035001
Section Chapter

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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OFFICE OF
PESTICIDES AND TOXIC SUBSTANCES

MEMORANDUM

SUBJECT: Dimethoate Registration Standard (FRSTR)

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TO: William Miller, Product Manager Team 16
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Attached are the Disciplinary Review, Topical Summaries, and Generic Data Requirements for the Ecological Effects Chapter of the Dimethoate (FRSTR) Registration Standard.

Attachment

cc: J. Heckman (Memorandum only)
A Rispin (SIS)

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DIMETHOATE

Ecological Effects Chapter
(Revised)

INTRODUCTION

The Pesticide Registration Standard for Dimethoate was published in March 1983. Very little data on fish and wildlife toxicity were available at that time. Consequently, the minimum required studies were requested and the upper tier studies were reserved. Using the data submitted in response to the 1983 Registration Standard, the Agency is now rereviewing and amending the original document as a Final Registration Standard and Tolerance Reassessment (FRSTR). The submitted data are such that substantial changes are necessary in the original Standard.

Consequently, the Ecological Effects Chapter is being rewritten rather than amended. In the revised chapter, those data that were considered in the initial document are designated with an asterisk (*), and have not been rereviewed. Ecological effects data that are not marked with an asterisk are those that have become available since the initial document and have been reviewed as part of the revision process.

Ecological Effects Topical Summary

A. EFFECTS ON BIRDS

Thirteen studies in seven documents were received and evaluated under this topic. Ten studies are acceptable for use in a hazard assessment.

Author	Date	MRID No.
*Hill, et al.	1975	00022923
*Tucker	1970	FEOMIM03
*Schafer	1972	00020560
*Schafer	1982	FEODIM04
Munk	1986	00159768
Munk	1986	00162777
Hudson, et al.	1984	00160000

In order to establish the toxicity of dimethoate to birds, the minimum data required on the technical material are:

- An avian single-dose LD_{50} test with either one species of waterfowl, preferably the mallard, or one species of upland game bird, preferably bobwhite, and
- Two avian dietary LC_{50} tests with one species of waterfowl, preferably the mallard, and one species of upland game bird, preferably the bobwhite.

1. Avian Acute Oral Toxicity Technical

The acceptable acute oral toxicity data on technical dimethoate are listed below:

Species	% ai	LD_{50} (mg/kg)	Author	Date	MRID No.	Fulfills Guideline Requirements
Mallard	97	41.6	Tucker & Crabtree	1970	FEODIM03	Yes
Mallard	99.8	63.5	Hudson, Tucker, & Haegele	1984	00160000	Yes
Pheasant	97.0	20.0	Hudson, Tucker, & Haegele	1984	00160000	Yes

Species	% ai	LD_{50} (mg/kg)	Author	Date	MRID No.	Fulfills Guideline Requirements
Red-winged blackbird	Tech.*	5.4	Schafer Schafer	1972 1982	00020560 FEODIM04	Partial 1/
Starling	Tech.*	32	Schafer Schafer	1972 1982	00020560 FEODIM04	Partial 1/
Red-winged blackbird	Tech.*	17.8	Schafer	1982	FEODIM04	Partial 1/

*Personal communication

1/ Not a recommended test species.

The data indicate that technical dimethoate ranges from moderately toxic to very highly toxic to birds on an acute oral basis. The avian acute oral LD_{50} Guideline requirement has been satisfied.

2. Avian Dietary Toxicity - Technical

The acceptable avian dietary toxicity studies on technical dimethoate are listed below:

Species	% ai	LC_{50} (ppm)	Author	Date	MRID No.	Fulfills Guideline Requirements
Mallard	99.0	1011	Hill, et al.	1975	00022923	Yes
Ring-necked Pheasant	99.0	332	Hill et al.	1975	00022923	Yes
Japanese quail	99.0	346	Hill et al.	1975	00022923	Partial 1/

1/ Not a recommended test species.

These data indicate that technical dimethoate is highly toxic to upland game birds and slightly toxic to waterfowl on a dietary basis. The Guideline requirement for avian dietary studies has been fulfilled.

3. Avian Reproduction Testing

Avian reproduction studies on bobwhite and mallard are required for technical dimethoate because most of the use patterns would subject birds to repeated exposure during the breeding season.

The acceptable avian reproduction toxicity data for use in a hazard assessment on technical dimethoate are listed below:

Species	% ai	NOEL	Author	Date	MRID No.	Fulfills Requirements
Bobwhite quail	96.8	6 mg/kg	Munk	1986	00162777	Partial[1]/
Mallard	97.3	$\leq$ 30 mg/kg	Munk	1986	00159768	No[2]/

1/The study may fulfill data requirements if the data discrepancies addressing the diet additives and the postmortem examination are satisfied.

2/The study indicated that two of the six control pens did not produce eggs; therefore, the study cannot fulfill requirements.

The bobwhite quail reproduction study indicated that dimethoate technical caused reproductive impairment for the number of eggs laid, eggs set, viable embryos, and a live embryo at a level of $\geq$ 30 mg/kg in the diet. The no-observable-effect level (NOEL) was determined to be 6 mg/kg. The NOEL for number of eggs cracked and number of normal hatchlings is $\geq$ 30 mg/kg.

The mallard reproduction study indicated that dimethoate technical did not cause adverse reproductive effects at levels $\leq$ 30 mg/kg.

These data have not satisfied the Guidelines requirement for avian reproduction studies on upland game birds or waterfowl.

Additional Avian Toxicity Data

The following two studies were conducted by Hudson, Tucker, and Haegele 1984, 00160000.

A 30-day daily oral administration test with male and female mallards (n = 6) indicated that the lowest daily oral dosage that produced one or two deaths by the end of the 30-day period (30-day empirical minimum lethal dosage) was 6.0 mg/kg/day. The resulting cumulative toxicity index 41.7/6 (acute oral divided by EMLD) = 7, indicating a moderate degree of cumulative action in mallards.

"Another 30-day EMLD study for 20 to 25-week-old pheasants (both males and females) (n = 12) indicates an EMLD of 4.0 and 10.0. The cumulative toxicity index is 20.0/4.0 - 10.0 = 2.0 - 5.0, indicating a slight degree of cumulative action in pheasants."

"Acetylcholinesterase measurements were obtained from the brains of the mortalities and the survivors of the pheasant EMLD test." The survivors showed 71.7 percent inhibition and the mortalities showed 88.0 percent inhibition when compared to their controls.

Precautionary Labeling

Based on the data in the above sections, a precautionary statement for birds is required.

B. EFFECTS ON FRESHWATER FISH

Four studies in four documents were evaluated under this topic. All four studies were found acceptable for use in a hazard assessment.

Author	Date	MRID No.
*Johnson	1980	00003503
*USEPA	1977	FEODIM02
*USEPA	1970	00077504
*Palawski	1985	FEODIM05

The minimum data required for establishing the acute toxicity of dimethoate to fish are the results from two 96-hour studies with technical grade material. The studies should be conducted with one coldwater species (preferably rainbow trout) and one warmwater species (preferably bluegill).

1. Technical Dimethoate

The fish acute toxicity data that are acceptable for use in a hazard assessment are listed below.

Species	% ai	LC_{50} (ppm)	Author	Date	Fiche ID No.	Fulfills Requirements
Bluegill	97.4	5.8	Johnson & Finley	1986	00003503	Yes
			Palawski	1982	FEODIM05[1]/	

Species	% ai	LC_{50} (ppm)	Author	Date	Fiche ID No.	Fulfills Requirements
Rainbow trout	97.4	6.2	Johnson & Finley	1980	00003503	Yes
			Palawski	1982	FEODIM05[1]/	
Rainbow trout	95.0	7.5	USEPA	1977	FEODIM02	Yes

1/This submission contained the raw data sheets for 00003503.

These data indicate that technical dimethoate is moderately toxic to both coldwater and warmwater fish. The Guidelines requirements for acute toxicity testing with freshwater fish are fulfilled.

2. Formulated Dimethoate

One acute toxicity study on the formulation, Cygon 267 (30.5% ai) was considered acceptable for a hazard assessment. This study (U.S. EPA 1970, 00077504) indicated that the 48-hour LC_{50} was 180 ppm for goldfish. It was also determined that at a concentration of 150 ppm, 30.5% dimethoate can be expected to kill goldfish. This study does not fulfill Guidelines requirements for formulated testing, but since the estimated environmental concentration (EEC) does not exceed the LC_{50}, this requirement is waived.

3. Fish Early Life Stage Test

No studies were evaluated under this topic.

Toxicity data on technical dimethoate from fish early life stage tests are required to support the registration of an end-use product when the product is expected to be transported to water from the intended use site and the acute toxicity of the technical material is less than 1 mg/L or the EEC in water is equal to or greater than 0.01 times the LC_{50} from acute testing.

The lowest fish acute LC_{50} on the technical material is 5.8 mg/L and the aquatic EEC for single application at the highest use rate is estimated to be 458 ppb.[1]/ Since the EEC (458 ppb) exceeds 0.01 of the LC_{50} (58 ppb), the fish early life stage test is required.

1/This calculation is based on the maximum rate, which is 0.75 lb ai/100 gal on crops such as grapefruit, lemon, and oranges. According to the EPA Compendium of Registered Pesticides, Vol. II, 2000 gal are typically applied to 1 acre of grapefruit, or lemons, or oranges--therefore, a total of 15 lb dimethoate ai/A can be expected to be applied. See Attachment A for EEC calculation sheet.

Precautionary Labeling

Since the LC_{50} values for both warmwater and coldwater fish are greater than 1 ppm, labeling is not required for fish.

C. EFFECTS ON FRESHWATER INVERTEBRATES

Three studies in five documents were evaluated under this topic. All studies were acceptable for use in a hazard assessment.

Author	Date	MRID No.
*Johnson, et al.	1980	00003503
*U.S. EPA	1979	FEODIM01
*Sanders	1969	00057053
*Sanders and Cope	1968	05010360
*Palawski	1982	FEODIM05

The minimum data required for establishing the acute toxicity of dimethoate to freshwater invertebrates are the results from a 48-hour study with the technical material on first instar Daphnia magna (preferably) or on early instar amphipods, stoneflies, or mayflies.

1. Technical Dimethoate

The acceptable data on the acute toxicity of technical dimethoate to freshwater invertebrates are listed below:

Species	% ai	LC_{50} (ppm)	Author	Date	MRID No.	Fulfills Requirements
Pteronarcys	97.4	0.043 1/	Johnson & Finley	1980	00003503	Yes
			Sanders & Cope	1968	05010360 2/	
			Palawski	1982	FEODIM05 3/	
Gammarus lacustris	97.4	0.20 1/	Johnson & Finley	1980	00003503	No 4/
			Sanders	1969	00057053 2/	
			Palawski	1982	FEODIM05 3/	

1/A 96-hour study.
2/These reports refer to the same dimethoate studies cited in 00003503.
3/This submission contained the raw data sheets for 00003503.
4/Mature individuals were used instead of the recommended early instar.

These data indicate that technical dimethoate is very highly toxic to highly toxic to freshwater invertebrates. The Guidelines requirements for an acute toxicity study on freshwater invertebrates with technical dimethoate is fulfilled.

2. Formulated Products

No studies were evaluated under this topic.

Acute toxicity studies on freshwater invertebrates with the formulated product may be required when the product will be introduced directly into water or when the maximum expected environmental concentration (MEEC) or the EEC exceeds the LC_{50} of the technical material to freshwater invertebrates. Since the EEC of 458 ppb exceeds the Pteronarcys californica LC_{50} of 43 ppb, data are required on the toxicity of a typical end-use product (using 2.67 lb/gal EC) in freshwater invertebrates.

3. Aquatic Invertebrate Life Cycle

A Daphnia magna life cycle study reported (*U.S. EPA 1979, FEODIM01) that the estimated concentration necessary to reduce average total production per female by 50 percent over 28 days is 0.52 ppm, only slightly less than that estimated to reduce adult survival by 50 percent over this period (0.65 ppm). The NOEL for survival and total production per female is 0.23 ppm (230ppb). Since solvent control mortality and control mortaliy ranged from 9 to 19 %, the study was considered acceptable of use in a hazard assessment, but does not satisfy Guideline requirements.

Data on the toxicity of technical dimethoate to aquatic invertebrate life cycles are required to support the registration of an end-use product when the product is expected to be transported to water from the intended use site and the acute toxicity of the technical material is less than 1 mg/L or the EEC in water is equal to or greater than 0.01 of any LC_{50} determined in acute toxicity testing. The aquatic invertebrate LC_{50} of 43 ug/L is considerably below 1 mg/L (ppm) and the EECs are at least 4 times greater than the LC_{50}. In addition, the EEC exceeds the estimated NOEL, which is support for the concern for aquatic invertebrates. Therefore, the aquatic invertebrate life cycle test is required.

Precautionary Labeling

Based on the above sections, a precautionary statement for aquatic invertebrates is required.

D. EFFECTS ON ESTUARINE AND MARINE ORGANISMS

Two studies in one document were evaluated under this topic.

Author	Date	MRID No.
Mayer	1986	40228401

Acute toxicity testing with estuarine and marine organisms is required for a chemical when the end-use product (EP) is intended for direct application to the marine/estuarine environment or is expected to reach this environment in significant concentrations when the product is used as directed. Dimethoate is used as an insecticide in citrus, cotton, corn, sorghum, soybeans, and tobacco. These use patterns may result in exposure to the estuarine environment through drift and runoff.

1. Technical Dimethoate

The minimum data for establishing the acute toxicity of technical dimethoate to estuarine and marine organisms are:

a. A 96-hour LC_{50} study for a fish, preferably Menidia sp. or spot, Leiostomus xanthurus,

b. A 96-hour LC_{50} study on an invertebrate, preferably a species of penaid shrimp, and

c. A 48-hour EC_{50} study with oyster embryolarvae or a 96-hour LC_{50} oyster shell deposition study.

The estuarine/marine toxicity data that are acceptable for use in a hazard assessment are as follows:

Species	% ai	LC_{50} (ppm)	Author	Date	Fiche ID No.	Fulfills Requirements
Penaeus aztecus	99.3	> 1.0	Mayer	1986	40228401	Partial[1]/
Fundulus similis	99.3	> 1.0	Mayer	1986	40228401	Partial[1]/[2]/

1/These data are scientifically sound, but since the actual LC_{50} was not determined, a hazard assessment cannot be completed. Therefore, the studies only partially fulfill Guideline requirements.

2/Not a recommended test species.

These data indicate that technical dimethoate may be at least moderately toxic to the marine organisms, brown shrimp and the killifish.

Since the EEC is greater than 0.01 of the LC_{50} (> 1.0 ppm), the estuarine/marine acute toxicity stuidies are needed to complete a hazard assessment. Therefore, the Guideline requirement for all three estuarine organisms has not been fulfilled.

2. Formulated Product

When the EC_{50} or LC_{50} of the technical material to estuarine organisms is less than the EEC for estuarine environments, acute toxicity testing of the end-use product on estuarine or marine organisms is required.

No acceptable data on end-use products of dimethoate have been submitted. Testing is required depending upon the results of acute toxicity testing of estuarine/marine organisms on technical dimethoate.

E. FIELD TESTING AND MONITORING STUDIES

Two simulated avian field studies in three documents were received and evaluated. Only one was acceptable for a hazard evaluation.

Author	Date	MRID No.
*Boudreau	1971	00075585
*Boudreau	1972	00077485
*Wang	1971	00075575

Simulated or actual field studies and residue monitoring studies are required on a case-by-case basis depending on the intended use pattern of the chemical, the toxicity to nontarget organisms, and relevant environmental fate characteristics. The following study was acceptable for use in a hazard assessment.

Species	Results	Author	Date	MRID No.	Fulfills Guideline Requirements
Starling House Finch (Linnet)	No pesticide-related effects were seen following four applications of dimethoate (Cygon Systemic 25W) to grapes at 5- to 6-day intervals (2 lb ai/A/application) in this small-pen field study. Actual residues and dimethoate consumption were not measured, however.	Boudreau Wang	1971	00075585 00075575	Partial[1]/

1/ Since the residues were not measured on the grapes, supplemental food or the water, the study does not fulfill requirements.

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Additional Avian Field Studies

The U.S. Fish and Wildlife Service (USFWS) (Larry Blus,personal communications) have conducted studies in 1983, 1985, and 1986 regarding the effects of dimethoate on sage grouse, applied at rates of 0.5 lb. ai/A, on alfalfa and potato fields of Idaho. The following is a summary of these studies.

In 1983, USFWS investigated possible effects to sage grouse from exposure to dimethoate around potato fields. At that time, it was determined that acetylcholinesterase (ChE) inhibition was at levels of 7 to 22 percent in five birds exposed to dimethoate.

In 1985, USFWS, EPA, EG&G, and the Idaho State Fish and Game Commission, under a cooperative effort, conducted an intensive study to determine the effects of organophosphate insecticides on sage grouse using radio-telemetry.

A total of 15.4 percent of the grouse were adversely affected from exposure to dimethoate. Acetylcholinesterase inhibition ranged from 31 to 72 percent lower than the controls.

In 1986, the cooperative grouse study was continued, with improvements in the tracking of sage grouse. The range was increased to include potato fields as well as alfalfa.

A total of 69 sage grouse were radio-tracked, of which, 25 (36%) were found dead within 7 days post-treatment. An additional 38 nonradio-tracked birds were found dead within 11 days post-treatment. Of the total 64 sage grouse found dead, 43 birds were assayed for ChE inhibition, and found to have levels ranging from 50.6 to 90.3. The crop contents of 14 birds (within 10 days post-treatment) indicate dimethoate residues ranged from < 0.5 to 30 ug/g and brain ChE inhibition ranged from 38.7 percent to 88.6 percent.

Dimethoate ranges from moderately toxic to very highly toxic to birds on an acute oral basis. This compound is highly toxic to mammals on an acute oral basis. Reproductive studies indicated that reproductive impairment can occur at levels greater than 6 mg/kg for the bobwhite quail.

The estimated EECs (dry weight) range from 360 ppm (for alfalfa) to 10,800 ppm (for oranges). These levels clearly exceed the LC_{50} values for the bobwhite and the mallard. Therefore, field studies on the acute effects of dimethoate on terrestrial vertebrates are required to support registration for the various sites.

Ecological Effects Disciplinary Review

I. ECOLOGICAL EFFECTS PROFILE

A. Technical Product

1. Avian Studies

There is sufficient information to characterize technical dimethoate as moderately toxic or very highly toxic to birds on an acute oral basis, with mallard LD_{50} values ranging from 41.6 mg/kg to 63.5 mg/kg (Tucker 1970, FEOMIM03, Hudson 1984, 00160000), LD_{50} value of 20.0 mg/kg for the pheasant (Hudson 1984, 00160000), and red-winged blackbird LD_{50} values ranging from 5.4 to 17.8 mg/kg (Schafer 1979, 00020560 and Schafer 1982, FEODIM04).

Dimethoate is highly toxic to upland game birds and slightly toxic to waterfowl on a dietary basis with LC_{50} values ranging from 332 ppm (pheasant) to 1011 ppm (mallard), respectively.

A bobwhite quail reproduction study indicated that dimethoate technical caused reproductive impairment at levels of 30 mg/kg. The reported NOEL was 6 mg/kg in the diet.

The mallard reproduction study indicated that dimethoate cause no adverse reproductive effects at levels $\leq$ 30 mg/kg in the diet.

Two additional 30-day oral administration studies, one on the pheasant and one on the mallard indicated EMLDs of 4 to 10.0 mg/kg/day and 6 mg/kg/day, respectively. The pheasant EMLD study showed levels of acetylcholinesterase inhibition to be 71.7 percent for survivors and 88.0 percent for the mortalities, when compared to their controls.

2. Aquatic Studies

There is sufficient information to characterize technical dimethoate as moderately toxic to both warmwater and coldwater fish. Acute LC_{50} values are 5.8 ppm to bluegill (Johnson and Finley 1980, 00003503 and Palawski 1982, FEODIM05) and 6.2 and 7.5 ppm to rainbow trout (Johnson and Finley 1980, 00003503, Palawski 1982, FEODIM05 and U.S. EPA 1977, FEODIM02).

An acute toxicity study on goldfish indicated that formulated dimethoate (30.5% ai) is practically nontoxic to goldfish (U.S. EPA 1970, 00077504).

Dimethoate (technical) is very highly toxic to the freshwater invertebrate, Pteronarcys californica, with an LC_{50} value of 0.043 ppm (Johnson and Finley 1980, 00003503).

A Daphnia magna life cycle study indicated that the NOEL is 0.23 ppm based on survival and female production (U.S. EPA 1979, FEODIM01).

There is sufficient information to characterize technical dimethoate as at least moderately toxic to the estuarine organisms, Penaeus aztecus and Fundulus similus, with LC_{50} values greater than 1 ppm (Mayer 1986, 40228401).

B. Dimethoate Formulated Product

Avian Studies

One simulated field study indicated that no pesticide related effects were seen in grape vineyards when starlings and house finch were exposed to dimethoate at a rate of 2 lb ai/A.

The USFWS has been conducting research since 1983 on the effects of dimethoate on sage grouse at a rate of 0.5 lb ai/A on alfalfa and potato fields in Idaho. In 1985, an estimated 15.4% of the sage grouse were adversely affected from exposure to dimethoate. In 1986, a total of 36% of the radio-tracked birds and 38 non-tracked birds were reported dead.

II. FORMULATIONS AND USE

Information contained in this section was extracted from (1) "Oualitative Use Assessment for Dimethoate" prepared by Y. Ng, SSB/BUD, August 5, 1987; (2) "Preliminary Quantitative Usage Analysis of Dimethoate" prepared by R. Dumas, EAB/BUD, July 1987; and (3) the draft index entry for dimethoate, prepared by SSB/BUD, May 13, 1987.

Dimethoate is a systemic insecticide-acaracide. Common trade names include Cygon, De-fend, and Rebelate. The use patterns include: terrestrial food crops and nonfood crops; ornamental plants and forest trees; domestic dwellings, indoor uses; animal premises; greenhouse nonfood crop; and noncrop agricultural areas, roadsides.

Dimethoate is registered as 94%, 95%, and 96% technical and 38.6% and 82% formulation intermediates. In addition, dimethoate exists as end-use products in the form of 5% granular and 25% wettable powder. Several emulsifiable concentrates are available as well. They are as follows: 2 lb/gal, 2.1 lb/gal, 2.67 lb/gal, 4 lb/gal, 8%, 12%, 22.7%, 23.4%, 30%, and 30.5%.

There are nine registered products containing dimethoate and other multiple active ingredients. There are 67 section 3 registrations, 20 intrastate products, and 100-24(c) registrations.

Based on current data, the total annual use of dimethoate is estimated to be 1.6 million lb ai. This is 43 percent less than the usage reported in the 1980 POUA on dimethoate. Agricultural usage includes 23 sites, with an annual usage of 2000 lb ai or more.

Approximately 67 percent of the current usage of dimethoate is for the following five crops: cotton, grapes, alfalfa, pecans, and oranges. Cotton and grapes are the only sites where usage has increased significantly. Usage on most other sites has declined since 1980. Usage on sorghum, pecans, soybeans, and lettuce has declined to less than a quarter of its 1979 level. In addition, ornamental use indicated at 100,000 lb ai/yr, is now thought to be a small part of the total dimethoate market.

Cotton

Up to 22.4 percent of the total usage of dimethoate is in cotton. Dimethoate is predominately applied in the Delta, Southwest, and Southeast regions of the United States. This compound is primarily applied as an aerial application and, to some extent, as a ground application. The maximum application rates are 0.25 to 0.5 lb/A in California and Arizona and 0.25 lb/A for the rest of the United States. The applications may be repeated as often as every 14 days in all States. In California and Arizona, only two applications per season are allowed at the higher rate (0.5 lb). Typically dimethoate is applied once per season.

Grapes

Approximately 19.2 percent of the dimethoate usage is in grapes. This chemical is applied by ground equipment in California. The maximum application rate is 2 lb/A, and is only applied until the berries reach 1/4-inch diameter. There is no restriction on the number of applications per year (season), but is typically applied 1-2 times per season.

Alfalfa

A total of 10.9 percent of the dimethoate usage is for alfalfa throughout the United States. Dimethoate is applied by both aerial and ground equipment at a maximum rate of 0.5 lb/A with one application per cutting. The major alfalfa-producing States include California, Idaho, Iowa, Kansas, Michigan, Minnesota, Nebraska, North Dakota, South Dakota, and Wisconsin. The number of cuttings per season are as follows:

Location	No. of Cuttings/ Season
Northern States	2-3
Central & South Central States	3-5
Irrigated Arizona & California	6-8

Pecans

Approximately 7.7 percent of the dimethoate usage is on pecans and is primarily used in Southeast United States, using aerial or ground equipment. The maximum application rate is 0.67 lb ai/A. The number of applications per season does not appear to be restricted, but typically is applied 2 times per season.

Oranges

Up to 7.1 percent of the dimethoate usage is for oranges, primarily in Florida and California. Dimethoate may be foliar applied by either aerial or ground equipment at a maximum application rate of 0.75 lb ai/100 gal. According to the EPA Compendium of Registered Pesticides, Vol. II, up to 2000 gallons of formulation may be applied per acre. Therefore, the total application rate may be as high as 15 lb ai/A on oranges. The number of applications per season does not appear to be restricted except when the fruit are mature, then it is restricted to two applications. Typically dimethoate is applied 1-2 times per season.

Other Uses

See Appendix I for other uses of dimethoate. Application is by aerial or ground spray. Dimethoate is used to treat 35.4 percent of the lettuce areas (1.6% total usage), and 18 percent of the cauliflower acres (0.3% total usage).

III. ENVIRONMENTAL FATE AND RESIDUES

Environmental Fate

According to the available environmental fate data, (Mastradome, P. EAB, Draft Dimethoate FRSTR 9/87), the hydrolysis rate of dimethoate is calculated to be 156, 68 and 4.4 days at a pH of 5, 7, and 9, respectively. This chemical photo-degraded in water with a half-life of >15 days(calculated >175 days) in a pH of 5 buffered aqueous solution. This chemical was very mobile in columns of sand, sandy loam, clay loam soils leached in 51 cm of water.

Previously reported environmental fate data indicate that dimethoate residues dissipate rapidly from the upper 6" of sandy loam soil, with a half-life of <7 days. This chemical degrades rapidly with a half-life of <2 weeks in non-sterile chelralis clay loam soil. Dimethoate degrades rapidly with a half-life <15 days in aerobic sandy clay loam soil at 25° C and 10-30% soil moisture.

Terrestrial Residues

Foliar spray applications of dimethoate are made at a maximum application rate of 0.17 to 16.6 lb ai/A depending on the

crop. Residues may occur on the crop itself or on the surrounding vegetation. Residues on adjacent vegetation could occur from spray drift and could be up to 10 percent of the applied amount within 100 feet of the edge of the crop, or 11 ppm on long grass adjacent to the crop for each 1 lb. a.i. Understory vegetation in orchards could have as much as 30 percent of the applied amount as residues. Thus, understory long grass could have as much as 33 ppm residues for each 1 lb. a.i. applied (Phosalone FRSTR, 1986).

Since dimethoate is used on a variety of crops (both food and nonfood), the crops were grouped as follows:

Type of Crop[1]/	Max. Application Rate lb ai/A
Field Crops, i.e., Alfalfa, cotton	0.5
Vegetable Crops, i.e.,	
Beans, potatoes,	0.5
grapes	2.0
Citrus/Nut Trees, i.e.,	
Pecans	0.67
Oranges	15.0
Apples	4.0

1/See Appendix for a detailed list of sites.

Dimethoate is also registered for many terrestrial nonfood crop uses, i.e., roadsides; greenhouse nonfood crop; domestic outdoor (domestic dwellings); indoor uses, i.e. animal premises and manure treatments and commercial outdoor(refuse areas) sites.

Based on EEB's nomograph (Urban, D.J; Cook, N.J. 1986, Hazard Evaluation Division, Standard Evaluation Procedure, Ecological Risk Assessment), maximum residues were estimated for a single application. These residues are designated as "wet-weight residues." See Table 1.

Some actual residue data were available from the Residue Chemistry Branch reviews. In alfalfa, initial residues following application of 0.5 lb ai/A, residues for dimethoate ranged from 12.0 to 36.0 ppm and < 0.05 to 1.9 ppm for the metabolite dimethoxon. A comparison of expected and actual residues indicates that the nomograph estimates are a reasonable approximation of actual residues but that, in some circumstances, actual residues could be higher.

In the past, EEB has assessed toxicity to avian wildlife by not only estimating the potential exposure from residues by Kenaga 1972 (Table 1), but by also taking into account that the residues

by both RCB and the nomograph are "wet-weight" residues. Estimates of avian dietary exposure may be understated, when the values are based on dry laboratory diets and then compared to wet-weight residue levels.

As stated by Kenaga, E.E. 1973, "birds eating food with a high moisture may consume greater quantities of pesticides than birds with diets containing a low moisture content because of the increased bulk needed for equivalent nutritive value."

Therefore, the "wet-weight" residues (with estimates of 67% moisture) have been converted to "dry-weight" residues by multiplying by three, to estimate the actual potential exposure. In Table 1, the residues have been recalculated to "dry-weight basis" which is a more appropriate comparison when comparing to the birds' dry mash diet with < 15% moisture in the LC_{50} studies.

In addition, Table 1 lists the terrestrial estimated environmental concentration (TEEC) for the major use patterns (and application rate) for dimethoate. The computer model uses the application rate, estimated residue (in this case dry-weight was used), number of applications (maximum of 2 was used), interval (maximum of 14 days) and a foliar half-life of 5 days (Based on WHO, 1986).

Aquatic Residues

A direct application to water of 1 lb ai/A would result in residues of 734 ppb in the top 6 inches or 61.2 ppb in 6 feet of water. Direct applications to water are not expected. However, a pond located 100 meters from a treated site could receive 5 percent of the applied amount as spray drift (Phosalone FRSTR, 1986). This would amount to 36.7 ppb in the top 6 inches or 3.1 ppb in 6 feet of water. With a water solubility > 100 ppm, 5 percent runoff may be expected. Using the standard EEB pond model of 10 acres of runoff feeding into a 1-acre pond 6 feet deep, maximum residues from a single lb ai/A foliar application would be 30.5 ppb. The combined exposure from drift and runoff could be 21.3 ppb from aerial application. The aquatic residues based on this model are presented in Table 1 for the different application rates associated with the various use patterns.

IV. RISK ASSESSMENT

A. Effects on Terrestrial Wildlife

Dimethoate is considered to be moderately toxic or very highly toxic to birds on an acute oral basis and slightly toxic or highly toxic to birds on a dietary basis. A mallard reproduction study indicated no reproductive impairment at levels $\leq$ 30 mg/kg in the diet. A bobwhite reproduction study showed reproductive impairment at levels > 6 mg/kg (NOEL = 6 mg/kg) in the diet. Thirty-day EMLD values were 6 mg/kg/day and 4 to 10 mg/kg/day for the mallard and the pheasant, respectively.

Adverse effects have been reported by USFWS in avian studies assessing the hazard to sage grouse from the application of dimethoate on potato and alfalfa fields in Idaho.

Health effects data on laboratory mammals indicate that dimethoate is moderately toxic or highly toxic to laboratory mammals on an acute oral basis. Teratogenicity studies in the rat indicate a maternal NOEL ranging from 3 mg/kg/day to 6 mg/kg/day and an LEL ranging from 10 mg/kg/day to 18 mg/kg/day for technical dimethoate. Chronic feeding studies in the dog (90-day) indicate ChE NOEL = 2 ppm to 32 ppm and systemic LEL of 400 to 1500 ppm. A 2-year feeding study in the mouse and the rat indicated a NOEL > 500 ppm. There is also a concern that the metabolite, dimethoxon, may be 100 to 1000 times more toxic than dimethoate (Position Document 1 - EPA).

The maximum application rates for dimethoate range from 0.17 lb ai/A to 15 lb ai/A for terrestrial food crops and the application rate may be as high as 16.6 lb ai/A for Douglas fir sites (terrestrial nonfood crops). Maximum expected dry-weight terrestrial residues immediately following a single application would be 14 ppm (for pecans at application rate of 0.67 lb ai/A) to 10,800 ppm (for short range grass in citrus groves) (see Table 1).

The following assumptions were made before estimating the potential hazard to avian wildlife.

- The birds will feed entirely in treated areas.
- The residues are based on the highest values Kenaga (1972) found in his survey.
- All exposure is assumed dietary. EEB is aware that there is a potential for dermal and inhalation exposure as well, but since this cannot be estimated, only dietary exposure was used for analysis.

Based on dry-weight residues, which have been shown to be a more appropriate comparison to the birds' diet which has little moisture (See Parathion Registration Standard, 1983), EEB estimated the maximum dimethoate residues on avian foods and the dietary intake (mg/kg/day) (see Table 2).

When comparing the potential dimethoate dose (mg/kg/day) that may be ingested by various birds (ranging from 0.6 to 129 mg/kg/day) potential hazard is evident since reported LD_{50} values range from 5.4 to 63.5 mg/kg, and 30-day EMLD values range from 4 to 10 mg/kg/day. Therefore, dimethoate, even when applied at rates as low as 0.5 lb ai/A, may occur in avian foods at concentrations high enough to acutely poison birds that feed heavily on or in treated fields.

Table 1. Estimated Residues (ppm)

Substrates and application rates were chosen to represent typical use patterns based on the top 5 sites for dimethoate: cotton, alfalfa, grapes, pecans, and oranges.

	Application Rate lb ai/A				
	0.5	1	2.0	4.0	15.0
Sparse foliage or Short range grass (including understory of citrus groves)					
Wet-weight	120	240	480	960	3600 [1]
Dry-weight	360	720	1440	2880	10,800 [1]
TEEC[2]					12,350
Leaves and Leafy Crops (crops such as cotton, potatoes)					
Wet-weight	63	125	250	500	1875
Dry-weight	189	375	750	1600	5625
TEEC					
Forage (Dense foliage) (crops such as alfalfa and clover)					
Wet-weight	29	58	116	232	870
Dry-weight	87	174	348	696	2610
TEEC	87				
Fruit/Nut (crops such as grapes, pecans, oranges, apples)					
Wet-weight	4	7	14	28	105
Dry-weight	12	21	42	56	315
TEEC					360
Soil	11	22	44	88	330
Aquatic EEC[3]	15 ppb	31 ppb	61 ppb	124 ppb	457 ppb

1/Realistic residues are only 30 percent of these values for the understory in the citrus groves. See III. Terrestrial Residues.

2/TEEC = Terrestrial estimated environmental concentration. Based on computer model by Richard Lee, EEB, HED. Only estimated for typical application rates and use patterns: cotton, alfalfa, pecans, oranges, and grapes, based on maximum dry-weight estimates.

3/Aquatic EEC = Aquatic estimated environmental concentration. See Aquatic Residue section for further details.

Table 2. Maximum Expected Dimethoate Residues on Avian Foods and Dietary Intake (mg/kg/day)--On a Dry-Weight Basis

	ppm[a] on Food Resulting From:	mg/kg/day Ingested By Different Sized Birds		
		20 g	100 g	1000 g
	1 lb/A Foliar Spray	18%[b]	9.2%	3.6%
Sparse foliage	720	129	66	27
Dense foliage/ insects	174	30	15.9	6.3
Fruit/Large insects	30	5.4	2.7	1.2
	0.5 lb/A Foliar Spray			
Sparse foliage	360	64	33	13.5
Dense foliage	87	15	8	3.2
Fruit/large insects	15	2.7	1.4	0.6

[a]Immediately after application.
[b]Percent of body weight ingested in dry food per day.

Supporting Avian Incidence Data

This theory is supported by the limited avian field studies conducted by the USFWS (Larry Blus, 1987). In 1986 alone, after one application of dimethoate at a rate of 0.5 lb ai/A to 1000 acre field, 64 sage grouse were reported dead from dimethoate poisoning witihn 11 days post-treatment. In this case it appears that the juveniles especially, prefer to feed on alfalfa. The dimethoate was applied within 2 weeks prior to cutting which is approximately 1 ft high and lush. Food consumption is believed to be as high as 15% for the juveniles, whereas typical food consumption of a 1000 gram bird is about 3%.

The weight of the crops of 14 birds varied from 3.5 to 32.5 g. Crops of healthy birds vary in weight from 10 to 20 g (Bennett, 1987). These birds were obviously healthy and showed a rapid response to dimethoate. Crops of birds dying from dietary exposure are often less in weight and the birds show signs of ataxia. Based on the estimated dry-weight residues, and the above information, an acute oral effect is evident.

Use patterns such as citrus with application rates of 15 lb ai/A may result in wet-weight residues as high as 3600 ppm on the shortgrass understory. Even 30 percent of the estimated wet-weight residues (see III . Terrestrial Residues) result in residues as high as 1080 ppm, which exceed both the bobwhite and mallard LC_{50} values (332 and 1011 ppm).

Conclusion for Avian Hazard

Using the special review criteria, where terrestrial residues are expected to exceed the LC_{50}, the following use patterns are expected to pose a hazard to avian wildlife: grapefruit, lemon, oranges, tangerine (citrus), and apples.

In addition, since there is a potential for an acute oral hazard, which is explained above and which is supported by the USFWS sage grouse field studies, there is a concern for uses such as alfalfa and potato with application rates as low as 0.5 lb ai/A.

Significant data gaps exist, such as adequate avian reproduction studies for both upland game and waterfowl. There are no data available to assess the potential hazards of repeated applications or the likelihood of chronic effects. Based on the potential hazard in orchards and the alfalfa fields, Level I terrestrial field studies are required for at least the uses on oranges and alfalfa. This is also be supported by the BUD usage data, where these two sites are among the top 5 uses for dimethoate.

B. Effects on Aquatic Organisms

Dimethoate is moderately toxic to both coldwater and warmwater fish. This chemical is very highly toxic to aquatic invertebrates. The Pteronarcys californica LC_{50} is 43 ppb and the bluegill sunfish LC_{50} is 5.8 ppm. A chronic Daphnia magna study indicates a NOEL for female production and survival may be 0.23 ppm.

Data on estuarine/marine organisms indicate dimethoate is at least moderately toxic to estuarine fish and invertebrates with LC_{50} values > 1.0 ppm. The EEC resulting from runoff and drift of single applications range from 15 ppb to 458 ppb for the various application rates associated with the various use patterns. See Table 1.

The EEC of 458 ppb is based on the highest application rate for a terrestrial food crop, oranges (15 lb. ai/A). Using this is scenario to estimate the potential hazard is not unreasonable since oranges is one of the top five major sites of dimethoate.

The residues are well above the invertebrate LC_{50} with the application rates > 1.4 lb ai/A. Therefore, any use pattern requiring an application rate of $\geq$ 1.4 lb ai/A would be expected to have a substantial impact on invertebrates and possibly on fish as a result of removing their invertebrate prey base.

There are significant data gaps that need to be addressed prior to assessing the hazard to aquatic organisms. Only one chronic study on aquatic invertebrates was available. The estimated EECs exceed the NOEL for this study. Limited environmental fate data were available for review. The limited acute and chronic toxicity data indicate that additional laboratory data are necessary to evaluate the potential impacts.

In addition, since the estimated residues exceed one-half the LC_{50} of the aquatic invertebrate, aquatic field studies are required. However, since limited environmental fate data were available, it may be possible to demonstrate through aquatic field monitoring that actual aquatic residues are much lower than estimated. If actual residues are less than 21 ppb, which is 1/2 the LC_{50} of the aquatic invertebrates, for use patterns with application rates $\geq$ 1.4 lb ai/A, then the requirement for actual aquatic field studies may be waived.

C. Classification

Restricted Use classification is required when residues of the various use patterns result in levels that exceed 1/5th the LC_{50} for terrestrial wildlife. Terrestrial residues from the use of dimethoate meet these criteria. The limited avian field studies on sage grouse support this concern. Restricted use classification

for aquatic organisms may be required pending the results of the monitoring and/or field study data. Therefore, this insecticide meets the criteria for restricted use classification for terrestial wildlife.

D. Endangered Species

There are sufficient data to indicate that the current registered uses of dimethoate may affect endangered species. In aquatic environments, all maximum application rates are expected to result in EECs that exceed 1/20th the LC_{50} for aquatic invertebrates.

The aquatic EECs only exceed 1/20th the LC_{50} for fish with use patterns that require application rates $\geq$ 9.5 lb ai/A. For dimethoate, these uses include citrus, and Douglas fir.

The terrestrial EECs for all use patterns (using sparse foliage wet-weight residues) exceed 1/10th the LC_{50}; therefore, there are endangered species concerns for avian species as well.

EEB will initiate formal consultation with the USFWS for all use patterns that are not addressed in the various clusters.

EEB is also assuming jeopardy for this chemical for the uses: corn, soybeans, sorghum, and cotton. The following labeling will be required.

DIMETHOATE ENDANGERED SPECIES LABELING FOR CORN, SOYBEANS, SORGHUM, AND COTTON WILL BE REQUIRED AS OF FEBRUARY 1989.

ENDANGERED SPECIES RESTRICTIONS

The use of any pesticide in a manner that may kill or otherwise harm an endangered or threatened species or adversely modify their habitat is a violation of federal laws. The use of this product is controlled to prevent death or harm to endangered species that occur in the following counties or elsewhere in their range.

Before using this pesticide in the following counties you must obtain the EPA Cropland Endangered Species Bulletin. The use of this pesticide is prohibited in these counties unless specified otherwise in the Bulletin. The EPA Bulletin is available from your local pesticide distributor, your County Agricultural Extension Agent, the Endangered Species Specialist in your State Wildlife Agency Headquarters or the appropriate Regional Office of either the U.S. Fish and Wildlife Service or the U.S. Environmental Protection Agency. THIS BULLETIN MUST BE REVIEWED PRIOR TO PESTICIDE USE.

"ALABAMA
COLBERT, GREENE, JACKSON, LAMAR, LAUDERDALE, LIMESTONE, MADISON, MARSHALL, MORGAN, PICKENS, AND SUMTER

ARKANSAS
CLAY, CLARK, CROSS, LAWRENCE, LEE, POINSETTE, RANDOLPH, SHARP, AND ST. FRANCIS

CALIFORNIA
BUTTE, COLUSA, GLENN, INYO, KERN, LOS ANGELES, MERCED, ORANGE, RIVERSIDE, SACRAMENTO, SAN BERNARDINO, SAN DIEGO, SANTA BARBARA, SOLANO, STANISLAUS, SUTTER, TEHEMA, VENTURA, AND YOLO

FLORIDA
ALACHUA, BAKER, BRADFORD, BREVARD, BROWARD, CHARLOTTE, CITRUS, CLAY, COLLIER, COLUMBIA, DADE, DE SOTO, DIXIE, DUVAL, FLAGLER, GADSDEN, GILCHREST, GLADES, HARDEE, HENDRY, HERNANDO, HIGHLANDS, HILLSBOROUGH, INDIAN RIVER, JEFFERSON, LAFAYETTE, LAKE, LEE, LEON, LEVY, MADISON, MANATEE, MARION, MARTIN, MONROE, NASSAU, ORANGE, OKEECHOBEE, OSCEOLA, PALM BEACH, PASCO, PINELLAS, POLK, PUTNAM, ST. JOHNS, ST. LUCIE, SARASOTA, SEMINOLE, SUMTER, SUWANNEE, TAYLOR, UNION, VOLUSIA, AND WAKULLA

GEORGIA
BRANTLEY, BRYAN, BULLOCH, BURKE, CAMDEN, CANDLER CHARLTON, CHATHAM, EFFINGHAM, EMANUEL, EVANS, GLASCOCK, GLYNN, JEFFERSON, JENKINS, JOHNSON, LIBERTY, LONG, MCINTOSH, PIERCE, RICHMOND, SCREVEN, WARE, WASHINGTON, AND WAYNE

KANSAS
CLARK, COMANCHE, MEADE, AND STAFFORD

KENTUCKY
BALLARD, BUTLER, EDMUNDSON, GREEN, HART, JACKSON, LAUREL, LIVINGSTON, MARSHALL, MCCRACKEN, MCCREARY, PULASKI, ROCKCASTLE, TAYLOR, WARREN, AND WAYNE

MISSISSIPPI
ITAWAMBA, LOWNDES, MONROE, AND NOXUBEE

MONTANA
GARFIELD, MCCONE, SHERIDAN, AND VALLEY

NEBRASKA
BOYD, BROWN, BUFFALO, BUTLER, CASS, CEDAR, COLFAX, DAWSON, DODGE, DOUGLAS, HALL, HAMILTON, HOLT, HOWARD, KEARNEY, KEYA PAHA, KNOX, MERRICK, NANCE, PHELPS, PLATTE, POLK, ROCK,

SARPY, AND SAUNDERS

NORTH CAROLINA
EDGECOMBE, NASH, AND PITT

NORTH DAKOTA
BANSON, BOTTINEAU, BURKE, BURLEIGH, DIVIDE, DUNN, EDDY, EMMONS, FOSTER, KIDDER, LOGAN, MCHENRY, MCINTOSH, MCKENZIE, MCLEAN, MERCER, MORTON, MOUNTRAIL, NELSON, OLIVER, PIERCE, RAMSEY, RANVILLE, ROLETTE, SHERIDAN, SIOUX, STUTSMAN, TOWNER, WARD, WELLS, AND WILLIAMS

SOUTH CAROLINA
AIKEN, BARNWELL, BEAUFORT, BERKELY, CHARLESTON, COLLETON, DORCHESTER, GEORGETOWN, HAMPTON, HORRY, JASPER, AND MARION

SOUTH DAKOTA
CLAY, HAAKON, HUGHS, POTTER, STANLEY, SULLY, UNION, WALWORTH, YANKTON, AND ZIEBACH

TENNESSEE
BEDFORD, BLOUNT, CLAIBORNE, DECATUR, FRANKLIN, HANCOCK, HARDIN, HICKMAN, KNOX, LINCOLN, LOUDON, MARSHALL, MAURY, MEIGS, MONROE, RHEA, ROANE, SCOTT, SEQUATCHIE, SMITH, SULLIVAN, AND WAYNE

TEXAS
ARKANSAS, AUSTIN, CAMERON, COLORADO, FORT BEND, GOLIAD, REFUGIO, AND VICTORIA

VIRGINIA
LEE, RUSSELL, SCOTT, SMYTH, TAZEWELL, WASHINGTON, AND WISE"

PRECAUTIONARY STATEMENTS

A. Manufacturing Use

This pesticide is toxic to aquatic invertebrates and is extremely toxic to birds. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters 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

This pesticide is toxic to aquatic invertebrates and is extremely toxic to birds. Birds in treated areas may be killed. Do not apply directly to water or wetlands (swamps, bogs, marshes, and potholes). Drift and runoff may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water by cleaning of equipment or disposal of wastes.

C. Endangered Species

See IV. Risk Assessment D. Endangered Species Section for required labeling.

Appendix 1

Terrestrial Food Crops	Application Rate (lb ai/A)	Maximum Wet-Weight Foliar Residues	Substrate
Field Crops			
Alfalfa	0.5	29	forage (f)
Corn	0.5	63	leaves and leafy crops (lc)
Cotton	0.5	63	lc
Sorghum	0.5	63	lc
Soybeans	0.5	63	lc
Wheat	0.375	41.2	long grass (lg)
Forage-Sweet	0.5	29	f
Safflower	0.5	63	lc
Vegetable Crops			
Beans	0.5	63	lc
Broccoli	0.5	63	lc
Cabbage	0.5	63	lc
Cauliflower	0.5	63	lc
Celery	0.5	63	lc
Collards	0.25	63	lc
Endive	0.25	63	lc
Kale	0.25	63	lc
Lentils	0.5	63	lc
Lettuce	0.25	63	lc

Appendix 1

Terrestrial Food Crops	Application Rate (lb ai/A)	Maximum Wet-Weight Foliar Residues	Substrate
Vegetable Crops (cont'd)			
Mustard Greens	0.25	32	lc
Peas	0.17	22	lc
Pepper	0.5	63	lc
Potato	0.5	63	lc
Spinach	0.25	63	lc
Swiss Chard	0.25	63	lc
Tomato	0.5	63	lc
Turnips	0.25	32	lc
Citrus Crops/Fruit/Nut			
Cherries	2.0	14- 240	fruit(f)- lg
Grapefruit	15.0	105-1650	f-lg
Grapes	2.0	14-240	f-lg
Lemon	15.0	105-1650	f-lg
Melons	0.5	4- 55	f-lg
Oranges	15.0	105-1650	f-lg
Pear	2.5	18-275	f-lg
Pecans	0.67	5-74	f-lg
Tangerine	15.0	105-1650	f-lg
Watermelon	0.5	4-55	f-lg
Apples	4.0	28-440	f-lg
Citrus	10.0	70-1100	f-lg

Appendix 1

Terrestrial Nonfood Crop - All these use patterns range from 0.25 lb ai/A to 4 lb ai/A except the Douglas fir, which can be 16.6 lb ai/A. The residues vary depending on the substrate.

Ornamental Plants and Forest Trees

American Holly	Ficus Nitida
Arbovitae	Gardenia
Azalea	Gladiolus
Birch	Hemlock
Boxwood	Iris
Cacti	Juniper
Camellia	Oak
Carnation	Ornamental and/or Shade Trees
Cedar	Pine
Cyprus	Pinyon Pine
Daisies	Poinsettia
Daylilies	Pyracantha
Douglas fir	Rose
Elaegnus	Taxus
English Holly	Transvaal Daisy
Euonymous	Virburnum

Other Uses

Domestic Dwellings, Indoor--e.g. animal premises, manure treatments, general indoor/outdoor treatments.

Greenhouse Nonfood Crop--ornamental ferns/foliage plants.

Noncrop Agricultural Areas--up to 2 lb ai/A.

Roadsides--0.5 lb ai/A.

Attachment A

EEC CALCULATION SHEET

I. For Foliar Application

Runoff

15 lb ai/A	x	0.05 (5 % runoff)	x	10 A (from 10 A drainage basin)	=	7.5 lb (total runoff)	

EEC of 1 lb ai direct application to 1 A pond 6-feet deep = 61 ppb.

Therefore, EEC = 61 ppb x 7.5 lb = 457.5 ppb.

II. For Aerial Application

A. Runoff

15 lb ai/A	x	0.6 (applied efficiency)	x	0.05 (5 % runoff)	x	10 A (10 A drainage basin)	=	4.5 lb (tot run

B. Drift

15 lb ai/A	x	0.05 (5% drift)	=	0.75 lb (total drift)

Total loading = 0.75 lb + 4.5 lb = 5.25 lb

Therefore, EEC = 61 ppb x 5.25 lb = 320.25 ppb.

TABLE A
Generic Data Requirements for Dimethoate

ta Requirement	Composition[1]	Use Pattern[2]	Does EPA Have Data to Satisfy This Requirement (Yes, No, Partially)	Bibliographic Citation	Must Additional Data Be Submitted Under FIFRA section 3(c)(2)(B)?	Time Period After EPA Notification To Report Data
58.145 Wildlife and Aquatic Organisms						
ian and Mammalian Testing						
-1 - Avian Single Dose Oral LD_{50}	TGAI, dimethoxon[3]	A,B,H	Yes	FEODIM03 00160000	No	
-2 - Avian Dietary LC_{50}						
Upland Game Bird	TGAI, dimethoxon[3]	A,B,H	Yes	00022923	No	
Waterfowl	TGAI, dimethoxon[3]	A,B,H	Yes	00022923	No	
-3 - Wild Mammal Toxicity	TGAI, dimethoxon[3]	A,B	No[4]		No	
-4 - Avian Reproduction						
Upland Game Bird	TGAI, dimethoxon[3]	A,B	Partially	00162777	Yes[5]	3 months
Waterfowl	TGAI, dimethoxon[3]	A,B	No		Yes	24 Months
-5 - Simulated and Actual Field Testing for Birds and Mammals	TEP	A,B	Partially	00075585 00075575	Yes[6,7,8]	30 Months (Oranges, Alfalfa, Apples)

TABLE A
Generic Data Requirements for Dimethoate (cont'd)

Data Requirement	Composition[1]	Use Pattern[2]	Does EPA Have Data to Satisfy This Requirement (Yes, No, Partially)	Bibliographic Citation	Must Additional Data Be Submitted Under FIFRA section 3(c)(2)(B)?	Time Period After EPA Notification To Report Data
§158.145 Wildlife and Aquatic Organisms						
Aquatic Organism Testing						
72-1 - Freshwater LC_{50}						
Warmwater	TGAI, dimethoxon[3]	A,B,H	Yes	00003503, FEODIM05	No	
	TEP	A,B	Partially	00077504	No [9]	
Coldwater	TGAI, dimethoxon[3]	A,B,H	Yes	00003503, FEODIM05	No	
	TEP	A,B	No		No	
72-2 - Freshwater Invertebrate LC_{50}						
	TGAI, dimethoxon[3]	A,B,H	Yes	00003503	No	
	TEP	A,B	No		Yes[10]	9 Months
72-3 - Estuarine and Marine Organisms LC_{50}						
Fish	TGAI	A,B	Partially	40228401	Yes[11]	12 Months
	TEP	A,B	No		Reserved[12]	

TABLE A
Generic Data Requirements for Dimethoate (cont'd)

Data Requirement	Composition[1]	Use Pattern[2]	Does EPA Have Data to Satisfy This Requirement (Yes, No, Partially)	Bibliographic Citation	Must Additional Data Be Submitted Under FIFRA section 3(c)(2)(B)?	Time Period After EPA Notification To Report Data
158.145 Wildlife and Aquatic Organisms						
Aquatic Organism Testing (cont'd)						
Shrimp	TGAI	A,B	Partially	40228401	Yes[11]	12 Months
	TEP	A,B	No		Reserved[12]	
Oyster	TGAI	A,B	No		Yes[11]	12 Months
	TEP	A,B	No		Reserved[12]	
2-4 - Fish Early Life Stage and Invertebrate Life Cycle						
Fish	TGAI	A,B	No		Yes[13]	15 Months
Invertebrate	TGAI	A,B	No		Yes[14]	15 Months
2-5 - Fish Life Cycle	TGAI	A,B	No		Reserved[15]	
2-6 - Aquatic Organisms Accumulation (Fish)	TGAI	A,B	No		Yes	
2-7 - Simulated or Actual Field Testing - Aquatic Organisms	TEP	A,B	No		Yes[16]	4 years

TABLE A
Generic Data Requirements for Dimethoate (cont'd)

Footnotes

1/TGAI = Technical Grade of the Active Ingredient; TEP = Typical End-Use Product.
2/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.
3/Pending the results of environmental fate and metabolism studies, studies on dimethoxon may be required.
4/No requirement currently exists.
5/Data discrepencies need to be addressed before the study can fulfill data requirements.
6/The study submitted did not include residue data, therfore does not fulfill data requirements.
7/Actual field testing with birds and mammals is required, as per 40 CFR 158.145, to support the use of end-use products containing dimethoate on citrus(oranges), alfalfa, and apples. The design of the field studies must include appropriate methods, such as thorough carcass searching, to determine whether there is pesticide-induced mortality and, if so, the extent of mortality. An acceptable protocol for conducting the field studies should be submitted to the Agency within 6 months from publication of this document, for review and approval prior to the initiation of the study. A Guidance Document is available from the Agency, which outlines an acceptable approach to these studies. The Agency encourages registrants to consult with EEB staff for assistance as needed. If the terrestrial field studies on oranges, alfalfa or apples indicate a hazard to wildlife then the Agency is reserving the option to require other terrestrial field studies where the use patterns require application rates of 0.5 lb ai/A or greater. If any of these use patterns are cancelled, then field studies (Level I) are still required for use patterns where the estimated environmental concentration (EECs) exceed the effect levels of the most sensitive species of avian wildlife.
8/Reserved-actual field testing with birds and mammals is required, as per 40 CFR 158.145, to support the use of dimethoate products where the Level I studies have identified a potential hazard to wildlife. The design of the field studies must include appropriate techniques to determine the potential field effects on reproduction and populations of birds and mammals in a multiple-year study. Acceptable protocols for conducting field studies (Level II) should be submitted to the Agency, within 6 months from Agency determination of the Level I study(s) posing a hazard to wildlife. A Guidance Document is available from the Agency, which outlines an acceptable approach to these studies. The Agency encourages registrants to consult with EEB staff for assistance, as needed.
10/Required to support all crop uses where dimethoate is applied at 1.4 lb ai/A or more because the EECs on technical dimethoate exceed the aquatic invertebrate LC_{50}.

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TABLE A
Generic Data Requirements for Dimethoate (cont'd)

Footnotes (Cont.)

11/Required to support use on citrus, cotton, corn, soybeans, sorghum, and tobacco because of potential exposure of estuarine/marine environments through runoff and drift. Two studies on dimethoate cited in 40228401 do not fulfill requirements. Neither study determined a LC_{50} and one study did not use a recommended test species. Depending on the results of these studies, additional studies may be required, i.e. marine fish early life stage, marine invertebrate life cycle.

12/Reserved pending the results of acute toxicity testing with technical dimethoate on marine/estuarine organisms. Required if such testing results in LC_{50} value(s) that is (are) below the EEC in estuarine/marine environments.

13/Required to support all crop uses with application rates $\geq$ 1.9 lb ai/A because the ECC in water will be greater than 0.01 times the acute LC_{50} for fish.

14/Required to support all crop uses because the acute toxicity of technical dimethoate is less than 1 mg/L and because the EEC in water is greater than 0.01 times the acute LC_{50}.

15/Reserved pending the results of fish early life stage and aquatic invertebrate life cycle tests.

16/Simulated or actual field testing with aquatic organisms is required unless aquatic residue monitoring studies are conducted and demonstrate that dimethoate and dimethoxon do not occur in aquatic environments near use sites at concentrations above (1/2 the LC_{50} of the most sensitive species, currently 21 ppb). If aquatic residue studies are conducted, they must include citrus (specifically oranges) as a high-use and a high-rate crop, with residue studies on other crops reserved pending the results. Multiple independent sites are to be monitored. Each site is to be located in an area where there is a maximum potential exposure due to soil type, proximity to aquatic habitats, and percentage of the local area crop treated with dimethoate. Residues must be monitored in receiving water and hydrolysis and should be monitored in runoff water if feasible. Protocols should be submitted to the Agency for review and approval prior to the initiation of the monitoring studies.

If aquatic residue monitoring studies are not conducted or show aquatic concentrations greater than 1/2 the LC_{50} of the most sensitive aquatic organsim, then mesocosm studies are preferred and would support all use patterns. Alternatively, fullfield studies may be conducted in citrus to support these uses. Additional full-field studies for other use patterns are reserved, pending an evaluation of the results for citrus and an analysis of their applicability to support other crop uses. For either mesocosm or full-field studies the study design must include appropriate techniques to determine acute mortality and effects on productivity and diversity of fish and aquatic invertebrates. Acceptable protocols for conducting residue monitoring, mesocosm, or full-field studies should be submitted to the Agency within 6 months from publication of this document, for review and approval prior to the initiation of the study. A Guidance Document is available from the Agency, which outlines an acceptable approach to mesocosm studies. This document also provides relevant, although general, guidance for full-field studies, which, if selected in place of mesocosm studies, must include multiple treated ponds and control ponds. The Agency encourages registrants to consult with EEB staff for assistance as needed.

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