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

OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

JUN 12 1985

MEMORANDUM

SUBJECT: Lindane Registration Standard

TO: George LaRocca, PM-15
Insecticide-Rodenticide Branch
Registration Division

THRU: Harry Craven, Head - Section 4
Ecological Effects Branch
Hazard Evaluation Division

THRU: Michael Slimak, Chief
Ecological Effects Branch
Hazard Evaluation Division

Attached is a copy of EEB's Lindane Data Evaluation Records, Topical Summaries, Disciplinary Review and Data Tables.

Ann Stavola
Aquatic Biologist
Ecological Effects Branch
Hazard Evaluation Division

Abbreviated Reviews

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

Author	Date	Fiche ID No.
Frear	1967	00002875
Rhone-Poulenc, Inc.	-	00006660
Reed	1966	00006692
Henderson	1959	00013531
Davis	1961	00028004
US FWS	1964	00029839
Clemens	1959	00033320
Tooby	1975	00034713
Pickering	1962	00035796
Bionomics, EG&G	1975	00038612
DeWitt	1962	00048109
Union Carbide Corp.	1974	00048824
Anonymous	-	00055673
Butler	1965	00058502
Ludemann	1971	00060630
USDA	-	00060869
Butler	1963	00060996
Pickering	1960	00065495
Rosenberg	1953	00072045
Lowe	-	00074879
US FWS	1965	00075542
Farbenfabriken	-	00081326
Henderson	1959	00091881
Prestt	1969	00101174
Walker	1967	00101196
Macek	1970	00103561
Macek	1970	00105518
Katz	-	00112131
Eisler	1964	00118180
Macek	1969	05003107

Ecological Effects
Topical Summaries

Effects on Birds

Sixteen studies (contained in six references) were received and evaluated under this topic. Seven studies are acceptable for use in a hazard assessment, and nine studies are not acceptable.

Author	Date	Fiche ID No.
Schafer	1972	00020560
Hill	1975	00022923
Martin	1969	00103562
Hudson	1984	HCOSTA01
Grolleau	1965	00099594
Turtle	1963	00101191

In order to establish the toxicity of lindane to birds the following tests are required using the technical grade: one avian single-dose oral study on either a waterfowl species (preferably mallard duck) or an upland game bird (preferably bobwhite quail); and two subacute dietary studies on one species of waterfowl (preferably mallard duck) and one species of upland game bird (preferably bobwhite quail or ring-necked pheasant.)

The acceptable acute oral toxicity studies are listed below:

Species	% ai	LD_{50} mg/kg	Author	Date	ID No.	Fulfills Guideline Requirements
Starling	Tech.	100	Schafer	1972	00020560	No
Redwing blackbird	Tech.	75	Schafer	1972	00020560	No
Mallard	25%	> 2000	Hudson	1984	HCOSTA01	No

There is sufficient information to characterize lindane as moderately toxic to birds on an acute oral basis. However, the guideline requirement for an avian acute oral study has not been fulfilled.

The acceptable subacute dietary toxicity studies are listed below:

Species	% ai	LC_{50} (ppm)	Author	Date	ID No.	Fulfills Guideline Requirements
Bobwhite quail	≥ 95%	882(755-1041)	Hill	1975	00022923	Yes
Ring-necked pheasant	≥ 95%	561(445-690)	Hill	1975	00022923	Yes
Mallard	≥ 95%	> 5000	Hill	1975	00022923	Yes

There is sufficient information to characterize lindane as moderately toxic to upland game birds and practically nontoxic to waterfowl on a dietary basis. The guideline requirements for avian subacute dietary studies have been satisfied by the evaluated studies.

Avian reproduction studies are required when birds are subject to repeated or continuous exposure to the pesticide or its metabolites, especially preceding or during the breeding season. This study may be required for the use of lindane on pecans if the environmental chemistry data indicate that the residues on avian food items may present a substantial risk.

A residue monitoring study was conducted under the National Pesticide Monitoring Program to assess the levels of pesticide residues in the environment (Martin, 1969, MRID 00103562). Starlings (Sturnus vulgaris) were collected from 128 sampling sites throughout the contiguous 48 states. The recovery of lindane appeared to follow more of a seasonal pattern than geographic distribution. The higher residues detected in the fall and winter appeared to be correlated with the higher lipid content of the starlings during these seasons. Residue levels across the country ranged from < 0.010 ppm to 1.17 ppm in the winter and from < 0.010 ppm to 0.075 ppm in the fall. During both seasons lindane residue levels were <0.02 ppm at the majority of the sampling sites. Lindane was found at only a few sites during the spring and summer at levels < 0.010 parts per million.

Although this study is not required by EPA it does provide useful field information regarding the accumulation of lindane by avian wildlife.

Occasionally specialized studies are required to obtain information on a particular aspect of the toxicological features of a product. A residue monitoring study of avian food items is needed for the use of lindane on pecans to determine the concentrations of residues that will be present on vegetation and insects.

Field tests may be required when the available toxicity data in conjunction with the exposure data and the intended use pattern (seed treatments, pecan orchards) information indicate there may be a substantial risk to nontarget organisms.

Precautionary Labeling

The available acute toxicity data do not indicate a requirement of toxicity label statements for birds on products containing lindane.

Effects on Freshwater Fish

Twenty-three studies (contained in three references) were received and evaluated under this topic. Thirteen are acceptable for use in a hazard assessment, and ten studies are not acceptable.

Author	Date	Fiche ID No.
Johnson	1980	00003503
Henderson	1959	00105346
Katz	1961	00105344

The minimum data required for establishing the acute toxicity of lindane to freshwater fish are the results from two 96-hour studies with the technical grade. These studies should be performed on one cold water species (preferably rainbow trout) and one warm water species (preferably bluegill sunfish.)

The acceptable acute toxicity data on the technical grade are listed below:

Species	% ai	LC_{50} (ppb)	Author	Date	ID No.	Fulfills Guideline Requirements
Coho salmon	99%	23 (19-28)	Johnson	1980	00003503	Yes
Rainbow trout	99%	27 (20-36)	Johnson	1980	00003503	Yes
Brown trout	99%	1.7 (1.2-2.4)	Johnson	1980	00003503	Yes
Lake trout	99%	32 (24-42)	Johnson	1980	00003503	Yes
Goldfish	99%	131 (92-187)	Johnson	1980	00003503	No
Carp	99%	90 (75-120)	Johnson	1980	00003503	No
Fathead minnow	99%	87 (69-101)	Johnson	1980	00003503	Yes
Black bullhead	99%	64 (49-81)	Johnson	1980	00003503	Yes
Channel catfish	99%	44 (37-52)	Johnson	1980	00003503	Yes
Green sunfish	99%	83 (47-149)	Johnson	1980	00003503	Yes
Bluegill	99%	68 (60-78)	Johnson	1980	00003503	Yes
Large mouth bass	99%	32 (27-38)	Johnson	1980	00003503	Yes
Yellow perch	99%	68 (60-76)	Johnson	1980	00003503	Yes

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There is sufficient information to characterize lindane as very highly toxic to freshwater fish. The guideline requirements for acute toxicity testing with lindane have been satisified by the evaluated studies.

Data from testing with a typical end-use product are required when the LC_{50} of the technical grade of the active ingredient is equal to or less than the EEC in the aquatic environment.

The EEC which was calculated for the use of lindane on pecans indicates that acute toxicity tests on cold water and warm water fish with the formulated product are needed to support the registration of lindane on pecans.

Data from fish early-life stage tests are needed to support the registration of an end-use product expected to be transported to water from the intended use site and if an LC_{50} value is less than 1 mg/l or if the EEC is equal to or greater than 0.01 of any LC_{50}. This study is required for the use of lindane on pecans.

Occasionally specialized studies are required to obtain information on a particular aspect of the toxicological features of a product. Aquatic residue monitoring is needed to determine if fish are exposed to lindane used in pecan orchards.

Field tests may be needed when the available toxicity data in conjunction with the exposure data and intended use patterns (pecan orchards) indicate there may be a substantial risk to nontarget organisms.

Precautionary Labeling

The available acute toxicity data indicate that a toxicity labeling statement for fish will be required on products containing lindane.

Effects on Freshwater Invertebrates

Ten studies (contained in three references) were received and evaluated under this topic. All are acceptable for use in a hazard assessment.

Author	Date	Fiche ID No.
Johnson	1980	00003503
Sanders	1969	00097842
Sanders	1972	05017538

The minimum data required for establishing the acute toxicity of lindane to freshwater invertebrates is an acute toxicity test with the technical grade. Test organisms should be first instar Daphnia magna or early instar amphipods, stoneflies, or mayflies. The duration of the test is 48 hours for daphnids and 96 hours for the other species.

The acceptable acute toxicity data on aquatic invertebrates are listed below:

Species	% ai	LC_{50} (ppb)	Author	Date	ID No.	Fulfills Guideline Requirements
Simocephalus	99%	520 (340-790)	Johnson	1980	00003503	Yes
Daphnia pulex	99%	460 (386-547)	Johnson	1980	00003503	Yes
Cypridopsis	99%	3.2 (2.2-4.6)	Johnson	1980	00003503	No
Asellus	99%	10 (7-14)	Johnson	1980	00003503	No
G. fasciatus	99%	10 (7-14)	Johnson	1980	00003503	No
G. lacustris	99%	88 (57-136)	Johnson	1980	00003503	No
Pteronarcys	99%	4.5 (3.6-5.7)	Johnson	1980	00003503	No
G. lacustris	Tech.	48 (35-65)	Sanders	1970	00097842	No
G. fasciatus	99%	10 (7-14)	Sanders	1972	05017538	No
Asellus	99%	10 (7-14)	Sanders	1972	05017538	No

There is sufficient data to characterize lindane as highly toxic to freshwater invertebrates. The guideline requirement for an LC_{50} value for freshwater invertebrates has been satisfied.

Data from testing with a typical end-use product are required when the LC_{50} of the technical grade of the active ingredient is equal to or less than the EEC in the aquatic environment.

The EEC which was calculated for the use of lindane on pecans indicates that acute toxicity tests on freshwater invertebrates with a formulated product are needed to support the registration of lindane on pecans.

Data from freshwater invertebrate life-cycle tests are needed to support the registration of an end-use product expected to be transported to water from the intended use site and if an LC_{50} value is less than 1 mg/ℓ or if the EEC is equal to or greater than 0.01 of an LC_{50}. This study is required for the use of lindane on pecans.

Occasionally specialized studies are required to obtain information on a particular aspect of the toxicological features of a product. Aquatic residue monitoring is needed to determine if aquatic invertebrates are exposed to lindane used in pecan orchards.

Field tests may be needed when the available toxicity data in conjunction with the exposure data and intended use patterns (pecan orchards) indicate there may be a substantial risk to nontarget organisms.

Precautionary Labeling

The available acute toxicity data indicate that a toxicity labeling statement for freshwater invertebrates will be required on products containing lindane.

Effects on Amphibians

Two studies (contained in one reference) were received and evaluated under this topic. Both studies are acceptable for use in a hazard assessment.

Author	Date	Fiche ID No.
Sanders	1970	00084757

A data requirement for determining the acute toxicity of pesticides to amphibians has not yet been established.

The acceptable acute toxicity studies are listed below:

Species	% ai	LC_{50} (ppm)	Author	Date	ID No.	Fulfills Guideline Requirements
Western chorus frog	Tech.	2.7	Sanders	1970	00084757	No
Fowler's toad	Tech.	4.4	Sanders	1970	00084757	No

There is sufficient information to characterize lindane as moderately toxic to amphibian tadpoles. There is currently no guideline requirement for acute toxicity testing with amphibians.

Precautionary Labeling

The available acute toxicity data do not indicate that a toxicity labeling statement for amphibians is required.

Effects of Estuarine and Marine Organisms

Three studies contained in one reference were received and evaluated under this topic. None is acceptable for use in a hazard assessment.

Author	Date	Fiche ID No.
Eisler	?	00118185

Estuarine and marine organism toxicity tests on pesticides are required to support registration when an end-use product is intended for direct application to an estuarine/marine environment or if the product may be expected to enter these environments in significant concentrations because of use of a mobility pattern. Because lindane is not registered for any use that will affect these environments, acute toxicity testing on estuarine/marine fish and shrimp are not required. However, the test on oyster larvae is needed in order to determine the toxicity of lindane to endangered mollusks due to potential exposure from the pecan use.

Ecological Effects Disciplinary Review

I. Ecological Effects Profile

A. Manufacturing-Use Lindane

1. Avian Studies

Results from the avian acute oral studies indicate that lindane is moderately toxic to passerine birds (LD_{50} values of 75 mg/kg to redwing blackbird, Schafer, 1972, ID #00020560) on an acute oral basis.

The results of the avian dietary studies (Hill, 1975, ID #00022923) indicate that lindane is moderately toxic to upland game birds (LC_{50} values of 561 and 882 ppm) and practically nontoxic to waterfowl (LC_{50} > 5000 ppm.)

A residue monitoring study conducted under the National Pesticide Monitoring Program (Martin, 1969, ID #00103562) indicate that lindane residue levels in starlings followed a seasonal pattern (highest in the fall and winter) across the country. They ranged from < 0.010 ppm to 1.17 ppm in the winter and from < 0.010 ppm to 0.075 ppm in the fall. Most of the measured residue levels were < 0.02 parts per million.

2. Aquatic Studies

Results from the acute fish studies (Johnson, 1980, ID #00003503) indicate that lindane is very highly toxic to freshwater fish. The 96-hour LC_{50} values ranged from 1.7 ppb (brown trout) to 32 ppb (lake trout) for cold water fish and from 32 (largemouth bass) to 131 ppb (goldfish) for warm water fish.

The acute toxicity tests with freshwater invertebrates indicate that lindane is highly toxic (Johnson, 1980, ID #0003503). The LC_{50} values were 460 ppb and 520 ppb for the immature daphnids and ranged from 3.2 ppb to 88 ppb for ostracods, amphipods and isopods.

Acute toxicity testing with amphibian tadpoles indicate that lindane is moderately toxic (Sanders, 1970, ID #00084757.) The LC_{50} values were 2.7 ppm and 4.4 ppm for Western chorus frog and Fowler's toad respectively.

B. Formulated Products

An acute oral LD_{50} study was done on mallard ducks with a 25 percent formulation. The LD_{50} > 2000 mg/kg indicates that 25 percent lindane is relatively nontoxic to waterfowl (Hudson, 1984, ID #HCOSTA01).

II. Ecological Hazard Assessment

Lindane is currently a restricted-use insecticide registered for commercial ornamentals, pecans, livestock, forestry (trunk treatments), Christmas trees (bark and foliar application), structural treatments, dog shampoos and dusts, seed treatments of agricultural crops and minor uses as foliar and soil applications of agricultural crops. It cannot be applied by aerial application.

A. Seed Treatments of Agricultural Crops

Lindane's major use on agricultural crops is for seed treatment. The major crops which have their seeds treated with lindane are corn, cotton, sorghum and soybeans. The application rates for these crops are 2 oz/100 pounds of seed for corn and soybeans, 2.25 oz/100 pounds of seed for cotton, and 1.25 to 2 oz/100 pounds of seed for sorghum.

In order to determine if the ingestion of seeds treated with lindane could be hazardous to birds, the amount of toxicant per seed and the numbers of seeds that would need to be ingested to provide a lethal dose were calculated for corn, a "larger size" seed and soybeans, a "smaller size" seed.

1. Available Toxicant/Corn Seed

Corn seed treatment rate: 2 oz ai/100 lb seed.

(2 oz ai)(28.35 g/oz) = ~~63,788~~ 56699 mg ai in 100 lb of seed.

assume: 3 seeds/g

(3 seeds/g)(454 g/lb)(100 lb of seeds) = 136,200 seeds per 100 lb.

(~~63,788~~ 56699 mg ai/100 lb seeds)/(136,200 seeds/100 lb) = 0.416 mg ai/seed.

2. Number of seeds to equal an LD_{50}

assume: LD_{50} of red-winged blackbird = 75 mg/kg
one bird weighs 50 g.

(75 mg/kg)(.050 kg body weight) = 3.75 mg/animal.

(3.75 mg/animal)/(0.416 mg ai/seed) = 9.01 seeds/animal.

= 9 seeds need to be consumed by one red-winged blackbird to provide a lethal dose.

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3. Number of Exposed Seeds

assume: 25,000 seeds/A to get a stand of 20,000 to 22,000 stalks/A.

43,560 sq ft/A; $\sqrt{43,650}$ = 208.7 ft/side.

208.7 ft/3 ft row space = 69.5 or 70 rows/A.

assume: John Deere Planter - cover wheel is 2' to 3' behind hopper box.

Corn seeds usually planted 5" to 6" apart in each row.

There will be 6 seeds at each end row.

9 seeds to provide a lethal dose/6 seeds per end row =

1.5 row ends required to provide a lethal dose.

6 seeds/row end x 70 rows/A x 2 ends/row = 840 seeds (at exposed row ends).

840 seeds + 1% seed exposed in open field = total exposed seeds per acre.

840 + (0.01)(25,000) = 840 + 250 = 1090 exposed seeds per acre.

(1090 exposed seeds/A)/(9 seeds per lethal dose) = 121 lethal doses per acre.

For soybeans the same calculations are used, with the following variables changed: application rate of 2 oz ai/100 lb seed; 10 seeds/g and 8 seeds exposed at each row end. The results for soybeans are:

1. Available Toxicant/Soybean Seed

(~~63,788~~ 56,699 mg ai in 100 lb of seed)/(454,000 seeds/100 lb) = ~~0.141~~ 0.125 mg ai/seed.

2. Number of Seeds to Equal an LD_{50}

(3.75 mg/animal)/(~~0.141~~ 0.125 mg ai/seed) = ~~26.6~~ 30 = ~~27~~ 30 seeds/animal

= ~~27~~ 30 seeds need to be consumed by one red-winged blackbird to provide a lethal dose.

3. Number of Exposed Seeds

(27 seeds/lethal dose)/(8 seeds/row end) = 3.4 row ends required to provide a lethal dose.

8 seeds/row end x 70 rows/A x 2 ends/row = 1120 seeds at exposed row ends.

1120 + 1% exposed in open field = 1120 + (0.01)(18,040) = 2924 exposed seeds/A.

(2924 exposed seeds/A)/(~~27~~ 30 seeds/lethal dose) = ~~108~~ 97 lethal doses per acre.

(Calculation methods provided by C. Laird, pers. comm.)

The calculations indicate that there is a potential hazard to birds from ingesting treated seeds. It is less likely that the hazard will be realized from exposure to treated seeds similar in size to soybean seeds. It is not likely that a single bird would consume all the treated seeds at more than 3 row ends or 27 treated seeds scattered around the field in order to ingest a lethal dose of lindane. However, larger treated seeds such as corn seeds may be hazardous to passerine birds since only 9 treated seeds need to be ingested for the bird to receive a lethal dose of lindane. In order to determine if this possibility can occur, a simulated avian field study may be required pending the receipt of a new acute oral LD_{50} study with the bobwhite quail.

Aquatic organisms are not significantly exposed to lindane from seeds treated with the chemical. Therefore, although lindane is highly toxic to aquatic organisms, the hazard from this use is not significant.

B. Forest Uses - Bark Application

The EC formulations of lindane are sprayed on trunks of forest trees. It is applied to the point of runoff at rates ranging from 0.008 to 0.018 lb ai/gal of oil. This range of application contains approximately 1 to 2.16 ppm lindane. This rate of application will not be hazardous to terrestrial wildlife since it is less than 1/5 the LC_{50} for pheasant (112.2 ppm.)

Although the label states it is to be applied to the point of runoff (actually dripping down the trunk), the pesticide is not expected to run off the tree trunks and into any nearby aquatic ecosystem. This is due to the ground cover which will effectively trap any dripping pesticide. Therefore, this use of lindane is not significantly hazardous to nontarget organisms.

C. Pecans

Lindane is applied at the rate of 1.89 pounds ai/a using airblast sprayers to pecans. This rate of application will produce the following residues on vegetation and insects:

	Maximum - immediately after application	Typical Limit
short range grass	454	236 ppm
long range grass	208	174 ppm
leaves	236	66 ppm
small insects	110	62 ppm
seeds, large insects	23	6 ppm
fruits	13	3 ppm

(From Hoerger and Kenaga, 1972)

Based upon a risk criterion of 1/5 the LC_{50} value or 112.2 ppm it is evident that the residues on grasses and leaves immediately after application and the typical residues on grasses (residues likely to result from the application of lindane) can produce a dietary hazard for birds. However, the level of risk is not considered to be unacceptable since the residue levels are less than the LC_{50} value (561 ppm.)

The amount of lindane actually available to birds may be less than the predicted residue concentration due to various environmental factors. However, we do not currently have environmental chemistry data on lindane to make this determination. We need these data to determine if further restrictions on the application of lindane to pecans are necessary to reduce the exposure to birds feeding from pecan orchards.

A preliminary prediction of the estimated environmental concentration (EEC) of lindane that would enter an aquatic ecosystem following a sprayer application was made to determine the exposure to aquatic organisms. The loading into a pond from aerial drift, 10 percent of the application rate, is 0.189 lb ai, and the loading from runoff, based on a loss of 1 percent of the application rate from a 10 acre field, is 0.189 lb ai. The total loading into a pond 1 acre in size and 6 feet deep, is 0.378 lb ai. One pound ai in a 6 ft deep pond produces a residue level of 61 ppb; therefore, 0.378 lb ai will produce a residue level of 23.1 parts per billion.

The acute toxicity data for aquatic organisms indicate that LC_{50} values for Coho salmon, rainbow trout, brown trout, bass, Daphnia, and gammarids are, respectively, 23, 27, 1.7, 32, 460, and 10 parts per billion. A comparison of these LC_{50} values with the aquatic residue level of 23.1 ppb indicates that the RPAR risk criterion of aquatic concentrations > 1/2 LC_{50} value is exceeded for fish and aquatic invertebrates other than cladocerans (i.e., daphnids.)

According to the U.S. Department of Commerce, Bureau of the Census in 1974 the total number of acres of pecan trees was 328,608. The majority of pecans were grown in Georgia and Texas. Other states in which pecans are commercially grown are Oklahoma, Alabama, Louisiana, New Mexico, Mississippi, South Carolina, Arkansas, Florida, and North Carolina (Agricultural Statistics, USDA, 1984.)

Data available to EEB indicate that the average height of pecan trees is 40 feet. Application from a ground rig to this this vertical height produces a significant amount of aerial drift that can be transported to nearby aquatic systems thereby exposing endemic organisms to lindane.

The data in the EEB files indicate that lindane is relatively persistent in both freshwater and seawater. Its presence in the water column depends on such factors as the amount of organic material present in the aquatic ecosystem as organochlorines have a high affinity for adsorption to suspended matter.

The persistence of lindane in water and the exposure of aquatic ecosystems to lindane from its use on pecans indicates the need for chronic toxicity testing on fish and invertebrates.

We also need more environmental chemistry data on the fate of lindane in aquatic ecosystems and aquatic residue monitoring data, and possibly, a full-scale field study to determine if this use of lindane will cause significant ecological effects in aquatic systems.

D. Minor Uses - Soil and Foliar Applications on Crops

Lindane is registered for use on such crops as broccoli, celery, cauliflower, and cabbage by foliar application at a maximum rate of 1 lb ai/a and by preplant soil application at a maximum rate of 2 lb ai/a. These application rates will produce the following residue profile on avian food items:

	1 lb ai/a		2 lb ai/a	
	Maximum	Typical (ppm)	Maximum	Typical (ppm)
short range grass	240	125	480	250
long range grass	110	92	220	184
leaves	125	35	250	70
small insects	58	33	116	66
seeds, large insects	12	3	24	6
fruits	10	1.5	20	3

Based upon a risk criterion of 1/5 the LC_{50} value or 112.2 ppm, it appears that the residues on short grasses and leaves immediately after a 1 lb ai/a foliar application and the typical residues on grasses at the same rate can produce a dietary hazard for birds. However, the risk is not considered to be unacceptable since the residue levels are less than the LC_{50} value of 561 parts per million.

The predicted maximum and typical residues from the 2 lb ai/a soil application are greater than would be expected since the pesticide must be incorporated into the soil for many of the crops receiving this treatment. With this application the food items most likely to be contaminated with lindane are insects, but as the table indicates only the maximum residues on small insects appear to be a potential problem.

As discussed under the section for use on pecans, we do not have sufficient environmental chemistry data to determine if the levels of residues in the field will reach these predicted values. However, the use of lindane as foliar and soil treatments on crops is relatively minor compared with the other uses discussed in the Standard. Therefore, the environmental chemistry data needed to complete the assessment for the pecan use will be sufficient to determine the risks from these uses.

A preliminary EEC based on a runoff loss of 2 percent of the application rate from a 10 acre field (based on a moderate water solubility of 10 ppm) was calculated. The concentration of lindane in a pond, one acre in size and 6 ft deep, is 12.2 ppb at 1 lb ai/a and 24.4 ppb at 2 lb ai/a. The RPAR risk criterion for unacceptable risks to aquatic organisms was fully discussed in the section on pecans. Both application rates exceed the criterion for fish and aquatic invertebrates other than cladocerans (daphnids). (They exceed 1/2 LC_{50} values for Coho salmon, brown trout, and gammarids.)

The chronic toxicity testing, environmental chemistry data and field testing data needed to complete the risk assessment for the use of lindane on pecans will be sufficient to determine the risk from the soil and foliar applications on crops.

E. Endangered Species

In order to fully determine the potential effects of using lindane in the habitats of endangered and threatened species we need the required toxicology data and appropriate environmental chemistry data.

The risks to endangered/threatened birds from the use of lindane on seed treatments can be more accurately defined once we receive a LD_{50} value from an acute oral study with the bobwhite quail. This species is a better indicator than a passerine species of the hazards of ingesting pesticide-treated seeds by those endangered/threatened birds likely to be exposed. These species are Attwater's Greater Prairie Chicken and the Aleutian Canada Goose.

EEB has a preliminary list of endangered/threatened aquatic species likely to be exposed to lindane by its use on pecans. The list developed for the chemical propargite includes 20 fish, 5 amphibians, one crustacean and 13 mussels. A Section 7 consultation with the Office of Endangered Species, USDI must be deferred until the appropriate chronic toxicity data and environmental chemistry data are available.

III. Precautionary Labeling

A. Manufacturing-Use

This pesticide is toxic to fish and aquatic invertebrates. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or public water unless this product is specifically identified and addressed in an NPDES permit. Do not discharge effluent containing this product to sewer systems without previously notifying the sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

B. End-Use Products

1. Nonseed Treatments

This pesticide is toxic to fish and aquatic invertebrates. Do not apply directly to water and wetlands. Drift and runoff from treated areas may be hazardous to aquatic organisms in adjacent aquatic areas. Do not contaminate water by cleaning of equipment or disposal of wastes.

2. Seed Treatment

This pesticide is toxic to ~~fish~~ birds. Collect spills of treated seeds. Do not contaminate water by cleaning of equipment or disposal of wastes. AMS 8/30/85

IV. Major Data Gaps

Please see Generic Data Requirement Table.

TABLE A
GENERIC DATA REQUIREMENTS FOR LINDANE

Data Requirements	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/
§158.150 Plant Protection					
121-1 - TARGET AREA PHYTOTOXICITY	EP		No	-	No 4/
NONTARGET AREA PHYTOTOXICITY					
TIER I					
122-1 - Seed Germination/ Seedling Emergence	TGAI	G	No	-	No 4/
122-1 - Vegetative Vigor	TGAI	G	No	-	No 4/
122-2 - Aquatic Plant Growth	TGAI		No	-	No 4/
TIER II					
123-1 - Seed Germination/ Seedling Emergence	TGAI		No	-	No 4/
123-1 - Vegetative Vigor	TGAI		No	-	No 4/
123-2 - Aquatic Plant Growth	TGAI		No	-	No 4/
TIER III					
124-1 - Terrestrial Field	TEP		No	-	No 4/
124-2 - Aquatic Field	TEP		No	-	No 4/

1/ Composition: TGAI = Technical grade of the active ingredient; TEP = Typical end-use product. EP = End-use product.

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

3/ Data must be submitted no later than _____.

4/ These requirements are generally waived unless it is believed there is a phototoxicity problem.

GENERIC DATA REQUIREMENTS FOR LINDANE

Guideline Citation	Date Requirement	Composition	Use Pattern 1/	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)? 2/
70-1	Special Test	TEP	A	No	-	Reserve 3/
71-1	Avian Single-Dose Oral LD_{50}	TGAI	A,G	Partially	00020560**	Yes 4/
		TEP	A	Partially	HCOSTA01**	~~Yes~~ 4/ no (2)
71-2	Avian Dietary LC_{50}					
	waterfowl	TGAI	A,G	Yes	00022923*	No
	upland game bird	TGAI	A,G	Yes	00022923*	No
71-3	Wildlife Mammal Toxicity	TGAI	A,G	No	-	No
71-4	Avian Reproduction	TGAI	A	No	-	Reserve 5/
71-5	Simulated and Actual Field Testing for Mammals and Birds	TEP	A	No	-	Reserve 5/
70-1	Special Test	TEP	A	No	-	Yes 6/
72-1	Fish Acute LC_{50}	TGAI	A,G	Yes	00003503*	No
	cold water	TEP	A	No	-	Yes 7/
	warm water	TGAI	A,G	Yes	00003503*	No
		TEP	A	No	-	Yes 7/
72-2	Acute LC_{50} Freshwater Invertebrates	TGAI	A,G	Yes	05017538**, 00097842**, 00003503*	No
		TEP	A	No	-	Yes 7/
72-3	Acute LC_{50} Estuarine + Marine Organisms					
	fish	TGAI	A	No	-	No
	shrimp	TGAI	A	No	-	No
	mollusks	TGAI	A	No	-	Yes 8/

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Guideline Citation	Date Requirement	Composition	Use Pattern 1/	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)? 2/
(Continued)						
72-4	Fish Early Life-Stage and Aquatic Invertebrate Life cycle					
	estuarine	TGAI	A	No	-	No
	freshwater	TGAI	A	No	-	Yes 9/
72-5	Fish Life cycle	TGAI	A	No	-	Reserve 5/
72-6	Aquatic Organism Accumulation	TGAI	A	No	-	Reserve 5/
72-7	Simulated or Actual Field Testing for Aquatic Organisms	TEP	A	No	-	Reserve 5/

1/ Composition of the material to be tested is technical grade unless otherwise specified in footnotes. The use patterns are coded as follows: A=Terrestrial, Food Crop; B=Terrestrial, Nonfood; C=Aquatic, Food Crop, D=Aquatic, Nonfood; E=Greenhouse, Food Crop; F=Greenhouse, Nonfood; G=Forestry; H=Domestic Outdoor; I=Indoor.

2/ Data must be submitted no later than _____.

3/ Residue monitoring of avian food items may be needed to determine if there should be further restrictions to reduce exposure of birds to lindane in pecan orchards. The residues on vegetation and insects theoretically exceeded the criterion.

4/ The bobwhite quail should be the test species for the avian single-dose oral LD_{50} studies.

5/ Pending results of environmental fate data and lower tier studies.

6/ Aquatic residue monitoring is needed to determine if aquatic organisms are exposed to lindane used in pecan orchards.

7/ Testing with a TEP is required when the LC_{50} of the technical grade is equal to or less than the EEC in the aquatic environment (such as for pecans and soil and foliar applications on crops).

8/ The result from the acute toxicity test with mollusks is used to determine lindane's risk to endangered mollusks from the pecan use.

9/ Based on LC_{50} values less than 1 mg/ℓ and EEC greater than 0.01 of any LC_{50}.

* This study alone fulfills the data requirement.

** This study alone does not fulfill the data requirement.

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