04/0PP#04154

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

APR 25 1994

MEMORANDUM

OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

SUBJECT: Fenamiphos RED- EEB Science Chapter

TO: Kathy Monk
Science Analysis and Coordination Staff
Environmental Fate and Effects Division (7507C)

FROM: Anthony F. Maciorowski, Chief
Ecological Effects Branch
Environmental Fate and Effects Division (7507C)

Attached is the EEB Science Chapter for the Fenamiphos RED. The EEB has sufficient information to assess acute risk to terrestrial wildlife and acute and chronic risk to aquatic organisms. The major area of uncertainty relates to avian reproduction and other chronic effects to terrestrial vertebrates.

The following is a summary of EEBs' risk assessment:

* Based on the available data and information, the EEB concludes that the use of fenamiphos both as a granular and/or emulsifiable concentrate formulation, exceeds both the acute high risk (0.5) and chronic (1.0) LOCs for terrestrial organisms.

* Based on the available data and information, the EEB concludes that the use of fenamiphos, both as a granular and/or emulsifiable concentrate formulation, exceed the acute high risk (0.5) and chronic (1.0) LOCs for freshwater as well as marine/estuarine aquatic organisms.

Any questions or comments on this memo should be referred to R. Felthousen at 305-5829.

1

DP Barcode : D186404
PC Code No : 100601
EEB Out : APR 25 1994

To: Larry Schnaubelt
Product Manager 72
Special Review and Reregistration Division (7508W)

From: Anthony F. Maciorowski, Chief
Ecological Effects Branch/EFED (7507C)

Attached, please find the EEB review of...

Reg./File # : 100601
Chemical Name : Fenamiphos
Type Product : Insecticide
Product Name : Fenamiphos Products
Company Name : Miles Inc.
Purpose : List A RED for Fenamiphos, Case No. 0333.

Action Code : 606 Date Due : 05/01/94
Scientist : R. Felthousen Date In : 01/12/93

EEB Guideline/MRID Summary Table: The review in this package contains an evaluation of the following:

GDLN NO	MRID NO	CAT	GDLN NO	MRID NO	CAT	GDLN NO	MRID NO	CAT
71-1(A)			72-2(A)			72-7(A)		
71-1(B)			72-2(B)			72-7(B)		
71-2(A)			72-3(A)			122-1(A)		
71-2(B)			72-3(B)			122-1(B)		
71-3			72-3(C)			122-2		
71-4(A)			72-3(D)			123-1(A)		
71-4(B)			72-3(E)			123-1(B)		
71-5(A)			72-3(F)			123-2		
71-5(B)			72-4(A)			124-1		
72-1(A)			72-4(B)			124-2		
72-1(B)			72-5			141-1		
72-1(C)			72-6			141-2		
72-1(D)						141-5		

Y=Acceptable (Study satisfied Guideline)/Concur
P=Partial (Study partially fulfilled Guideline but additional information is needed
S=Supplemental (Study provided useful information but Guideline was not satisfied)
N=Unacceptable (Study was rejected)/Nonconcur

ECOLOGICAL EI
REREGISTRATION ELIGIBILITY
SCIENCE (

Acute oral
mallard duck
Strike submitted?

PHOS

I. TOXICITY

A. Topical Summaries

1. Avian and Mammalian Species

The acute oral LD_{50} value of technical fenamiphos for the bobwhite quail (Colinus virginianus) was determined to be 1.6 mg/kg (Acc. No. 0012189). Dietary LC_{50} values of 38 and 316 ppm were determined for the bobwhite quail and mallard duck (Anas platyrhyncos), respectively (Acc. Nos. 00025959 and 00025958). Based on these data, fenamiphos can be characterized as very highly toxic to the bobwhite quail and highly toxic to the mallard duck.

Dietary exposure to 8 ppm of technical fenamiphos reduced bobwhite quail chick survival by 31 percent. The lowest no-effect-level (NOEL) was determined to be 2 ppm (Acc. No. 00121291). Dietary exposure to 16 ppm of technical fenamiphos reduced feed consumption and egg production in the mallard duck. The highest (NOEL) was determined to be 8 ppm (Acc. No. 00121290). These data indicate that fenamiphos causes some reproductive impairment in both the mallard duck and bobwhite quail at exposure levels as low as 16 and 8 ppm, respectively.

Several simulated (i.e., small pen) field studies have been conducted for pineapple, turf, and orchard use patterns. Although these studies were deficient in various design features, results suggest both the liquid (Nemacur 3) and granular (Nemacur 15G) formulations of fenamiphos can cause mortality and other adverse effects to wildlife species under normal use conditions (Acc. Nos. 00114008, 0082115, 00114013, 00025956, 00025957 and 00121292).

Applications of Nemacur 15G at a rate of 134 lbs./acre to turf, without irrigation, resulted in 70 and 18 percent mortality to English sparrows (Passer domesticus) and bobwhite quail, respectively, when these birds were penned on the treated area (Acc. No. 00114013). Mortality occurred to pheasants (Phasianus colchicus) when confined to small pens in pineapple fields, even when soil incorporation occurred immediately following application (Acc. No. 00082115). In another study, significant avian and mammalian mortality occurred for five days following an application of Nemacur 3 sprayed at a rate of 23.8 lbs./acre (00121293).

In addition to the simulated field studies, several actual field studies have been conducted for the use of fenamiphos on tobacco, turf, and citrus (MRID Nos. 42029904, 42029903,

42029902, 42029901, 42029905). These studies suggest that, for most uses, mortality and other adverse effects are likely to occur when fenamiphos is applied according to label directions.

Treatment-related avian mortalities were documented at six different golf courses when Nemacur 3 was applied to control mole crickets (MRID # 42029901). In addition, 23 birds showed symptoms of behavioral impairment. While conducting a bird census study, several instances of mortality and/or behavioral deficits were observed when Nemacur 10G was applied according to label directions on golf courses (MRID # 41012902). The application of Nemacur 15G to Florida citrus groves resulted in depressed plasma ChE levels in nearly 1/3 of the avian focal species for approximately 30 days post-treatment (MRID # 42029902).

Acute oral toxicity studies show that fenamiphos is very highly toxic to mammals (rat LD_{50} = 2.38 mg/kg).

Table 1. Data Summary for the Toxicity of Fenamiphos to Birds

Guid.	Study Type (Species)	Test Mat.	Cat.	Acc. MRID #	Results
71-1(a)	Acute oral (Bobwhite)	Tech.	Core	00121289	LD_{50} = 1.6 mg/kg
71-2(a)	Avian Diet. (Bobwhite)	Tech.	Core	00025959	LC_{50} = 38 ppm
71-2(a)	Avian Diet. (Mallard)	Tech.	Core	00025958	LC_{50} = 316 ppm
71-2(a)	Avian Diet. (Jap. Quail)	Tech.	Supp.	00022923	LC_{50} = 59 ppm
71-4(a)	Avian Repro. (Bobwhite)	Tech.	Core	00121291	Dietary exposure of 8 ppm reduced quail chick survival by 31%. NOEL= 2 ppm.
71-4(a)	Avian Repro.	Tech.	Core	00121290	Dietary exposure of 16 ppm reduced feed consumption and egg prod.NOEL= 8 ppm.
71-5(a)	Small Pen (Pheasants Rice Birds)	15G	Supp.	00114008	Mortality
71-5(a)	Small Pen	15G	Supp.	00082115	Mortality

Table 1. Data Summary for the Toxicity of Fenamiphos to Birds-Cont.

Guid. #	Study Type (Species)	Test Mat.	Cat.	Acc. or MRID #	Results
71-5(a)	Small Pen (E. Sparrows) (Bobwhite) (Rabbits)	15G	Supp.	00114013	70% mortality to sparrows, 18% mort. to quail on non-irrigated. 50% mort. to sparrows on irrigated. No death to rabbits.
71-5(a)	Small pen/ Actual Field (Bobwhite) (Nat. popns.)	15G	Supp.	00025956	No effects to nat. popns. 1 quail died. Body wt. decrease.
71-5(a)	Small pen (Bobwhite) (Pheasant)	15G	Supp.	00025957	No hazard
71-5(a)	Small pen (Bobwhite)	Nem 3	Supp.	00121292	10% Mortality
71-5(b)	Field Study/ (Robins) (Sparrows) (Starlings) (Woodchucks)	Nem. 3	Supp.	00121293	Sign. avian mort.
71-5(b)	Field Study (Tobacco) Nat. popns.	Nem 3	Supp.	42029904	Mort. Documented
71-5(b)	Field Study (Tobacco) Nat. popns.	Nem. 3	Supp.	42029903	Mort. Documented
71-5(b)	Field Study (Citrus) Nat. popns.	15G	Supp.	42029902	Plasma ChE showed that nearly 1/3 of avian species exposed.
71-5(b)	Golf Course	Nem. 3	Supp.	42029901	Treatment related mort. occurred on all courses.
N/A	Golf Course Nat. Popns.	10G	Supp.	41012902	Several instances of mortality and/or behavioral effects

2. Fish Species

The 96-hour LC_{50} of fenamiphos to the bluegill sunfish (Lepomis macrochirus) has been determined to be 9.6 (MRID # 00025962) and 17.7 (MRID # 00114012) ppb, respectively for the 88% and 81% technical grade material. The 96-hour LC_{50} for the rainbow trout (Salmo gairdnarii)is 72.1 ppb for the 81% grade technical material (MRID # 00114012). The 96-hour LC_{50} value of technical (88.7%) fenamiphos to the sheepshead minnow (Cyprinodon variegatus) is 17 ppb (MRID # 40799710). Based on these data, technical fenamiphos can be classified as being very highly toxic to both freshwater and marine fish species.

The 96-hour LC_{50} value of Nemacur 3 (TEP) to the bluegill sunfish and rainbow trout is 4.5 (MRID # 40799704) and 68 ppb (MRID # 40799701), respectively. The 96-hour LC_{50} value of the 15G formulation (TEP) to the bluegill sunfish and rainbow trout is 151 (MRID # 00114012) and 563 ppb (MRID # 00114012), respectively. Based on these data, both the concentrate and granular formulations can be classified as being very highly toxic to freshwater fish species.

The early life-stage MATC value of technical fenamiphos for the rainbow trout is >3.8 <7.4 ppb (MRID # 41064301). Results of a mesocosm study, with the Nemacur 3 TEP showed that adverse effects occurred at levels > 3.5 ppb.

Table 2. Data Summary for the Toxicity of Fenamiphos to Fish

Guid.	Study Type (Species)	Test Mat.	Cat.	Acc. MRID #	Results
72-1(a)	Acute (bluegill)	Tech (88%)	Core	00025962	LC_{50}= 9.6 ppb
72-1(a)	Acute (bluegill)	Tech. (81%)	Core	00114012	LC_{50}= 17.7 ppb
72-1(b)	Acute (bluegill)	TEP (15G)	Core	00114012	LC_{50}= 151 ppb
72-1(b)	Acute (bluegill)	TEP (Nem3)	Core	40799704	LC_{50}= 4.5 ppb
72-1(c)	Acute (rainbow)	Tech. (81%)	Core	00114012	LC_{50}= 72.1 ppb
72-1(d)	Acute (rainbow)	TEP (15G)	Core	00114012	LC_{50}= 563 ppb

(b)

72-1(d)	Acute (rainbow)	TEP (Nem3)	Core	40799701	LC_{50}= 68 ppb

Table 2. Data Summary for the Toxicity of Fenamiphos to Fish- Cont.

Guid. #	Study Type (Species)	Test Mat.	Cat.	Acc. or MRID #	Results
72-3(a)	Acute (Sheepshead)	Tech (88%)	Core	40799710	LC_{50}= 17ppb
72-4(a)	Early-life (rainbow)	Tech	Supp.	41064301	MATC >3.8<7.4 ppb
72-7(a)	Mesocosm	TEP	Core	42029906	Adverse effects at levels > 3.5ppb

3. Freshwater Invertebrates

The acute 48-hour EC_{50} for the water flea (Daphnia magna) was determined to be 1.9 ppb for technical fenamiphos (MRID # 40799706). The acute 48-hour EC_{50} for the water flea was determined to be 7.5 ppb for the sulfoxide degradate of fenamiphos (MRID # 41497701). The acute 48-hour EC50 for Nemacur 3 (TEP) was 1.3 ppb.

Results of a Daphnia magna life cycle study showed that the MATC for technical fenamiphos was 0.17 ppb.

Results of these studies show that technical fenamiphos, Nemacur 3 and the major degradate (sulfoxide) can be classified as being very highly toxic to the Daphnia magna.

Table 3: Data Summary for the Toxicity of Fenamiphos on Fresh water Invertebrates.

Guid. #	Study Type (Species)	Test Mat.	Cat.	Acc. or MRID #	Results
72-2(a)	Acute Daphnia magna	Tech (88.7)	Core	40799706	EC50 = 1.9 ppb
72-2(a)	Acute D. magna	Sulfoxide	Supp.	41497701	EC50 = 7.5 ppb
72-2(b)	Acute D. magna	Nemacur 3	Core	43183501	EC50 = 1.3 ppb
72-4(b)	Life Cycle	Tech.	Core	40922201	MATC= 0.17 ppb

D. magna

4. Estuarine/Marine Organisms

The acute EC50/LC50 of technical fenamiphos to the Eastern oyster (Crassostrea virginica) and mysid shrimp was determined to be 1.65 ppm and 6.2 ppb, respectively.. Based on these data, fenamiphos can be classified as being moderately toxic to the eastern oyster and very highly toxic to the mysod shrimp.

Table 4: Data Summary for the Toxicity of Fenamiphos on Estuarine/Marine Invertebrates.

Guid. #	Study Type (Species)	Test Mat.	Cat.	Acc. or MRID #	Results
72-3(b)	Shell Dep. Eastern oyster	Tech.	Core	40799709	EC50= 1.65 ppm
72-3(b)	Mysid Shmp	Tech.	Core	40799708	LC_{50}= 6.2 ppb

5. Non-target Insects

The acute contact LD_{50} value of fenamiphos to the honey bee (Apis mellifera) was determined to be 1.87 micrograms per bee. Based on this data fenamiphos can be classified as being highly toxic to honey bees.

Table 5: Data Summary for the Toxicity of Fenamiphos on Non-target Insects.

Guid. #	Study Type (Species)	Test Mat.	Cat.	Acc. or MRID #	Results
141-1	Acute Contact	tech.	Core	00036935	LD_{50} = 1.87 micro. per bee

II. USE PROFILE

Fenamiphos is a broad spectrum insecticide/nematicide registered for use on the following use sites: apples, asparagus, bananas (plantains) beets, Brussels sprouts, cabbage, cherries, Chinese cabbage, citrus fruits, cotton, eggplant, garlic, golf course turf, grapes, kiwi fruits, commercial /industrial lawns, nectarines, okra, ornamental and nursery stocks, peaches, peanuts, peppers, pineapples, raspberries, strawberries, and tobacco (Luis Report, 1992).

Fenamiphos is formulated as either a granulated or emulsifiable concentrate product. Fenamiphos is typically applied as a band or broadcast soil application made pre-plant, at planting, or post-plant prior to emergence (Residue Chemistry Branch, 1992).

III. EXPOSURE ASSESSMENT

A. Terrestrial Exposure Analysis

1. Granular Formulations

Fenamiphos is formulated as either a 10 percent (Nemacur 10G) or 15 percent (Nemacur 15G) active ingredient granulated formulation. Nemacur 10G is primarily used on turf use sites (i.e, golf courses, lawns, sod farms) while Nemacur 15G is primarily used on fruit, vegetables and field crops. Both formulations are used to control thrips, mole crickets and nematodes.

Table 6 presents the Estimated Environmental Concentrations (EECs), expressed as milligrams of active ingredient per square foot of treated area, that are likely to occur from the use of the granulated formulations. The EECs were determined by converting application rates, typically expressed as the number of ounces of product applied per 1000 feet of linear row, into application rates for a treated acre, by adjusting for band and row widths. This number was then adjusted to account for the various soil incorporation methods that are allowed by the label. The final number is an estimate of the amount of active ingredient/ square foot that is <u>likely to be available on the surface of the actual treated area.</u>

Based on these estimates, terrestrial exposure, from the use of granular fenamiphos, ranges from 1.2 mg ai/sq.ft., for a broadcast application on bananas, to 54.5 mg ai/sq. ft. for a 8 lb./ 1000 feet of row banded application on flower bulbs.

In addition, laboratory studies have shown that the sulfoxide metabolite is more toxic than the parent material. Environmental fate data show that fenamiphos and its' major metabolites are translocated systemically to plants and that the <u>sulfoxide</u> may be present in certain soils for up to 2 years after application.

2. Emulsifiable Formulations

Nemacur 3 is a 35% active ingredient emulsifiable concentrate registered for use as an insecticide-nematicide. Table 7 presents the maximum and minimum EECs, expressed as parts per million (ppm), that are likely to occur on avian food items (i.e., short grass, seeds, grains and fruit) from the

(9)

TABLE 6: ESTIMATED ENVIRONMENTAL CONCENTRATIONS (MG AI/SQ.FT) FOR GRANULATED FORMULATIONS OF FENAMIPHOS-

Crop	Form.	Pest [1]	Appl rate oz./1000 ft.	Band(ft)	Sq. ft /1000 ft. of row	Appl rate mg/sq ft.	Appl Rate mg ai/sq.ft.	Percent Unincorp. [2]	Exposed mg ai/sq. ft.
Cotton	15G	T	8	1	1000	227	34	8%	2.7
			8	0.1	100	2268	340	1%	3.4
			12	1	1000	340	51	8%	4.1
			12	0.1	100	3402	510	1%	5.1
Peanuts	15G	T,N	18.7	1	1000	530	80	15%	11.9
Bananas	15G	N	NA	NA	BC	52	8	15%	1.2
Bok Choy	15G	N	18.4	1.25	1250	417	63	15%	9.4
			14.7	1	1000	417	63	15%	9.4
Brussel Sprts	15G	N	18.4	1.25	1250	417	63	15%	9.4
Cabbage	15G	N	18.4	1.25	1250	417	63	15%	9.4
Eggplant	15G	N	14.7	1	1000	417	63	15%	9.4
Garlic	15G	N	18.4	0.1	100	5216	782	1%	7.8
Okra	15G	N	14.7	1	1000	417	63	15%	9.4
	15G		18.4	1.25	1250	417	63	15%	9.4
Peppers	15G	N	14.7	1	1000	417	63	15%	9.4
	15G		18.4	1.25	1250	417	63	15%	9.4
Strawberry	15G	N	14.7	1	1000	417	63	15%	9.4
	15G		22	1.5	1500	416	62	15%	9.4
	15G		17	1	1000	482	72	15%	10.8
Citrus	15G	N	67 lbs/1/2A	NA	BC 1/2A	1400	210	15%	31.5
Pineapple	15G	N	133.3 lbs./A	NA	BC/A	1400	210	15%	31.5
Turfgrass	10G	N,MC	100 lbs/A	NA	BC/A	1042	104	15%	15.6
Ornament.									
(L.Leaf Fern)	10G	N	100 lbs/A	NA	BC/A	1042	104	15%	15.6
(Protea)	10G	N	97.5 lbs/A	NA	BC/A	1013	101	15%	15.2
(Anthurium)	10G	N	100 lbs/A	NA	BC/A	1042	104	15%	15.6
Nur. Stock	10G	N	100 lbs/A	NA	BC	1042	104	15%	15.6
Bulbs	10G	N	128	1	1000	3632	363	15%	54.5

1. N=nematode, T=Thrips, MC=mole cricket

2: 1%= In-furrow Incorporation; 8%=band covered(specified);15%=Band incorporated(depth not specified)

TABLE 7: ESTIMATED ENVIRONMENTAL CONCENTRATIONS FOR NEMACUR 3

Crop	Pest [1]	Appl Method	Appl Rate oz/1000 row	Appl Rate oz. ai/1000 f	Band Width	Row Widt	Lbs ai/ Treated A	Unincorporated [2]	Lbs./A Exposed	Maximum EEC(ppm)	Minimum EEC(ppm)
Apple	N	Banded	NA	NA	NA	NA	20	100%	20	4800	140
Cherry	N	Banded	NA	NA	NA	NA	20	100%	20	4800	140
Peach	N	Banded	NA	NA	NA	NA	20	100%	20	4800	140
Nectarine	N	Banded	NA	NA	NA	NA	20	100%	20	4800	140
Citrus	N	Banded	NA	NA	NA	NA	20	100%	20	4800	140
Grapes	N	Banded	NA	NA	NA	NA	18	100%	18	4320	126
Non-Bear	N	Banded	NA	NA	NA	NA	18	100%	18	4320	126
Raspberry	N	Banded	NA	NA	NA	NA	12	100%	12	2880	84
Apple	N	Low Press.(ULV)	NA	NA	NA	NA	9	15%	1.35	324	9
Cherry	N	Low Press (ULV)	NA	NA	NA	NA	9	15%	1.35	324	9
Peach	N	Low Press.(ULV)	NA	NA	NA	NA	9	15%	1.35	324	9
Nectarine	N	Low Press.	NA	NA	NA	NA	9	15%	1.35	324	9
Grapes	N	Low Press.	NA	NA	NA	NA	9	15%	1.35	324	9
Citrus	N	Low Press.	NA	NA	NA	NA	9	15%	1.35	324	9
Non-Bear	N	Low Press.	NA	NA	NA	NA	6	15%	0.9	216	6
Kiwi	N	Low Press.	NA	NA	NA	NA	6	15%	0.9	216	6
Asparagus	N	Nursery	NA	NA	NA	NA	4	100%	4	960	28
	N	Field	NA	NA	NA	NA	4	100%	4	960	28
	N	P.Harvest	NA	NA	NA	NA	4	100%	4	960	28
Eggplant	N	Banded	5.9	2	1	40	5.4	100%	5.4	1307	38
Beets	N	Banded	6	2	1	40	5.4	100%	5.4	1307	38
Cotton	T	Banded	3.3	1.2	1	40	3.1	100%	3.1	755	22
	T	In-Furrow	3.3	1.2	0.1	40	31.4	100%	31.4	7547	220
	T,N	Banded	4.8	1.7	0.5	40	9.1	100%	9.1	2195	64
	T,N	In-Furrow	7.1	2.5	0.1	40	67.7	100%	67.7	16237	474
	T,N	Banded	8.9	3.1	1.5	40	5.7	100%	5.7	1357	40
(Calif)	T,N	Banded(si)	9.8	3.4	1.5	40	6.2	100%	6.2	1494	44
	T,N	Banded	4.8	1.7	0.5	40	9.1	100%	9.1	2195	64
	T,N	Banded	5.9	2.1	1	40	5.6	100%	5.6	1349	39
Cabbage (Fla)	N	Drench	NA	NA	NA	NA	1.7	15%	0.3	61	2
Peanuts	T,N	Banded	7.3	2.6	1	36	7.1	100%	7.1	1699	50
Tobacco	N,A	Brdcast	NA	NA	BC	NA	6.0	100%	6.0	1440	42
Bananas	N	Low Press.	NA	NA	NA	NA	5.0	15%	0.8	180	5
Pineapple											
(Preplant)HA	N	Brdcast	NA	NA	BC	NA	20.0	100%	20.0	4800	140
(Preplant)HA	N	Drip	NA	NA	NA	NA	20.0	15%	3.0	720	21
(Postplant)HA	N	Brdcast	NA	NA	BC	NA	6.0	100%	6.0	1440	42
(Postplant)PR	N	Brdcast	NA	NA	BC	NA	10.0	100%	10.0	2400	70
Strawberry	N	Banded	6.8	3.1	1.5	40	5.6	100%	5.6	1350	39
Turfgrass	N,MC	Brdcast	NA	NA	BC	NA	10.0	100%	10.0	2400	70

1 N=Nematodes, T=Thrips, A=Aphids, MC=Mole Crickets

2 = 100%=no incorportion; 15%= 85% incorporated

registered uses of Nemacur 3 on field crops and vegetables (Hoerger and Kenaga, 1972). Further, One hundred percent exposure is assumed for all applications except low pressure spray, drench and drip irrigation. For these methods contamination of food items may be less, or contaminated food items may be less available to organisms. Therefore, a 15% exposure factor is assumed.

Based on these estimates, maximum exposure, immediately following application, from the use of Nemacur 3 ranges from 61 ppm, for a 5 fl.oz. per 1,000 row ft. drench application on cabbage, to 16,237 ppm, for a 7.1 oz/1000 ft of row In-furrow application on cotton. Minimum exposure ranges from 2 to 474 ppm for cabbage and cotton, repsectively.

B. Aquatic Exposure Analysis

1. Runoff-Preliminary Estimates

Based upon laboratory data, EEB has characterized fenamiphos as very highly toxic to both cold and warm water fish species and aquatic invertebrates. As such, EEB is particularly concerned about any direct and/or indirect hazards that this material may pose to aquatic environments.

However, a review of all the labels shows that there are no use sites that allow for aerial application of either the emulsifiable or granulated products of fenamiphos. Therefore, the EEB does not believe that any direct contamination to aquatic environments is likely to occur from the use of fenamiphos.

In so much as label directions limit application to either ground equipment and/or low pressure irrigation/chemigation methods, contamination to aquatic environments from drift is also unlikely. As such, the EEB believes that the major route of exposure to aquatic environments is from runoff.

1. <u>Runoff - Exams Modeling</u>

EECs for fenamiphos from runoff have been determined for both lentic and lotic aquatic environments using the EXAMS II model (Exposure Analysis Modeling System, 1987). To calculate these EECs, the amount of runoff from a 10 hectare tobacco field (i.e., unit of runoff/acre from SWRRB x 10) was loaded into a Georgia farm pond (lentic) stream (lotic) scenario to simulate the fate of fenamiphos in a Georgia aquatic system.

The Georgia pond-stream scenario consists of a one hectare farm pond, 2 meters deep, that is surrounded by a 10 hectare drainage basin that drains into two streams. One stream is 100

meters-long, 3 meters-wide and 0.5 meters-deep while the other is 300 meters long, 3 meters wide and .05 meters deep). EECs of fenamiphos, applied at 20 lbs ai/A, soil incorporated (2-4") and/or watered-in are shown in Table 9.

Table 9: EEC (ppb) of fenamiphos in lentic and lotic scenarios from runoff. Estimates are based on the maximum label rate of product.

Soil Incorp. (2-4")	Pond	Stream I	Stream II
1% runoff	14.55	10.45	7.25
5% runoff	72.8	52.27	36.25
watered-in			
1% runoff	112	80.4	56
5% runoff	560	402	279

IV. HAZARD ASSESSMENT

A. Terrestrial Assessment

Because of the acute and chronic toxicity of Fenamiphos to avian species, the following discussion focuses on risks to nontarget avian wildlife. However, risks to nontarget mammals may be similar becasue of fenamiphos's acute and chronic toxicity to mammals (i.e., rat acute oral LD_{50} = 2.38 mg/kg; rat 2-generation reproduction NOEL = 40 ppm).

1. Emulsifiable formulations

(a) Avian Risk Quotients -Acute

Results of simulated and actual field studies suggest that applications of Nemacur 3 can cause mortality to avian species. In order to estimate the degree of hazard, the EEB has developed acute risk quotients, based on the maximum and minimum EEC as well as the lowest available LC_{50} values, for avian species.

Table 10 shows the maximum and minimum acute mortality risk quotients for the application of Nemacur 3 for all currently registered use sites. These risk quotients represent the ratio between the maximum and minimum EEC, as derived from the Kenaga nomograph, and the lowest LC50 value available for

(13)

Table 10: MAXIMUM AND MINIMUM DIETARY RISK QUOTIENTS FOR NEMACUR 3

Crop	Pest [1]	Appl Method	Lbs. ai/ Treated	Unicorporated [2]	Lbs.ai/A Exposed	Maximum EEC(ppm)	Minimum EEC/(ppm)	Max. Risk Quotient	Min. Risk Quotient
Apple	N	Banded	20	1	20	4800	140	126.3	3.7
Cherry	N	Banded	20	1	20	4800	140	126.3	3.7
Peach	N	Banded	20	1	20	4800	140	126.3	3.7
Nectarine	N	Banded	20	1	20	4800	140	126.3	3.7
Citrus	N	Banded	20	1	20	4800	140	126.3	3.7
Grapes	N	Banded	18	1	18	4320	126	113.7	3.3
Non-Bear	N	Banded	18	1	18	4320	126	113.7	3.3
Raspberry	N	Banded	12	1	12	2880	84	75.8	2.2
Apple	N	Low Press	9	0.15	1.35	324	9.45	8.5	0.2
Chery	N	Low Press	9	0.15	1.35	324	9.45	8.5	0.2
Peach	N	Low Press	9	0.15	1.35	324	9.45	8.5	0.2
Nectarine	N	Low Press	9	0.15	1.35	324	9.45	8.5	0.2
Grapes	N	Low Press	9	0.15	1.35	324	9.45	8.5	0.2
Citrus	N	Low Press	9	0.15	1.35	324	9.45	8.5	0.2
Non-Bear	N	Low Press	6	0.15	0.9	216	6.3	5.7	0.2
Kiwi	N	Low Press	6	0.15	0.9	216	6.3	5.7	0.2
Asparagus	N	Nursery	4	1	4	960	28	25.3	0.7
	N	Field	4	1	4	960	28	25.3	0.7
	N	P.Harvest	4	1	4	960	28	25.3	0.7
Eggplant	N	Banded	5.4	1	5.44	1305.6	38.08	34.4	1.0
Beets	N	Banded	5.4	1	5.44	1305.6	38.08	34.4	1.0
Cotton	T	Banded	3.1	1	3.14	755	22.01	19.9	0.6
	T	In-Furrow	31.4	1	31.44	7547	220	198.6	5.8
	T,N	Banded	9.1	1	9.15	2195	64	57.8	1.7
	T,N	In-Furrow	67.7	1	67.65	16237	474	427.3	12.5
	T,N	Banded	5.7	1	5.65	1357	40	35.7	1.0
(Calif)	T,N	Banded si	6.2	1	6.23	1494	44	39.3	1.1
	T,N	Banded	9.1	1	9.15	2195	64	57.8	1.7
	T,N	Banded	5.6	1	5.62	1349	39	35.5	1.0
Cabbage(Fla)	N	Drench	1.7	0.15	0.26	62	2	1.6	0.0
Peanuts	T,N	Banded	7.1	1	7.10	1704	50	44.8	1.3
Tobacco	N,A	Brdcast	6.0	1	6.00	1440	42	37.9	1.1
Bananas	N	Low Press	5	0.15	0.75	180	5	4.7	0.1
Pineapple									
(Preplant)HA	N	Brdcast	20	1	20.00	4800	140	126.3	3.7
(Preplant)HA	N	Drip	20	0.15	3	720	21	18.9	0.6
(Postplant)HA	N	Brdcast	6.0	1	6.00	1440	42	37.9	1.1
(Postplant)PR	N	Brdcast	10	1	10.00	2400	70	63.2	1.8
Strawberry	N	Banded	5.6	1	5.62	1349	39	35.5	1.0
Turfgrass	N,MC	Brdcast	10	1	10.00	2400	70	63.2	1.8

1 N=Nematodes T=Thrips, A=Aphids, MC=Mole Crickets

2 1=100% exposure, 0.15= 85% incorporated

fenamiphos (i.e, 38 ppm for the bobwhite quail). For example, the maximum risk quotient for eggplant, from the application of 5.9 ounces/1000 feet of row, in a one foot band and a row spacing of 40 inches, is 34.4 (i.e., 5.44 lbs. ai/A X 240 ppm/ 38 ppm = 34.4). Whenever this ratio is greater than 0.5, the Agency's acute level of concern (LOC) has been exceeded.

The maximum acute avian risk quotients ranged from a low of 1.6, for a 5 fl.oz. per 1,000 row ft. drench application on cabbage, to 427.3, for a 7.1 oz/1000 ft of row In-furrow application on cotton. The minimum acute risk quotients ranged from 0.05, for the drench use on cabbage, to a high of 12.5 for in-furrow application on cotton. All use patterns result in maximum acute risk quotients that are above the LOC. Low pressure applications on apples, cherries, peaches, nectarines, grapes, citrus, non-bearing fruit trees, kiwis, and bananas, as well as the drench application on cabbage, resulted in minimum risk quotients that were below the LOC. Based on these data, adverse ecological effects to avian species is expected to occur on all use sites.

(b). Avian Risk Quotients -Chronic

The LOC for chronic exposure is based on the lowest no-effect level (NOEL) as determined from avian laboratory reproductive studies. The lowest NOEL for fenamiphos is 2 ppm for the bobwhite quail (MRID # 00121291). Table 11 shows the maximum and minimum chronic risk quotients based on the NOEL for the bobwhite quail.

Maximum chronic risk quotients ranged from 31, for a 5 fl.oz. per 1,000 row ft. drench application on cabbage, to 8118, for a 7.1 oz/1000 ft of row In-furrow application on cotton. Maximum chronic risk quotients exceeded the NOEL for all use sites.

Minimum chronic risk quotients ranged from 1, for the drench application on cabbage, to 236 for the in-furrow application on cotton. Minimum chronic risk quotients exceeded the NOEL for all use sites.

Based on these calculations, avian reproductive effects are expected to occur on all use sites. However, there are no field incidents and/or other field information available that indicate Nemacur 3 actually causes reproductive impairment to avian species when used according to label directions.

c. Field Incidents

The EEB has only one record of a field incident involving avian mortality from the use of Nemacur 3. The incident involved approximately 58 birds (robins and cedar waxwings)

TABLE 11: MAXIMUM AND MINIMUM CHRONIC RISK FOR NEMACUR 3

Crop	Pest	Appl Method	Lbs.ai/A Exposed	Maximum EEC(ppm)	Minimum EEC/(ppm)	Max. Risk Quotient (BW)	Min. Risk Quotient (BW)
Apple	N	Banded	20	4800	140	2400.0	70.00
Cherry	N	Banded	20	4800	140	2400.0	70.00
Peach	N	Banded	20	4800	140	2400.0	70.00
Nectarine	N	Banded	20	4800	140	2400.0	70.00
Citrus	N	Banded	20	4800	140	2400.0	70.00
Grapes	N	Banded	18	4320	126	2160.0	63.00
Non-Bear	N	Banded	18	4320	126	2160.0	63.00
Raspberry	N	Banded	12	2880	84	1440.0	42.00
Apple	N	Low Press.	1.35	324	9.45	162.0	4.73
Chery	N	Low Press.	1.35	324	9.45	162.0	4.73
Peach	N	Low Press.	1.35	324	9.45	162.0	4.73
Nectarine	N	Low Press.	1.35	324	9.45	162.0	4.73
Grapes	N	Low Press.	1.35	324	9.45	162.0	4.73
Citrus	N	Low Press.	1.35	324	9.45	162.0	4.73
Non-Bear	N	Low Press.	0.9	216	6.3	108.0	3.15
Kiwi	N	Low Press.	0.9	216	6.3	108.0	3.15
Asparagus	N	Nursery	4	960	28	480.0	14.00
	N	Field	4	960	28	480.0	14.00
	N	P.Harvest	4	960	28	480.0	14.00
Eggplant	N	Banded	5.44	1305.6	38.08	652.8	19.04
Beets	N	Banded	5.44	1305.6	38.08	652.8	19.04
Cotton	T	Banded	3.14	754	21.98	376.8	10.99
	T	In-Furrow	31.44	7546	220	3772.8	110.04
	T,N	Banded	9.15	2196	64	1098.0	32.03
	T,N	In-Furrow	67.65	16236	474	8118.0	236.78
	T,N	Banded	5.65	1356	40	678.0	19.78
(Calif)	T,N	Banded	6.23	1495	44	747.6	21.81
	T,N	Banded	9.15	2196	64	1098.0	32.03
	T,N	Banded	5.62	1349	39	674.4	19.67
Cabbage(Fla)	N	Drench	0.26	62	2	31	1
Peanuts	T,N	Banded	7.10	1704	50	852.0	24.85
Tobacco	N,A	Brdcast	6.00	1440	42	720.0	21.00
Bananas	N	Low Press	0.75	180	5	90.0	2.63
Pineapple							
(Preplant)HA	N	Brdcast	20.00	4800	140	2400.0	70.00
(Preplant)HA	N	Drip	3	720	21	360.0	10.50
(Postplant)HA	N	Brdcast	6.00	1440	42	720.0	21.00
(Postplant)PR	N	Brdcast	10.00	2400	70	1200.0	35.00
Strawberry	N	Banded	5.62	1349	39	674.4	19.67
Turfgrass	N,MC	Brdcast	10.00	2400	70	1200.0	35.00

and occurred on a golf course in Martin county, Florida (#1000103). Acetylcholinesterase levels were determined for brain tissue and were found to be within normal ranges for the species. Residue analysis of the crop, ventriculus and contents of these birds showed Nemacur levels ranging from 15.4 ppm to 2090 ppm. No significant histopathologic abnormalities were noted. It was noted that the esophagus and proventriculus of the birds were full of Brazilian Pepper Tree (Schinus terebinthefolius) seeds. The report could not explain why the AChE levels were within normal range for the birds.

d. Field Studies

(i.) Tobacco

A multi-year field study was conducted on tobacco (MRID #s, 42029904 and 42029903) using Nemacur 3. The study was conducted in Martin county, North Carolina. Fenamiphos, formulated as Nemacur 3, was applied with ground equipment at an application rate of 6 lbs. a.i./acre with soil incorporation. Based on maximum and minimum EECs, risk quotients for the tobacco use pattern should range from 1.1 to 37.9 (See Table 10). These calculations suggest that mortality and other ecological effects should have occurred at levels significantly greater than that observed for the study. Although a total of 73 vertebrate mortalities (including birds, mammals and other vertebrates) were documented, of which 12 were found on treatment plots post-application, the casualty search data suggest that treatment did not result in any appreciable mortality when compared to controls. However, the carcass search techniques and the number of replicates, used in the conduct of the study, did not satisfy the requirements for the binomial theorem, as set forth by Fite et. al.(1988). Therefore, the EEB concludes that the results of the two year study do not rebut the Agency's presumption that the use of Nemacur 3 on tobacco, will exceed the high risk LOC of 0.5.

ii. Golf Course

Fenamiphos, formulated as Nemacur 3 and applied with ground equipment at a rate of 10 pounds ai/acre resulted in treatment related mortality to avian species when applied to golf courses (MRID# 42029901). In addition to mortality, behavioral-impaired birds were also observed. Eighty-nine percent of the treatment related deaths and behavioral impairments were found on the day of application or the next day, and only one occurred later than day 2 post-treatment. Residue levels in dead or dying invertebrates averaged 96.27 ppm on treatment day and birds were observed actively foraging on these items. By day +2 invertebrate residues had dropped to

< 3 ppm and the presence of dead or dying invertebrates on the turf surface was greatly reduced. Several species of birds were observed feeding on mole crickets (primary pest species) prior to and following application. Species feeding on mole crickets included; common grackles (Quiscalus quiscula), boat-tailed grackles (Quiscalus major), European starlings (Sturnus vulgaris), northern mockingbirds (Mimus polyglottos), blue jays (Cyanocitta cristata), red-winged blackbirds (Agelaius phoeniceus) fish crows (Corvus ossifragus) common ground doves (Columbina passerina) and common nighthawks (Chordeiles minor).

In general, results from Nemacur 3 field studies show that (1) exposure occurred to numerous non-target avian species, (2) residues appeared in all the matrices sampled and (3) residues, at least for some matrices, exceed the reference LC_{50} value of 38 ppm. In addition, results show that Nemacur 3, even when applied according to label directions, has an effect on numerous non-target terrestrial wildlife.

2. Granulated Formulations

a. Avian Risk Quotients -Acute

Table 12 shows the avian risk quotients for the granulated formulations of fenamiphos. Risk quotients were determined by comparing the EEC, expressed as mg ai./sq. ft, with the LD50 value for the bobwhite quail.

Avian risk quotients range from a low of 4, for a broadcast use on bananas, to 190 for a banded application on flower bulbs. All of the use sites exceed the high risk LOC (0.5) for avian species and indicate that total exposure (i.e., all routes of exposure including dermal, oral and inhalation) will result in high risk to avian species.

The primary route of exposure to avian species is expected to be from the ingestion of granules as either food and/or grit and drinking contaminated water. Based upon the acute oral LD50 value for the bobwhite quail (16.0 mg/kg of 15G formulation, E.Hill- Patuxent Wildlife Research Center) the average weight of a 15G granule (0.087 mg) (Balcomb et al. 1984), the number of granules equivalent to an LD50 value can be determined. Table 13 shows the calculations for six avian species likely to be exposed to both the 10G and 15G formulations.

Table 13: The number of 10 and 15G granules equivalent to LD50 for six avian species.

TABLE 12: AVIAN RISK QUOTIENTS FOR GRANULATED FORMULATIONS OF

Crop	Exposed mg ai/sq. ft.	Bird wt.(kg)	Quail LD50 (mg/kg)	Avian Risk Quotient (LD50 /sq.ft.)
Cotton	2.7	0.178	1.6	9
	3.4	0.178	1.6	12
	4.1	0.178	1.6	14
	5.1	0.178	1.6	18
Peanuts	11.9	0.178	1.6	42
Bananas	1.2	0.178	1.6	4
Bok Choy	9.4	0.178	1.6	33
	9.4	0.178	1.6	33
Brussel Sprts	9.4	0.178	1.6	33
Cabbage	9.4	0.178	1.6	33
Eggplant	9.4	0.178	1.6	33
Garlic	7.8	0.178	1.6	27
Okra	9.4	0.178	1.6	33
	9.4	0.178	1.6	33
Peppers	9.4	0.178	1.6	33
	9.4	0.178	1.6	33
Strawberry	9.4	0.178	1.6	33
	9.4	0.178	1.6	33
	10.8	0.178	1.6	38
Citrus	31.5	0.178	1.6	111
Pineapple	31.5	0.178	1.6	111
Turfgrass	15.6	0.178	1.6	55
Ornament.				
(L.Leaf Fern)	15.6	0.178	1.6	55
(Protea)	15.2	0.178	1.6	53
(Anthurium)	15.6	0.178	1.6	55
Nur. Stock	15.6	0.178	1.6	55
Bulbs	54.0	0.178	1.6	190

Species	Body Weight(G)	LD_{50} [1] Mg/Animal	No. 15G [2] Granules	No. 10G Granules
Bobwhite	200	3.2	37	55
Robin	80	1.2	13.8	22
Mourning Dove	100	1.6	18.5	27.5
House Sparrow	20	0.32	3.7	5.5
Redwing Blackbird	50	0.80	9.0	14.0
Grasshopper Sparrow	14	0.22	2.5	3.8

Balcomb et al., (1984) found that 40 and 60 percent mortality occurred in red-winged blackbirds when dosed with 5 and 10 granules of Nemacur 10G, respectively. These results compare with the estimates presented in Table 13 and suggest that there is little margin for safety, especially for small birds that forage for food or grit on the soil surface, from the application of granulated formulations of fenamiphos.

EEB has reviewed two field studies involving granulated formulations of fenamiphos. One study was conducted on various golf courses located near Orlando, Florida (MRID# 41012902) while the other study was conducted in citrus, near Titusville, Florida (MRID# 42029902).

b. Field Studies

i. Citrus

A citrus field study where fenamiphos, formulated as Nemacur 15G, was applied with ground equipment at an application rate of 20 lbs. ai./acre, was conducted on six groves located near Titusville, Florida (42029902). After application, a spiked drag was used to soil incorporate the exposed granules. A total of 93 species of birds were recorded on and around the groves during the study. Based on results obtained from

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[1] LD_{50} /bird=16.0 mg/kg (formulation) X .2 kg/bird=3.2 mg/bird

[2] No. gran./animal=3.2 mg/animal/0.087 mg/gran.=37 gran/animal

analysis of plasma ChE for the northern cardinal, approximately one third of the birds present on the treated groves were exposed to Nemacur 15G. However, ChE levels recovered to near control levels by 30 days post-treatment. The mean residue value for soils collected immediately post-application was 29.41 ppm. Nemacur 15G residues in soil were found to have an overall half-life of approximately 8.2 days. The mean residue value for vegetation collected post-application was 0.72 ppm with a half-life of 10.9 days.

ii. Golf Course

As part of a baseline study, Nemacur 10G was applied at recommended label rates to several golf courses in central Florida. Several instances of bird mortality and/or behavioral effects were documented. Twenty seven of the 158 observed birds showed symptoms of toxicological poisoning, with 13 birds dying. Affected species included fish crows, starlings, mockingbirds, boat-tailed grackles, blue jay, brown thrasher (Toxostoma rufum), and loggerhead shrike (Lanius ludovicianus). In addition to mortality the following behaviors were noted: opening and closing of bill, loss of balance, outstretched wings, tucking the head inward, limping, and salivating. Again several species were observed feeding on mole crickets prior to and following application. In addition to the mortalities documented in this study golf course personnel indicated they often notice that cattle egrets (Bulbucus ibis) are also killed from Nemacur 10G applications.

iii. Summary

In general, results of the Nemacur 10 and 15G field studies show that (1) exposure occurred to numerous non-target avian species, and (2) mortality as well as other toxicological symptoms occurred (i.e., behavioral effects and ChE depression), even when fenamiphos is applied according to label directions.

3. Summary

Based upon the available toxicity data and EECs, including the results of field studies and field incidents, the EEB concludes that the use of fenamiphos, both as an emulsifiable concentrate and/or granular formulation, exceed high risk LOCs for terrestrial wildlife.

B. Aquatic assessment

a. Acute and Chronic Risk

The greatest potential for hazard to non-target fish and

aquatic invertebrates would occur if fenamiphos was applied directly to water. This could happen if fenamiphos was aerially applied as a broadcast treatment. However, a review of all the labels shows that there are no use sites that allow for aerial application of either the emulsifiable or granulated products of fenamiphos. Therefore, the EEB does not believe that any direct contamination to aquatic environments is likely to occur from the use of fenamiphos.

In so much as label directions limit application to either ground equipment and/or low pressure irrigation/chemigation methods, contamination to aquatic environments from drift is also unlikely. As such, the EEB believes that the major route of exposure to aquatic environments is from runoff.

Using the Georgia pond exposure model, the EEB has computed pond and lake EECs based on different soil incorporation practices as described on the Nemacur labels. EECs likely to occur in a one hectare pond are expected to range from 14.55 to 72 ppb, for 1 and 5 percent runoff events, respectively. These estimates assume that the pesticide is soil incorporated to a depth of 2-4 inches immediately following application. The EECs likely to occur to the same pond from a watering-in incorporation and 1 and 5 percent runoff events are 112 and 560 ppb, respectively. All of these values exceed the bluegill sunfish LC50 values of 9.6 (MRID # 00025962) and 4.5 ppb (MRID # 40799704), for the technical material and Nemacur 3 formulation, respectively. These EECs also exceed the MATC value (>3.8<7.4 ppb) for the rainbow trout (MRID# 42029906), the 48-hour EC50 value (1.9 ppb) for the water flea (MRID #40799706) and the 48-hour EC50 (17 ppb) for the sheepshead minnow (MRID #40799710). These data suggest that even though soil incorporation and/or watering-in can reduce exposure, levels of fenamiphos likely to get into ponds and lakes from runoff still exceed the high risk LOC (0.5) for aquatic organisms.

The Georgia stream scenario estimates EECs for a short stream (i.e., 100 meters-long, 3 meters-wide and 0.5 meters-deep and a long stream (300 meters long, 3 meters wide and .05 meters deep). EECs of fenamiphos, expected to occur in the short stream, when applied at 20 lbs ai/A and soil incorporated to a depth of 2-4" range from 10.45 to 52.27 ppb, for a 1 and 5 percent run-off event, respectively. EECS for the long section of stream range from 7.25 to 36.25 ppb, for a 1 and 5 percent runoff event, respectively. The EECs likely to occur in the short stream, from watering-in, range from 80 to 420 ppb for a 1 and 5 percent run-off event, respectively. The EECs likely to occur in the long stream section, after watering-in, range from 56 to 279 ppb, for the 1 and 5 percent runoff events, respectively. Again, these data suggest that levels of fenamiphos and its metabolites, likely to get into

streams and small rivers, exceed the high risk LOC (0.5) for aquatic organisms.

b. Field Studies - Mesocosm

An experimental pond (mesocosm) study was conducted to determine the potential effects of fenamiphos on fish an other aquatic organisms (MRID# 42029906). Because potential field exposures exceed the results derived from laboratory toxicity studies, dosing levels for the study were not based on EECs. Instead the mesocosms were dosed at 12.5, 3.5 and 1.0 ppb.

Treatment at 12.5 ppb caused a reduction in number and richness of zooplankton for several weeks post treatment. Zooplankton groups affected most were rotifiers (decrease) and copepoda (increase). Macro-invertebrate populations were also affected. There was a reduction in species richness at 3.5 and 12.5 ppb treatment when compared to controls. In addition a number of secondary effects (enhanced populations) related to reduced predation pressures were produced as a result of the acute effects of Nemacur on fish. No acute effects were observed on adult fish at the 1.0 and 3.5 levels. Acute effects were observed at both the 12.5 ppb level in both adult and young fish within 24 hours after application. Based on these results, a no-significant-adverse -effects concentration (NOEC) for this study would be the nominal test concentration of 3.5 ppb.

C. Field Incidents

The EEB has records of 5 fish kills from the use of fenamiphos. All of these kills occurred from the golf course use pattern and were observed after heavy rainfall occurring shortly after treatment (usually within 2 days of application).

On May 18,1981 a fish kill was reported to occur at the Kimberland Country Club in Cape Girardeau, Missouri. Nemacur (formulation not known) was applied to greens as per label directions. A heavy rain occurred with drainage from the greens going into two small ponds and two small lakes. It was estimated that several thousand bluegill, a few largemouth bass (Micropterus salmoides) and a few catfish (Ictalurus sp.) were killed over a five day period. The event occurred over about a five acre area. Analysis for fenamiphos residues in fish tissue or water was not conducted.

On July 22, 1989 a fish kill was reported to occur on the Pine Valley Golf Club (Lekau, Clementon, and Laurel Lakes) at Pine Hill, New Jersey. Nemacur 10G had been applied on July 18,19 and 20, at the rate of 3,035 lbs. over 15.9 acres. Evidence suggests that the material was not watered-in immediately

following application. That night a storm occurred and about 5 inches of rain fell on the golf course. Water samples collected from the lakes between July 24-26 showed fenamiphos concentrations ranging from 38.8 to 74.5 ppb while soil samples ranged from ND to 2.8 ppb. Follow-up sampling was conducted on August 3, 1989. Water samples ranged from 6.59 to 23.8 ppb. Fish kill specimens were analyzed for ChE inhibition. The ChE activity for the specimen was depressed 28% relative to the lowest control level. This suggests exposure to fenamiphos but is not conclusive for pesticide induced mortality.

On July 9, 1991, a fish kill occurred at the Bellerive Country Club in St. Louis, Missouri. Nemacur was applied to the greens by an unlicensed applicator to control nematodes. Approximately 25 fish were found. It was believed that heavy rains, following application, caused run-off of the pesticide into the pond.

On June 11, 1992 a fish kill occurred at the English Turn golf course in Orleans parish, Louisiana. The presence of Nemacur was not confirmed but authorities believed that Nemacur was a contributing factor in the kill in so much as it was applied near the pond. There were no violations found during subsequent investigation.

On July 29, 1993 a fish kill occurred at the Golf Club of Miami, in Miami, Florida. Nemacur 10G was applied to all the fairways and tees at the golf course (approximately 100 acres) over a two day period. Heavy rains fell immediately following application. Fenamiphos was detected in all surface water samples collected. Massive numbers of fish were killed with fenamiphos being found in all samples taken.

Summary

Based on laboratory toxicity data and EECs, the results of a mesocosm study, and actual field incidents, the EEB concludes that the use of fenamiphos, both as an emulsifiable concentrate and granulated formulation, exceeds the high risk LOC (0.5) for freshwater as well as marine/estuarine aquatic organisms.

C. Endangered Species

The Endangered Species Protection Program is expected to become final in early 1994. Fenamiphos has existing biological opinions for which EPA will require a generic endangered species label statement (or an equivalently protective alternative) when the Program is in place. Additional consultation with the United States Fish and Wildlife Service will be required to address newly listed species and also any

514

use sites not previously considered. However, no additional label changes are anticipated as a result of consultation if the label already contains the generic label statement.

D. Value of Information

The Agency has sufficient information to assess acute risk to terrestrial wildlife and acute and chronic risk to aquatic organisms. The major area of uncertainty relates to avian reproduction and other chronic effects to terrestrial vertebrates.

Although the Registrant has proposed risk reduction measures, that reduce potential exposure to non-target avian species, EECs are still expected to exceed the Agency's LOC for both acute (0.5) and chronic (1.0) effects. Although the EEB has the results of field studies which suggest mortality and other behavioral effects occur from acute exposure to fenamiphos, there are no data and/or other information regarding the potential for chronic effects. The EEB notes that the NOEL for reproductive impairment in the bobwhite is well below the maximum EECs expected to occur on avian food items <u>even with risk reduction measures</u>.

V. RISK REDUCTION/MITIGATION MEASURES

In response to the EPA's Avian Granular Initiative, the Registrant (Miles) has submitted proposed risk reduction measures for fenamiphos. In preparing these measures Miles specifically addressed the following options as outlined by the Agency (L. Fisher letter dated May 20, 1992):

1. reducing the amount of active ingredient applied/acre
2. requiring better soil incorporation
3. eliminating products with high percentages of a.i
4. reducing the number of applications/year
5. other innovative methods to reduce exposure

The following measures were proposed by Miles based on these options:

1. The Nemacur 10% Turf label was amended to reduce the application rate from 20 to 10 lbs. a.i./A. Application reductions for other crops were considered but could not be supported because of a lack of efficacy data.

2. Enhancing soil incorporation was deemed feasible for only cotton. The label amendment now requires that fenamiphos on cotton be in-furrow application only.

3. Eliminating products with a high percentage of active ingredient is not possible for fenamiphos since only

formulations with a relatively high percentage of a.i. are economically feasible.

4. Since nearly all use sites permit only one application/year this option is generally not feasible. Where more than one application is permitted, reducing the number of applications to one would severely reduce efficacy.

5. Miles did not provide any new "innovative" risk reduction measures.

The EEB has reviewed the proposed label amendments and concludes that they are risk reduction measures that should result in less risk to both terrestrial and aquatic organisms. However, the EEB does not have any way to determine the amount of reduction. In addition, the EEB believes that the following mitigation measures might reduce hazard to nontargets:

* Reduced application rates;
* Reduced application frequency;
* Alternate use of Fenamiphos with other pesticides from treatment to treatment or from season to season;
* Establish vegetative buffers around nearby aquatic environments.

VII. LABELING

1. Manufacturing

This pesticide is extremely (a.i.) toxic to birds, mammals, fish, and aquatic invertebrates. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

2. End Use

a. Precautionary statements

The following precautionary statements are required:

i. <u>Granular End-Use Products</u>

" This pesticide is extremely (a.i.) toxic to birds, mammals, fish and aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below

the mean high water mark. Runoff may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwater or rinsate.

ii. Non-granular End-Use Products

"This pesticide is extremely toxic to birds, mammals, fish and aquatic invertebrates. Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high-water mark. Drift and runoff may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment washwater or rinsate."

b. Restricted Use

All use sites exceed the Agency's LOCs (0.2 for terrestrial; 0.1 for aquatic) for restricted use classification.

VIII. DATA REQUIREMENTS

(See attached data table)

Date:
Case No:
Chemical No:

PHASE IV
DATA REQUIREMENTS FOR
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
6 Basic Studies in Bold					
71-1(a) Acute Avian Oral, Quail/Duck	TGAI	A,B	YES	00121289	NO
71-1(b) Acute Avian Oral, Quail/Duck	(TEP)				
71-2(a) Acute Avian Diet, Quail	TGAI	A,B	YES	00025959	NO
71-2(b) Acute Avian Diet, Duck	TGAI	A,B	YES	00025958	NO
71-3 Wild Mammal Toxicity			YES		
71-4(a) Avian Reproduction Quail	TGAI	A,B	YES	00121291	NO
71-4(b) Avian Reproduction Duck	TGAI	A,B	YES	00121290	NO
71-5(a) Simulated Terrestrial Field Study	TEP	A,B	PART	00114008, 00114013, 00025956, 00025957,00121292	NO
71-5(b) Actual Terrestrial Field Study	TEP	A,B	PART	42029904, 42029903, 42029902, 00121293,42029901, 41012902	NO
72-1(a) Acute Fish Toxicity Bluegill	TGAI	A,B	YES	00025962,00114012	NO
72-1(b) Acute Fish Toxicity Bluegill	(TEP)	A,B	YES	00114012, 40799704	NO
72-1(c) Acute Fish Toxicity Rainbow Trout	TGAI	A,B	YES	00114012	NO
72-1(d) Acute Fish Toxicity Rainbow Trout	(TEP)	A,B	YES	40799701	NO
72-2(a) Acute Aquatic Invertebrate Toxicity	TGAI TGAI	A,B A,B	YES PART	40799706 41497701	NO NO
72-2(b) Acute Aquatic Invertebrate Toxicity	(TEP)	A,B	NO	40799707	NO
72-3(a) Acute Estu/Mari Tox Fish	TGAI	A,B	YES	40799710	NO
72-3(b) Acute Estu/Mari Tox Mollusk	TGAI	A,B	YES	40799709	NO
72-3(c) Acute Estu.Mari Tox Shrimp	TGAI	A,B	YES	40799708	NO

* In Bibliographic Citation column indicates study may be upgradeable

Date:
Case No:
Chemical No:

PHASE IV
DATA REQUIREMENTS FOR
ECOLOGICAL EFFECTS BRANCH

Data Requirements	Composition[1]	Use Pattern[2]	Does EPA Have Data To Satisfy This Requirement? (Yes, No)	Bibliographic Citation	Must Additional Data Be Submitted under FIFRA3(c)(2)(B)?
72-3(d) Acute Estu/Mari Tox Fish	(TEP)				
72-3(e) Acute Estu/Mari Tox Mollusk	(TEP)				
72-3(f) Acute Estu/Mari Tox Shrimp	(TEP)				
72-4(a) Early Life-Stage Fish	TGAI	A,B	PART	41064301	NO
72-4(b) Live-Cycle Aquatic Invertebrate	TGAI	A,B	YES	40922201	NO
72-5 Life-Cycle Fish	TGAI	A,B	NO		NO
72-6 Aquatic Org. Accumulation	TGAI	A,B	NO		NO
72-7(a) Simulated Aquatic Field Study	TEP	A,B	YES	42029906	NO
72-7(b) Actual Aquatic Field Study					
122-1(a) Seed Germ./Seedling Emerg.					
122-1(b) Vegetative Vigor					
122-2 Aquatic Plant Growth					
123-1(a) Seed Germ./Seedling Emerg.					
123-1(b) Vegetative Vigor					
123-2 Aquatic Plant Growth					
124-1 Terrestrial Field Study					
124-2 Aquatic Field Study					
141-1 Honey Bee Acute Contact	TGAI	A,B	YES	00036935	NO
141-2 Honey Bee Residue on Foliage					
141-5 Field Test for Pollinators					

* In Bibliographic Citation column indicates study may be upgradeable

1.Composition: TGAI = Technical grade of the active ingredient; PAIRA = Pure active ingredient, radiolabeled; TEP = Typical end-use product

2.Use Patterns: 1 = Terrestrial/Food; 2 = Terrestrial/Feed; 3 = Terrestrial Non-Food; 4 = Aquatic Food; 5 = Aquatic Non-Food (Outdoor); 6 = Aquatic Non-Food (Industrial); 7 = Aquatic Non-Food (Residential); 8 = Greenhouse Food; 9 = Greenhouse Non-Food; 10 = Forestry; 11 = Residential Outdoor; 12 = Indoor Food; 13 = Indoor Non-Food; 14 = Indoor Medical; 15 = Indoor Residential

DP BARCODE: D186404 REREG CASE # 03:

CASE: 819346 DATA PACKAGE RECORD DATE: 04/26/9
SUBMISSION: S433147 BEAN SHEET Page 1 of :

* * * CASE/SUBMISSION INFORMATION * * *

CASE TYPE: REREGISTRATION ACTION: 606 GENERIC DATA
CHEMICALS: 100601 Fenamiphos

ID#: 100601-
COMPANY:
PRODUCT MANAGER: 72 LARRY SCHNAUBELT 703-308-8058 ROOM: CS1 3E3
PM TEAM REVIEWER: IRWIN HORNSTEIN 703-308-8042 ROOM: CS1 3J5
RECEIVED DATE: 01/08/93 DUE OUT DATE: 04/08/93

* * * DATA PACKAGE INFORMATION * * *

DP BARCODE: 186404 EXPEDITE: N DATE SENT: 01/08/93 DATE RET.: / /
CHEMICAL: 100601 Fenamiphos
DP TYPE: 999 Miscellaneous Data Package
CSF: N LABEL: N

ASSIGNED TO	DATE IN	DATE OUT
DIV : EFED	01/11/93	08/14/94
BRAN: EEB	01/11/93	/ /
SECT: RS2	01/11/93	04/26/94
REVR : RFELTHOU	01/11/93	04/25/94
CONTR:	/ /	/ /

ADMIN DUE DATE: 03/19/93
NEGOT DATE: 05/01/94
PROJ DATE: 05/01/94

* * * DATA REVIEW INSTRUCTIONS * * *

PLEASE REVIEW THIS REDs MINI-DELIVERABLES PACKAGE FOR FENAMIPHOS IN ORDER FOR THE SCIENCE ASSESSMENT PHASE OF THE REREGISTRATION PROCESS TO PROCEED.

* * * DATA PACKAGE EVALUATION * * *

No evaluation is written for this data package

* * * ADDITIONAL DATA PACKAGES FOR THIS SUBMISSION * * *

DP BC	BRANCH/SECTION	DATE OUT	DUE BACK	INS	CSF	LABEL

(31)