degradates, fenamiphos sulfoxide and fenamiphos sulfone, are mobile and sufficiently persistent to leach to ground water. Fenamiphos and its degradates exhibit many of the properties and characteristics associated with chemicals that have been detected in ground water. Fenamiphos is mobile with Kd values that range from 0.95 to 3.4 L/kg in sandy loam and silt loam soils. The degradates, fenamiphos sulfone and fenamiphos sulfoxide, are more mobile than the parent compound. An acceptable study indicated that the aerobic half-life for fenamiphos was approximately 16 days; other information reports half-lives up to 30 days for the parent. In addition, the hydrolysis and anaerobic soil metabolism half-lives for parent fenamiphos indicate that it will persist once it reaches ground water. For these reasons, fenamiphos use is likely to have a significant impact on ground-water quality.

Leaching of fenamiphos was confirmed by detections in ground water in Florida during a small-scale retrospective monitoring study. Concentrations of parent fenamiphos in ground water ranged up to 22.5 ppb or approximately 1100 percent of the lifetime Health Advisory. The sulfoxide and sulfone degradate concentrations ranged up to 204 ppb and 19.9 ppb respectively (DP Barcode D157194). For this reason, the Agency required that the registrant conduct a prospective ground-water monitoring study in 1992. The Agency also requested a label advisory at that time.

Because fenamiphos and its degradates are both mobile and persistent under certain conditions, they are likely to have an impact on ground-water quality. In addition, over the long term, persistent pesticides that have leached to ground water may be discharged to surface-water bodies (i.e., streams, rivers, lakes, wetlands). Therefore, contamination of ground-water resources may also have an impact on ecological endpoints. Based on our current knowledge about these endpoints, fenamiphos may have an impact on aquatic invertebrates and fish through ground-water discharge. As illustrated on graph in Appendix A, fenamiphos is not likely to exceed some of the other risk-based levels of concern (LOCs) for ecological effects.

Because certain LOCs for ground water have been exceeded, EFGWB recommended that all fenamiphos labels contain a ground-water advisory. In 1992, EFGWB recommended that a prospective ground-water monitoring study be conducted for fenamiphos and its degradates. The study is expected to begin sometime in 1994, primarily to satisfy the State of Florida requirements. In light of the acetochlor decision, EFGWB now recommends that several other prospective ground-water monitoring studies be conducted for fenamiphos. In addition, the registrant should be requested to propose mitigation activities that will eliminate or reduce the contamination of ground water by fenamiphos residues, and that voluntary cancellation of this chemical in the United States be considered if contamination continues.

Fenamiphos Surface Water Advisory

Under some conditions fenamiphos and its sulfoxide and sulfone degradates may have a high potential for runoff into surface water (primarily via dissolution in runoff water), for several weeks to months post-application. These include poorly draining or wet soils with readily visible slopes, frequently flooded areas, areas experiencing immediate post-application runoff events before fenamiphos can be soil incorporated, areas over-laying extremely shallow ground water, and areas over-laying tile drainage systems that flow to surface water.

Surface Water Source Drinking Water Concerns

Fenamiphos is of potential concern to surface source drinking water because of its relatively low soil/water partition coefficient and relatively low lifetime health advisory of 2 ug/L which may become its MCL. It also has relatively low acute 1-10 day health advisories of 9 ug/L. Although fenamiphos is normally incorporated, it remains a potential threat to surface water due to frequently high application rates, and to tile drainage.

The Surface Water Section has not seen any data on the concentrations of fenamiphos in surface water. Since fenamiphos is not currently regulated under the Safe Drinking Water Act (SDWA), water supply systems are not required to sample and analyze for it.

Because of potential concerns for surface water source drinking water, it is recommended that reregistration of fenamiphos be contingent upon the registrants agreeing to fund monitoring programs for fenamiphos and its sulfoxide and sulfone degradates in surface source water supply systems which drain watersheds which typically receive high fenamiphos applications. The numbers and locations of the systems for which monitoring would be funded can be negotiated as well as the duration of the monitoring programs.

Based upon major fenamiphos uses, crop distribution maps, and areas of no to limited irrigation, potential areas of interest for monitoring surface water might include turf drainage systems in any part of the country which flow to surface water; the Mississippi River Basin in AR, TN, MS, and LA (cotton); Southeast AL, Southwest GA, Southeast VA, Northeast NC (peanuts); Florida (citrus), KY, NC, and Southern MD (tobacco); Southwest NY (grapes); Western MI, Western NY, Southeastern NY, and 4 state intersection area of VA, WV, MD, and South Central PA (apples); Central GA, SC, South Central PA (peaches); and HI (pineapples).

If the results of the monitoring program indicate that fenamiphos exceeds drinking water health advisories, the following is recommended:

Surface Water Scenario I:

If one (1) community water supply system, that derives its water primarily from surface water, detects an annual time-weighted mean concentration of $\geq$2 ppb, or confirmed peak concentration $\geq$9 ppb fenamiphos, then either;

The use of fenamiphos in the related watershed will be prohibited. Such prohibition will be implemented by means of amendment of the fenamiphos registration to prohibit sale, distribution, and use in the specified watershed. The timing, content, and implementation of such restriction shall be governed EPA and the registrant.

The registrant will adsorb 100% of costs required to restore

the community water supply system to compliance. If EPA determines that the registrant has failed to meet this obligation, it may cancel the registration without opportunity for hearing.

Surface Water Scenario II:

If EPA determines two (2) large (serving 100,000 people) community water supply systems, or ten (10) community water supply systems of any size across wide use areas have an annual time-weighted mean concentration of ≥2 ppb, or confirmed peak concentrations ≥9 ppb, or are otherwise determined to be out of compliance based on Office of Water criteria, the registration will be automatically canceled.

7.1 STATUS OF DATA REQUIREMENTS:

Data requirements	Review Status	MRID #
161-1 Hydrolysis	Satisfied	00079270, 42149302
161-2 Photolysis--Water	Satisfied	00133402
161-3 Photolysis--Soil	Satisfied	40608001
161-4 Photolysis--Air	Waived[1]	EAB # 80118 (2Aug88)
162-1 Aerobic Soil Metabolism	Satisfied	42149303
162-2 Anaerobic Soil Metab.	Satisfied	41286901
163-1 Leaching and Ads./Des.	Partially satisfied Aged portion satisfied--40547502 Unaged portion upgradeable--40774808	
163-2 Laboratory volatility	Satisfied	40774810
164-1 Terrestrial Field Diss.	(EC) Upgradeable Granular (15% G) Unsatisfied	42149301, 42216201
165-4 Fish Bioaccumulation	Satisfied	40274201, 40274202, 40274203
166-1 Prospective GW Monitoring	Unsatisfied	
201-1 Droplet Size Spectrum	Waived[2]	EAB # 80118 (2Aug88)
202-1 Field Spray Drift Evaluation	Waived[2]	EAB # 80118 (2Aug88)

1. This study was waived because its method of application results in low exposure of fenamiphos to sunlight.

2. Based on the method of application (applied by ground spray (EC) or granule to soil surface and immediately soil incorporated) fenamiphos is not expected to present an appreciable exposure to humans and other non-target organisms by spray drift or runoff. However, if the label is amended in the future to include other methods of application, spray drift, runoff, and/or surface water monitoring data may be requested.

ENVIRONMENTAL FATE SUMMARY:

Based on acceptable hydrolysis data fenamiphos appears to be relatively stable to hydrolysis in buffer solutions with reported half-lives of 245 days at pH 5.0, 301 days at pH 7.0, and 235 days at pH 9.0. The major degradate reported was fenamiphos sulfoxide which by day 31 of the study accounted for 9.9% of the radioactivity in the pH 5.0 samples, 8.1% in the pH 7.0 samples, and 4.1% in the pH 9.0 samples. Fenamiphos phenol was found in the pH 9.0 samples (5.2% of the total radioactivity by day 31).

Based on acceptable aqueous photolysis data submitted previously the aqueous photolysis half-life was 2-4 hours at pH 7.0 when exposed to artificial (450 watt mercury arc lamp emitting light of ~5200 uW/cm^2 intensity at the sample surface) between 300-600 nm. After 24 hours of irradiation fenamiphos accounted for ~4% of the applied radioactivity and the major degradates reported were fenamiphos sulfonic acid phenol (~19%), fenamiphos sulfoxide (~17%), and fenamiphos sulfonic acid (~6%). Based on acceptable soil photolysis data the half-life of fenamiphos was 2.7 hours when exposed natural sunlight. The radioactive components identified from the treated exposed soil samples were fenamiphos sulfoxide and parent fenamiphos.

Based on acceptable aerobic soil metabolism data fenamiphos applied at a rate of 13.7 ppm to Howe sandy loam soil degraded rapidly (half-life = 15.7 days) to form fenamiphos sulfoxide (maximum of 51.4% by day 14), fenamiphos sulfone (maximum of 3.5% at day 14), fenamiphos phenol (<0.1% at all sampling times), fenamiphos sulfoxide phenol (maximum of 5.4% on day 31), fenamiphos sulfone phenol (maximum of 24.3% on day 63), and fenamiphos sulfone anisole (maximum of 4.4% on day 365). By the end of the study 34.2% of the applied radioactivity was quantitated as $^{14}CO_2$. The proposed metabolic pathway indicated that fenamiphos transformed to the corresponding sulfoxide metabolite and further degraded to fenamiphos sulfoxide phenol and fenamiphos sulfone phenol. CO_2 appeared to be produced from the degradation of fenamiphos sulfoxide phenol, fenamiphos sulfone phenol and possibly from the degradation of fenamiphos phenol. An additional ancillary study indicated that fenamiphos degraded in the soil more rapidly at 22°C than at 16°C and also more rapidly at 28°C than at 22°C.

Based on acceptable anaerobic soil metabolism data fenamiphos, applied at a rate of 13.3 ppm to a Howe sandy loam soil, degraded with a half-life of 87.9 days. In this study fenamiphos was incubated for 6 days under aerobic conditions followed by 60 days incubation under anaerobic conditions. Fenamiphos declined from 36.3% on day 0 of anaerobic incubation (following the 6 day aerobic incubation) to 21.8 ± 1.9% after 60 days anaerobic incubation. The major metabolite was fenamiphos sulfoxide (maximum of 46.5% at day 6 of aerobic conditions and decreasing to 14.3% after 60 days anaerobic incubation). Other reported metabolites were fenamiphos

sulfone (maximum of 0.5% on days 52 and 66), fenamiphos phenol (maximum of 3.2% on day 36), fenamiphos sulfone phenol (maximum of 8.7% on day 66), and fenamiphos sulfone anisole (<1% on day 66).

Based on upgradeable batch equilibrium data the reported Freundlich K_{ad} values from four unclassified soils ranged from 0.95 in a sandy loam soil to 3.4 in a silt loam soil. The K_{oc} values ranged from 165.6 to 543.4. These values indicate that parent fenamiphos has the potential to be relatively mobile in the soils tested.

Four mobility and adsorption/desorption studies were submitted. Two (MRID No. 40547501 and 40547502) had been previously reviewed. Based on acceptable column leaching studies, parent fenamiphos was mobile (16.2% to 63.8% of applied radioactivity was found in the leachate). The major metabolites, fenamiphos sulfoxide and fenamiphos sulfone were more mobile. The greatest mobility of fenamiphos and its metabolites was in the soil with the lowest cation exchange capacity and the lowest percentage of organic matter (Indiana sand soil) and vice versa (Kansas sandy loam soil). No parent fenamiphos was found in the leachate from the Kansas sandy loam soil. The leachate from the soil columns contained 47.2% of applied radioactivity in the California sandy loam soil, 63.8% in the Indiana sand soil, and 16.2% in the Kansas sandy loam soil. Of this radioactivity found in the leachates the majority was fenamiphos sulfoxide (86.44% of radioactivity in leachate from the California sandy loam soil, 76.48% of radioactivity in leachate from the Indiana and soil and 90.12% of radioactivity in the leachate from the Kansas sandy loam soil). These results indicated that fenamiphos sulfoxide was the most mobile metabolite, followed by fenamiphos sulfone, and the majority of parent fenamiphos did not leach through the soil columns.

Based on acceptable laboratory volatilization data fenamiphos did not volatilize very rapidly when applied at a rate of 12 lb ai/A to a sandy loam soil. After 7 days less than 0.1% fenamiphos volatilized indicating that volatilization was not a major route of dissipation for fenamiphos applied to the soil.

Based on upgradeable terrestrial field dissipation studies conducted in Chualar and Fresno, California on established turf plots previously used for crop production, parent fenamiphos (Nemacur 3 EC) applied at 10 lb ai/A was not very mobile. The half-life of fenamiphos was 16.2 days at the Chualar site and 17 days at the Fresno site. Parent fenamiphos was not detected (detection limits 0.01 ppm) below the 0-6 inch soil horizon at either of the two sites. Fenamiphos sulfone was detected as far as the 6-12 inch soil horizon at the Chualar site and as far as the 18-24 inch soil horizon at the Fresno site. Fenamiphos sulfoxide was detected as far as the 24-30 inch soil horizon at the Chualar site and as far

as the 30-36 inch soil horizon at the Fresno site. These studies confirmed the results of the laboratory leaching and adsorption/desorption studies demonstrating that the metabolites fenamiphos sulfoxide and fenamiphos sulfone are both more mobile than the parent and have a greater potential to leach in the soil. It appears that fenamiphos dissipates in the soil by microbial degradation to fenamiphos sulfoxide and fenamiphos sulfone followed by leaching into the soil and eventual further degradation as proposed in the aerobic soil metabolism study.

At the Chualar site the concentration reported for total fenamiphos residues at day 0 of the first application at a rate of 10 lb ai/A was 0.32 ppm (parent fenamiphos accounted for 0.21 ppm). The maximum concentration reported at this site for fenamiphos sulfoxide was 0.98 ppm at day 28 posttreatment and the maximum fenamiphos sulfone concentration was 0.32 also at day 28. At the Fresno site the total residue concentration at day 0 was 4.06 ppm (parent fenamiphos was 2.668 ppm and fenamiphos sulfoxide was 1.39 ppm) and this was when the maximum concentration of parent fenamiphos and fenamiphos sulfoxide were reported. The maximum concentration of fenamiphos sulfone was 0.52 ppm at day 60 posttreatment. No information from acceptable field dissipation studies using granular (Nemacur 15% G) formulations is currently available.

Leaching of fenamiphos was confirmed by detections in ground water in Florida during a small-scale retrospective monitoring study. Concentrations of parent fenamiphos in ground water ranged up to 22.5 ppb or approximately 1100 percent of the lifetime Health Advisory. The sulfoxide and sulfone degradate concentrations ranged up to 204 ppb and 19.9 ppb respectively (DP Barcode D157194). For this reason, the Agency required that the registrant conduct a prospective ground-water monitoring study in 1992. The Agency also requested a label advisory at that time.

Based on an acceptable fish bioaccumulation study, the maximum bioaccumulation factors (BCF) for fenamiphos residues were 89X for whole fish at 14 days exposure, 24X for fillet tissue at 7 days exposure, and 230X for viscera at 7 days exposure. The average steady state BCF was 86X during the course of the study. After 28 days the BCFs were 21X, 61X, and 98X for fillet, whole fish, and viscera, respectively. During the 14 day depuration period, accumulated ^{14}C-fenamiphos residues dropped >95% to 98% of the observed concentration at day 28 of uptake exposure in the fillet, whoe fish and viscera, respectively. The phenol sulfone metabolite was the primary metabolite found in the tissue and accounted for 42.7% and 51.0% of the radioactivity in the 21 and 28 day viscera tissues. Parent fenamiphos, the sulfoxide, sulfone, phenol, and phenol sulfoxide metabolites were found in amounts less than 10%. These results indicated that fenamiphos did not bioaccumulate in fish and any residues taken up by fish were depurated when fish were no longer exposed to these residues.

Registration Actions

7.2 (DP Barcode D195745) The State of California, Department of Pesticide Regulation has requested the reissuance of a Section 18 Specific Exemption for the use of fenamiphos (Nemacur 3 Emulsifiable Nematicide, EPA Reg. No. 3125-283-AA) on broccoli and cauliflower. The request specifies that approximately 95% of 127,980 acres of broccoli and 48,719 acres of cauliflower will require treatment. Fenamiphos is to be applied as a banded application at a rate equivalent to a maximum of 6 lbs fenamiphos per broadcast acre once per season at planting or transplant and is to be incorporated into the soil by mechanical equipment or by low volume irrigation (drip type system with the lines at least 2 inches below the soils surface). Although the environmental fate data base for fenamiphos is not complete, sufficient information is currently available to establish the dissipation of the emulsifiable formulation of fenamiphos (Nemacur 3 EC) beneath the soil surface. Fenamiphos appears to degrade rapidly by photolysis and aerial and broadcast applications of this product are prohibited under the emergency exemption. Because fenamiphos and its degradates are both mobile and persistent under certain conditions, they are likely to have an impact on ground-water quality.

7.3 (DP Barcode 169871) Mobay Corporation has submitted a petition proposing amendment of 40 CFR 180.349 by establishing tolerances for residues of Nemacur and its cholinesterase inhibiting metabolites in or on the raw agricultural commodities almonds, almond hulls, pecans, plums and walnuts. This action pertains to HED.

7.4 (DP Barcode 165005, 164920) Mobay Corporation has requested a change in the labelling to propose use of Nemacur 3 and Nemacur 15% Granular for control of nematodes and banana root borer infesting bananas and plantains grown in Puerto Rico and bananas in Hawaii. For bananas in Hawaii the application states that not more than 3.5 gallons (10 lb ai) are to be applied per acre per year for Nemacur 3EC or not more than $66^{2/3}$ lbs of Nemacur 15% G (10 lb ai/A) per acre per year. However, the label for both Nemacur 3 EC or Nemacur 15% G in Puerto Rico does not specifically state the maximum amount of active ingredient that may be applied. It states that for the EC formulation that not more than 25 ml per production unit per year are to be applied and that for the 15% G formulation that not more than 60 grams per production unit per year are to be applied. The label needs to be modified to reflect the maximum application of active ingredient per acre. A tolerance of 0.10 ppm has been established for the combined residues of fenamiphos and its cholinesterase inhibiting metabolites in/on bananas. Additional Field Dissipation Studies are necessary to determine the dissipation of granular formulations (Nemacur 15% G) of fenamiphos. EFGWB is concerned that the use of fenamiphos in these locations may result in contamination of ground water because of the soil

types prevalent in these areas.

7.5 (DP Barcode D175638, D175632). This action is in response to DP Barcode D155171 (EFGWB # 90-0843) for use of Nemacur 3 EC and Nemacur 15% G on broccoli and cauliflower. Mobay has addressed the concern for lack of data requirements. In addition a revised label was submitted which addressed the maximum use rate (3 lb ai/A) per field acre was specified as well as the application rate (2.0 to 9.8 fluid ounces per 1000 ft of row for any row spacing for the Nemacur 3 EC formulation and 20 lb of the Nemacur 15% G formulation). Mixing instructions were also included on the label. It is to be noted that additional field dissipation studies are necessary to determine the dissipation of granular formulations of fenamiphos.

7.6 (DP Barcode D170529, D170534) Nemacur 15% G is currently registered as a single application prior to transplanting for control of nematodes infesting brussels sprouts. A tolerance of 0.1 ppm has been established to cover residues of fenamiphos and its sulfone and sulfoxide metabolites in or on the raw agricultural commodity brussels sprouts. The enclosed draft labeling is seeking to expand the current Nemacur 15% G label on brussels sprouts by adding directions for multiple applications. No information was provided on the maximum use of active ingredient per acre per season on the label. A second request (D170534) seeks to add the use of Nemacur 3 EC for use of a single (prior to transplanting) and multiple applications (prior to transplanting plus additional applications after planting) for control of nematodes infesting brussels sprouts. This label does not contain information specifying the maximum application of active ingredient per season and should contain this information. Additional field dissipation studies are necessary to determine the dissipation of granular formulations of fenamiphos.

7.7 (DP Barcode D165691) Resubmission of proposed labeling for potatoes, sweet potatoes (to include yams), sugarbeets and tomatoes for both Nemacur 3 EC and Nemacur 15% G. For each crop the label directions were not very clear and did not specify the maximum application rate per season (ai/A). The maximum use rate in the LUIS Report is 20 lb ai/A per season. In the submitted label for the 15% G, the row spacing and equivalent dosage for the row spacing should be listed. It presently lists 22 oz for any row spacing for potatoes (20 lb ai/A for 36 inch rows) but does not list 20 lb ai/A per season as the maximum. If the rows were spaced closer and the application rate were the same then the dosage per acre would exceed this application rate.

The label submitted for the proposed use of Nemacur 3 EC and Nemacur 15% G on carrots did not list the maximum application per season (ai/A). The difference between application of the formulation and active ingredient per acre in the labels was not

delineated and must be made clear. Additional field dissipation studies with Granular formulations are still necessary to determine the the dissipation of these formulations.

8.0 RECOMMENDATIONS:

The environmental fate data base is not complete. The unaged leaching and adsorption/desorption (163-1) portion of the study is upgradeable. The field dissipation studies using the emulsifiable concentrate formulation of fenamiphos (Nemacur 3 EC) are upgradeable. However, additional field dissipation studies using granular formulations (Nemacur 15% G) are necessary to determine the dissipation of fenamiphos when applied in this type of formulation. Previous unacceptable field dissipation studies using granular formulations (MRID Nos. 00118796-A and B with 10% G formulations and 00118796-F, G, and I with 15% G formulations) did not use specific analytical methods to identify parent and degradates, did not address the formation and decline of degradates, and soil samples were taken only from 0-6 inches and could not define the extent of leaching.

EFGWB recommends that several additional prospective ground-water monitoring studies be conducted for fenamiphos. The locations for these studies will depend on the use areas.

EFGWB recommends that the registrant should be requested to propose mitigation activities that will eliminate or reduce the contamination of ground water by fenamiphos residues. If contamination of ground water continues, the registrant should consider voluntary cancellation of this chemical in the United States.

9.0 BACKGROUND:

The LUIS Report (12/1/93) indicates that fenamiphos is an insecticide and nematicide registered for a variety of terrestrial food crop, terrestrial food + feed crop, and terrestrial non-food crop use sites. These include apples, asparagus, bananas (plantains), beets, bok choy, brussels sprouts, cabbage, cherries, citrus fruits, cotton, eggplant, garlic, grapes, kiwi fruits, nectarines, okra, peaches, peanuts, peppers, pineapples, raspberries, strawberries, and tobacco. Other uses also include application to ornamental herbaceous plants, ornamental lawns and turf, and golf course turf. All formulations are restricted use. The chemical is applied to the soil by broadcast spray, soil injection, chemigation, ground spray, soil band treatment, or soil in furrow treatment. Unless otherwise specified, product must be incorporated into the soil for optimum results. Incorporation may be accomplished by irrigation or mechanical equipment. Application rates range from 0.5 to 20 lb ai/A. Multiple applications may be made during the growing season. Tolerances for residues of

fenamiphos in/on raw and in processed plant commodities are currently expressed in terms of the combined residues of fenamiphos and its cholinesterase-inhibiting metabolites, fenamiphos sulfoxide and fenamiphos sulfone. These tolerances currently are set at 0.02-0.60 ppm.

10.0 DISCUSSION OF INDIVIDUAL STUDIES:

10.1 Unaged leaching and adsorption/desorption batch equilibrium study, MRID No. 407748-08. In this study the origin and classification of the four soils used in the study was not provided. This study did provide information on the potential mobility of parent fenamiphos in four different soils.

10.2 Terrestrial Field Dissipation study, MRID No. 42149301, EC formulations. In this study it is requested that an explanation of the poor initial (day 0) recovery of parent and continual low material balance from the Chualar site be explained. The recovery of total fenamiphos residues on day 0 at the Fresno site was significantly greater. However, an explantion for the high recovery of fenamiphos sulfoxide at day 0 (the maximum concentration of fenamiphos sulfoxide and of parent fenamiphos was on the day of application) at this site is requested. No explanation was provided as to how the turf in the soil cores was handled or extracted at either of the two sites.

Additional field dissipation studies using granular formulations (Nemacur 15% G) are necessary to determine the dissipation of fenamiphos, the pattern of formation and decline of degradates, and the potential for leaching for this type of formulation. Previous unacceptable studies using granular formulations (MRID Nos. 00118796-A and B using a 10% G formulation and 00118796-F, G and I using a 15% G formulation) were all unsatisfactory because the analytical methods were non specific, the formation and decline of degradates was not addressed, and the soil was not sampled deep enough (only 6-inch soil samples taken) to define the extent of leaching.

Registration Actions

10.3 DP Barcode D195745, ID# 94CA0002. The State of California has requested the reissuance of a Section 18 Specific Exemption Nemacur 3 Emulsifiable Nematicide (EPA Reg. No. 3125-283-AA) for broccoli and cauliflower for cyst nematodes (sugarbeet cyst nematode- Heterodera schachtii; cabbage cyst nematode- Heterodera cruciferae). This request specifies that the main counties where broccoli are grown are Monteray, San Benito, Fresno, Kings, San Luis Obispo, Santa Barbara, Ventura, Riverside and Imperial and that an estimated 127,980 acres of broccoli will be planted. The main counties where cauliflower are grown are Monteray, San Luis Obispo, Santa Barbara, Santa Cruz, Imperial, Riverside, San Diego and Stanislaus and that an estimated 48,719 acres of cauliflower

will be planted. In both cases it was estimated that 95% of the acreage will require treatment. However, the total acreage listed that will require treatment was 176,699 acres (100%).

The total amount of fenamiphos to be applied was not specified. The alternate control measures listed were: 1) Telone- the use of Telone products in California has been suspended; 2) Vapam- provided inconsistent nematode control; high rates of 75-100 gallons per acre for field application; cost prohibitive; application equipment and material problems; treatment problems and extended waiting periods after application; 3) Methyl Bromide- high volumes for field application; application problems and waiting periods prior to planting; weather sensitivity, buffer zones, and rotation restrictions all listed as adverse problems. Technical experts project broccoli and cauliflower yield losses to be 20-80% without the use of the proposed material.

An attachment included the use directions. In this attachment the dosage specifies that banded application at a rate equivalent to a maximum of 6 lbs fenamiphos per broadcast acre. The frequency of application is to be once per season at planting or transplant.

At present the current data in EFGWB files is incomplete but sufficient information is available to establish the mode of dissipation of fenamiphos in soil when applied as an emulsifiable concentrate. Fenamiphos is acutely toxic to mammals, birds and fish. The State of California Fish and Wildlife staff has concluded that "although fenamiphos is highly toxic to fish and wildlife, soil incorporation should preclude significant exposures. Use on broccoli and cauliflower should not pose a threat to fish and wildlife generally or endangered species in particular due to low probability of exposure." Because fenamiphos and its degradates are both mobile and persistent under certain conditions, they are likely to have an impact on ground-water quality.

10.4 DP Barcode 169871. Mobay has petitioned for establishing tolerances for residues of fenamiphos and its cholinesterase inhibiting metabolites in or on the raw agricultural commodities almonds at 0.3 ppm, almond hulls at 0.4 ppm, pecans at 3.5 ppm, plums at 0.02 ppm, and walnuts at 0.4 ppm, and a food additive tolerance on prunes at 0.04 ppm. It is specified that Nemacur 3 EC should be applied at the rate of 1.5 gallons (72 oz ai/A) per acre in a 50% band or at 2 quarts (0.5 gallon) to 1.5 gallons (24 to 72 oz ai/A) per acre by low pressure irrigation. The maximum amount of Nemacur which can be applied is 3 gallons (9 lb ai/A) per acre per year. These rates do not exceed the rates used for laboratory or field studies.

10.5 DP Barcode 165005, 164920. Mobay has requested a change in the labeling to include the use of both Nemacur 3 EC and Nemacur 15% G for control of nematodes and banana root borer infesting bananas and plantains grown in Puerto Rico and bananas grown in Hawaii. The

maximum application of active ingredient per acre for use in Hawaii was specified on the label (10 lb ai/A). However, the labeling was not specific as to the maximum application rate for use of either formulation in Puerto Rico (for the EC it stated that not more than 25 ml per production unit per year are to be applied and for the 15% G formulation that not more than 60 grams per production unit per year are to be applied). EFGWB is concerned that the use of fenamiphos in these locations may result in contamination of ground water because of the soil types prevalent in these areas. Additional field dissipation studies with granular formulations are necessary to satisfy this environmental fate data (164-1) requirement.

10.6 DP Barcode D175638, D175632. This response was to previous request (DP Barcode D155171, EFGWB # 90-0843) for use of Nemacur 3 EC and Nemacur 15% G on broccoli and cauliflower. At that time only the data requirements for hydrolysis, photodegradation in water and the aged portion of the leaching and adsorption/desorption studies had been satisfied. In this response a revised label was submitted addressing the maximum use rate (2.0 to 9.8 fluid oz per 1000 ft of row for any row spacing for the Nemacur 3 EC formulation and 20 lb of the Nemacur 15% G formulation). Adequate mixing instructions were also included. Additional field dissipation studies are required to determine the dissipation of granular formulations of fenamiphos.

10.7 DP Barcode 170529, 170534. Nemacur 15% G is currently registered as a single application prior to transplanting for control of nematodes infesting brussels sprouts. A tolerance of 0.1 ppm has been established to cover residues of fenamiphos and its sulfone and sulfoxide metabolites in or on the raw agricultural commodity brussels sprouts. One enclosed draft labeling (DP Barcode 170529) is seeking to expand the current Nemacur 15% G label on brussels sprouts by adding directions for use of a single (prior to transplanting) and multiple applications (prior to transplanting plus two additional 6-inch band or side-dress applications on each side of the row at 30 and 60 days after planting) for control of nematodes infesting brussels sprouts. A second draft labeling (DP Barcode 170534) is seeking to expand the current Nemacur 3 EC lanbel by adding directions for use of a single (prior to transplanting) and multiple (prior to transplanting plus two additional 6-inch band or side-dress applications on each side of the row at 30 and 60 days after planting) applications for control of nematodes infesting brussels sprouts. Residue data submitted in Mobay Report No. 99712 indicated that the proposed multiple application use pattern will not result in residues of fenamiphos and its sulfoxide and sulfone metabolites over the currently established tolerance of 0.1 ppm. In both draft labeling requests information specifying the maximum application of active ingredient was not included.

10.8 DP Barcode D165691. Mobay has resubmitted a proposed labeling for potatoes, sweet potatoes (to include yams), sugarbeets, and tomatoes for both Nemacur 3 EC and Nemacur 15% G. The label directions were not very clear as to the dosage applied or to the maximum application per season. The distinction between ounces of applied material or of active ingredient was not made. For the crops the minimum row spacing and its application per season was not clear, i.e.-potatoes (20 lb/A on 36-inch rows) and no mention made as to if this is the minimum spacing and maximum application rate of active ingredient/A/season. Labeling did not distinguish between dosage of formulated material or of active ingredient per 1000 ft of row.

In the proposed new use on carrots for both Nemacur 3 EC and Nemacur 15% G there was no specification of the maximum application per season.

11.0 COMPLETION OF ONE-LINER: updated 10 March 1994

12.0 CBI APPENDIX: None

APPENDIX A

GROUND WATER ASSESSMENT
FENAMIPHOS RED

Background

In 1989, the State of Florida requested that Miles, Inc. (then Mobay) conduct a small-scale retrospective ground-water study for the registration of fenamiphos on citrus. In a 6(a)2 report submitted to the Agency in 1990, Miles reported detections of the parent fenamiphos in ground water on the study site that greatly exceeded the 2 ppb lifetime Health Advisory. High levels of two of the degradates, fenamiphos sulfoxide and fenamiphos sulfone, were also found. Concentrations in ground water ranged up to 22.5 ppb, 204 ppb, and 19.9 ppb for the parent, sulfoxide degradate, and sulfone degradate, respectively (DP Barcode D157194). The highest level of total residues detected in ground water during one sampling event was 239 ppb.

Following the receipt of the retrospective study information, EFGWB recommended that a ground-water advisory be placed on the fenamiphos label. A revised label with this advisory was issued in 1992.

In order to better define the fate of fenamiphos in the environment, EFGWB requested that the registrant conduct a small-scale prospective ground-water monitoring study (Memorandum from E. Behl to Cynthia Giles-Parker, 1/13/92). The State of Florida also requested a prospective study for this chemical because of its citrus use. A protocol was submitted in 1993 (DP Barcode D193324, 8/25/93) for a study to be conducted in Florida, but the protocol was found to be unacceptable by both the State of Florida and the Agency. The study is anticipated to begin sometime in 1994, primarily to satisfy the requirements of the State of Florida.

Environmental Fate Assessment

Fenamiphos and its degradates exhibit many of the properties and characteristics associated with chemicals that have been detected in ground water. Fenamiphos is mobile with Kd values that range from 0.95 to 4.24 L/kg in sandy loam, silt loam, and clay loam soils. The degradates, fenamiphos sulfone and fenamiphos sulfoxide, are more mobile than the parent compound. An acceptable study indicated that the aerobic half-life for fenamiphos was approximately 16 days; other information reports half-lives up to 30 days for the parent. In addition, the anaerobic soil metabolism half-life for parent fenamiphos is approximately 88 days (13 weeks) which indicates that it will persist once it reaches ground water. For these reasons, fenamiphos use is likely to have a significant impact on ground-water quality.

The lifetime Health Advisory for fenamiphos has been established at 2 ppb; Health Advisory levels have not been established for the degradates. Fenamiphos has been classified as a D carcinogen which indicates that there is inadequate evidence of carcinogenicity in humans and animals or that no data are available. Although monitoring has been conducted for fenamiphos in six states, and for fenamiphos sulfoxide and sulfone in two, no detections of these chemicals had been reported when the "Pesticides in Groundwater Database" (Hoheisel et al., 1992) was published. However, fenamiphos has been detected in ground water in Florida at extremely high levels (see above) compared to human health standards, and it therefore presents a concern to human health via drinking water.

Because fenamiphos and its degradates are both mobile and persistent under certain conditions, they are likely to have an impact on ground-water quality. In addition, over the long term, persistent pesticides that have leached to ground water will be discharged to surface-water bodies (i.e., streams, rivers, lakes, wetlands). Therefore, contamination of ground-water resources can also have an impact on ecological endpoints. Based on our current knowledge about these endpoints, fenamiphos may have an impact on aquatic invertebrates and fish through ground-water discharge. No information is presently available to assess any impacts that fenamiphos may have on aquatic or terrestrial plants. As illustrated on the accompanying graph, fenamiphos is not likely to exceed some of the other risk-based levels of concern for ecological effects.

<u>Fenamiphos exceeds the following Levels of Concern for ground water:</u>

- **GROUND-WATER QUALITY.** EFGWB is concerned about the potential degradation of ground-water quality that occurs in fenamiphos use areas. Fenamiphos is registered for use on a variety of terrestrial food and nonfood crops. Fenamiphos and/or its degradates will probably be detected in ground water in areas where these crops are grown on vulnerable soils. This has already been demonstrated in Florida where fenamiphos was applied to a citrus grove on vulnerable soils and high levels of the pesticide and two of its degradates were detected.

- **HUMAN HEALTH.** Fenamiphos residues were detected in ground water in Florida at levels which greatly exceeded the 2 ppb lifetime Health Advisory. The concentration in ground water for the parent alone ranged up to 22.5 ppb or approximately 1100 percent of the HA. Health advisory levels have not been established for either of the fenamiphos degradates. Total residues (parent and degradates) from the Florida study exceeded the concentration of the parent by over 10 times.

Additional areas of concern:

- **ECOLOGICAL IMPACT.**

  Aquatic Invertebrates. Fenamiphos is highly toxic to some aquatic invertebrates, with an LC_{50} for water fleas (Daphnia magna) of 1.6 ppb. Fenamiphos is also moderately toxic to pink shrimp (Penaeus duorarum) with an LC_{50} of 150 ppb. Fenamiphos residues in ground water could have an impact on aquatic invertebrates in areas where ground water is discharged to surface water.

  Fish. Fenamiphos is highly toxic to fish, with an LC_{50} for bluegill sunfish (Lepomis macrochirus) of 9.6 ppb, and an LC_{50} of 72.1 ppb for rainbow trout (Oncorhynchus mykiss). Several fenamiphos-related fish kills are reported in the EPA Incident Database. Fenamiphos residues in ground water could have an impact on fish in areas where ground water is discharged to surface water.

Data requirements not satisfied

166-1. Small-Scale Prospective Ground-Water Monitoring. *All data are required.*

Recommendations

1. Because fenamiphos exceeds certain Levels of Concern for ground water, the GWTS recommended a ground-water advisory on the fenamiphos label in 1992. In addition, EFGWB requested that a prospective ground-water monitoring study be conducted for fenamiphos. This study is scheduled to begin sometime in 1994.

2. Fenamiphos meets the persistence and mobility triggers for classification as a restricted use chemical for ground-water concerns. At the present time, insufficient monitoring information is available to determine whether fenamiphos would be classified as a restricted use chemical for ground-water concerns. Additional monitoring may be required for this chemical to determine whether all the restricted use criteria are met.

3. In light of the acetochlor decision, the Ground Water Technology Section recommends that several additional prospective ground-water monitoring studies be conducted for fenamiphos.

4. The GWTS recommends that the registrant attempt to make every effort to stop the contamination of ground water by fenamiphos residues. If contamination of ground water continues to occur

from use in accordance with label directions or in accordance with commonly recognized practices, the registrant should consider voluntarily cancellation of this chemical in the United States.

4. The GWTS requests a meeting with representatives from Miles, Inc. to discuss fenamiphos use areas in the United States. The locations for the prospective studies requested above will depend on this information.

REFERENCES

Hoheisel, C., Karrie, J., Lees, S., Davies-Hilliard, L., Hannon, P., Bingham, R., Behl, E., Wells, D., and E. Waldman. 1992. Pesticides in Ground Water Database - A Compilation of Monitoring Studies: 1971-1991, EPA 734-12-92-001, September 1992.

Comparison of Detections in Ground Water with Levels of Concern
FENAMIPHOS (Nemacur)