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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

To: Dana Pilitte, Team 15
Registration Division (TS-767C

Thru: Harry Craven, Registration Standard Coordinator
Ecological Effects Branch (EEB)
Hazard Evaluation Division (TS-769)

Thru: Clayton Bushong, Chief
Ecological Effects Branch
Hazard Evaluation Division (TS-769)

Subject: Fensulfothion Registration Standard

Attached is EEB's portion of the Fensulfothion Registration Standard. Included are: Topical discussions, Disciplinary review, and Data gap table. The Data Evaluation Records will be provided at a later date under separate cover.

Dennis J. McLane
Wildlife Biologist
Ecological Effects Branch

Ecological Effects

The following studies were sent to EEB but are not cited in the Topical Summaries. They received only an abbreviated review.

Author	Fiche ID No.
Anderson, Atkins (19??)	00028772
Anon. (19??)	00074646
Atkins et al. (1976)	00066220
Atkins, Anderson (1967)	00060633
Bacon (1965)	00012539
Cunningham, Decino (1962)	00048316
DeCino (1963)	00077863
DeCino (1963)	00077869
DeCino, Cunningham, Besser (1963)	00077860
DeWitt (1962)	00077862
DeWitt (1962)	00077858
DeWitt, Crabtree, Finley, George (1960)	00004769
DeWitt, Stickel, Springer (1962)	00004771
DuBois (1962)	00094242
FMC Corp. (1976)	00071456
Harris, Svec (1970)	00078515
Hill, Heath, Spann (1975)	00022923
Johansen (1963)	00078519
Jahansen, Hutt (1963)	00091653
Jahansen, Hutt (1963)	00077808
Lamb (1973)	00029320
MacDougall (1964)	00094243
MacDougall (1964)	00094244
MacDougall (1964)	00094245
MacDougall (1964)	00094257
MacDougall (1964)	00094248
MacKenzie (19??)	00048318
MacKenzie (19??)	00077868
Marking (1965)	00051551
Marking (1965)	00051527
Mobay Chemical Corp. (1966)	00077874
Pinkenberger (1971)	00078523
Schafer (1971)	00094236
Schafer (1972)	00073683
Schafer (1972)	00057751
Schafer (1972)	00094240
Schafer, Brunton (1973)	00036482
Tuttle, Arvizo (1960)	00012571
U.C.R. (1973)	00061021
U.C.R. (19??)	00049252
USDA, ARS (19??)	00060869
USDI, FWS (19??)	00077859
USDI, FWS (19??)	00013534
USDI, FWS (19??)	00059352
USDI, FWS, Denver Wildlife Research Center (1963)	00040253
USDI, FWS, Fish Control Laboratory (19??)	00005215
USDI, FWS, Wildlife Research Center (1963?)	00038470
Walker (1963)	00049249
Walker (1963)	00058507

FENSULFOTHION TOPICAL DISCUSSION

Effects on Freshwater Fish

Table I contains the seven (7) studies which were received and evaluated under this topic. None were acceptable for use in the hazard assessment for freshwater fish.

TABLE I - Studies Evaluated

Author	Fiche I.D. No.
Galletta	00094219
Lamb and Roney	00078526
Lamb and Roney	00078527
Lamb and Roney	00094237
Lamb and Roney	00094238
Pickering and Henderson	05014941
Rowehl	00078513

The minimum data required for establishing the acute toxicity of fensulfothion in freshwater fish are results from two (2) 96-hour studies with technical fensulfothion; one coldwater species (preferably rainbow trout) and one warmwater species (preferably bluegill sunfish). Guidelines requirements are described in Sec. 72-1. The acute toxicity data for studies using technical grade fensulfothion are listed in Table II below.

TABLE II

Acute Toxicity Studies Testing Technical Fensulfothion

Species	Percent Active	Results 96 hr. LC50 (ppm) (95% C.L.)	Author	Date	ID	Fulfills Guideline Requirements
Lepomis macrochirus (Bluegill sunfish)	94% (Technical)	0.12 (0.08-0.19)	Lamb & Roney	1972	00078526	No

Salmo gairdneri (Rainbow trout)	94% (Technical)	8.6 (7.1-10.4)	Lamb & Roney	1972	00078526	No
Lepomis macrochirus (Bluegill sunfish)	(Technical)	0.056 (0.009-0.1)	Pickering & Henderson	1966	05014941	No
Lepomis macrochirus (Bluegill sunfish)	(Technical)	0.07 (0.02-0.16)	Pickering & Henderson	1966	05014941	No
Salmo gairdneri (Rainbow trout)	90% (Technical)	9.20 (7.58-11.16)	McCann	1977	MCOFENOL	

There is sufficient supplementary information to characterize the toxicity of fenosulfothion as "very highly toxic" to bluegill sunfish and "moderately toxic" to rainbow trout.

The guideline requirements for acute toxicity studies on cold and warmwater fish species are satisfied for an acute 96 hour LC50.

Aquatic toxicity studies on formulated (end-use-single active ingredient) products can be required as per Sec. 72-1 (c)(i), (ii) or (iii). Although no such requirements are made for this topic at this time the acceptable acute studies testing freshwater fish with formulated products are listed in Table III below.

TABLE III

Acute Toxicity Studies Testing Formulations
With Freshwater Fish

Species	Percent Active (Formulation)	Results 96 hr. LC50 (ppm)	Author	Date	ID	Fulfills Guideline Requirements
Lepomis macrochirus (Bluegill sunfish)	63% 6 lbs/gal Spray	0.16 (0.12-0.20)	Lamb & Roney	1972	00078526	No
Salmo gairdneri (Rainbow trout)	63% 6 lbs/gal Spray	14.1 (12.5-16.0)	Lamb & Roney	1972	00078526	No
Lepomis macrochirus (Bluegill sunfish)	15% Granular	0.76 (0.66-0.87)	Lamb & Roney	1972	00078526	No
Salmo gairdneri (Rainbow trout)	15% Granular	96 (82-111)	Lamb & Roney	1972	00078526	No

There is sufficient information to characterize both the 15% - Granular and 63%-6 lbs/gal spray as "very highly toxic" to bluegill sunfish. The rainbow trout studies indicate the "slightly toxic" range for these products. Although the Agency does not have definitive information on the toxicity to freshwater fish of the 10% granular and 1.2%, 1.22%, 15%, 2.941% and 16.667% granulars with fertilizer, given the range of values obtained and the number of species studied, the Agency considers the acute toxicity of formulated fensulfothion products to be reasonably characterized and would not require additional data on similar end-use products for use in non-aquatic sites.

Aquatic toxicity studies on formulated (end-use-multiple active ingredients) products can be required as per Sec. 72-1 (c),(i), (ii) or (iii). Although no such requirements are made at this time the acceptable acute studies testing freshwater fish with formulated products are listed in Table IV below.

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Precautionary labeling: Based upon available data, products containing fensulfothion must bear the statement: This pesticide is toxic to fish.

TABLE IV

Acute Toxicity Studies Testing Formulations
(Multiple Active Ingredients)
With Freshwater Fish

Species	Percent Active Formulation	Results 96 hr. LC50 (ppm)	Author	Date	ID	Fulfills Guideline Requirements
Lepomis macrochirus (Bluegill sunfish)	13.35% and Tillam® 6.65%	0.46 (0.38-0.56)	Lamb & Roney	1972	00094238	No
Lepomis macrochirus (Bluegill sunfish)	32% Disulfoton 32% (Dasanit® Di-syston® 3 lbs-3 lbs/gal Spray Concentrate)	0.12 (0.10-0.16)	Lamb & Roney	1972	00078527	No
Salmo gairdneri (Rainbow trout)	32% Disulfoton 32% (Dasanit® Di-syston® 3 lbs-3 lbs/gal Spray Concentrate)	4.8 (4.2-5.5)	Lamb & Roney	1972	00078527	No
Salmo gairdneri (Rainbow trout)	Dasanit® Di-syston® 7.5%-7.5%	27 ppm	Lamb & Roney	1972	00094237	No
Lepomis macrochirus (Bluegill sunfish)	Dasanit® Di-syston® 7.5%-7.5%	0.27 ppm	Lamb & Roney	1972	00094237	No

Effects on Freshwater Invertebrates

No studies were received under this topic.

The minimum data requirement for establishing the acute toxicity of fensulfothion in freshwater invertebrates is the result from one (1) 48-hour study with technical fensulfothion on a representative native freshwater invertebrate species, preferably Daphnia magna (Sec. 72-2).

Effects on Estuarine and Marine Organisms

Only one study was received and evaluated under this topic. Lowe's (00037909) study was performed with the technical product.

Under Sec. 72-3 acute toxicity testing of technical grade of the active ingredient may be required to support the registration of formulated products if the pesticide is intended for direct application to the estuarine/marine environments, or may be expected to enter such environments. No acceptable studies are available under this topic. Use such as cotton and corn for which this chemical is presently registered may be expected to result in fensulfothion entering the estuarine environment.

Sec. 72-3 (c)(1(i), (ii) or (iii) also requires data from studies testing formulated products in circumstances including direct applications to water, expected residues in water approximating the technical LC50 for aquatic species or if a product's other ingredients are expected to cause a two-fold increase of the toxicity of the active ingredient. These data are not presently required because these conditions are expected to be met for estuarine/marine environments.

This study would address the data requirement for technical product testing if one were proposed, though, without further information would be unacceptable.

Table II - Toxicity Testing of Estuarine/Marine Organisms Using Unknown Fensulfothion Formulation.

Species	% a.i.	Results	Author	Date	I.D.	Fulfills Guidelines Requirements
Penaeus aztecus Shrimp, brown	Technical	48-hr. EC50 0.01 ppm	Lowe	19??	00037809	No
Crassostrea virginica (Eastern oyster)	Technical	20% decrease @ 1.0 ppm oyster shell growth	Lowe	19??	00037809	No
Fundulus similis (Longnose Killifish)	Technical	48 hr. TL = 0.055 ppm	Lowe	19??	00037809	No

Effects on Birds

Eleven (11) studies were received and evaluated under this topic. Nine (9) studies are acceptable for use in hazard assessment for birds. Table I below contains studies received and evaluated.

Table I
Studies Received and Evaluated

Author	ID
Guarino et al.	00078522
Hill et al.	00022923
Hudson, Haegele, Tucker	05008363
Hudson, Tucker, Haegele	05003462
Lamb and Jones	00094233
Lamb and Nelson	00094339
Lamb and Nelson	00078516
Nelson	00078511
Schafer et al.	05003191
Thomas	00010190

The minimum data required for establishing the acute toxicity of fensulfothion to birds is the result from one (1) single-dose oral LD50 study on either an upland game species (preferably Bobwhite or other native quail or the Ring-necked Pheasant) or a wild waterfowl (preferably Mallard Duck) (Sec. 71-1), using the technical grade of the active ingredient. The acceptable data is listed in Table II below.

Table II

Single-Dose Oral LD50-Technical Fensulfothion

Species	% a.i. (technical)	Results (95% c.i.)	Author	Date	I.D.	Fulfills Guidelines Requirements
Quelea quelea	90-99%	mg/kg 0.24 (unknown)	Schafer et al.	1973	05003191	No
Passer domesticus (House sparrow)	90-99%	0.32 (unknown)	Schafer et al.	1973	05003191	No
Angelains phoeniceus (Red-winged Blackbird)	90-99%	0.32 (unknown)	Schafer et al.	1973	05003191	No
Anas platyrhyhos (Mallard Duck)	90%	0.749 (0.595-0.944)	Hudson et al.	1979	05008363	No

The guidelines requirement is not satisfied, however, there is sufficient information to characterize the acute toxicity of fensulfothion to birds as "very highly toxic."

The minimum data required for establishing the dietary (subacute) toxicity of fensulfothion to birds are the results from at least two (2) avian dietary toxicity studies (LC50 values) Sec. 71-2). These test one upland gamebird (preferably Bobwhite or other native quail, or the Ring-necked pheasant, plus one (1) wild waterfowl (preferably Mallard Duck). Acceptable data addressing this topic are listed in Table IV below.

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TABLE IV

Dietary Toxicity to Birds - Fensulfothion Technical

Species	Formulation	Results (ppm) LC50 95% C.L.)	Author	Date	ID	Fulfills Guideline Requirements
Anas platyrhynchos (Mallard Duck)	94%	43 (36-51)	Hill et al.	1975	00022923	Yes
Colinus virginianus (Bobwhite Quail)	94%	35 (28-43)	Hill et al.	1975	00022923	Yes
Phasianus colchicus (Ring-necked Pheasant)	94%	148 (119-179)	Hill et al.	1975	00022923	Yes
Anas platyrhynchos (Mallard Duck)	Technical	47 (35-64)	Lamb & Jones	1973	00094233	No
Colinus virginianus (Bobwhite-Quail)	Technical	22 (19-26)	Lamb & Jones	1973	00094233	No

The guidelines requirement for two (2) avian dietary toxicity studies is satisfied. There is sufficient information to characterize fensulfothion as "very highly toxic" to "highly toxic" to birds when administered in subacute dietary tests.

Although there is no requirement for testing with mixtures of end-use formulations in dietary toxicity studies of birds, Table V lists the acceptable data submitted testing birds with formulations in dietary studies.

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TABLE V

Dietary Toxicity To Birds - Fensulfothion

Mixtures with Other Pesticides

Species	Formulation	Results (ppm) LC50 (95% C.L.)	Author	Date	ID	Fulfills Guideline Requirements
Anas platyrhynchos (Mallard Duck)	Dasanit® Di-syston® (1:1 combination)	84 ppm (64-109)	Lamb & Jones	1973	00094233	No
Colinus virginianus (Bobwhite Quail)	Dasanit® Di-syston® (1:1 combination)	46 ppm (160-274)	Lamb & Jones	1973	00094233	No
Anas platyrhynchos (Mallard Duck)	Dasanit® Tilliam® (13.35% and 6.65%, respectively)	209 ppm (160-274)	Lamb & Jones	1973	00094233	No
Colinus virginianus (Bobwhite Quail)	Dasanit® Tilliam® (13.35% and 6.65%, respectively)	168 ppm (126-223)	Lamb & Jones	1973	00094233	No

There is no requirement for dietary toxicity testing of birds with mixtures of formulated products, therefore, no data requirement is satisfied by studies in Table III. There is however, sufficient information to characterize the combination of Dasanit® - Di-syston® as "very highly toxic," and the combination of Tilliam®-Dasanit® as "highly toxic " to birds when exposed through the diet.

Data addressing effects on avian reproduction may be required to support the registration of formulated products (Sec. 71-4.) The Agency has determined that birds may be subjected to repeated or continued exposure.

Therefore, an avian reproduction test is needed. No data addressing this topic are available.

The simulated or actual field testing (under 71-5) is necessary. This would be required due to the acute and subacute toxicity. The acceptable data addressing this topic are listed in Table VI below.

TABLE VI

Simulated or Actual Field Tests with Birds - Fensulfothion

Species	% a.i. Formulation	Results	Author	Date	ID	Fulfills Guideline Requirements
Colinus virginianus (Bobwhite Quail)	Dasanit 6 lbs/gal Spray Concentrate (application rate 20 lbs a.i./acre incorporated 4 to 6 inches with a rototiller to simulate a corn treatment. No corn was planted.	Caged birds were placed on the field after treatment. No hazard found. However the most hazardous situations were not simulated. Also, detection of effects was limited to observation. Methods such as brain cholinesterase testing were not used.	Lamb & Nelson	1970	00094539	No

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Ricebirds & Pheasant	10% Granular (application rate 100 a.i./acre in pineapple.	The study produced mortalities among the ricebirds but not the pheasants. The birds were placed in cages on top of plastic film used to cover the field. The areas of the field which were not covered, such as the edge, would be expected to be hazardous to birds. This area was not tested.	Lamb & Nelson	1970	00078516	No

These studies do not satisfy the requirement for simulated or actual field testing for effects on birds. These types of studies are indicated since the acute and subacute studies indicate a very highly toxic chemical. The above studies do not sufficiently address the hazards which could be expected from its use.

Effects on Beneficial Insects

Four studies were received and evaluated under this topic. These studies are acceptable for use in a hazard assessment and listed as follows:

Author		ID
Atkins and Anderson	(1967)	00049254
Johansen & Hutt	(1962)	00060625
Johansen & Hutt	(1963)	00074043
Harris & Svec.	(1969)	05011163

The acceptable beneficial insects data are listed below:

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Species	Formulation	Results	Author(s)	Date	ID	Fulfills Guideline Requirements
Honey bee (Apis mellifera)	Probably formulated product	Fensulfothion is highly toxic to honey bees. The acute contact LD50 at 48 hr. was 0.35 mg/bee with a slope value of 5.46	Atkins & Anderson	1967	00049254	N/A
Honey bee (Apis mellifera)	2 lb E	Fensulfothion is highly toxic to honey bees in direct contact tests but toxicity decreased rapidly in residual tests. The 24 hr % mortalities are 100% for A.C. and 22% for 3 days residuals (0.75 lb a.i./A).	Johnsen & Hutt	1962	00060625	N/A
Honey bee (Apis mellifera)	4 lb E	Fensulfothion is highly toxic to honey bees in direct contact tests but toxicity decreased rapidly in residual tests. The 24 hr % mortalities are 100% for A.C. and 6% for 2 days residuals (0.75 lb a.i./A).	Johnsen & Hutt	1963	00074043	N/A

Honey bee (Apis mellifera)	Tech.	The lab. direct contact test show that the 18 h % mortalities were 0, 72, 100 and 100 at application rates of .001, .01, 01 and 1.0% respectively. Fensulfothion is highly toxic to honeybees tested.	Harris & Svec	1969	05011163	N/A

There is sufficient information to characterize fensulfothion as highly toxic to honey bees with direct contact spray, but is of low toxicity when exposed to the residue. There are presently no guideline requirements for evaluating toxicity to beneficial insects.

Precautionary Labeling

Based upon available information the environmental precautionary label should bear a statement regarding toxicity to honey bees.

Effects on Nontarget Soil and Surface Invertebrates

One study was received and evaluated under this topic. This study was acceptable for use in a hazard assessment and is listed as follows:

Author	ID
Tomlin (1975)	05009819

The acceptable beneficial soil and surface invertebrate data is listed below:

Species	Formulation	Results	Author(s)	Date	ID	Fulfills Guideline Requirements
Ground beetles (Stenolophus comma, Pterostichus melanarius)	Technical	Fensulfothion is highly toxic to both beetles tested. It caused 100% mortalities for both S. comma (A.C.; 0.01%) and P. melanarius (Soil residue; 0.8 ppm).	Tomlin	1975	05009819	N/A

There is sufficient information to characterize fensulfothion as highly toxic to beneficial beetles.

There are presently no guideline requirements for evaluating toxicity to beneficial soil and surface invertebrates.

Fensulfothion - Ecological Effects Disciplinary Review

1. ECOLOGICAL EFFECTS PROFILE

a. Manufacturing Use - fensulfothion

i. Avian studies.

Schaefer, 1973 (05003191) performed acute oral studies with technical fensulfothion on quelea, house sparrow, and red-winged blackbird (LD50 values 0.24, 0.32 and 0.32 mg/kg, respectively). Hudson et al., 1979 (05008363) performed the same type of study with mallard which resulted in an LD50 of 0.749 mg/kg. Technical fensulfothion may therefore be considered as "very highly toxic" in acute doses.

One (1) dietary study with technical fensulfothion tested several species. Hill et al., 1975 (00022923) found a 94% active ingredient material provided the following LC50s: Mallard Duck - 43 ppm, Bobwhite Quail - 35 ppm. Ring-necked Pheasant - 148 ppm. Technical fensulfothion is therefore considered "highly toxic" to "very highly toxic" to birds in dietary tests.

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ii. Aquatic studies

One (1) study tested technical fensulfothion in 96-hour acute exposures to freshwater fish. Lamb and Roney, 1972 (00078526) found a 94% active ingredient material to have an LC50 of 0.12 ppm for bluegill sunfish and 8.6 ppm for rainbow trout. Fensulfothion is therefore considered "highly toxic" to "very highly toxic" to freshwater fish. Lowe (19??; 00037809) found the technical product to have an EC50 of 0.01 ppm for the Brown Shrimp, a 20% decrease @1.0 ppm for the (eastern) oyster shell growth and a TLm of 0.055 ppm for the longnose killifish. Therefore, fensulfothion is considered "very highly toxic" to marine fish and shrimp and "highly toxic" to oysters.

iii. Beneficial Insects

The results based of the laboratory direct contact test show that the 18 h % mortalities were 0, 72, 100 and 100 at application rates of 0.001, 0.01, 0.1 and 1.0%, respectively (Johnsen & Hutt, 00074043). There is sufficient information to characterize technical fensulfothion on an acute basis as highly toxic to honey bees.

iv. Beneficial Soil and Surface Invertebrates

Available data show that fensulfothion was highly toxic to adult S. comma at concentration of 0.01% and above, when exposure was through direct contact. At 0.8 ppm (dried weight in soil), fensulfothion was highly toxic to larvae of P. melanarius (Tomlin, 05009819). There is sufficient information to characterize technical fensulfothion acute contact basis as highly toxic to both beneficial beetles tested.

b. Formulated fensulfothion products

6 lbs/gal Spray Concentrate

i. Avian study - One field study is available which tested Bobwhite Quail with 6 lbs/gal Spray Concentrate. Lamb and Nelson, 1970 (00094339) indicated no acute effects, however, the "worst case" (20 lbs/acre) was not simulated. Birds in cages were placed in the field after a soil incorporated application of 20 lbs/acre.

ii. Aquatic studies - Lamb and Roney, 1972 (00078526) studied the acute toxicity of 6 lbs/gal Spray Concentrate to bluegill sunfish and rainbow trout. The 96-hour LC50s were 0.16 ppm and 14.1 ppm, respectively. This indicates 6 lbs/gal spray concentrate is "very highly toxic" to warmwater fish and "slightly toxic" to cold-water fish.

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15% Granular

i. Aquatic studies - Lamb and Roney, 1972 (00078526) studied the acute toxicity of 15% Granular to bluegill sunfish and rainbow trout. The 96-hour LC50s were 0.76 ppm and 96 ppm, respectively. This indicates 15% Granular is "very highly toxic" to warmwater fish and "slightly toxic" to coldwater fish.

10% Granular

i. Avian studies - Lamb & Nelson, 1970 (00078516) tested rice birds and pheasants in a pineapple field treated with 100 lbs active ingredient per/acre. However, caged birds were placed on the field after the application was covered with plastic sheeting. This did not adequately address the hazards at the edge of the field and turn around areas where the plastic sheeting may not cover the pesticide. However, of the 35 ricebirds exposed, 21 died following 1 to 3 days exposure while eight survived 4 to 11 days.

ii. Aquatic studies - None available

13.35% Granular and pebulate 6.65% Granular

i. Avian studies - Lamb & Jones, 1973 (00094233) studied the acute toxicity of fensulfothion 13.35% Granular + pebulate 6.65% to Mallard Duck and Bobwhite Quail; the 8 days LC50s = 209 ppm and 168 ppm, respectively. Hence, this mixture is at least "highly toxic" to waterfowl and upland game.

ii. Aquatic study - Lamb and Roney, 1972 (00094238) studied the acute toxicity of 13.35% fensulfothion + tilliam 6.65% (both were granulars), to bluegill sunfish. The 96 hr LC50 was 0.46 ppm indicating that these product are "very highly toxic" to warmwater fish.

3 lbs/gal + 3 lbs/gal disulfothon

i. Avian studies

ii. Aquatic studies - Lamb and Roney, 1972 (120480) studied the acute toxicity of 3 lbs/gal fensulfothion + 3 lbs/gal disulfoton to bluegill sunfish and rainbow trout. The 96-hour LC50s were 0.12 ppm and 4.8 ppm, respectively. Hence, this mixture is at least "very highly toxic" to warmwater fish and "moderately toxic" to coldwater fish.

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(Formulation Unknown)

i. Beneficial Insects. The result from the acute contact toxicity study (Atkins and Anderson, 00049254) showed that 48 h. LD50 was 0.35 mg/bee with a slope value of 5.46. In two other laboratory studies, Johnson and Hutt (00060625 and 00074043) report that the 24 h mortalities were 100% for both direct contact tests but decreased to 22% (3 day) and 6% (2 day) in residual tests. There is sufficient information to characterize fensulfothion as highly toxic to honey bees with direct spray, but of low toxicity when exposed to the residue. Therefore, fensulfothion can be regarded as safe to be applied whenever honey bees are not foraging.

2. HAZARD ASSESSMENT

a. Discussion

Fensulfothion has nematocidal and insecticidal uses. As per the Qualitative Use Assessment for Fensulfothion Applied as a Nematocide, the following paragraph mentions the specific crops:

> A review of labels for products registered by individual states (24(c)) reveals crop uses (peanuts, tobacco, and tomato) which are federally registered but which vary as to type of formulation. In addition, the granular and sprayable formulations are registered in Idaho as a preplant, incorporated, broadcast treatment (five pounds a.i., per acre) for white potatoes.

Similarly, the Qualitative Use Assessment for Insecticidal Uses of Fensulfothion, the following items and crops were mentioned:

> Fensulfothion is registered for use on a number of agricultural and ornamental sites. The agricultural uses are: banana, plantain, citrus (seedlings), corn (field, pop and sweet), cotton, onion, peanuts, potato, rutabaga, sorghum, soybeans, sugarcane, sugarbeets, sweet potato, tomato, and tobacco. The ornamental uses are: lawns, ornamental turf, ornamental trees. The 10 and 15% granular products may only be used by commercial growers, applicators and nurserymen while the 6 lbs/gal. emulsifiable concentrate is a restricted use pesticide.
>
> Environmental fate studies have shown some persistence for fensulfothion. Photodegradation in silt loam soil samples indicated a half-life of 56

and nurserymen while the 6 lbs/gal. emulsifiable concentrate is a restricted use pesticide.

Environmental fate studies have shown some persistence for fensulfothion. Photodegradation in silt loam soil samples indicated a half life of 56 days, whereas in water photolysis provided a half life of 5 to 6 days. The degradation in soil by microorganisms revealed a half life of 4 days for aerobic and 9 days for anaerobic. Leaching studies (2) indicate 80% of the original activity was still in the top 4 to 5 cm after an initial 30 days of aging. Bioaccumulation studies for freshwater fish indicate an accumulation in the fish 39 times the concentration found in water.

b. Aquatic Hazard Assessment

The concentrations expected in water (pond) after use on turf were estimated using the Simulator for Water Resources in Rural Basins (SWRRB) and Exposure Analysis Modeling System (EXAMS). (see attached EAB report) Also, the Environmental Fate and Exposure Assessment Chapter cites five runoff studies. These studies added to the validity of the SWRRB estimates. The computer model is based on severe events and the runoff studies on a steady flow from irrigation. The runoff study was based on an application of 20 lbs a.i./A; a slope of 7.5% and a 37 day test period. The percent runoff was 3.23% of the applied pesticide. Due to the method of irrigation the maximum amount per day would be 1/37th of the percent runoff or .087%. This is equal to an applied rate of 0.0028 lbs/A. This value is very similar to the SWRRB value on days of little or no precipitation. (.001 lbs/A). Both these methods give values for runoff at the edge of the field. In order to estimate residues in a nearby farm pond, the EXAM portion of the program was utilized. EXAMS provides estimated residues for the chemical dissolved in the water column, attached to semi-buoyant particles, dissolved in the pores of the bottom sediment, and attached to the bottom sediment. Below is a table which condenses the results of the computer model.

Estimated Residue and Exposure Periods
from the SWRRB-EXAMS Models

Sample Type*	No. of Consecutive Days EEC Exceeded LC50 fish(56ppb)	shrimp(10ppb)	Estimated Concentration for the Period Exceeding the LC_{50}s MIN (ppb / date**)	MAX
Water Dissolved	11	15	Fish 60.81/137	395/135
			Shrimp 13.61/141	395/135
Water Semi-buoyant Particles	13	17	Fish 70.49/139	968/132
			Shrimp 10.85/141	968/132

*Bottom - porewater and sediments were minimal concentrations and not toxicologically significant.
**The dates for EEC are from Julian date 125 through 175.

Hazard is expected for both fish and aquatic invertebrates from the pesticide dissolved in water. As demonstrated in the table the acute LC_{50} values are expected to be exceeded for periods much longer than the duration of a standard laboratory test. Additional hazard to aquatic organisms may be indicated by the high residue on the semi-buoyant particles. However, dermal toxicity, oral toxicity, and the ability of the chemical to transfer to the gill surface are just a few of the unknown items necessary for estimating the hazard from contaminated floating particles. Therefore, hazard from the fensulfothion attached to semi-buoyant particles is unknown, although hazard is expected from the pesticide in the water. In addition, the risks to fresh water invertebrates is unknown, no acute studies were uncovered as a result of this review.

This hazard assessment has not addressed the life-stages of fish or invertebrates. This is due to the lack of such information. Considering this deficiency and the following facts, further aquatic testing is indicated:

1. The EEC demonstrated that fensulfothion can reach water.
2. The LC50 values are less than 1 mg/l.
3. The EEC is greater than 0.01 of the LC50 for fish and shrimp.
4. The half-life in water is greater than 4 days.

Aquatic Regulatory Triggers

	Brown Shrimp LC50 = 10 ppb	Bluegill LC50 = 56 ppb
Endangered Species > 1/20 LC50	0.5 ppb	2.8 ppb
Restricted > 1/10 LC50	1.0 ppb	5.6 ppb
RPAR > 1/2 LC50	5.0 ppb	28. ppb

As previously discussed the average EEC for four (4) days was 6.15 ppb. Hence, all of the above levels have been exceeded except the RPAR > 1/2 LC50 for bluegill.

c. Terrestrial Hazard Assessment.

Avian species are expected to be at risk when fensulfothion is applied at label prescribed rates. For field and vegetable crops for insecticidal use, the following range of application rates were found; 0.5 lbs/A (4 inch band and 40 inch row spacing) to 1.03 lbs/A (2 inch band and 40 inch row spacing). Higher rates were found for the nematicidal uses, as follows: 2.03 lbs/A (12 inch band and 36 inch row spacing) to 6.0 lbs/A (10 inch band and 48 inch row spacing). Fensulfothion products are emulsifiable concentrates, spray concentrates, or granulars. All products are represented by the range of application rates above. For the purpose of this hazard assessment the application rates in the band area were calculated as well as estimate the concentration which may be expected on avian food items. The application rates within the band are as follows:

Conversion of Rates
from Label to Rate Within the Band

Use	Label Rate	Rate within the Band
Insecticide	0.5 lbs/A, (4 inch band-40 inch row)	5 lbs/A
	1.03 lbs/A, (2 inch band-40 inch row)	20.6 lbs/A
Nematocide	2.03 lbs/A, (12 inch band and 36 inch row)	6 lbs/A
	6.01 lbs/A, (10 inch band and 48 inch row)	28.8 lbs/A

The greatest hazard would be expected to those birds which feed on insects and other food items turned up by the soil incorporation process. Both the spray and granular products would be expected to leave sufficient number of granules or contaminated food and grit items to present a hazard.

Also, incorporation would not be expected to be as efficient at the turning around area at the ends of the rows. The maximum estimated expected soil and insect residues from application of the liquid products are reported in the following table:

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Estimated Field Crop Residues

Resulting from Application of the Liquid Products

	Insecticidal Rates		Nematocidal Rates	
Item	Rate within the Band	Residue ppm	Rate within the Band	Residue ppm
Large Insects	5 lbs/A	60	6 lbs/A	72
	20.6 lbs/A	247	28.8 lbs/lbs/A	345.6
Small Insects	5 lbs/A	290	6 lbs/A	348
	20.6 lbs/A	1194.8	28.8 lbs/A	1670.4
Soil @ 0.1" depth	5 lbs/A	110.2	6 lbs/A	132.3
	20.6 lbs/A	441.1	28 lbs/A	634.0

Birds feeding on insects which escape soil incorporation with the lowest expected residue, 60 ppm, would obtain 273% of the LC_{50} concentration for Bobwhite Quail and those feeding on the maximum expected residue would receive nearly 76 times the Bobwhite Quail LC_{50}. Only 0.749 mg/kg is necessary for the Mallard duck to receive a lethal dose. Therefore, though the hazard to birds may be mitigated somewhat by soil incorporation, any treated object the size of an insect ingested by a bird would be expected to be hazardous.

The use of fensulfothion on turf is expected to result in hazard to avian species. For the turf treatment fensulfothion is applied as a broadcast granular or spray. Following application irrigation with 0.25 to 0.5 inches of water is required by the label. The residue on shortgrass prior to irrigation for the spray product is 5184 ppm at the maximum application rate of 21.6 lbs active ingredient/acre. In contrast to this only a residue of 84 ppm is needed to reach the Mallard LC_{50}. Although irrigation could be expected to dilute and wash off the insecticide, if 98% of the material were removed the remaining 2% (104 ppm) would still exceed the Mallard LC_{50}.

Waterfowl appear to be particularly susceptible to poisoning through turf applications. Small birds appear more sensitive than the Mallard. LD50 values are available for comparison of the House Sparrow,

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1/ See Attachment I for Avian Incidents with Fensulfothion.

2/ See calculation in Table I.

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Redwinged Blackbird, and Mallard. The Mallard value is 0.749 mg/kg whereas the smaller bird LD50's were both 0.32 mg/kg.[1/] These smaller birds are less likely to graze than the waterfowl. Thus, the residue on a small insect (100g) was calculated and expressed as the percentage of the insect which equals one (1) LD50. When sprayed at the maximum rate (21.6 lbs a.i./A) only 6% (6/100) of an insect is equal to one (1) LD50 for a sparrow (25g).[2/] Reversing this calculation the minimum application rate was obtained by assuming a sparrow LD_{50} per insect. This reveals a rate of 1.4 lbs/A. However, the minimum application rate for the liquid products to field crops and turf is 5 lb a.i./A in the band.

Other than turf the remaining ornamental use patterns are nursery stock potting soil, containerized plants, roots dipped (including tubers) and soil application. The first three methods, nursery stock potting soil, containerized plants, and root dipping are performed many times indoors and will take individual attention which will limit the amount of outdoor use and exposure. In addition, roots would be buried reducing exposure. Hence, minimal hazard is expected to birds from these use patterns.

The soil treatment for nursery stock beds would be expected to be hazardous, due to the high application rate of 82 lbs/A. The resultant expected residue on small insects would be 4756 ppm. Similar to turf, the label directs watering the treated beds until the soil is wet to a depth of 4 to 6 inches. Also 3 applications a year are permitted, with a 4 month interval. Watering in application would not mitigate the risks. For example, if watering washed off 99% of the residue, the remaining 1% would be nearly twice the Bobwhite Quail LC_{50}. In addition, songbirds are more likely to be found among ornamentals. Their smaller size, as demonstrated by the LD50s of House Sparrow and Redwinged Blackbird, indicate even less toxicant is needed to produce mortality. Hence, hazard would be expected for birds feeding on small insects or insect size grit in and around nursery stock beds.

Based on this the liquid products are expected to be hazardous and further testing is indicated. Past field studies have failed to simulate the hazards to birds. Hence, an avian field monitoring study will be required.

3/ See attached calculations in Table II.

Granular products are expected to pose risks to birds. To assess the hazard in this case the amount of fensulfothion contained in various granules was calculated and compared to the LD_{50} for House Sparrows. The results demonstrate that less than 1/3 of the least toxic granule contains, 27% on LD_{50} for the sparrow.[3/] Balcomb (per comm.) indicate that 4 out of 5 sparrows died after receiving only one granule of Dasanit 10G. Hence, in soil incorporation in order to mitigate the hazard, every granule should be adequately buried. As reported in the registration standard for carbofuran: "Erbach and Toffefson (unpublished) found that when applied in front of the press wheel, approximately 7.9% of applied granules were visible on the soil surface following incorporation with a drag chain, 5.8% after incorporation with spring tine and 14.7% with no incorporation (other than the press wheel). When applied behind the press wheel, the following percentages of granules remained visible on the soil surface; drag chain - 16%, spring tine - 7.4%, and no incorporation other than the press wheel - 40.2%." The average percentage of unincorporated granules is 15.3% or 130-749 granules/sq.ft. As previously determined one granule would carry more than the lethal dose. Hence, soil incorporation would not mitigate the hazard. Hazard would be expected from the foliar application of granules to corn since granules would be available in the whorls as well as the soil surface.

Banana trees are treated with a different method that may result in hazard. A shaker can with the 15% granular product is used to distribute the pesticide in a 2 to 2.5 foot band at the base of a plant. The user is then instructed to mix with the covering soil. This method is likely to leave exposed granules, particularly, when distributed at 33 lbs/A/plant.[4/]

Hazard is expected for birds feeding in treated areas. Hence, avian field monitoring is indicated. Also, due to the repeat applications allowed for the use on corn, an avian reproduction study is indicated.

Avian Regulatory Risk Triggers

The following chart indicates that the liquid products of fensulfothion exceed all the risk triggers.

Criteria	Concentration (Bobwhite Quail LC50 = 22 ppm)

4/ See calculation on Table III.

Endangered Species 1/5 LC10	2.6 ppm
Restricted Use 1/5 LC50	4.4 ppm
RPAR LC50	22 ppm

Estimated concentration (ppm) = 280 ppm at 5 lbs/A in the diet within the band and 1,405.44 ppm at 28.8 lb/A within the band. (Assuming a dietary composition of 80% insects and 20% plant).

As demonstrated in the hazard assessment, fensulfothion is hazardous to avian species and all the regulatory triggers indicate hazard and substantiate the projected risks.

Mammalian Hazard Assessment

Hazard is expected for small mammals, such as, shrews. In order to evaluate the expected hazard the following estimates were derived.5/ The maximum residue from the 28.8 lbs/A application rate is 1670 ppm, for insects. Hence, 3% of an insect is sufficient to one (1) LD_{50} for the shrew. To determine how large an animal could be threatened at the 28.8 pounds per acre application rate the above calculations were reversed and solved for the animal's weight, assuming an LD50 of one (1) per insect. The results of this calculation indicate a small mammal weighing 133.8 g. would receive a residue equivalent to the rat LD_{50}. The last calculation using the above methods derived the lowest application rate the shrew would receive one (1) LD_{50} per insect. The results indicate that 0.88 lbs/A, would provide sufficient residues to equal the shrew LD_{50}. These calculations are particularly significant for the Least shrew. This shrew is known to consume its weight in food every day and 65% of this diet is insects. Thus, the shrew and mammals up to 134 g may die by ingesting a contaminated insect treated at 28.8 lbs/A. Also, at a rate of 0.88 lb/A, a sprayed insect would be expected to kill a shrew size mammal.

Mammalian Regulatory Risk Triggers

The following chart indicates that fensulfothion products exceed all the risk triggers:

5/ See calculations on Table IV.

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Endangered Species

Endangered species are expected to be impacted by the use of fensulfothion. Several chemicals with similar uses, toxicity,[6/] and formulations (granular and liquid) have been reviewed by the Office of Endangered Species through the Section 7 formal consultation mechanizm. The following is a list of fensulfothion uses which coincide with previous consultations where jeopardy was indicated:

Fensulfothion/Jeopardy Opinion Uses

1. Citrus Fruits
2. Corn
3. Peanuts
4. Soybeans
5. Tobacco
6. Sorghum
7. Sugarcane

This list indicates the species found to be at jeopardy for the above uses:

Species

Attwater's Greater Prairie Chicken
(Tympanuchus cupido attwateri)

Aleutian Canada Goose
(Branta canadensis leucopareia)

Everglade Kite
(Rostrhamus sociabilis plumbeus)

Slackwater Darter
(Etheostoma boschungi)

Alabama Lamp Pearly Mussel
(Lampsilis virescens)

Appalachian Monkey-face Pearly Mussel
(Quadrula sparsa)

Cumberland Monkey-face Pearly Mussel
(Quadrula intermedia)

6/ See the hazard assessment portion of this chapter for endangered species triggers.

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Dromedary Pearly Mussel
(*Dromus dromas*)

Birdwing Pearly Mussel
(*Conradilla caelata*)

Cumberland Bean Pearly Mussel
[*Villosa* (= *Micromya*) *trabalis*]

Green-blossom Pearly Mussel
[*Epioblasma* (= *Dysnomia*) *torulosa gubernaculum*]

Tan Riffle Shell
(*Epioblasma walkeri*)

Turgid-blossom Pearly Mussel
[*Epioblasma* (= *Dysnomia*) *turgidula*)

Pale Lilliput Pearly Mussel
[*Toxolasma* (= *Carunculina*) *cylindrella*]

Fine - rayed Pigtoe
(*Fusconaia cuneolus*)

Shiny pigtoe
(*Fusconaia edgariana*)

Woundfin (*Plagopterus argentissimus*)

Valley Elderberry Longhorn Beetle
(*Desmocerus californicus dimporphus*)

Delta Green Ground Beetle
(*Elaphrus viridus*)

The remaining use patterns not addressed by the Office of Endangered Species are as follows: banana, plantain, onions, ornamentals (trees, shrubs, vines, herbaceous plants,tubers, and turf). Of these use patterns, three are expected to overlap the range of endangered species. The following is a breakdown by species and use pattern:

Use Pattern	Species
Turf	Stock Island 7/
	Snail
	Mohave Chub
Banana	Puerto Rican
Plantain	Plain Pigeon 8/
	(Columba inormata wetmorei)

The remaining use patterns are not expected to expose endangered species due to the small acreage, wide distribution, a portion in a greenhouse, and previous cultural disruption of the habitat (e.g. housing developments, highways, etc.).

In conclusion, the Office of Endangered, in some cases, has offered product labeling which negates any further regulatory action. However, the approval of wording regarding such labeling has been delayed due to implimentation of the "cluster"approach .9/ Hence, though a consultation for most uses of fensulthion is warrented, until implementation of the "cluster"approach is finalized, this consultation will not be requested.

7/ EEB endangered species file indicated both these species are found on golf courses.

8/ Per. comm. with Mr. Robert Pace of USDI, Ecological Services, Mayaguez, Puerto Rico. Mr. Pace indicated the pigeon is found in the area with plantations and 30% of its diet is acquired form the soil surface.

9/ The "cluster" approach is a review of products by use rather than chemical.

B. Outdoor Uses

This pesticide is toxic to fish and extremely toxic to wildlife. Use with care when applying in areas frequented by wildlife. Birds feeding on treated areas may by killed. Cover, disc, or incorporate spill areas. Drift and runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not apply directly to water or wetlands. Do not contaminate water by cleaning of equipment or disposal of wastes. This product is highly toxic to bees exposed to direct treatment on blooming crops or weeds. Do not apply this product or allow it to drift to blooming crops or weeds while bees are actively visiting the treatment area.

RESTRICTED USE PESTICIDE

References

Erbach, Donald C. and Jon J. Tollefson. Unpublished. Granular insecticide application for corn rootworm control. Iowa Agriculture and Home Economics Experiment Station, Ames. 24 pp. (Cited in the Carbofuran Registration Standard).

U.S. Environmental Protection Agency. 1976. Substitute Chemical Program: Initial Scientific and Minieconomic Review of Dasanit® Washington, D.C.

Avian Incidents with Fensulfothion*

- 100 mynas, 35 golden plovers, 15 doves, and eight sparrows were found dead near water into which an estimated 50 lb of Dasanit® 15% granules had been washed 3 days earlier.

- 23 robins (Turdus migratorius) were found on and around a lawn which had recently been treated with Dasanit®.

- Deaths of a number of species of birds were reported in New Zealand after the application of Dasanit® (and two other organophosphate insecticides) for aphid and grass grub control.

- 236 dead birds, mainly whitebacked magpie (Gymnorhina tibicem), black-backed gull (Larus dominicanus) and harrier hawk (Circus approximans, were reported after a single application of Dasanit® in New Zealand. Dasanit® application to a pasture also reduced the bird population in the treated area by 86% within 2 days of treatment.

*Reported in "Initial Scientific and Minieconomic Review of Dasanit®" Nov 1975.

Calculations Table I

Estimating the number of small insects which must be consumed to reach the LD_{50} for the House Sparrow.

Assumptions:

1. Weight of the typical small insect - 100 mg
2. House Sparrow's LD_{50} - 0.32 mg/kg
3. House Sparrows' body weight - 25g
4. Concentration on an insect when sprayed at 21.6 lbs a.i./A - 1253 ppm (this assumes 58 ppm/insect @ 1 lb a.i./A)

Formula:

$$\text{No. (fraction) of insect required to reach sparrow } LC_{50} \text{ value} = \frac{\text{House Sparrow } LD_{50} \times \text{Kilograms of Sparrow}}{\text{Weight of the Insect} \times \text{Concentration Expected on the Insect}}$$

$$\frac{0.32 \text{ mg/kg} \times 25\text{g}/1000\text{g} = .008 \text{ mg/sparrows}}{100 \text{ mg} \times 1253/1{,}000{,}000 = 0.125 \text{ mg/insect}}$$

$$= 0.064 \text{ No. (fraction) of insect require to reach sparrow } LC_{50} \text{ value}$$

Reversing these calculations the minimum application rate still leaves one LD_{50} per insect.

$$1\ LD_{50}/\text{insect} = \frac{0.32 \text{ mg/kg} \times 25\text{g}/1000\text{g}}{100 \text{ mg} \times \text{Expected Concentration (ppm)}}$$

Expected Concentration = 80 ppm

Conversion to Application rate

$$\frac{80 \text{ ppm}}{58 \text{ ppm}} = 1.4 \text{ lbs a.i./A.}$$

Calculations Table II

Estimating the number of granules which must be consumed to reach the LC_{50} for the House sparrow.

Assumptions:

1. House sparrow weight - 25g
2. House sparrow LD_{50} - 0.32 mg/kg
3. A weight range of 0.3 - 2.0 mg will include most granules.
4. Weight of Fensulfothion per Granule:

Formulation	Granule Weight	
	0.03	2.0 mg
10G	0.03	0.2
15G	0.045	0.3

Formula:

$$\text{No. (fraction) of } LD_{50} \text{ value per granule} = \frac{\text{Sparrow } LD_{50} \times \text{Kilograms of sparrow per granule}}{\text{Weight of active ingredient per granule}}$$

$$\text{10G small granule} = \frac{(0.32 \text{ mg/kg}) (.025 \text{ kg})}{0.03}$$

No. (fraction) of LD_{50} value/granule = 0.27 granules

$$\text{10G large granule} = \frac{(0.32 \text{ mg/kg}) (.025 \text{ kg})}{0.2 \text{ mg}}$$

No. (fraction) of LD_{50} value/granule = 0.04 granules

$$\text{15G small granule} = \frac{0.32 \text{ mg/kg}) (.025 \text{ kg})}{0.045 \text{ mg}}$$

No. (fraction) of LD_{50} value/granule = 0.17 granules

$$\text{15G large granule} = \frac{0.32 \text{ mg/kg}) (0.025\text{kg})}{0.3 \text{ mg}}$$

No. (fraction) of LD_{50} value/granule = 0.027 granules

Calculations Table III

Calculations of Application Rate in Pounds/Acre for Banana

Assumptions:

1. 2 ft band around the tree
2. 0.23 oz fensulfothion per tree
3. Area of a circle = π radius squared
4. π = 3.1416

Calculations:

Radius of the band and tree trunk

Radius = 24" band
= 6" tree trunk

Total Radius = 30"

Area of band and tree trunk = 3.1416×30^2
= 2827.44 sq. in.

Area of tree trunk = 3.1416×6^2
= 113.0976 sq. in.

Area of band only
2827.44 - 113.1 = 2714.34 sq. in./tree

Area of band in sq. ft.

$$\frac{2714.34 \text{ sq. in./tree}}{144 \text{ sq. in./ sq. ft.}} = 18.8 \text{ sq. ft./tree}$$

Portion of an acre treated / tree

$$\frac{18.8 \text{ sq. ft/tree}}{43{,}560 \text{ sq. ft/A}} = .0004327 \text{ A/tree}$$

Application/tree in Pounds

$$\frac{.23 \text{ oz/band}}{16 \text{ oz/lbs}} = 0.014375 \text{ lbs/tree}$$

Application Rate in Pounds/Acre

$$\frac{0.014375 \text{ lbs}}{.0004327 \text{ Acres / tree}} = 33.22 \text{ lbs/A/tree}$$

Calculations Table IV

Estimating the number of small isects which must be consumed to reach the LD_{50} for the Least's shrew.

Assumptions:

1. Weight of the typical small insect - 100 mg
2. Rat LD_{50} - 1.25 mg/kg
3. Least's shrew's bodyweight - 4.1 g
4. Esimated pesticide residue on a small insect sprayed at 28.8 lbs a.i./A. in ppm - 1670 ppm

Formula:

$$\text{No (fraction) of insect require to reach sparrow } LC_{50} \text{ value} = \frac{\text{Rat LD50 x Kilograms of shrew}}{\text{Weight of Insect x Concentration Expected on the Insect}}$$

$$= \frac{1.25 \text{ mg/kg} \times 4.1\text{g}/1000\text{g}}{100 \text{ mg} \times 1670/1{,}000{,}000}$$

$$= 0.031 \text{ Shrew } LD_{50}\text{/insect}$$

Estimating the maximum size of the mammal which could still receive one LD_{50} from a sprayed insect.

$$1\ LD_{50} = \frac{1.25 \times (\text{Wt})}{100 \text{ mg} \times 1670/1{,}000{,}000}$$

$$\text{Wt} = \frac{1670/1{,}000{,}000 \times 100 \text{ mg}}{1.25 \text{ mg/kg}}$$

$$\text{Weight} = 133.6 \text{ g.}$$

Corrected SWWRB-EXAMS values

Turf

WITHOUT NONPOINT SOURCE FLOW CHANGES

Date	Inputs
125	IMAS(1) TO 0.000001
127	IMAS(1) TO 2.932
129	IMAS(1) TO .474
130	IMAS(1) TO .560
131	IMAS(1) TO 1.509
132	IMAS(1) TO 5.993
157	IMAS(1) TO .215
159	IMAS(1) TO .086

WITHOUT NONPOINT SOURCE FLOW CHANGES DAY 125

EXAMS -- EXPOSURE ANALYSIS MODELING SYSTEM -- V2.0: MODE 2
ECOSYSTEM: POND, AERL DEVELOPMENT PHASE TEST DEFINITION
CHEMICAL: FENSULFOTHION

TABLE 4. INPUT DATA DESCRIBING ENVIRONMENT: DEPTHS AND INFLOWS.

# TY	DEPTH M	STFLO CU M/HR	STSED KG/HR	NPSFL CU M/HR	NPSED KG/HR	INTFL CU M/HR
1L	2.000	20.00	0.6000	5.000	4.000	
2B	5.0000E-02					1.500

EXAMS -- EXPOSURE ANALYSIS MODELING SYSTEM -- V2.0: MODE 2
ECOSYSTEM: POND, AERL DEVELOPMENT PHASE TEST DEFINITION
CHEMICAL: FENSULFOTHION

TABLE 9. TRANSPORT PROFILE OF ECOSYSTEM.

CP T* Y	VOLUME (CUBIC M)	SEDIMENT MASS (KG)	WATER FLOW (CU. M/DAY)	SED. FLOW (KG/DAY)	RESIDENCE TIME (DAYS) WATER	SEDIMENTS
1L	2.000E+04	600.	643.	9.021E+03	31.1	6.651E-02
2B	500.	6.752E+05	39.3	9.002E+03	6.35	75.0

* COMP. TYPE: "L"=LITTORAL; "E"=(EPI) AND "H"=(HYPO)LIMNION; "B"=BENTHIC

WITHOUT NONPOINT SOURCE FLOW CHANGES

EXAMS -- EXPOSURE ANALYSIS MODELING SYSTEM -- V2.0: MODE 2
ECOSYSTEM: POND, AERL DEVELOPMENT PHASE TEST DEFINITION
CHEMICAL: FENSULFOTHION

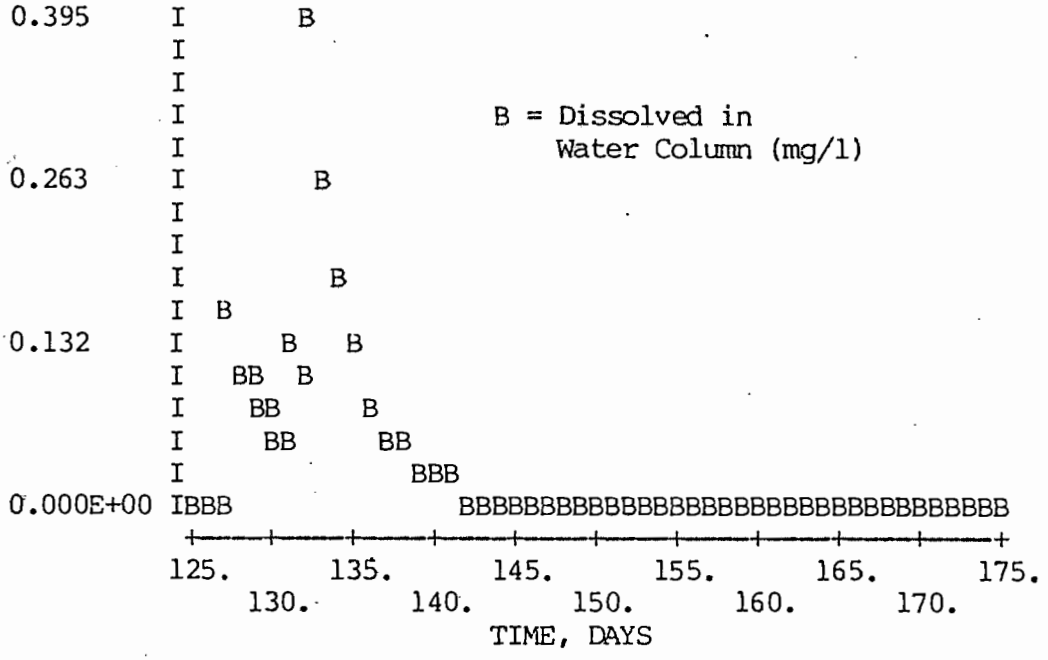
TABLE 16. SIMULATION RESULTS -- TIME-TRACE OF CHEMICAL CONCENTRATIONS.

TIME	AVERAGE CHEMICAL CONCENTRATIONS				MASS OF CHEMICAL	
DAYS	WATER COLUMN		BOTTOM SEDIMENTS		WATER COL	SEDIMENTS
	FREE(MG/L)	SED(MG/KG)	PORE(MG/L)	SED(MG/KG)	TOTAL KG	TOTAL KG
125.	5.000E-08	1.225E-07	0.000E+00	0.000E+00	1.0000E-06	0.000E+00
126.	3.448E-08	8.448E-08	1.501E-13	3.677E-13	6.8971E-07	2.857E-13
127.	0.147	0.359	1.054E-13	2.582E-13	2.932	2.007E-13
128.	0.101	0.247	4.388E-07	1.075E-06	2.017	8.355E-07
129.	9.305E-02	0.228	3.018E-07	7.394E-07	1.861	5.747E-07
130.	9.200E-02	0.225	2.785E-07	6.824E-07	1.840	5.303E-07
131.	0.139	0.340	2.754E-07	6.747E-07	2.775	5.243E-07
132.	0.395	0.968	4.152E-07	1.017E-06	7.901	7.906E-07
133.	0.272	0.666	1.182E-06	2.897E-06	5.435	2.251E-06
134.	0.187	0.458	8.133E-07	1.993E-06	3.738	1.549E-06
135.	0.129	0.315	5.594E-07	1.371E-06	2.571	1.065E-06
136.	8.842E-02	0.217	3.848E-07	9.427E-07	1.768	7.326E-07
137.	6.081E-02 F	0.149	2.647E-07	6.484E-07	1.216	5.039E-07
138.	4.183E-02	0.102	1.820E-07	4.460E-07	0.8366	3.466E-07
139.	2.877E-02 F	7.049E-02 F	1.252E-07	3.068E-07	0.5755	2.384E-07
140.	1.979E-02	4.848E-02	8.612E-08	2.110E-07	0.3958	1.640E-07
141.	1.361E-02 D	3.335E-02 F	5.924E-08	1.451E-07	0.2722	1.128E-07
142.	9.362E-03	2.294E-02	4.074E-08	9.982E-08	0.1873	7.758E-08
143.	6.439E-03 D	1.578E-02	2.802E-08	6.866E-08	0.1288	5.336E-08
144.	4.429E-03	1.085E-02	1.927E-08	4.722E-08	8.8581E-02	3.670E-08
145.	3.046E-03	7.463E-03	1.326E-08	3.248E-08	6.0927E-02	2.524E-08
146.	2.095E-03	5.133E-03 D	9.118E-09	2.234E-08	4.1905E-02	1.736E-08
147.	1.441E-03	3.530E-03	6.271E-09	1.536E-08	2.8821E-02	1.194E-08
148.	9.911E-04	2.428E-03	4.313E-09	1.057E-08	1.9824E-02	8.213E-09
149.	6.817E-04	1.670E-03	2.967E-09	7.268E-09	1.3634E-02	5.648E-09
150.	4.688E-04	1.149E-03	2.040E-09	4.999E-09	9.3774E-03	3.885E-09
151.	3.225E-04	7.901E-04	1.403E-09	3.438E-09	6.4502E-03	2.672E-09
152.	2.218E-04	5.433E-04	9.651E-10	2.365E-09	4.4356E-03	1.838E-09
153.	1.524E-04	3.734E-04	6.634E-10	1.625E-09	3.0487E-03	1.263E-09
154.	1.048E-04	2.567E-04	4.560E-10	1.117E-09	2.0957E-03	8.682E-10
155.	7.207E-05	1.766E-04	3.137E-10	7.685E-10	1.4416E-03	5.972E-10
156.	4.958E-05	1.215E-04	2.158E-10	5.287E-10	9.9173E-04	4.109E-10

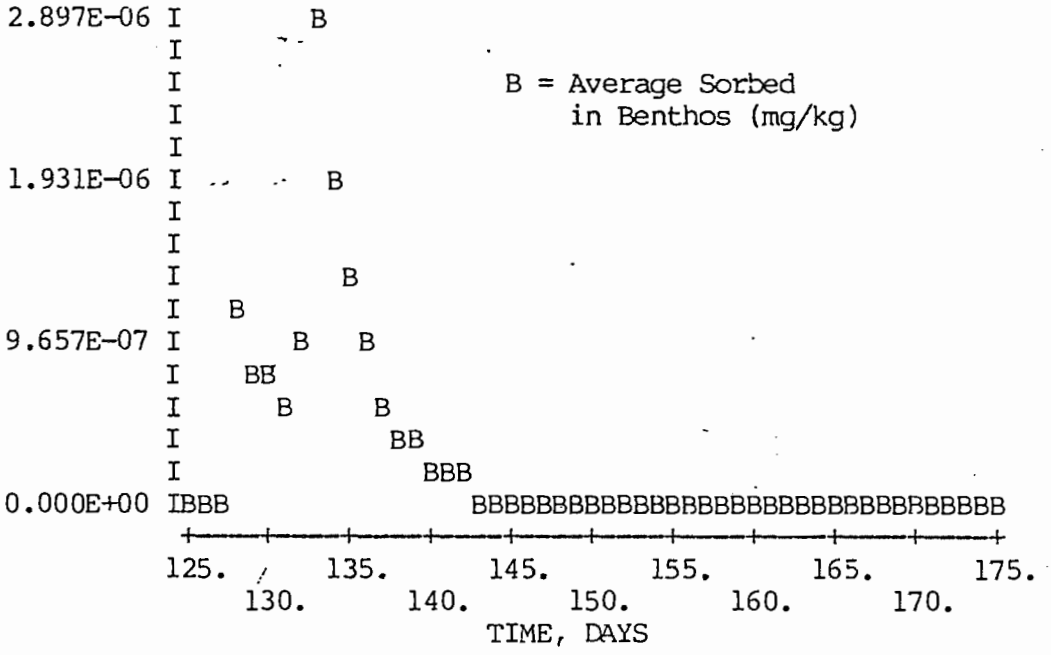
157.	1.078E-02	2.642E-02	1.483E-10	3.633E-10	0.2157	2.823E-10
158.	7.417E-03	1.817E-02	3.228E-08	7.908E-08	0.1483	6.146E-08
159.	9.401E-03	2.303E-02	2.220E-08	5.439E-08	0.1880	4.227E-08
160.	6.466E-03	1.584E-02	2.814E-08	6.895E-08	0.1293	5.358E-08
161.	4.448E-03	1.090E-02	1.936E-08	4.742E-08	8.8960E-02	3.685E-08
162.	3.059E-03	7.495E-03	1.331E-08	3.262E-08	6.1185E-02	2.535E-08
163.	2.104E-03	5.155E-03	9.156E-09	2.243E-08	4.2081E-02	1.743E-08
164.	1.447E-03	3.545E-03	6.298E-09	1.543E-08	2.8943E-02	1.199E-08
165.	9.955E-04	2.439E-03	4.332E-09	1.061E-08	1.9911E-02	8.249E-09
166.	6.848E-04	1.678E-03	2.980E-09	7.301E-09	1.3696E-02	5.674E-09
167.	4.710E-04	1.154E-03	2.050E-09	5.022E-09	9.4207E-03	3.903E-09
168.	3.241E-04	7.941E-04	1.411E-09	3.456E-09	6.4826E-03	2.686E-09
169.	2.231E-04	5.466E-04	9.710E-10	2.379E-09	4.4625E-03	1.849E-09
170.	1.535E-04	3.762E-04	6.682E-10	1.637E-09	3.0711E-03	1.272E-09
171.	1.056E-04	2.588E-04	4.597E-10	1.126E-09	2.1128E-03	8.753E-10
172.	7.270E-05	1.781E-04	3.164E-10	7.751E-10	1.4540E-03	6.024E-10
173.	5.015E-05	1.229E-04	2.183E-10	5.347E-10	1.0031E-03	4.156E-10
174.	3.473E-05	8.508E-05	1.511E-10	3.703E-10	6.9461E-04	2.878E-10
175.	2.406E-05	5.894E-05	1.047E-10	2.565E-10	4.8121E-04	1.994E-10

WITHOUT NONPOINT SOURCE FLOW CHANGES

SYSTEM: POND, AERL DEVELOPMENT PHASE TEST DEFINITION
CHEMICAL: FENSULFOTHION



SYSTEM: POND, AERL DEVELOPMENT PHASE TEST DEFINITION
CHEMICAL: FENSULFOTHION



SYSTEM: POND, AERL DEVELOPMENT PHASE TEST DEFINITION
CHEMICAL: FENSULFOTHION

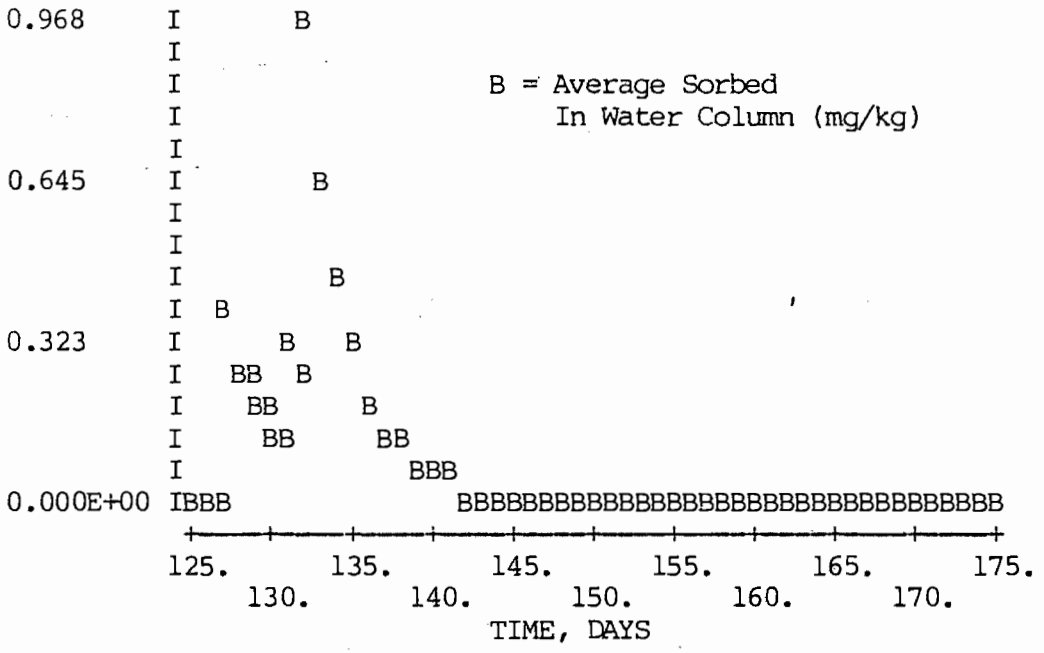


TABLE A
GENERIC DATA REQUIREMENTS FOR FENSULFOTHION

Data Requirement	Composition 1/	Use Pattern 2/	Does EPA Have Data To Satisfy This Requirement? (Yes, No or Partially)	Bibliographic Citation	Must Additional Data Be Submitted Under FIFRA Section 3(c)(2)(B)? 3/
§158.145 Wildlife and Aquatic Organisms					
AVIAN AND MAMMALIAN TESTING					
71-1 - Avian Oral LD_{50}	TGAI	A,B,F,H,I	Yes	05003191** 05008363**	No
71-2 - Avian Dietary LC_{50}	TGAI				No
a-waterfowl		A,B,H	Yes	00094233*	
b-upland game		A,B,F,H,I	Yes	00094233*	No
71-3 - Wild Mammal Toxicity	TGAI	N/A 9/	N/A 9/	N/A 9/	N/A 9/
71-4 - Avian Reproduction	TGAI	A	No	N/A 9/	Yes 4/
71-5 - Simulated and Actual Field Testing - Mammals and Birds	TEP	A,B	No	N/A 9/	Yes 5/
AQUATIC ORGANISM TESTING					
72-1 - Freshwater Fish LC_{50}	TGAI			05014941**	
a. warmwater		A,B,F,H,I	Yes	00078526**	No
b. coldwater		A,B,H,	Yes	00078526** GS01070026**	No
72-2 - Acute LC_{50} Freshwater Invertebrates	TGAI	A,B,F,H,I	No		Yes
72-3 - Acute LC_{50} Estuarine and Marine Organisms	TGAI				
a. Shrimp		A,B,	Partially	00037809**	Yes 6/
b. Marine fish		A,B	Partially	00037809**	Yes 6/
c. Oyster		A,B	Partially	00037809**	Yes 6/
72-4 Fish Early Life Stage and Aquatic Invertebrate Life-Cycle	TGAI	A,B	No	N/A 9/	Yes 7/

TABLE A
GENERIC DATA REQUIREMENTS FOR FENSULFOTHION

Data Requirement	Composition 1/	Use Pattern 2/	Does EPA Have Data To Satisfy This Requirement? (Yes, No or Partially)	Bibliographic Citation	Must Additional Data Be submitted Under FIFRA Section 3(c)(2)(B)? 3/
§158.155 Nontarget Insect					
NONTARGET INSECT TESTING - POLLINATORS:					
141-1 - Honey bee acute contact LD_{50}	TGAI	A,B	Yes	00049254*	No
141-2 - Honey bee - toxicity of residues on foliage	TEP	A,B,	Yes	00074043*	No
141-3 - Wild bees important in alfalfa pollination - toxicity of residues on foliage	TEP				
141-4 Honey bee subacute feeding study	[Reserved]				
141-5 - Field testing for pollinators	TEP				

1/ Composition: TGAI = Technical grade of the active ingredient; TEP = Typical end-use product.
2/ The use patterns are coded as follows: A=Terrestrial, Food Crop; B=Terrestrial, Non-Food; C=Aquatic, Food Crop: D=Aquatic, Non-Food; E=Greenhouse, Food Crop; F=Greenhouse, Non-Food; G=Forestry; H=Domestic Outdoor; I=Indoor.
3/ Data must be submitted no later than _____.

5

72-5	Fish Life - Cycle	TGAI	A,B	No	Yes 6/ 7/
72-6	Aquatic Organism Accumulation	TGAI, PAI or Degradation Product	N/A 9/	N/A 9/	N/A 9/
72-7	Simulated or Actual Field Testing - Aquatic Organisms	TEP	A,B	No	Reserved 8/

1/ Composition: TGAI - Technical grade of the active ingredient; PAI = pure active ingredient; TEP = Typical end-use product;

2/ The use patterns are coded as follows: A=Terrestrial, Food Crop; B=Terrestrial, Non-Food Crop; C=Aquatic, Food Crop; D=Aquatic, Non-food; E=Greenhouse, Food Crop; F=Greenhouse, Non-Food; G=Forestry; H=Domestic Outdoor I=Indoor.

3/ Data must be submitted no later than _____ .

E

4/ Avian reproduction study is required since repeat applications are allowed on corn and the half-lifes on soil indicate persistence. The range from 96 hours to 2640 hours.

5/ Field studies are required due to the very high acute toxicity to birds and mammals demonstrated by laboratory studies and field incidents which relate bird mortality to the use of fensulfothion. At this time two full-scale field monitoring studies are required: One for the use of granular product on field corn and another on the use of the 6 lbs/A spray concentrate of field corn. Depending on the results of the first two studies, further testing on additional crops may be necessary.

6/ Acute estuarine and marine studies are indicated for crops which are grown in excess of 300,000 acres in coastal counties. The following fensulfothion uses meet this requirement: corn, soybean, and sorghum.

7/ Fish early life-stage and aquatic invertebrate life-cycle studies are required since the SWRRB - EXAMS model fensulfothion will transport to water, the LC_{50} for bluegill is less than 1 mg/l, and the fensulfothion half-life in water is greater than 4 days.

8/ The requirement for simulated or actual field testing for aquatic organisms is reserved pending review of the fish early life-stage and aquatic invertebrate life-cycle studies.

9/ Not applicable at this time.

* Study on its own fulfills Guideline requirements.

** Study must be combined with other studies to fulfill Guidelines.