United States
Environmental Protection
Agency

Prevention, Pesticides
and Toxic Substances
(7508C)

EPA 738-R-02-013
November 2002

Reregistration Eligibility Decision for Endosulfan

United States Environmental Protection Agency | Prevention, Pesticides And Toxic Substances (7508C) | EPA-738-F-02-012 November 2002

EPA R.E.D. FACTS

Endosulfan

Pesticide Reregistration

All pesticides sold or distributed in the United States must be registered by EPA, based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment. Because of advances in scientific knowledge, the law requires that pesticides which were first registered before November 1, 1984, be reregistered to ensure that they meet today's more stringent standards.

In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. To implement provisions of the Food Quality Protection Act of 1996, EPA considers the special sensitivity of infants and children to pesticides, as well as aggregate exposure of the public to pesticide residues from all sources, and the cumulative effects of pesticides and other compounds with common mechanisms of toxicity. The Agency develops any mitigation measures or regulatory controls needed to effectively reduce each pesticide's risks. EPA then reregisters pesticides that meet the safety standard of the FQPA and can be used without posing unreasonable risks to human health or the environment.

When a pesticide is eligible for reregistration, EPA explains the basis for its decision in a Reregistration Eligibility Decision (RED) document. This fact sheet summarizes the information in the RED document for reregistration case 0014, endosulfan.

Use Profile

Endosulfan is a broad spectrum contact insecticide and acaricide registered for use on a wide variety of vegetables, fruits, cereal grains, and cotton, as well as ornamental shrubs, trees, vines, and ornamentals for use in commercial agricultural settings. Total average annual use of endosulfan is estimated at approximately 1.38 million pounds of active ingredient (lbs. ai), according to Agency and registrant estimates. Crops with the highest average percent drop treated are: squash (40%), eggplant (41%), cantaloupe (31%), sweet potato (31%), broccoli (26%), pears (20%), and pumpkins (20%). Crops with the highest sales in 2001 include: cotton (14.2%), cantaloupe (13.2%), tomatoes (12.2%), and potatoes (8.15%).

Endosulfan is formulated as a liquid emulsifiable concentrate (9-34% ai) and wettable powder (1-50% ai). The wettable powder formulation is frequently packaged in water soluble bags. Endosulfan can be applied by groundboom sprayer, fixed-wing aircraft, chemigation (potatoes only), airblast sprayer, rights-of-way sprayer, low pressure handwand sprayer, high pressure handwand sprayer, backpack sprayer and dip treatment.

Regulatory History

Endosulfan was first registered as a pesticide in the U.S. in 1954 to control agricultural insect and mite pests on a variety of field, fruit, and vegetable crops. A Registration Standard dated September 17, 1981, and a Guidance Document dated April 1982 were issued for endosulfan, which required additional generic and product-specific data for the manufacturing products of the technical registrants. Since the Guidance Document was issued, there have been seven DCIs generated: 10/23/85, 5/19/86, 5/27/86, 1/30/87, 6/19/87, 9/02/92, and 5/10/94 concerning the potential formation of chlorinated dibenzo-p-dioxins and dibenzofurans in technical endosulfan products. An additional DCI was issued in October 1994, which primarily concerned residue chemistry data deficiencies.

Further, in 1991, the technical registrants amended labels to incorporate a 300-foot spray drift buffer for aerial applications between treated areas and water bodies. This setback was adopted in order to address concerns about contamination of water and risks to aquatic organisms. In 2000, the technical registrants amended technical product labels to remove all residential use patterns. Currently, there are 94 endosulfan products registered.

Human Health Assessment

Toxicity

Endosulfan generally has been shown to have high acute oral and inhalation toxicity as well as slightly toxic dermal toxicity. It is an irritant to the eyes and is not a dermal sensitizer. Endosulfan is neither mutagenic nor carcinogenic. Endosulfan primarily affects the nervous system. Toxic effects observed in animals from acute, subchronic, developmental neurotoxicity, and chronic/carcinogenic toxicity studies found that endosulfan causes neurotoxic effects, which are believed to result from over-stimulation of the central nervous system. Further, there is evidence (effects observed in a submitted chronic oral toxicity study in rats) that endosulfan acts as an endocrine disruptor. However, further investigation is necessary to determine the relevance and impact of such findings on public health.

Dietary Exposure

EPA has assessed dietary risk by estimating exposure to endosulfan residues from consumption of food and drinking water that can occur over a single-day (acute) or longer (chronic). Generally, a dietary (food) risk estimate that is less than 100% of the acute or chronic Population Adjusted Dose does not exceed the Agency's risk concern. Acute risk estimates from exposures to food, associated with the use of endosulfan exceed the Agency's level of concern for some population subgroups. For example, for exposure resulting from applications of endosulfan, for the most exposed population subgroup, children 1-6 years old, the percent acute PAD value is 150% at the 99.9^{th} percentile of exposure from consumption of food alone. The crops that contributed the most to the risks of concern are succulent beans and peas. Chronic dietary (food) exposure estimates are below the Agency's level of concern for all

subpopulations. For the most highly exposed subpopulation, children 1-6 years old, the percent chronic PAD value is 17% from consumption of food alone.

Drinking water exposure to endosulfan can occur through ground and surface water contamination. EPA used modeled Tier 2 estimates of endosulfan and endosulfan sulfate to estimate risk for acute exposures. Taking into account the supported uses of endosulfan, the Agency concluded that residues of endosulfan in drinking water are of concern. Drinking water estimates for chronic exposures, based on models, from both ground and surface water are not of concern.

Risk from All Registered Pesticide Endosulfan Exposures

To assess risks from all endosulfan exposures, the Agency combined risk from food and drinking water exposure only. The technical registrants are not supporting residential or other non-occupational uses of endosulfan. As a result, these use patterns have not been considered for regulatory purposes at this time. The acute estimated drinking water concentrations for endosulfan are above the acute drinking water level of comparisons (DWLOCs) for infants <1 year and the most sensitive population subgroup, children 1-6 years old. The chronic estimated drinking water concentrations for the U.S. general population and all population subgroups are below the chronic drinking water levels of comparisons (DWLOCs) for the U.S. general population and all population subgroups and, therefore, are not of concern.

Occupational Exposure

Occupational handlers can be exposed to endosulfan through mixing, loading and/or applying a pesticide or re-entering treated sites. Occupational handlers of endosulfan include individual farmers or growers who mix, load and/or apply pesticides and professional or custom agricultural applicators. The post-application occupational risk assessment considered exposures to workers entering treated sites in agriculture.

Risk for all of these potentially exposed populations is measured by a Margin of Exposure (MOE), which determines how close the occupational exposure comes to a NOAEL. Generally, MOEs greater than 100 are not of concern. Restricted Entry Intervals (REIs) are 24 hours on current endosulfan labels. The Agency has determined that there are potential mixer, loader, applicator as well as post-application exposures to occupational handlers. Based on current use patterns, there are some short-term dermal and inhalation risks of concerns for workers who mix, load and apply endosulfan to agricultural sites as well as to those workers who re-enter a treated area following application of endosulfan.

Environmental Assessment

Ecological risks are also of concern to the Agency. The environmental risk assessment suggests that exposure to endosulfan could result in both acute and chronic risks of concern for terrestrial and aquatic organisms. Exposure to

endosulfan has resulted in both reproductive and development effects in nontarget animals, particularly birds, fish and mammals.

Risk Mitigation Measures

To mitigate human health and ecological risks of concern for endosulfan, the following measures will be implemented:

Dietary (Food) Risk

- Delete use on succulent beans, succulent peas, spinach, and grapes

Dietary (Drinking Water) and Ecological Risk

Several mitigation measures are needed to reduce the potential for contamination of drinking water.

- Delete use on pecans;
- Reduce maximum seasonal application rates from 3lbs./ai/A to 2.5 lbs./ai/A for pome fruit, stone fruit, and citrus;
- Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A for melons, cucurbits, lettuce, tomatoes, sweet potatoes, cotton (ground), broccoli, cauliflower, cabbage, kohlrabi, brussels sprouts, strawberries, filberts, walnuts, almonds, macadamia nuts, peppers, eggplant, potatoes, carrots, dry beans, dry peas, and tobacco;
- Reduce maximum seasonal application rate from 3 lbs./ai/A to 1.5 lbs./ai/A for sweet corn, cotton (aerial) and blueberries;
- Reduce maximum seasonal application rate from 3 lbs./ai/A to 1 lb./ai/A for celery;
- Require 100 ft. spray buffer for ground applications between a treated area and water bodies;
- Require 30 ft. maintained vegetative buffer strip between a treated area and water bodies;
- Require all products to be Restricted Use;
- Restrict use on cotton to AZ, CA, NM, OK and TX only; and
- Restrict use on tobacco to IN, KY, OH, PA, TN and WV only.

Occupational Risk

- Require all wettable powers to be packaged in water soluble bags;
- Cancel use of wettable powders on tomatoes, sweet corn, sweet potatoes, cotton, small grains, alfalfa (seed), carrots, dry beans, dry peas, pineapples, and tobacco;
- Cancel aerial application using the wettable powder formulation on pome fruits, stone fruits, citrus, blueberries, strawberries, collard greens (seed), kale (seed), mustard greens (seed), radish (seed), turnip (seed), rutabaga

(seed), broccoli, (seed), cauliflower (seed), kohlrabi (seed), cabbage (seed), filberts, walnuts, almonds, and macadamia nuts;

- Require closed mixing/loading systems for aerial application using the EC formulation on pome fruits, stone fruits, citrus, sweet corn, sweet potatoes, cotton, collard greens (seed), kale (seed), mustard greens (seed), radish (seed), turnip (seed), rutabaga (seed), broccoli, (seed), cauliflower (seed), kohlrabi (seed), cabbage (seed), blueberries, small grains, alfalfa (seed), filberts, walnuts, almonds and macadamia nuts;
- Require closed cabs for airblast applications on pome fruits, stone fruits, citrus, filberts, walnuts, almonds and macadamia nuts;
- Prohibit use of high pressure handwands with rates greater than 0.005 lbs/ai/gal;
- Increase REI to 48 hours for all crops except as noted in the following bullets;
- Increase REI for WP products to 3 days for melons and cucurbits;
- Increase REI for WP products to 4 days for lettuce, celery, pome fruit, stone fruit, citrus, collard greens, kale, mustard greens, radish, turnip, rutabaga, ornamental trees and shrubs;
- Increase REI for WP products to 5 days for collard greens (seed), kale (seed), mustard greens (seed), radish (seed), turnip (seed) and rutabaga (seed);
- Increase REI for WP products to 9 days for blueberries, broccoli, cauliflower, kohlrabi, cabbage, and brussels sprouts;
- Increase REI for WP products to 12 days for broccoli (seed), cauliflower (seed), kohlrabi (seed), and cabbage (seed);
- Increase REI for EC products to 3 days for sweet potatoes
- Increase REI for EC products to 4 days for broccoli, cauliflower, kohlrabi, cabbage, and brussels sprouts;
- Increase REI for EC products to 6 days for blueberries;
- Increase REI for EC products to 7 days for broccoli (seed), kohlrabi (seed), and cabbage (seed); and
- Increase REI for EC products to 17 days for sweet corn.

Stakeholder Process

Given the toxicity and persistence of endosulfan and potential risks to aquatic organisms, the Agency has developed a number of mitigation measures in order to reduce the risks to aquatic organisms outlined in this document. While the Agency believes that these measures will reduce the potential for exposures to aquatic organisms and reduce the overall environmental loading of endosulfan, it also believes that in specific geographic areas where conditions exist that make aquatic organisms especially vulnerable (e.g., shallow, leaky aquifers, highly erodible lands, the presence of especially sensitive organisms and

high use of endosulfan) additional measures may be identified. In order to more fully evaluate the risks in these vulnerable areas; the risk management strategies that may be in place or could potentially be implemented in such areas (e.g., use of retention ponds) to reduce exposure; and the benefits of the use of endosulfan in those areas, the Agency is planning to conduct a stakeholder process to accomplish this objective. Further, the impacts of atmospheric transport may require additional evaluation during this time period.

Additional mitigation measures may be needed following the completion of this process.

Additional Data Required

EPA is requiring the following additional generic studies for endosulfan to confirm its regulatory assessments and conclusions:

- OPPTS 850.2100: Avian acute oral toxicity of bobwhite quail and mallard ducks
- OPPTS 850.2200: Avian subchronic oral toxicity of bobwhite quail and mallard ducks
- OPPTS 850.2300: Avian reproduction study
- OPPTS 850.1075: Freshwater fish acute toxicity study of bluegill sunfish
- OPPTS 850.1300: Early life stage fish
- OPPTS 850.1350: Life cycle invertebrate
- OPPTS 850.1500: Freshwater fish full life cycle using rainbow trout
- OPPTS 850.1075: Estuarine/marine fish acute toxicity study
- OPPTS 850.1035: Estuarine/marine invertebrate acute toxicity study of
- mysid shrimp
- OPPTS 850.1735: Whole sediment acute toxicity testing using a freshwater invertebrate
- OPPTS 850.1740: Whole sediment acute toxicity testing using a estuarine/marine invertebrate
- OPPTS 850.1735S: Whole sediment chronic toxicity testing using a freshwater invertebrate
- OPPTS 850.1740S: Whole sediment chronic toxicity testing using an estuarine/marine invertebrate
- 164-2 (Special Study): Vegetative buffer effectiveness study
- OPPTS 835.7100: Groundwater monitoring study
- OPPTS 835.7200: Surface drinking water monitoring study
- OPPTS 870.6200: Subchronic Neurotoxicity - Rat
- OPPTS 870.6300: Developmental Neurotoxicity Toxicity Study - Rat
- OPPTS 860.1380: Storage stability (oils seed, non-oily grain and processed commodities)

- OPPTS 860.1500: Crop field trials for the following raw agricultural commodities: barley hay, and pearled barley; oat forage, hay, and rolled oats; rye forage; wheat forage, and hay
- OPPTS 860.1500: Crop field trials for tobacco and a pyrolysis
- OPPTS 860.1520: Magnitude of residue in processed food/feed commodities
- OPPTS 875.1100: Dermal outdoor exposure for applying dip treatments to trees and roots or whole plants
- OPPTS 875.1700: Product use information for applying dip treatments to trees and roots or whole plants

The Agency is also requiring product-specific data including product chemistry and acute toxicity studies, revised Confidential Statements of Formula (CSFs), and revised labeling for reregistration.

Regulatory Conclusion

The Agency has assessed all 80 tolerances for endosulfan and can make a FQPA safety determination based on a review of the dietary (food and drinking water), ecological and occupational risks associated with the supported uses of currently registered pesticides containing endosulfan.

Agricultural uses of endosulfan based on approved labeling pose occupational risks of concern and ecological risks that constitute unreasonable adverse effects on the environment. However, the Agency believes these risks can likely be mitigated to levels below concern through changes to pesticide labeling and formulations. Accordingly, the Agency has determined that endosulfan is eligible for reregistration provided that: (1) additional required data will confirm this decision for occupational exposures associated with the application of dip treatment to roots or whole plants and ecological risks; and (2) the risk mitigation outlined in the RED are adopted, and label amendments are made to reflect these measures. Further, if vulnerable areas in specific geographic areas are identified as a result of the stakeholder process, additional ecological risk mitigation measures may be necessary to protect especially sensitive organisms. The endosulfan RED document includes guidance and time frames for complying with any label changes for products containing endosulfan.

For More Information

EPA is requesting public comments on the Reregistration Eligibility Decision (RED) document for endosulfan during a 60-day time period, as announced in a Notice of Availability published in the Federal Register. To obtain a copy of the RED document or to submit written comments, please contact the Pesticide Docket, Public Information and Records Integrity Branch, Information Resources and Services Division (7502C), Office of Pesticide Programs (OPP), US EPA, Washington, DC 20460; telephone number 703-305-5805.

Electronic copies of the RED, this Fact Sheet, and all supporting documents are available on the Internet. See http://www.epa.gov/REDs.

The Agency has also established an official record for this action under docket control numbers OPP-34242 and eDocket OPP-2002-0262.

Printed copies of the RED and fact sheet can be obtained from EPA's National Service Center for Environmental Publications (EPA/NSCEP), PO Box 42419, Cincinnati, OH 45242-2419, telephone 1-800-490-9198; fax 513-489-8695.

Following the comment period, the endosulfan RED document also will be available from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161, telephone 1-800-553-6847, or 703-605-6000.

For more information about EPA's pesticide reregistration program, the endosulfan RED, or reregistration of individual products containing endosulfan please contact the Special Review and Reregistration Division (7508C), OPP, US EPA, Washington, DC 20460, telephone 703-308-8000.

For information about the health effects of pesticides, or for assistance in recognizing and managing pesticide poisoning symptoms, please contact the National Pesticide Information Center (NPIC). Call toll-free 1-800-858-7378, from 6:30 am to 4:30 pm Pacific Time, or 9:30 am to 7:30 pm Eastern Standard Time, seven days a week. Their internet address is http://npic.orst.edu.

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

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

July 31, 2002

CERTIFIED MAIL

Dear Registrant:

This is to inform you that the U.S. Environmental Protection Agency (hereafter referred to as EPA or the "Agency") has completed its review of the available data and public comments received related to the risk assessments for the chlorinated cyclodiene pesticide endosulfan. The public comment period on the preliminary risk assessment phase of the reregistration process commenced on September 13, 2001 and closed on November 13, 2001. The Agency has revised the human health and environmental effects risk assessments based on the comments received during the public comment period and additional data received from the registrant.

Based on its review, the Agency has identified risk mitigation measures that it believes are necessary to address the human health and ecological risks associated with the current uses of endosulfan. The Agency believes that these risk mitigation measures will adequately address human health and ecological risks for endosulfan. However, further mitigation measures for ecological risk may be warranted following the completion of the stakeholder process outlined in this document. The Agency has identified several mitigation measures to address ecological risks. While the Agency believes that these measures will reduce the potential for exposures to aquatic organisms and reduce the overall environmental loading of endosulfan, it also believes that in specific geographical areas where conditions exist that make aquatic organisms especially vulnerable additional measures may be identified. Further, the Agency is unable to fully evaluate the ecological risks associated with the atmospheric transport of endosulfan at this time. In order to more fully evaluate the risks in these vulnerable areas; the risk management strategies that may be in place or could potentially be implemented in such areas to reduce exposure; and the benefits of the use of endosulfan in those areas, the Agency is planning to conduct a public comment and stakeholder process.

EPA is now publishing its reregistration eligibility, risk management, and tolerance reassessment decisions for the current uses of endosulfan, and its associated human health risks which address risks from dietary exposure to food and water and occupational exposures. As mentioned above, the Agency will conduct a stakeholder process to address environmental risks in especially vulnerable areas at the completion of which the Agency may identify additional mitigation measures that may be needed. The enclosed "Reregistration Eligibility Decision for Endosulfan," which was approved on July 31, 2002, contains the Agency's decision on the individual chemical endosulfan.

A Notice of Availability for the Reregistration Eligibility Decision (RED) for Endosulfan is being published in the *Federal Register*. To obtain a copy of the RED document, please contact the OPP Public Regulatory Docket (7502C), US EPA, Ariel Rios Building, 1200 Pennsylvania Avenue NW, Washington, DC 20460, telephone (703) 305-5805. Electronic copies of the RED and all supporting documents are available on the Internet. See ***http://www.epa.gov/pesticides/reregistration/status.htm***.

As part of the Agency's effort to involve the public in the implementation of the Food Quality Protection Act of 1996 (FQPA), the Agency is undertaking a special effort to maintain open public dockets and to engage the public in the reregistration and tolerance reassessment processes. In cooperation with the U.S. Department of Agriculture, the Agency held a teleconference on July 29, 2002, during which the results of the human health and environmental effects risk assessments were presented to interested stakeholders. Information discussed during the call, such as endosulfan usage and occupational practices, are reflected in this RED. Also, a close-out conference call was conducted on July 30, 2002 with many of the same participants from the July 29 conference call to discuss the risk management decisions and resultant changes to the endosulfan labels.

A risk mitigation proposal for endosulfan was submitted by the Endosulfan Task Force (ETF), the technical registrant. During the public comment period provided for the preliminary risk assessment, EPA also received comments from the Natural Resources Defense Council, World Wildlife Fund, Pesticide Action Network Asia and the Pacific, Boulder Regional Group, American Society of Consulting Arborists, Gaia Foundation, Rural Action Safe Pest Control Program, and private citizens.

Please note that the endosulfan risk assessment and the attached RED concern only this particular pesticide. The Food Quality Protection Act (FQPA) requires that, when considering whether to establish, modify, or revoke a tolerance, the Agency consider "available information" concerning the cumulative effects of a particular pesticide's residues and other substances that have a common mechanism of toxicity with other pesticides. The Agency does not currently have data available to determine with certainty whether endosulfan or endosulfan sulfate have a common mechanism of toxicity with any other substances. For the purposes of this decision, the Agency has assumed that there are not any other chemical substances that share a common mechanism of toxicity with endosulfan and has not performed a cumulative risk assessment as part of this reregistration review of endosulfan. If the Agency identifies other substances that share a common mechanism of toxicity with endosulfan, then the cumulative risks of these chemicals will be considered.

As mentioned above, the Agency has identified risk mitigation measures that it believes are necessary to address the human health risks associated with the current uses of endosulfan and measures to reduce the potential for exposures to aquatic organisms and reduce the overall environmental loading of endosulfan. Accordingly, the Agency recommends that registrants implement these risk mitigation measures on an accelerated schedule. Sections IV and V of this RED describe labeling amendments for end-use products and data requirements necessary to implement these mitigation measures. Instructions for registrants for submitting the revised labeling can be found in the set of instructions for product-specific data that accompanies this RED.

Should a registrant fail to implement any of the risk mitigation measures outlined in this document, the Agency will continue to have concerns about the risks posed by endosulfan. Where the Agency has identified any unreasonable adverse effect to human health and the environment, the Agency may at any time initiate appropriate regulatory action to address this concern.

There will be a 60-day public comment period for this document, commencing on the day the Notice of Availability publishes in the Federal Register. In addition to the public comment period the Agency will initiate a stakeholder process, which will be initiated in the near future to address potentially vulnerable areas.

This document contains a generic and/or a product-specific Data Call-In(s) (DCI) that outline(s) further data requirements for this chemical. Note that a complete DCI, with all the pertinent instructions, is being sent to registrants under separate cover. Additionally, for product-specific DCIs, the first set of required responses is due 90 days from the receipt of the DCI letter. The second set of required responses is due eight months from the date of the DCI.

If you have questions on this document or the proposed label changes, please contact the Special Review and Reregistration Division representative, Stacey Milan at (703) 305-2505. For questions about product reregistration and/or the Product DCI that accompanies this document, please contact Karen Jones at (703) 308-8047.

Sincerely,

Lois A. Rossi, Director
Special Review and
Reregistration Division

Attachment

Reregistration Eligibility Decision

for

Endosulfan

Case No. 0014

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GLOSSARY OF TERMS AND ABBREVIATIONS

AE	Acid Equivalent
a.i.	Active Ingredient
AGDCI	Agricultural Data call-in
ai	Active Ingredient
aPAD	Acute Population Adjusted Dose
AR	Anticipated Residue
ARC	Anticipated Residue Contribution
BCF	Bioconcentration Factor
CAS	Chemical Abstracts Service
CI	Cation
CNS	Central Nervous System
cPAD	Chronic Population Adjusted Dose
CSF	Confidential Statement of Formula
CFR	Code of Federal Regulations
CSFII	USDA Continuing Surveys for Food Intake by Individuals
DCI	Data Call-In
DEEM	Dietary Exposure Evaluation Model
DFR	Dislodgeable Foliar Residue
DRES	Dietary Risk Evaluation System
DWEL	Drinking Water Equivalent Level (DWEL) The DWEL represents a medium-specific (i.e., drinking water) lifetime exposure at which adverse, noncarcinogenic health effects are not anticipated
DWLOC	Drinking Water Level of Comparison.
EC	Emulsifiable Concentrate Formulation
EEC	Estimated Environmental Concentration. The estimated pesticide concentration in an environment, such as a terrestrial ecosystem.
EP	End-Use Product
EPA	U.S. Environmental Protection Agency
FAO	Food and Agriculture Organization
FDA	Food and Drug Administration
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FFDCA	Federal Food, Drug, and Cosmetic Act
FQPA	Food Quality Protection Act
FOB	Functional Observation Battery
G	Granular Formulation
GENEEC	Tier I Surface Water Computer Model
GLC	Gas Liquid Chromatography
GLN	Guideline Number
GM	Geometric Mean
GRAS	Generally Recognized as Safe as Designated by FDA
HA	Health Advisory (HA). The HA values are used as informal guidance to municipalities and other organizations when emergency spills or contamination situations occur.
HAFT	Highest Average Field Trial
HDT	Highest Dose Tested
IR	Index Reservoir
LC_{50}	Median Lethal Concentration. A statistically derived concentration of a substance that can be expected to cause death in 50% of test animals. It is usually expressed as the weight of substance per weight or volume of water, air or feed, e.g., mg/l, mg/kg or ppm.
LD_{50}	Median Lethal Dose. A statistically derived single dose that can be expected to cause death in 50% of the test animals when administered by the route indicated (oral, dermal, inhalation). It is expressed as a weight of substance per unit weight of animal, e.g., mg/kg.

LEL	Lowest Effect Level
LOC	Level of Concern
LOD	Limit of Detection
LOAEL	Lowest Observed Adverse Effect Level
MATC	Maximum Acceptable Toxicant Concentration
MCLG	Maximum Contaminant Level Goal (MCLG) The MCLG is used by the Agency to regulate contaminants in drinking water under the Safe Drinking Water Act.
mg/kg/day	Milligram Per Kilogram Per Day
mg/L	Milligrams Per Liter
MOE	Margin of Exposure
MP	Manufacturing-Use Product
MPI	Maximum Permissible Intake
MRID	Master Record Identification (number). EPA's system of recording and tracking studies submitted.
NA	Not Applicable
N/A	Not Applicable
NAWQA	USGS National Water Quality Assessment
NOEC	No Observable Effect Concentration
NOEL	No Observed Effect Level
NOAEL	No Observed Adverse Effect Level
NPDES	National Pollutant Discharge Elimination System
NR	Not Required
OP	Organophosphate
OPP	EPA Office of Pesticide Programs
OPPTS	EPA Office of Prevention, Pesticides and Toxic Substances
Pa	Pascal, the pressure exerted by a force of one newton acting on an area of one square meter.
PAD	Population Adjusted Dose
PADI	Provisional Acceptable Daily Intake
PAG	Pesticide Assessment Guideline
PAI	Purified Active Ingredient
PAM	Pesticide Analytical Method
PCA	Percent Crop Area
PDP	USDA Pesticide Data Program
PHED	Pesticide Handler's Exposure Data
PHI	Preharvest Interval
ppb	Parts Per Billion
PPE	Personal Protective Equipment
ppm	Parts Per Million
PRN	Pesticide Registration Notice
PRZM/ EXAMS	Tier II Surface Water Computer Model
Q_1*	The Carcinogenic Potential of a Compound, Quantified by the EPA's Cancer Risk Model
RAC	Raw Agriculture Commodity
RBC	Red Blood Cell
RED	Reregistration Eligibility Decision
REI	Restricted Entry Interval
RfD	Reference Dose
RQ	Risk Quotient
RS	Registration Standard
RUP	Restricted Use Pesticide
SAP	Science Advisory Panel
SCI-GROW	Tier I Ground Water Computer Model
SF	Safety Factor
SLC	Single Layer Clothing

SLN	Special Local Need (Registrations Under Section 24(c) of FIFRA)
TC	Toxic Concentration. The concentration at which a substance produces a toxic effect.
TD	Toxic Dose. The dose at which a substance produces a toxic effect.
TEP	Typical End-Use Product
TGAI	Technical Grade Active Ingredient
TLC	Thin Layer Chromatography
TMRC	Theoretical Maximum Residue Contribution
torr	A unit of pressure needed to support a column of mercury 1 mm high under standard conditions.
TRR	Total Radioactive Residue
UF	Uncertainty Factor
µg/g	Micrograms Per Gram
µg/L	Micrograms Per Liter
USDA	United States Department of Agriculture
SGS	United States Geological Survey
UV	Ultraviolet
WHO	World Health Organization
WP	Wettable Powder
WPS	Worker Protection Standard

Executive Summary

EPA has completed its review of public comments concerning the preliminary risk assessments and is issuing its risk management decision for endosulfan. The revised risk assessments are based on review of the required target data base supporting the use patterns of currently registered products and additional information received. The Agency invited stakeholders to provide proposals, ideas or suggestions on appropriate mitigation measures before the Agency issued its risk mitigation decision concerning endosulfan. After considering the risks identified in the revised risk assessment, mitigation measures proposed by the Endosulfan Task Force, which consists of the technical registrants of endosulfan, and comments and mitigation suggestions from other interested parties, the Agency developed its risk management decision for uses of endosulfan that pose risks of concern. This decision is discussed fully in this document.

Endosulfan, a dioxathiepin (broadly classified as an organochlorine), is a broad spectrum contact insecticide and acaricide that is used on a wide variety of vegetables, fruits, cereals, and cotton, as well as ornamental shrubs, trees, vines, and ornamental herbaceous plants in commercial agricultural settings. Technical grade endosulfan is composed of two stereochemical isomers: α-endosulfan and β-endosulfan, in concentrations of approximately 70% and 30%, respectively. Endosulfan was first registered in 1954 to control a broad spectrum of agricultural insect and mite pests on various crops. Use data from 1987 to 1997 indicate an average domestic use of approximately 1.38 million pounds of active ingredient per year.

The Food Quality Protection Act of 1996 (FQPA) requires that, when considering whether to establish, modify, or revoke a tolerance, the Agency consider "available information" concerning the cumulative effects of a particular pesticide's residues and other substances that have a common mechanism of toxicity with other pesticides. The Agency does not currently have data available to determine with certainty whether endosulfan or endosulfan sulfate have a common mechanism of toxicity with any other substances. For the purposes of this decision, the Agency has assumed that there are not any other chemical substances that share a common mechanism of toxicity with endosulfan and has not performed a cumulative risk assessment as part of this reregistration review of endosulfan. If the Agency identifies other substances that share a common mechanism of toxicity with endosulfan, then the cumulative risks of these chemicals will be considered once the final framework the Agency will use for evaluating cumulative risks is available.

Overall Risk Summary

The Agency's human health risk and ecological risk assessments for endosulfan indicate risks of concern. Acute dietary (food) risk exceeds the Agency's level of concern (>100% aPAD) at the 99.9th exposure percentile for children 1-6 years of age (150% aPAD). Significant contributors to acute exposure have been identified as succulent beans and succulent peas. The dietary (food) assessment also concludes that for all commodities, the chronic risk estimates are below the Agency's level of concern (<100% cPAD) for the U.S. population (<1% of the cPAD)

and all population subgroups with the highest exposed population subgroup, children 1-6 years of age occupying 17% of the cPAD.

Dietary (drinking water) risk for acute exposures, based on models, from both ground and surface water are of concern. Drinking water estimates for chronic exposures, based on models, from both ground and surface water are not of concern. Further, there are some concerns for workers who mix, load and apply endosulfan to agricultural sites as well as to those workers who re-enter a treated area following application of endosulfan.

For ecological effects, the Agency has conducted a screening level assessment for terrestrial impacts and a refined exposure assessment for aquatic impacts of endosulfan use. These assessments indicate that endosulfan is likely to result in acute and chronic risk to both terrestrial and aquatic organisms.

To mitigate risks of concern posed by the uses of endosulfan, the Agency considered the mitigation proposal submitted by the technical registrants, as well as comments and mitigation ideas from other interested parties, and has decided on a number of label amendments to address the dietary (food and drinking water), worker and ecological concerns. Results of the risk assessments, and the necessary label amendments to mitigate those risks, are presented in this RED.

Dietary Risk

Acute risk estimates for food and drinking water exceed the Agency's level of concern; therefore, mitigation measures are warranted at this time for dietary exposure to endosulfan. To mitigate the risks from acute food exposure, the following crop uses will be canceled: succulent beans, succulent peas, grapes, and spinach.

Several mitigation measures are needed to reduce the potential for the contamination of drinking water. These include a 100-foot setback for ground applications between treated areas and water bodies, a 30-foot vegetative buffer between treated areas and water bodies, reductions in maximum application rates, reductions in maximum seasonal application rates and reductions in the maximum number of applications allowed per use season. These measures, together with conservative assumptions used in the modeled estimates of drinking water exposure, lead the Agency to believe that risk from drinking water will not exceed its level of concern. Drinking water monitoring data will be required to confirm this conclusion.

Occupational Risk

Occupational exposure to endosulfan is of concern to the Agency, and it has been determined that a number of measures are necessary to mitigate these risks. For the agricultural uses of endosulfan, several mixer/loader/applicator risk scenarios currently exceed the Agency's level of concern. To mitigate these risks several steps are needed including placing all wettable powder (WP) products in water soluble bags, the deletion of some uses from WP products,

deletion of aerial application of WP products for some crops, requiring closed mixing/loading systems for aerial applications of the emulsifiable concentrate (EC) formulation for some uses, requiring closed cabs for all airblast applications except for ornamental trees/shrubs and reductions in application rates.

The risks to workers reentering treated fields are of concern for several crops. These risks can be mitigated provided the restricted entry intervals recommended in this document are established.

Ecological Risk

Ecological risks are also of concern to the Agency. The environmental risk assessment suggests that exposure to endosulfan could result in both acute and chronic risks of concern for terrestrial and aquatic organisms. To reduce these risks, several mitigation measures are needed. These measures include a 100-foot setback for ground applications between treated areas and water bodies, a 30-foot vegetative buffer between treated areas and water bodies, reductions in single maximum application rates, reductions in maximum seasonal application rates, reductions in maximum numbers of applications allowed in a single growing season and deletion of use on pecans.

Stakeholder Process to Address Aquatic Risks and Long Range Transport

Given the toxicity and persistence of endosulfan and potential risks to aquatic organisms, the Agency has developed a number of mitigation measures in order to reduce the risks to aquatic organisms outlined in this document. While the Agency believes that these measures will reduce the potential for exposures to aquatic organisms and reduce the overall environmental loading of endosulfan, it also believes that in specific geographic areas where conditions exist that make aquatic organisms especially vulnerable (e.g., shallow, leaky aquifers, highly erodible lands, the presence of especially sensitive organisms and high use of endosulfan) additional measures may be identified. In order to more fully evaluate the risks in these vulnerable areas; the risk management strategies that may be in place or could potentially be implemented in such areas (e.g., use of retention ponds) to reduce exposure; and the benefits of the use of endosulfan in those areas, the Agency is planning to conduct a public comment and stakeholder process to accomplish this objective. Further, the impacts of atmospheric transport may require additional evaluation during this time period. Additional mitigation measures may be needed following the completion of this process.

Endosulfan is a semivolatile and persistent cyclodiene pesticide that can migrate over a long distance through various environmental media such as air, water, and sediment. Once endosulfan is applied to crops, it can either persist in soil as a sorbed phase or be removed through several physical, chemical, and biological processes. Recent studies suggest that secondary emissions of residual endosulfan continue to recycle in the global system while they slowly migrated and are redeposited via wet deposition in the Northern Hemisphere. The occurrence of endosulfan in remote regions like the Great Lakes, the Arctic, and mountainous

areas is well documented. Endosulfan can also enter the air as adsorbed phase onto suspended particulate matter, but this process does not appear to be a major contributor to long range transport like volatilization.

The presence of endosulfan in the remote areas like Arctic and the Great Lakes requires further understanding of the transport mechanisms from the atmosphere. The potential impact of atmospheric deposition of endosulfan into surface water and its potential effect on water quality and aquatic organisms in the non-use areas is not well documented. Despite the progress made in recent years in estimating the persistence and long-ranged transport of chemicals using models, a validated global model has not been published because of uncertainties involved in the source inventories, chemical fate data, degradative pathways and exposure analyses. Future work will be aimed at developing a comprehensive screening tool that can be used reliably in risk assessments for regulatory purposes. Part of the stakeholder process will include an evaluation of to what extent data related to long range transport may be necessary.

I. Introduction

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) was amended in 1988 to accelerate the reregistration of products with active ingredients registered prior to November 1, 1984. The amended Act calls for the development and submission of data to support the reregistration of an active ingredient, as well as a review of all submitted data by the U.S. Environmental Protection Agency (referred to as EPA or "the Agency"). Reregistration involves a thorough review of the current scientific database underlying a pesticide's registration. The purpose of the Agency's review is to reassess the potential hazards arising from the currently registered uses of the pesticide, to determine the need for additional data on health, and environmental effects and to determine whether the pesticide meets the "no unreasonable adverse effects" criteria of FIFRA.

On August 3, 1996, the Food Quality Protection Act of 1996 (FQPA) was signed into law. This Act amends FIFRA to require tolerance reassessment of all existing tolerances. The Agency has decided that, for those chemicals that have tolerances and are undergoing reregistration, the tolerance reassessment will be initiated through this reregistration process. It also requires that by 2006, EPA must review all tolerances in effect on the day before the date of the enactment of the FQPA, which was August 3, 1996.

FQPA also amends the Federal Food, Drug, and Cosmetic Act (FFDCA) to require a safety finding in tolerance reassessment based on factors including an assessment of cumulative effects of chemicals with a common mechanism of toxicity. Endosulfan belongs to a group of pesticides called organochlorines. Although chemical class is not necessarily equivalent to a common mechanism of action, in some cases, chemicals within the same class have been shown to share a common mechanism of action and are being considered together for purposes of a cumulative assessment (e.g., the organophosphates). Specifically, endosulfan belongs to the chlorinated cyclodiene (organochlorine) class of insecticide/acaricide. The Agency does not currently have data available to determine with certainty whether endosulfan or endosulfan sulfate have a common mechanism of toxicity with any other substances. For the purposes of this decision, the Agency has assumed that there are not any other chemical substances that share a common mechanism of toxicity with endosulfan and not performed a cumulative risk assessment as part of this reregistration review of endosulfan. If the Agency identifies other substances that share a common mechanism of toxicity with endosulfan, then the cumulative risks of these chemicals will be considered once the final framework the Agency will use for evaluating cumulative risks is available.

The implementation of FQPA has required the Agency to revisit some of its existing policies relating to the determination and regulation of dietary risk and has also raised a number of new issues for which policies need to be created. These issues were refined and developed through collaboration between the Agency and the Tolerance Reassessment Advisory Committee (TRAC), which was composed of representatives from industry, environmental groups and other interested parties.

This document summarizes the Agency's revised human health and ecological risk assessments, its progress toward tolerance reassessment and the reregistration eligibility decision for endosulfan. This document consists of six sections. Section I contains the regulatory framework for reregistration/tolerance reassessment. Section II provides a profile of the use and usage of the chemical. Section III gives an overview of the revised human health and environmental effects risk assessments resulting from public comments and other information. Section IV presents the Agency's decision on reregistration eligibility and risk management decisions. Section V summarizes the label changes necessary to implement the risk mitigation measures outlined in Section IV. Section VI provides information on how to access related documents. Finally, the Appendices list Data Call-In (DCI) information. The revised risk assessments and related addenda are not included in this document, but are available on the Agency's web page ***http://www.epa.gov/pesticides/endosulfan***, and in the public docket.

II. Chemical Overview

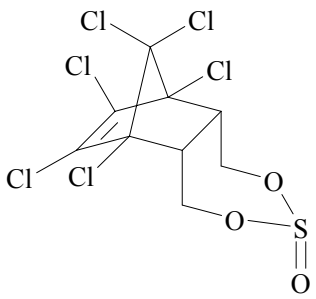
A. Regulatory History

Endosulfan is a broad spectrum insecticide and acaricide first registered for use in the United States in 1954 to control agricultural insect and mite pests on a variety of field, fruit, and vegetable crops. A Registration Standard dated September 17, 1981, and a Guidance Document dated April 1982 were issued for endosulfan, which required additional generic and product-specific data for the manufacturing products of the technical registrants. In addition, Data-Call-Ins (DCIs) were issued in June 1987 and September 1992 concerning the potential formation of chlorinated dibenzo-p-dioxins and dibenzofurans in technical endosulfan products. Since the Guidance Document was published in April 1992, there have been a total of seven DCIs issued (10/23/85, 05/19/86, 05/27/86, 01/30/87, 06/19/87, 09/02/92, and 05/10/94). Another DCI was issued in October 1994, which primarily concerned data residue chemistry deficiencies.

In 1991, the technical registrants amended labels to incorporate a 300-foot spray drift buffer for aerial applications between treated areas and water bodies. This setback was adopted in order to address concerns about contamination of water and risks to aquatic organisms. In 2000, the technical registrants amended technical product labels to remove all residential use patterns. Further, the registrants have agreed to restrict the annual maximum use rate for all uses to 3lbs. active ingredient per acre.

B. Chemical Identification

Endosulfan:



- **Common name:** Endosulfan
- **Chemical name:** 6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide
- **Chemical family:** Organochlorine
- **Case number:** 0014
- **CAS registry number:** 115-29-7
- **OPP chemical code:** 079401
- **Empirical formula:** $C_9H_6CL_6O_3S$
- **Molecular weight:** 406.95 daltons
- **Trade and other names:** Thiodan®
- **Basic manufacturers:** Bayer CropScience, Makhteshim-Agan of North America, FMC Corporation, Gowan, Platte Chemical, and Drexel Company.

Endosulfan is often referred to generically as a "cyclodiene-type" insecticide, but it contains only one double bond. Technical endosulfan (70% α- and 30% β-endosulfan) is a light to dark brown crystalline solid. The melting point of the α-isomer ranges from 108-110^0 C and the melting point of the β-isomer is 208-210^0 C. The melting point of technical endosulfan ranges from 70 to 100^0 C. The vapor pressure of α-endosulfan is 3.0 x 10^{-6} mm Hg, β-endosulfan 7.2 x 10^{-7} mm Hg, and technical endosulfan 1 x 10^{-5} mm Hg at 25 ^{0}C. Technical endosulfan has a water solubility that varies from insoluble to ~0.33 mg/L at 25 ^{0}C, but has appreciable lipophilicity (log P_{ow} 4.445 to 5.689).

C. Use Profile

The following information is based on the currently registered uses of endosulfan:

Type of Pesticide: Insecticide/Acaricide

Summary of Use Sites:

Food Crops: barley, beans (dry and succulent), blueberries, broccoli, brussels sprouts, cabbage, carrots, cauliflower, celery, collards, kale, corn (fresh only), cucumbers, eggplants, grapes, peppers, oats, lettuce, melons, mustard greens, pineapples, rye, potatoes, pumpkins, spinach, squash, sweet potatoes,

strawberries, tomato, turnip, apples, apricots, almonds, cherries, filberts, macadamia nuts, nectarines, peaches, pecans, pears, plums, prunes, walnuts, and wheat.

Other Agricultural Sites: Alfalfa (seed only), radish (seed only), cotton, rutabaga (seed only), clover (seed only), kohlrabi (seed only), and tobacco.

Residential: None

Public Health: None

Other Nonfood: Christmas tree plantations, woody plants, peaches (root dip only), cherry and plum roots and crowns, whole strawberry plants, shade trees, citrus (non-bearing), tobacco, nursery stock, ornamental plants and shrubs.

Target Pests:

Agricultural: Meadow spittlebug, Army cutworm, Aphids, Bean leaf skeletonizer, Cowpea curculio, Cucumber beetle, Flea beetle, Green stink bug, Leafhoppers, Mexican bean beetles, Cabbage looper, Cabbage worm, Cabbage aphid, Cucumber beetles, Whitefly, Cutworms, Diamondback moth, Corn earworm, Boll weevil, Bollworm, Lygus bugs, Thrips, Melonworm, Pickleworm, Rindworm, Squash beetle, Squash bug, Blister beetle, Potato beetle, Rose chafer, Pepper maggot, Cinch bug, Crown mite, June bug, Harlequin bug, Grape phylloxera, and Grape leafhopper.

Orchards: Aphids (including Apple aphids, Black cherry aphid, Black peach aphid, Green peach aphid, Rosy apple aphids, Black pecan aphid, Filbert aphid, Rusty plum aphids, Wooly apple aphids), Apple rust mites, Green fruitworm, Tarnished plant bug, Tentiform leafminers, Whitefly leaf hoppers, Peachtree borer, Peach twig borer, Plum rust mite, Bud moth, Bud mites, Twig mites, Filbert leafroller, Filbert bud mite, Pecan nut casebearer, and Spittlebug.

Ornamental Trees and Shrubs: Leather leaf fern borer, Aphids, Cyclamen mite, Rose chafer, Whitefly, Dogwood borer, Lilac borer, Colley spruce gall adelgid, Douglas fir needle midge, Walnut aphid, and Stink bug.

Formulation Types Registered: Endosulfan is formulated for occupational use as a technical grade manufacturing product (95 percent active ingredient [ai]), emulsifiable concentrate (EC) (9 percent to 34 percent active ingredient), and a wettable powder (WP) (1 percent to 50 percent active ingredient). The wettable powder is frequently packaged in water soluble bags.

Methods and Rates of Application:

Equipment - Endosulfan can be applied by groundboom sprayer, fixed-wing aircraft, chemigation (potatoes only), airblast sprayer, rights-of-way sprayer, low pressure handwand sprayer, high pressure handwand sprayer, backpack sprayer and dip treatment.

Rates of Application- The crop groupings with their corresponding maximum label application rates are as follows (both formulations unless noted, EC = emulsifiable concentrate, WP = wettable powder formulations):

Agricultural crops (vegetables and field crops): alfalfa (seed only, 1 lb ai/A EC); barley, rye, oats and wheat (0.75 lb ai/A); beans and tomatoes (1 lb ai/A); clover (0.5 lbs ai/A EC); blueberries (1.5 lb ai/A); broccoli, cabbage, collard, lettuce, melons, and mustard greens (1 lb ai/A or 2 lb ai/A for seed); brussels sprouts, carrots, cauliflower, celery, cucumbers, eggplants, peas, peppers, potatoes, pumpkins, spinach, and squash (1 lb ai/A); cotton and corn (fresh only) (1.5 lb ai/A); grapes (1.5 lb ai/A or 0.005 lb ai/gallon); kale (0.75 lb ai/A or 2 lb ai/A for seed); kohlrabi, radish, turnip and rutabaga (2 lb ai/A seed only); strawberries, pineapples and sweet potato (2 lb ai/A); and tobacco (1.5 lb ai/A WP, 1 lb ai/A EC).

Fruit and nut trees (orchard crops): apples (2.5 lb ai/A or 0.005 lb ai/gal); apricots, peach, and nectarines (3 lb ai/A or 0.0025 lb ai/gal); almonds, cherries, pears, plums, and prunes (2.5 lb ai/A or 0.04 lb ai/gallon); filberts (hazelnuts 2lb ai/A or 0.005 lb ai/gallon); macadamia nuts (3.0 lb ai/A or 0.01 lb ai/gallon); pecans (3 lbs ai/A or 0.0075 lb ai/gallon); walnuts (2 lb ai/A or 0.02 lb ai/gallon WP, 2.5 lb ai/A or 0.04 lb ai/gallon EC). A currently registered label (EPA reg # 34704-516) contains a higher application rate (7.5 lb ai/A) for pecans and macadamia nuts than is listed above. At this time only the 3.0 lb ai/A rate for pecans and macadamia nuts is being supported and this assessment therefore only assesses these crops for a 3.0 lb ai/A maximum application rate.

Ornamental Trees and Shrubs: shade trees, citrus (non-bearing and nursery stock), shrubs, nursery stock, Christmas tree plantations, and woody plants (1 lb ai/A or 0.01 lb ai/gallon).

Root dip: cherry, peaches, and plum roots and crowns (0.05 lb ai/gallon) and whole strawberry plants (0.01 lb ai/gallon EC).

Bark Treatment: apricot, cherry, grapes, nectarines, peach, plums and prunes (see above for application rates, applied with high pressure handwands and rights-of-way sprayers).

Use Classification: General use

D. Estimated Usage of Pesticide

This section summarizes the best estimates available for many of the pesticide uses of endosulfan, based on available pesticide survey usage data for the years 1990 through 1999. A full listing of all uses of endosulfan, with the corresponding use and usage data for each site, has been completed and is in the "Quantitative Use Assessment" document dated September 10, 2000, which is available in the public docket and on the Agency's website: ***http://www.epa.gov/pesticides/endosulfan***. The data, reported on an aggregate and site (crop) basis, reflect annual fluctuations in use patterns as well as the variability in using data from various information sources. Total average annual use of endosulfan is estimated at approximately 1.38 million pounds of active ingredient (lbs ai), according to Agency and registrant estimates.

This long-term average is not necessarily consistent with some recent trends. Data from USDA (*Agricultural Chemical Usage, Field Crop Summary*, 1999, 2000, 2001; *Agricultural Chemical Usage, Fruit and Nut Summary*, 1999; *Agricultural Chemical Usage, Vegetable Summary*, 2000) and other EPA sources appear to indicate declining use of endosulfan in U.S. agriculture. This decline is driven mainly by replacement of endosulfan by other insecticides for use on small grains and soybeans. Usage on fruit and nut crops may also be decreasing, although the decline is not as clear and may be sensitive to yearly fluctuation in pest problems. Usage on vegetable crops appears steady and may be increasing. Within these broad categories, there may be significant shifts in use patterns in response to the dynamics of the agricultural system (e.g., changes in crop area), pest populations (e.g., pest outbreaks) and changes in pesticide availability (e.g., new pesticides registered and restrictions on old pesticides).

Table 1. Endosulfan Estimated Usage

Crop	Lbs. A.I. Applied (wghtd Avg. in 000 pounds)[1]	Percent Crop Treated (Weighted Avg.)	Percent Crop Treated (Likely Max)
Food Commodities			
Alfalfa (seed) (non food)	10	<1%	<1%
Almonds	<1	<1%	<1%
Apples	110	13%	20%
Apricots/Nectarines	2	2%	4%
Barley	<1	1%	1%
Beans, Dry	5	1%	3%
Beans, Lima	**Not Available**	2%	6%
Beans, Snap Fresh	2	2%	6%
Beans, Snap Processed	3	2%	6%
Blueberries	1	2%	6%
Broccoli	16	13%	26%
Brussels Sprouts	<1	2%	10%

Crop	Lbs. A.I. Applied (wghtd Avg. in 000 pounds)[1]	Percent Crop Treated (Weighted Avg.)	Percent Crop Treated (Likely Max)
Cabbage, Fresh and Processed	18	14%	27%
Cantaloupes	39	31%	57%
Carrots	1	2%	5%
Cauliflower	4	9%	32%
Celery	2	6%	11%
Cherries, Sweet and Tart	5	3%	7%
Citrus - Grapefruit	3	1%	5%
Citrus - Oranges	4	<1%	1%
Citrus - Other[2]	<1	<1%	<1%
Collards	1	6%	7%
Corn, Sweet	4	<1%	1%
Cucumbers, fresh and processed	27	8%	15%
Eggplant	3	41%	83%
Grapes	17	1%	6%
Hazelnuts (Filberts)	2	7%	18%
Lettuce	58	14%	31%
Macadamia Nuts	**Not Available**	7%	30%
Melons, Honeydew	6	19%	58%
Mustard Greens	**Not Available**	6%	17%
Oats/Rye	<1	<1%	<1%
Peas, Dry	<1	<1%	4%
Peas, Green	1	<1%	4%
Pears	35	20%	48%
Pecans	59	11%	18%
Peppers (bell and hot)	14	12%	17%
Peaches	29	7%	17%
Pineapple (flowering ac)	1	2%	6%
Plums and Prunes	8	3%	7%
Potatoes, White	120	10%	16%
Potatoes, Sweet	20	31%	46%
Pumpkins	11	20%	30%
Roots/Tubers	13	4%	6%
Spinach, Fresh	1	4%	11%
Strawberries	9	14%	21%
Squash	44	40%	84%
Tomatoes	55	6%	11%
Vegetables, Other Leafy	**Not available**	<1%	5%
Walnuts	1	0%	1%

Crop	Lbs. A.I. Applied (wghtd Avg. in 000 pounds)[1]	Percent Crop Treated (Weighted Avg.)	Percent Crop Treated (Likely Max)
Watermelon	40	12%	17%
Non-Food Sites			
Cotton	286	2%	4%
Tobacco	63	8%	12%
Ornamentals			
Horticultural Nurseries Stock	50	Not Available	Not Available

[1] Usage data primarily covers 1990 to 1999. Calculations of the above numbers are displayed as rounded.

[2] Calculations of the above numbers may not appear to agree because they are displayed as rounded: to the nearest 1000 for acres treated or lb. a.i.

Sources:
Agricultural (Crop) Sites: USDA Agricultural Chemical Usage Reports, NCFAP, and various proprietary data sources, including Doane, Maritz, Mike Buckley.
Pineapple estimates from Calvin Oda, Pineapple Growers Assoc. of Hawaii, 4/21/99, memo to Nako;
Macadamia nut estimates from Alan Yamaguchi, Hawaii Macadamia Nut Assoc., 4/21/99, personal communications with Nako.
USDA, Biological and Economic Assessment of Pest Management in the United States Greenhouse and Nursery Industry, NAPIAP Report, 1-CA-96;
1993 Certified/Commercial Pesticide Applicator Survey; Kline; SRI.

III. Summary of Endosulfan Risk Assessments

The purpose of this summary is to assist the reader in better understanding the conclusions reached in the assessments by identifying the key features and findings of the risk assessments conducted for endosulfan. Following is a list of EPA's revised human health and ecological risk assessments and supporting information that was used to formulate the findings and conclusions for the pesticide endosulfan. The listed documents may also be found on the Agency's web page at ***www.epa.gov/pesticides/*** and in the public docket.

Human Health Risks

- *Assessment of the Dietary Cancer Risk of Hexachlorobenzene and Pentachlorobenzene as impurities in Chlorothalonil, PCNB, Picloram, and several other pesticides*, February 26, 1998.
- Product Chemistry Chapter for the Reregistration Eligibility Decision, December 18, 1998.
- *Review of Endosulfan Incident Reports*, January 18, 2000.
- *Re-Evaluation of Toxicology Endpoint Selection for Dermal and Inhalation Risk Assessments and 3X Safety Factor for Bioaccumulation*, February 7, 2002.
- *Revised Residue Chemistry Chapter For The Endosulfan Reregistration Eligibility Decision (RED) Document*, February 14, 2002.
- *Report of the FQPA Safety Factor Committee*, February 14, 2002.
- *Third Revision of Occupational and Residential Exposure Assessment and Recommendations for the Reregistration Eligibility Decision Document*, February 26, 2002.
- *Anticipated Residues and Revised Chronic Dietary Exposure Analyses*, February 28, 2002.

- *New FQPA and PDP Data, Anticipated Residues, and Revised Acute and Chronic Dietary Exposure Analyses*, April 22, 2002.
- *Supporting documentation for findings of FQPA Safety Committee on February 11, 2002*, May 9, 2002.
- *Reevaluation of the HED Risk Assessment for the Endosulfan Reregistration Eligibility Decision (RED) Document*, May 30, 2002.
- *New FQPA, PDP, and Processing Data, Anticipated Residues, and Revised Acute and Chronic Dietary Exposure Analyses, July 19, 2002*

Environmental Fate and Ecological Effects

- *Final EFED Risk Assessment for the Reregistration Eligibility Decision on Endosulfan*, February 26, 2002.
- *Endosulfan and Endosulfan Sulfate: Drinking Water EECs in Surface Water for Use in the Human Health Risk Assessment,* July 3, 2002.

A. Human Health Risk Assessment

EPA issued its preliminary risk assessments for endosulfan on January 31, 2001 (Phase 3 of the TRAC process). In response to comments and studies submitted during Phase 3, the risk assessments were updated and refined. Major revisions to the human health risk assessment are listed below:

- Adjusted dietary risk estimates to reflect FQPA Safety Factor of 10X.

- Use of new toxicological endpoints for dermal risk assessment. These data affect the lowest observed adverse effect level, and no observed adverse effect level used in the dermal risk assessments.

- 2000 PDP data was incorporated in the dietary assessment.

- Processing factors for pear juice, pineapple juice, raisins, and canned fruits and vegetables were incorporated in the dietary assessment.

- Recalculated Tier II drinking water EECs incorporating the Index Reservoir and Percent Cropped Area.

- Incorporated updated % crop treated values.

1. Dietary Risk from Food

a. Toxicity

The Agency has reviewed all toxicity studies submitted and has determined that the toxicity database is sufficiently complete except for the data identified in Section V, and that it supports a reregistration eligibility determination for all currently registered uses. Further details on the toxicity of endosulfan can be found in the document "Endosulfan: Reevaluation of the

HED Risk Assessment for the Endosulfan Reregistration Eligibility Decision (RED) Document," dated May 30, 2002, and related documents. A brief overview of the studies and safety factors used for the dietary (food) risk assessment is outlined in Table 2 in this document.

b. FQPA Safety Factor

The FQPA Safety Factor of 10X was retained for endosulfan. A weight-of-the-evidence approach indicated that there were no reliable data available to address concerns or uncertainties raised by the following matters: 1) evidence for increased susceptibility of young rats, (2) additional evidence for endocrine disruption, 3) uncertainty regarding the neuroendocrine effects in the young, and 4) the need for a developmental neurotoxicity study (DNT). The FQPA safety factor (10x) is applicable for all populations when assessing acute and chronic dietary exposure. There are no longer any residential uses for this chemical, so the FQPA Safety factor does not apply to the short-term or intermediate-term exposure scenarios. More information concerning the FQPA Safety Factor can be found in the document " Endosulfan: Report of the FQPA Safety Factor Committee" dated February 13, 2002, and related documents.

Although developmental toxicity was only seen at or above parentally toxic doses, there were treatment-related clinical signs of neurotoxicity following oral exposures in the rat, rabbit, and dog, and via the dermal route in rats. The acute neurotoxicity study was reviewed and found to be acceptable/guideline. The subchronic neurotoxicity study has not been received by the Agency and remains a data gap. The Agency re-reviewed the hazard and exposure data for endosulfan and concluded that a DNT study in rats should be requested for endosulfan due to concern for: 1) fetal effects reported in the open literature; 2) the severity of effects seen in female offspring of the F_0 generation (increased pituitary) and F_1b generation (increased uterine weights) at the high-dose when compared to the toxicity observed in parental animals at this dose in the two-generation reproduction study in rats; and 3) because the subchronic neurotoxicity study will only address the neuropathological concerns resulting from exposure to endosulfan in adults. A developmental neurotoxicity study will provide the critical data needed to determine the potential toxic effects of endosulfan on the developing fetal nervous system.

Under the conditions of the available Agency guideline studies, there is no evidence of enhanced susceptibility of the offspring to exposure to endosulfan. However, a recent review by the Agency for Toxic Substances and Disease Registry [*Toxicological Profile for Endosulfan (Update)*. *ATSDR. September 2000*] reported the results of non-guideline studies which demonstrated that young rats may be more susceptible than older rats upon exposure to endosulfan. Studies conducted by Sinha *et al.* (1995 & 1997) and Zaidi *et al.* (1985) illustrate effects to the offspring at doses lower than those showing effects in adults. Sinha *et al*.(1995 & 1997), treated both three week and three month old rats orally. Decreased intratesticular spermatid count and increased percentage of abnormal sperm were seen in three week old rats at doses lower than those eliciting similar effects in three month old rats. Zaidi (1985) dosed neonatal rat pups for 25 days intraperitoneally and found increased serotonin binding to the frontal cortical membranes of the brain and increased aggressive behavior. Adults exposed in a similar manner did not display these effects.

There is evidence for endocrine disruption both in studies submitted to the Agency and those published in the open literature. In an National Cancer Institute (NCI) chronic toxicity/carcinogenicity study in rats, endosulfan induced testicular atrophy and parathyroid hyperplasia. In the multi-generation reproduction study, increased pituitary and uterine weights were seen. Endosulfan is considered to be a potential endocrine disruptor. Substances that act as endocrine disruptors may perturb the endocrine system in a variety of ways including, but not limited to, interfering with the synthesis, secretion, or transport of hormones in the organism. The endocrine system integrates a variety of CNS-pituitary-target organ pathways that not only affect reproductive or sexually regulated parameters but also regulate a wide array of bodily functions and homeostasis.

c. Population Adjusted Dose (PAD)

The PAD is a term that characterizes the dietary (food) risk of a chemical and reflects the Reference Dose (RfD), either acute or chronic, that has been adjusted to account for the FQPA safety factor (i.e., RfD / FQPA safety factor). The RfD is calculated by taking the no observed adverse effect level (NOAEL) from an appropriate study and dividing it by an uncertainty factor (i.e., NOAEL/UF). A risk estimate that is less than 100% of the acute or chronic PAD does not exceed the Agency's risk concern. In the case of endosulfan, the FQPA safety factor is 10x; therefore, the acute or chronic PADs are equivalent to the acute and chronic RfDs divided by 10, respectively. The aPAD for endosulfan is 0.0015 mg/kg/day. The cPAD for endosulfan is 0.0006 mg/kg/day. The basis for the aPAD and the cPAD are summarized in Table 2 below.

Table 2. Summary of the Toxicological Endpoints for Endosulfan

Exposure Scenario	Dose (mg/kg/day)	Endpoint	Study
Acute Dietary	NOAEL = 1.5 UF = 100 FQPA SF = 10	Oral LOAEL = 3 mg/kg/day; based on increased incidence of convulsions seen in female rats within 8 hours after dosing.	Acute neurotoxicity study in rats
		Acute RfD = 0.015 mg/kg/day aPAD = 0.0015 mg/kg/day	
Chronic Dietary	NOAEL = 0.6 UF = 100 FQPA SF = 10	LOAEL = 2.9 mg/kg/day based on reduced body weight gain, enlarged kidneys, increased incidences of marked progressive glomerulonephrosis; & blood vessel aneurysms in male rats.	Combined chronic toxicity/carcinogenicity study in rats
		Chronic RfD = 0.006 mg/kg/day cPAD = 0.0006 mg/kg/day	

d. Exposure Assumptions

The Agency conducts dietary (food) risk assessments using the dietary exposure evaluation model (DEEM™), which incorporates consumption data generated in USDA's continuing survey of food intakes by individuals, 1989-1992. For the assessment of dietary

(food) exposure to residues of endosulfan, monitoring data generated through the USDA Pesticide Data Program (PDP) and through the Food and Drug Administration (FDA) Surveillance Monitoring Program were used for most crops. Anticipated residue values from crop residue field trial studies, and percent crop-treated data were used for cotton, macadamia nuts, filberts, pecans, and walnuts.

The Agency has developed procedures for handling FDA surveillance monitoring data in dietary exposure analyses in order to generate more refined probabilistic dietary exposure estimates. In the FDA data, if there are significant differences between domestic and import samples, either in terms of likelihood of detected residues or residue levels themselves, then it would be most desirable to "weight" the FDA data such that it better reflects the proportionate "mix" between domestic and foreign produce which the U.S. population consumes. Additional estimates of the percent of commodity imported as well as imported %CT are also incorporated. The crops for which these procedures were incorporated are dried beans, blueberries, cauliflower, fresh sweet corn, melons (except cantaloupe), fresh succulent peas, hot peppers, plums, and summer squash.

For acute probabilistic dietary risk assessments, the entire distribution of single-day food consumption events is combined with a distribution of residues to obtain a distribution of exposure in mg/kg/day. Chronic dietary (food) risk assessments use the three-day average of consumption for each subpopulation combined with residues in commodities to determine average exposure in mg/kg/day.

e. Food Risk Characterization

Generally, a dietary (food) risk estimate that is less than 100% of the acute or chronic Population Adjusted Dose does not exceed the Agency's risk concern. Acute risk estimates from exposures to food, associated with the use of endosulfan exceed the Agency's level of concern for some population subgroups. For example, for exposure resulting from applications of endosulfan, for the most exposed population subgroup, children 1-6 years old, the percent acute PAD value is 150% at the 99.9th percentile of exposure from consumption of food alone. The crops that contributed the most to the risks of concern are succulent beans and succulent peas. The results of the acute dietary (food) assessment are summarized in the Table 3.

Table 3. Summary of Acute Dietary (food) Risk Assessment

Population Subgroup	aPAD	Food Exposure	% aPAD
U.S. General Population	0.0015	0.0012	80%
All Infants	0.0015	0.0014	94%
Children 1-6	0.0015	0.0022	150%
Children 7-12	0.0015	0.0014	95%

Chronic dietary (food) exposure estimates are below the Agency's level of concern for all subpopulations. For the most highly exposed subpopulation, children 1-6 years old, the percent chronic PAD value is 17% from consumption of food alone.

2. Dietary Risk from Drinking Water

Dietary (drinking water) exposure to pesticides can occur through ground water and surface water contamination. EPA considers both acute (one day) and chronic (lifetime) drinking water risks and uses either modeling or actual monitoring data, if available, to estimate those risks. Modeling is considered to be an unrefined assessment. Limited water monitoring data exist for endosulfan; therefore, modeling was used to estimate drinking water risks from these sources.

The GENEEC and PRZM-EXAMS models were used to estimate surface water concentrations, and SCI-GROW was used to estimate groundwater concentrations. All of these are considered to be screening models, with the PRZM-EXAMS model being somewhat more refined than the other two.

a. Surface Water

The Tier II PRZM-EXAMS screening model is used to estimate upper-bound environmental concentrations (EECs) in drinking water derived from surface water. This model, in general, is based on more refined, less conservative assumptions than the Tier I GENEEC screening model. The Agency also used the recently implemented Index Reservoir (IR) and Percent Crop Area (PCA) modifications to the Tier II PRZM-EXAMS model to calculate upper-bound EECs for endosulfan and its degradate, endosulfan sulfate, in drinking water derived from surface water. Applying the IR and PCA modifications, acute modeled EECs for endosulfan in surface water range from 4.49 ppb to 23.86 ppb depending on the crop site. Chronic modeled EECs for endosulfan in surface water range from 0.53 ppb to 1.5 ppb, depending on the crop site.

Monitoring data for endosulfan and endosulfan sulfate in surface water are available but not of sufficient quality to be used in a quantitative risk assessment. A review of the STORET database for α- and β-endosulfan, unspecified endosulfan residues, and endosulfan sulfate showed numerous detections. The STORET data are not reliable enough to enable an accurate quantitative assessment of the endosulfan distribution throughout the U.S., but it does give some insight into where endosulfan is being found. The mean concentration found in this data is 0.17 ppb, with a standard deviation of 0.98 ppb. The 90^{th} percentile value (one in ten year value) was 0.31 ppb and the median value was 0.03 ppb. However, as mentioned above, there are limitations to this data which make it unuseable for quantitative risk assessment. As such, the data do not necessarily represent the most vulnerable sites or sampling at peak exposure times and little is known about actual sample conditions. In addition, the limits of detection vary widely depending on the purpose of the monitoring and the availability of analytical methods and equipment so that reported non-detections do not necessarily mean that endosulfan was not present where a non-detect was reported.

The National Sediment Quality Survey (U.S. EPA, 1997) reported detections of endosulfan residues in stream sediments in 30 out of 76 watersheds tested for endosulfan. The watersheds are located in 12 states, ranging from Rhode Island to California and from Mississippi to Michigan. As with the STORET data, one of the sources of data used in the survey, this summary provides more of a qualitative evaluation of the extent to which endosulfan may be found in the environment rather than a quantitative assessment of endosulfan occurrence.

The U.S. Geological Survey (USGS) in its National Water Quality Assessment (NAWQA) program is not currently analyzing for endosulfan.

b. Ground Water

The Tier I screening model, SCI-GROW, was used to estimate drinking water concentrations derived from groundwater. The acute and chronic EEC for endosulfan in groundwater is 0.012 ppb. This includes potential residues of endosulfan sulfate in addition to endosulfan. The Agency believes that the potential for endosulfan to reach ground water is limited to acidic to neutral soils and aquifers where preferential flow may be a prevalent pathway to ground water or where the ground water is shallow and is overlain by highly permeable soils. Available evidence suggests that the transformation products – endosulfan sulfate and endosulfan diol – may be persistent. Endosulfan sulfate is similar in mobility to the parent endosulfan.

The Pesticides in Ground Water Database (PGWDB) reports detections of endosulfan, ranging from trace to $\leq$20 ppb, in 1.3% of 2410 discrete samples (32 wells). Detections were reported in California, Maine, and Virginia. All sampling was conducted on or before the year 1989. The abbreviated nature of the PGWDB does not capture important factors such as depth of the water table, soil permeability, proximity of crops to wells, usage (application) of the chemical in the years prior to sampling, suitability of the analytical methodology used and/or limits of detection. Endosulfan sulfate was detected in 0.3% of the samples (6 out of 1,969), with detections ranging from < 0.005 to 1.4 ppb. The detections were reported in Indiana and New York. Sampling occurred at or prior to 1990.

c. Drinking Water Levels of Comparison (DWLOC)

To determine the maximum allowable contribution from water containing pesticide residues permitted in the diet, the Agency first looks at how much of the overall allowable risk is contributed by food (and if appropriate, residential uses) then determines a "drinking water level of comparison"(DWLOC) to determine whether modeled or monitoring levels exceed this level. The Agency uses the DWLOC as a surrogate to capture risk associated with exposure from pesticides in drinking water. The DWLOC is the maximum concentration in drinking water which, when considered together with dietary (food) exposure, does not exceed a level of concern.

The results of the Agency's drinking water analysis are summarized here. Details of this analysis, which used screening models, are found in the documents "Endosulfan: Reevaluation of the HED Risk Assessment for the Endosulfan Reregistration Eligibility Decision (RED) Document" dated May 30, 2002 and "α- and β-Endosulfan and Endosulfan Sulfate: Drinking Water EECs in Surface Water for Use in the Human Health Risk Assessment" dated July 3, 2002.

Since acute risk exposures to endosulfan in food alone pose a potential risk of concern for children 1-6 years of age additional exposures from water would increase the concern and therefore the DWLOC for this population is zero. These drinking water risk estimates are summarized below in Table 4.

Table 4. Endosulfan Drinking Water Levels of Comparison for Acute Dietary Exposure

Population Subgroup	Acute PAD (mg/kg/day)	Food Exposure (mg/kg/day) @ 99.9th percentile	Maximum Allowable Water Exposure (mg/kg/day)	$DWLOC_{acute}$ (ppb)	Surface Water Peak EEC (ppb	Ground Water EEC (ppb)
U.S. Population	0.0015	0.0012	0.0003	3	23.86	0.012
Females (13-50 yrs)	0.0015	0.00098	0.00052	16	23.86	0.012
Infants <1 yr	0.0015	0.0014	0.0001	<1	23.86	0.012
Children 1-6 yrs	0.0015	0.0023	0	0	23.86	0.012

Chronic risk estimates from exposures to food, do not exceed the Agency's level of concern for the U.S. general population and all population subgroups. The chronic dietary (food only) risk estimate is 17% of the cPAD, for the most highly exposed population subgroup, children ages 1-6 years of age. Based on these estimates, the Agency can conclude with reasonable certainty that residues of alpha and beta endosulfan and endosulfan sulfate combined with drinking water, would not likely result in a chronic dietary risk to infants, children, and adults that further exceeds the Agency's level of concern (Table 5).

Table 5. Drinking Water Levels of Comparison for Chronic Dietary Exposure

Population Subgroup	Chronic PAD (mg/kg/day)	Food Exposure (mg/kg/day)	Maximum Allowable Water Exposure (mg/kg/day)	$DWLOC_{chronic}$ (ppb)	Surface Water Chronic EEC (ppb)	Ground Water EEC (ppb)
U.S. Population	0.0006	0.000038	0.00056	20	1.5	0.012
Females (13-50 yrs)	0.0006	0.000027	0.00057	17	1.5	0.012
Infants <1 yr	0.0006	0.000045	0.00045	6	1.5	0.012
Children 1-6 yrs	0.0006	0.00010	0.00050	5	1.5	0.012

3. Aggregate Risk

An aggregate risk assessment examines the combined risk from dietary exposure (food and drinking water routes) and any non-occupational exposures (residential use). Acute and chronic aggregate risk assessments were conducted for endosulfan. Residential uses of endosulfan have been voluntarily canceled by the technical registrants. Therefore, aggregate short-term exposures were not estimated. Results of the aggregate risk assessment are summarized here, and are discussed in the endosulfan human health risk assessment.

The Agency was only able to quantify food sources of dietary exposure to endosulfan because dietary exposures through drinking water have only been estimated using models.

Neither adequate groundwater or surface water monitoring data were available to estimate potential drinking water exposures to endosulfan.

Acute Aggregate Risk Assessment: Potential acute dietary risks from food sources alone exceed the Agency's level of concern. The most exposed subpopulation, children 1-6, are estimated to consume 150% of the acute PAD at the 99.9th percentile of exposure, based on highly refined exposure estimates. Therefore, there is no additional room in the "risk cup" for exposure via drinking water (DWLOC = 0).

Chronic Aggregate Risk Assessment: In the case of the food component of the chronic aggregate risk assessment, risks are well below the Agency's level of concern. No more than 17% of the chronic PAD is consumed for children 1-6. Further, potential drinking water risks from exposure to drinking water sources do not exceed the chronic DWLOCs and, therefore, do not exceed the Agency's level of concern.

4. Occupational Risk

Occupational handlers can be exposed to endosulfan through mixing, loading and/or applying a pesticide or re-entering treated sites. Occupational handlers of endosulfan include individual farmers or growers who mix, load and/or apply pesticides and professional or custom agricultural applicators. The post-application occupational risk assessment considered exposures to workers entering treated sites in agriculture. Risk for all of these potentially exposed populations is measured by a Margin of Exposure (MOE), which determines how close the occupational exposure comes to a NOAEL. Generally, MOEs greater than 100 are not of concern. Restricted Entry Intervals (REIs) are 24 hours on current endosulfan labels. The Agency has determined that there are potential mixer, loader, applicator as well as post-application exposures to occupational handlers.

a. Toxicity

The toxicity of endosulfan is integral to assessing the occupational risk. The Agency has conducted short term dermal and inhalation exposure assessments for the occupational handler. In addition, the Agency has conducted short term and intermediate term postapplication dermal exposure assessments for occupational uses.

All risk calculations are based on the most current toxicity information available for endosulfan, including a 21-day dermal toxicity study in rats for short-term and intermediate-term (post-application only) exposure durations. An uncertainty factor (UF) of 100 was applied to the risk assessment:10x to account for interspecies extrapolation and 10x to account for intraspecies variability. The toxicological endpoints and other factors used in the occupational risk assessments for endosulfan are listed below.

Table 6. Summary of Toxicological Endpoints and Other Factors Used in the Human Occupational Risk Assessment for Endosulfan

Route / Duration	NOAEL (mg/kg/day)	Effect	Study	Uncertainty Factors
Short- and Intermediate-term Dermal (one day to one month; one month to several months)	12.0	Mortality in females at 27 mg/kg/day (LOAEL)	21-day dermal toxicity study in rats	Interspecies: 10x Intraspecies: 10x
Short- and Intermediate-term Inhalation (one day to one month; one month to several months)	0.2	Decreased body-weight gain and decreased leukocyte counts in males and increased creatinine values in females at 0.40 mg/kg/day (LOAEL)	21-day inhalation study in rats.	Interspecies: 10x Intraspecies: 10x

Endosulfan is highly toxic following acute oral exposure and moderately toxic following acute inhalation exposure. In rats, oral median lethal doses (LD_{50} values) are 82 mg/kg (males) and 30 mg/kg (females). Median lethal concentrations (LC_{50} values) in rats following acute inhalation exposure range from 0.16 to 0.5 mg/L. Endosulfan is considerably less lethal, however, following acute dermal exposure (LD_{50} is 2.0 g/kg).

Endosulfan is an eye irritant in rabbits (Toxicity Category I) but is not a dermal irritant or sensitizer. Refer to Table 7 below for a summary of the acute toxicity of endosulfan.

Table 7. Summary of Results from Acute Toxicity Studies of Technical Endosulfan

Guideline Number	Study Type	MRID	Results	Toxicity Category
870.1100	Acute Oral	41183502	LD_{50} = 82 mg/kg in ♂ LD_{50} = 30 mg/kg in ♀	I
870.1200	Acute Dermal	41183503	LD_{50} = 2000 mg/kg	III
870.1300	Acute Inhalation	41183504	LC_{50} = 0.16-0.5 mg/L	II
870.2400	Primary Eye Irritation	41183505	Eye irritant (Residual opacity at day 13)	I
870.2500	Primary Skin Irritation	41183506	Non-irritant	IV
870.2600	Dermal Sensitization	41183507	Not a dermal sensitizer	NA

b. Occupational Exposure

Three chemical-specific dislodgeable foliar residue studies that were submitted to the Agency by the technical registrant were used to evaluate post-application exposures. Chemical-specific exposure data for handlers were not available for endosulfan, so risks to pesticide handlers were assessed using data from the Pesticide Handlers Exposure Database (PHED). In addition, standard assumptions about average body weight, work day, area treated daily and volume of pesticide handled were used to calculate risk estimates. The quality of the data and exposure factors represent the best sources of data currently available to the Agency for completing these kinds of assessments. The exposure factors (e.g., body weight, amount treated per day, protection factors, etc.) are all standard values that have been used by the Agency over several years, and the PHED unit exposure values are the best available estimates of exposure.

The quality of the data used for each scenario assessed is discussed in the Human Health Assessment document for endosulfan, which is available in the public docket and on the Agency's web page: ***http://www.epa.gov/pesticides/***.

Calculations were completed for a range of maximum application rates for specific crops available from endosulfan labels. These rates were assessed in order to bracket risk levels associated with the various use patterns. Anticipated use patterns and application methods, range of application rates and daily amount treated were derived from current labeling. On the majority of endosulfan product labels, the number of maximum allowable applications typically ranges between 1 and 3 per season or year, and does not exceed 5. The Agency uses acres treated per day values that are thought to represent an eight hour workday for a particular type of application equipment or specific crop.

Occupational handler exposure assessments are conducted by the Agency using different levels of personal protection. The Agency typically evaluates all exposures with baseline protection and then adds additional protective measures using a tiered approach to obtain an appropriate MOE (i.e., increasing levels of protection). The lowest combination of personal protective equipment (PPE) is baseline PPE. If required (i.e., MOEs are less than 100), increasing levels of risk mitigation PPE are applied. If MOEs are still less than 100, engineering controls are applied. In some cases, EPA will conduct an assessment using PPE or engineering controls taken from a current label. The levels of protection that formed the basis for calculations of exposure from endosulfan include:

- Baseline: Long-sleeved shirt and long pants, shoes and socks.
- Minimum PPE: Baseline + chemical-resistant gloves and a dust/mist respirator.
- Maximum PPE: Coveralls over long-sleeved shirt and long pants, chemical resistant gloves, chemical footwear plus socks, chemical resistant headgear for overhead exposures, and an ov respirator.

- Engineering controls: Engineering controls such as a closed cab tractor for application scenarios, or a closed mixing/loading system such as a closed mechanical transfer system for liquids or water soluble packaging for wettable powders. Some engineering controls are not applicable for certain scenarios (e.g., for handheld application methods there are no engineering controls that lower the exposures).

c. Occupational Handler Risk Summary

Inhalation and dermal exposure to endosulfan can result from occupational use. The Agency assessed dermal and inhalation risks (MOEs) for each crop currently registered for endosulfan. Dermal and inhalation MOEs were not aggregated but were assessed separately because the end effects seen at the LOAEL were different. It is Agency policy not to aggregate the risks (inhalation plus dermal) if the toxicological effects are not the same. Handler exposures to endosulfan are expected to be short-term only (1 - 30 days) because of the types of crops on which endosulfan is used. For endosulfan, occupational MOEs greater than 100 are not of risk concern to the Agency.

(1) Agricultural Handler Risk

EPA has determined that there are potential exposures to mixers, loaders, applicators, and other handlers during usual use-patterns associated with endosulfan. The scenario numbers below correspond to the scenario numbers detailed and discussed in Appendix A of the Occupational and Residential Exposure Chapter of the HED risk assessment dated May 30, 2002. Based on the use patterns, 21 major occupational exposure scenarios were identified for endosulfan:

- (1a) mixing/loading liquid formulations for aerial application;
- (1b) mixing/loading liquid formulation for chemigation;
- (1c) mixing/loading liquid formulations for groundboom application;
- (1d) mixing/loading liquid formulations for airblast application;
- (1e) mixing/loading liquid formulations for rights-of-way sprays;
- (1f) mixing/loading liquid formulations for plant and root dip;
- (2a) mixing/loading wettable powders for aerial application;
- (2b) mixing/loading wettable powders for groundboom application;
- (2c) mixing/loading wettable powders for airblast application;
- (2d) mixing/loading wettable powders for rights-of-way spray application;
- (2e) mixing/loading wettable powders for plant and root dip;
- (3) applying sprays with aerial equipment;
- (4) applying sprays with a groundboom sprayer;
- (5) applying sprays with an airblast sprayer;
- (6) applying sprays with a rights-of-way sprayer;
- (7) applying dip treatment to roots, or whole plants;
- (8) mixing/loading/applying liquids with a low pressure hand wand;
- (9) mixing/loading/applying wettable powders with a low pressure handwand;
- (10) mixing/loading/applying liquids with a high pressure hand wand;
- (11) mixing/loading/applying liquids with backpack sprayer; and
- (12) flagging aerial spray applications.

There were three scenarios that were not evaluated due to a lack of data available to conduct an assessment. These scenarios are mixing/loading/applying wettable powders with backpack sprayer, mixing/loading/applying wettable powders with a high pressure hand wand and application of liquids or wettable powders as a root dip/crown dip.

PPE requirements on current endosulfan labels range from no PPE listed to long sleeved shirt and long pants, waterproof gloves, shoes, socks, chemical resistant headgear, respirator with either an organic vapor removing cartridge with a prefilter or canister approved for pesticides. Mixers and loaders must also wear a chemical resistant apron.

As summarized in Table 8, occupational risks are of concern (i.e., MOEs < 100) for many scenarios, even when maximum PPE are utilized. Handler risks are also of concern for some scenarios with engineering controls. Engineering controls are considered to be the maximum

feasible mitigation. Twelve scenario/application rate combinations have risks that exceed the Agency's level of concern based on application rates supported by the technical registrants. These mainly involve mixing/loading liquids for aerial applications, mixing/loading wettable powders for aerial applications, groundboom applications and airblast applications, application using aerial equipment, application using airblast equipment, application using rights-of-way sprayers and mixing/loading/applying using a high-pressure handwand.

Table 8. Summary of Occupational Handler Risks to Endosulfan

Exposure Scenario (Scenario #)	Crop Type/Use[a]	Range of Application Rates (lb ai/A)[b]	Acres Treated Amount Handled/ Day[c]	Baseline[f]		Minimum PPE[g]		Maximum PPE[h]		Engineering Controls[i]	
				Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]
Mixer/Loader Exposures											
Mixing/Loading Liquid Formulations for Aerial Application (1a)	clover	0.5	350	2	67	210	330	-	-	-	-
	pineapple	2.0		0.41	17	52	83	71	170	140	-
	pecans	3.0		0.28	11	35	56	47	110	**93**	**-**
	small grains	0.75	1,200	0.32	13	41	65	55	130	110	-
	cotton	1.5		0.16	7	20	32	27	65	**54**	**94**
Mixing/Loading Liquid Formulation for Chemigation (1b)	potatoes (Idaho)	1.0	350	0.83	33	100	170	-	-	**-**	-
Mixing/Loading Liquid Formulations for Groundboom Application (1c)	clover	0.5	80	7	290	910	-	-	-	-	-
	pineapple	2.0		2	73	230	360	-	-	-	-
	small grains	0.75	200	2	78	240	390		-	-	-
	cotton	1.5		1	39	120	190		-	-	-
Mixing/Loading Liquid Formulations for Airblast Application (1d)	Ornamental Trees/Shrubs	1.0	10	29	1,200	3,700	-	-	-	-	-
	Hazelnuts	2.0	40	4	150	460	-	-	-	-	-
	pecans	3.0		2	97	300	490	-	-	**-**	-
Mixing/Loading Liquids for Rights-of-way Spray Application (1e)	grapes	0.005	100 Gallons	58	2,300	7,300	-	-	-	-	-
	cherry	0.04		7	290	910	-	-	-	-	-
Mixing/Loading Liquids for Plant and Root Dip (1f)	cherry, peach and plums	0.05	100 Gallons	58	2,300	7,300	-	-	-	-	-
Mixing/Loading Wettable Powders for Aerial Application (2a)	beans	1.0	350	0.65	0.93	14	5	18	10	240	170
	sweet potato	2.0		0.32	0.47	7	2	9	5	120	**83**
	peach	3.0		0.22	0.31	5	2	6	3	**82**	**56**
	small grains	0.75	1,200	0.25	0.36	6	2	7	4	**95**	**65**
	cotton	1.5		0.13	0.18	3	1	4	2	**48**	**32**
Mixing/Loading Wettable Powders for Groundboom Application (2b)	beans	1.0	80	3	4	62	20	81	41	1,100	730
	sweet potato	2.0		1.4	2	31	10	40	20	540	360
	small grains	0.75	200	1.5	2	33	11	43	22	570	390
	cotton	1.5		0.76	1	16	5	22	11	290	190

Exposure Scenario (Scenario #)	Crop Type/Use[a]	Range of Application Rates (lb ai/A)[b]	Acres Treated Amount Handled/ Day[c]	Baseline[f]		Minimum PPE[g]		Maximum PPE[h]		Engineering Controls[i]	
				Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]
Mixing/Loading Wettable Powders for Airblast Application (2c)	Ornamental Trees/ Shrubs	1.0	10	23	33	490	160	-	-	-	-
	hazelnuts	2.0	40	3	4	62	20	81	41	1,100	730
	peaches	3.0		2	3	41	14	54	27	710	490
Mixing/Loading Wettable Powders for Rights-of-way Spray Treatment (2d)	grapes	0.005	1,000 Gallons	45	65	990	330	-	-	-	-
	walnut	0.02		11	16	250	81	-	160	-	-
Mixing/Loading Wettable Powders for Plants and Root Dip (2e)	cherry, peach, and plum	0.05	100 Gallons	45	65	990	330	-	-	-	-
Applicator Exposures											
Applying Spray with Aerial Equipment (3)	clover	0.5	350	See Eng. Controls						960	1,200
	pineapple	2.0								240	290
	pecans	3.0								160	200
	small grains	0.75	1,200							190	230
	cotton	1.5								**93**	110
Applying Sprays with a Groundboom Sprayer (4)	clover	0.5	80	1,500	470	-	-	-	-	-	-
	pineapple	2.0		380	120	-	-	-	-	-	-
	small grains	0.75	200	400	130	-	-	-	-	-	-
	cotton	1.5		200	63	-	310	-	-	-	-
Applying Sprays with an Airblast Sprayer (5)	ornamental trees	1.0	10	230	310	-	-	-	-	-	-
	hazelnuts	2.0	40	29	39	48	190	48	-	550	-
	pecans	3.0		19	26	32	130	32	-	370	-
Applying Sprays with a Rights-of-way Sprayer (6)	grapes	0.005	1,000 Gallons	130	720	-	-	-	-	NF	NF
	cherries	0.04		16	90	54	450	**72**	-	NF	NF
Applying Dip Treatment to Roots, or Whole Plants (7)	cherry, peach, plum roots	0.05	100 gallons	No Data	No Data	ND	ND	ND	ND	ND	ND
Mixer/Loader/Applicator Exposure											
Mixing/Loading/Applying Liquid Formulations with a Low Pressure Handwand (8)	tobacco (drench)	0.005	40 Gallons	42	2,300	9,800	-	-	-	NF	NF
	tomato greenhouse	0.01		21	1,200	4,900	-	-	-	NF	NF
	cherries	0.04		5	290	1,200	-	-	-	NF	NF

Exposure Scenario (Scenario #)	Crop Type/Use[a]	Range of Application Rates (lb ai/A)[b]	Acres Treated Amount Handled/ Day[c]	Baseline[f]		Minimum PPE[g]		Maximum PPE[h]		Engineering Controls[i]	
				Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]	Dermal MOE[d]	Inhalation MOE[e]
Mixing/Loading/Applying Wettable Powders with a Low Pressure Handwand (9)	tomato/ tobacco	0.005	40 Gallons	140	64	-	320	-	-	NF	NF
	walnut	0.02		36	16	120	80	-	160	NF	NF
Mixing/Loading/Applying Liquid with a High Pressure Handwand (10)	tobacco (drench)	0.005	1,000 Gallons	48	23	67	120	110	-	NF	NF
	tomato greenhouse	0.01		24	12	34	58	**53**	120	NF	NF
	cherries	0.04		6	3	9	15	**13**	**29**	NF	NF
Mixing/Loading/Applying Liquid with Backpack Sprayer (11)	tobacco (drench)	0.005	40 Gallons	1,700	2,300	-	-	-	-	NF	NF
	tomato greenhouse	0.01		840	1,200	-	-	-	-	NF	NF
	cherries	0.04		210	290	-	-	-	-	NF	NF
Flagger Exposures											
Flagging Aerial Spray Applications (12)	clover	0.5	350	440	230	-	-	-	-	-	-
	pineapple	2.0		110	57	-	290	-	-	-	-
	pecans	3.0		73	38	67	190	80	-	3,600	-

Footnotes:

a Crops named are index crops which are chosen to represent all other crops at or near that application rate for that use. See the application rates listing in the use summary section of this document for further information on application rates used in this assessment.

b Application Rates are based on the maximum application rates listed on the endosulfan labels.

c Daily amount treated are based on Science Advisory Council for Exposure Policy # 9.1.

d Short- term Dermal MOE = Short- term NOAEL (mg/kg/day)/ Daily Dermal Dose (mg/kg/day).

e Short-term MOE = Short- term NOAEL (mg/kg/day)/ Daily Inhalation Dose (mg/kg/day).

f Baseline clothing: long pants, long sleeved shirt, shoes, socks. Chemical resistant gloves are included for mixing/loading/applying liquids with a backpack sprayer and wettable powders with a low pressure handwand (scenarios 9 and 11).

g Minimum PPE clothing: Baseline clothing plus dust/mist respirator, and chemical resistant gloves.

h Maximum PPE clothing: Baseline clothing plus organic vapor respirator, double layer of clothes, and chemical resistant gloves.

i Engineering controls: Enclosed mixing/loading, closed cab, truck or cockpit. Baseline level clothing. Chemical resistant gloves for airblast sprayer application and mixing/loading liquid formulation (scenarios 1 and 5).

Scenario's calculated MOE exceeds the target MOE at the previous level of mitigation. (MOE > 100)

NF = Not feasible for this scenario (no available engineering controls). ND = No data.

Bolded MOE values show a risk of concern at the highest possible level of mitigation for the corresponding scenario.

(2) Post-Application Occupational Risk

The Agency also assessed post-application risks to workers who may be exposed to endosulfan when they enter previously treated fields, because their skin may contact treated surfaces. Exposures are directly related to the kind of tasks performed. EPA examines the amount of pesticide residue workers may be exposed to as the result of performing these tasks. The Agency evaluates this information to determine the number of days following application

that must elapse before the pesticide residues dissipate to a level where worker MOEs equal or exceed 100 while wearing baseline attire. Baseline attire is defined as long-sleeved shirt, long pants, coveralls, shoes and socks. Based on the results of the post-application worker assessment, the Agency establishes REIs before workers may enter treated areas. At present, endosulfan labels generally have REIs of 24 hours.

The Agency completed a post-application exposure assessment for endosulfan for a number of scenarios as outlined in Table 9 below. The dermal NOAEL of 12 mg/kg/day based on a 21-day dermal toxicity study in rats (Table 6) was used to assess potential dermal exposure to workers re-entering treated fields. The post-application assessment is also based on 8 hours of daily exposure and the default transfer coefficients (Tcs) shown in Table 9. Also, three chemical-specific DFR studies were conducted for endosulfan which were used to determine the values used in conducting the post-application risk assessment.

For post-application risks to endosulfan, an MOE of 100 or greater is not of concern to the Agency. Table 9 summarizes the occupational post-application risk assessment following foliar applications of endosulfan. In summary, REIs as high as 30 days are necessary to achieve an MOE greater than or equal to 100 (e.g. foliar application of the WP on grapes). In general, post-application risks were higher for the wettable powder formulation versus the emulsifiable concentrate.

Table 9. Summary of Post-application Exposure

Crop[a]	Maximum Label Application Rate (lbs ai/acre)[d]		Transfer Coefficient[e] (cm^2/hr)	Activity[f]	Day after Application When MOE ≥ 100[g]	
	WP[b]	EC[c]			WP[b]	EC[c]
Table Grapes / Raisins	1.5	1.5	10,000	Cane turning and tying, and girdling	30	6
Juice Grapes	1.5	1.5	5,000	Tying, training, hand harvesting, hand pruning, and thinning.	20	0
Grapes, Table and Juice	1.5	1.5	1,000	Scouting and irrigating	0	0
Apple, Apricot, Cherry, Nectarines, Peach, Pear, Plum, Prune, Christmas Trees, Ornamental Trees / Shrubs including Evergreen Trees and Non-bearing Citrus Trees.	3	3	3,000	Thinning, staking, topping, training, hand harvest, hand pruning and seed cone harvesting	5	0
Apple, Apricot, Cherry, Nectarines, Peach, Pear, Plum, Prune, Ornamental Trees / Shrubs including Evergreen Trees, Non-bearing Citrus Trees. and Christmas Trees.	3	3	1,000	Scouting and irrigating	0	0
Macadamia nuts, Pistachio Nuts, Pecans, Hazelnut, Almonds and Walnut	2	3	2,500	Hand harvesting, pruning, and thinning	0	0
			500	Scouting and irrigating	0	0

Crop[a]	Maximum Label Application Rate (lbs ai/acre)[d]		Transfer Coefficient[e] (cm^2/hr)	Activity[f]	Day after Application When MOE ≥100[g]	
	WP[b]	EC[c]			WP[b]	EC[c]
Blueberries, Kohlrabi, Broccoli, and Cabbage.	2	2	5,000	Hand harvesting, pruning, thinning, and irrigating.	14	9
Kohlrabi, Broccoli, and Cabbage.	2	2	4,000	Scouting and irrigating	12	7
Blueberries	2	2	1,000	Scouting and irrigating	3	0
Brussels Sprouts and Cauliflower	1	1	5,000	Topping, irrigating, hand harvesting, and tying.	9	4
			4,000	Scouting and irrigating	7	2
Corn	1.5	1.5	17,000	Detassling	21	17
			1,000	Scouting and irrigating	1	0
Cucumber, Melons, Pumpkin, Squash, Beans, Peas, Celery, Lettuce, Spinach, and Carrots.	1	1	2,500	Hand harvesting, pruning, thinning, turning, and leaf pulling	4	0
Alfalfa, Barley , Clover, Oats, Rye, Wheat, White Potatoes, Cucumber, Melon, Pumpkin, Squash, Bean, Peas, Celery, Lettuce, and Spinach.	1	1	1,500	Scouting and irrigating	0	0
Carrots	1	1	300	Scouting and irrigating	0	0
Pepper, Eggplant, and Tomato	1	1	1,000	Hand harvesting, staking, tying, pruning, thinning, and training.	0	0
			700	Scouting and irrigating	0	0
Pineapple	2	2	1000	Hand harvesting	3	0
			500	Scouting and irrigating	0	0
Strawberry	2	2	1,500	Hand harvesting, pinching, pruning, and training.	5	0
			400	Scouting and irrigating	0	0
Cotton, Collard Greens, Kale, Mustard Greens, Sweet Potato, Radish, Rutabaga, and Turnip.	2	2	2500	Hand harvesting, pruning, and thinning.	9	3
Cotton, Collard Greens, Kale, Mustard Greens and Sweet Potato.	2	2	1,500	Scouting and irrigating	5	0
Radish, Rutabaga, and Turnip.	2	2	300	Scouting and irrigating	0	0
Tobacco	1.5	1	2,000	Hand harvesting, pruning, striping, thinning, topping, and hand weeding	5	0
			1,300	Scouting and irrigating	2	0

Footnotes:

Day 0 = day of application after sprays have dried (12 hours).

a Crops were grouped according to similar application rates, transfer coefficients, and surrogate DFR data sources.

b WP = wettable powder formulation

c EC = emulsifiable concentrate formulation

d maximum application rates as stated on current endosulfan labels.

e Transfer Coefficients from Science Advisory Council on Exposure Policy 3.1[16]

f Activities are from Science Advisory Council on Exposure Policy 3.1.[16] Each activity many not occur for every crop listed in group.

g Day after application when the calculated MOE is greater than the target MOE of 100.

(3) Human Health Incident Data

The Agency has reviewed the Incident Data System (IDS), the Poison Control Center, the California Department of Food and Agriculture (Department of Pesticide Regulation), and the National Pesticide Telecommunications Network (NPTN) databases for reported incident information for endosulfan. A number of accidental human poisonings from exposure to endosulfan in occupational settings have been reported. The data from these sources often lacked specific information on the extent of exposure and the circumstances of exposure. Collectively, however, the incidence information indicate definite poisoning risks from misuse of products that contain endosulfan, or from not wearing personal protective equipment.

Several incidents of acute accidental human exposure to endosulfan have been reported. The clinical signs and symptoms observed in humans following acute accidental exposure to endosulfan are similar to those observed in acute toxicity studies in animals. In humans, acute toxicity caused by endosulfan is characterized by nervousness, agitation, tremors, convulsions, and death. In one incident, a 70 year old woman died about three hours after she swallowed "drops" of an endosulfan formulation. Prior to death the woman experienced vomiting, diarrhea, agitation, tonoclonic convulsions, dyspnea, cyanosis, and loss of consciousness. In one incident, nine workers experienced at least one convulsion after bagging a 50% wettable powder formulation of endosulfan. Five of the men were said to be wearing a respirator and protective clothing at the time of exposure. Prodromal symptoms included malaise, vomiting, dizziness and confusion. Further, California data show a consistent risk of skin rash or irritation among field workers who come into substantial contact with endosulfan-treated foliage.

B. Environmental Risk Assessment

A summary of the Agency's environmental risk assessment is presented below. For detailed discussions of all aspects of the environmental risk assessment, see *Final EFED Risk Assessment for the Reregistration Eligibility Decision on Endosulfan*, February 26, 2002, available in the public docket and on the internet at http://www.epa.gov/pesticides/reregistration/endosulfan. Major revisions to the ecological risk assessment are listed below:

- Some risk estimates were recalculated to reflect supported application rates.
- Some RQs were recalculated to include endosulfan sulfate exposure.

1. Environmental Fate and Transport

Technical grade endosulfan is a mixture of two biologically-active isomers, the alpha (α) and beta (β) isomers, which differ in physico-chemical and fate properties. Endosulfan is a persistent, semivolatile compound that has been detected in nearly all environmental compartments, including water and in areas where it is not used (*e.g.*, the Arctic and national parks). The end-use product is a mixture of two endosulfan isomers, typically 70% α-endosulfan and 30% β-endosulfan. The β-isomer is generally more persistent and the α-isomer

is more volatile. For both isomers, hydrolysis at pH values greater than 7 is an important degradation route; however, at pH values below 7, both isomers are rather persistent. At a pH of 7, α-endosulfan and β-endosulfan hydrolyze with half-lives of 11 and 19 days, respectively, and at a pH of 9, the isomers have half-lives of 4 to 6 hours. Under acidic conditions, both isomers are stable to hydrolysis, and microbial degradation in soils becomes the predominant route of degradation. Half-lives in acidic to neutral soils range from one to two months for α-endosulfan and from three to nine months for β-endosulfan under aerobic conditions. Dissipation rates observed in the field studies, which capture a combination of degradation, transport, and uptake, suggest that endosulfan will persist in the surface soil for weeks to months after application (similar order of magnitude to rates observed in the soil metabolism studies).

The major transformation products found in the fate studies are endosulfan diol (hydrolysis) and endosulfan sulfate (soil metabolism). Both the diol and sulfate transformation products have structures similar to the parent compound and are also of toxicological concern. Available data suggest that endosulfan sulfate will be more persistent than the parent. The estimated half-lives for the combined toxic residues (endosulfan plus endosulfan sulfate) ranged from roughly 9 months to 6 years.

Laboratory studies indicate that α- and β-endosulfan have a high affinity for sorption onto soils. The average organic carbon partition coefficients (K_{oc}) were 10,600 and 13,600 mL/g, for the α- and β-endosulfan isomers, respectively. These isomers are not expected to be highly mobile in the soil environments; therefore, they should not be frequently detected in ground water; however, due to their persistence, vulnerable aquifers below acidic soils could be prone to contamination. Moreover, horizontal transport is possible via erosion or dissolution in runoff events. Endosulfan can also contaminate surface waters through spray drift. Its high affinity to sorb to soil indicates that endosulfan is likely to be associated predominantly with the sediment phase in runoff. Endosulfan reaching the water column, through spray drift or runoff, will have a propensity to sorb to benthic sediment, and this sediment may eventually become a source of endosulfan redistribution into the overlying waters. Endosulfan may move beyond its use area through atmospheric transport (via volatilization and/or transport in dust particles).

Based on environmental fate laboratory studies, terrestrial field dissipation studies, available models, monitoring studies, and published literature, it can be concluded that endosulfan is a very persistent chemical which may stay in the environment for lengthy periods of time, particularly in acid media. Endosulfan may be transported via dissolution in water/via runoff, adsorption to soil particles/via erosion, vaporization and/or adsorption to dust particles/transport in the air. While atmospheric transport has been documented for endosulfan, the available data is not sufficient to evaluate its potential impacts on non-target organisms. The limited data available show measured concentrations significantly lower than those used in the Agency's risk assessment but exposures to more sensitive species are possible.

Endosulfan has a relatively high potential to bioaccumulate in fish with octanol-water partition coefficients (K_{ow}) of 55,500 for α endosulfan and 61,400 for β endosulfan. Studies suggest that endosulfan bioconcentration factors in fish ranged from 2400X to 11,000X for

combined isomers in whole fish and endosulfan depurated after 24 hours. Rates of depuration in field conditions will depend on the levels of endosulfan in the water column and the length of time those levels are maintained. Studies have revealed tissue residues are composed of both parent and the endosulfan sulfate degradate.

2. Risk to Birds and Mammals

The Agency's ecological risk assessment compares toxicity endpoints from ecological studies to estimated environmental concentrations (EECs) based on environmental fate characteristics and pesticide use data. To evaluate the potential risk to nontarget organisms from the use of endosulfan products, the Agency calculates a Risk Quotient (RQ), which is the ratio of the EEC to the toxicity endpoint values, such as the median lethal dose (LD_{50}) or the median lethal concentration (LC_{50}). These RQ values are then compared to the Agency's levels of concern (LOCs) which indicates whether a chemical, when used as directed, has the potential to cause adverse effects on nontarget organisms. In general, the higher the RQ the greater the concern. When the RQ exceeds the LOC for a particular category (e.g. endangered species), the Agency presumes a risk of concern to that category. The LOCs and the corresponding risk presumptions are presented in Table 10. In addition, the Agency has conducted a more refined, probabilistic assessment for aquatic organisms.

Table 10. LOCs and Associated Risk Presumptions

IF...	THEN the Agency presumes...
Mammals and Birds	
The acute RQ > LOC of 0.5,	Acute risk
The acute RQ >LOC of 0.2,	Risk that may be mitigated through restricted use
The acute RQ > LOC of 0.1,	Acute effects may occur in Endangered species
The chronic RQ > LOC of 1	Chronic risk *and* Chronic effects may occur in Endangered species
Fish and Aquatic Invertebrates	
The acute RQ > LOC of 0.5	Acute risk
The acute RQ > LOC of 0.1	Risk that may be mitigated through restricted use
The acute RQ >LOC of 0.05	Acute effects may occur in Endangered species
The chronic RQ > LOC of 1	Chronic risk *and* Chronic effects may occur in Endangered species

a. Toxicity (Hazard) Assessment

Endosulfan is classified as highly toxic to birds and mammals on an acute exposure basis and moderately toxic to birds on a subacute dietary basis. Chronic toxicity data on birds and mammals revealed that reproduction and growth were the most sensitive endpoints. For birds, at 60 ppm there were significant reductions in the number of eggs laid, number of eggs hatched, adult body weight and feed consumption. In rats, there was an increase in cumulative pup loss and a reduction in litter size at 100 ppm; parental systemic toxicity was based on decreased body weight and offspring toxicity was based on increased pituitary and uterine weights.

The acute and chronic toxicity endpoints for endosulfan are presented in Table 11. Information in the literature has indicated that in birds, endosulfan may impair the development of the genital tract. In mammals, reduced hormone levels, testicular atrophy and reduced sperm production were observed. These data suggest that endosulfan may affect endocrine-mediated pathways.

Table 11. Summary of Acute and Chronic Toxicity Data for Terrestrial Organisms

Species	Acute Toxicity				Chronic Toxicity	
	LD_{50} (ppm)	Acute Oral Toxicity	5-day LC_{50} (ppm)	Subacute Dietary Toxicity	NOEC/LOEC (ppm)	Affected Endpoints
Northern bobwhite quail *(Colinus virginianus)*	--	--	805	moderately toxic	60 / 120	reproduction
Mallard duck *(Anas platyrhynchos)*	28	highly toxic	1053	slightly toxic	30 / 60	reproduction and growth
Honey bee *(Apis meliferus)*	4.5	–	--	--	--	--
Laboratory rat *(Rattus norvegicus)*	10	highly toxic	--	--	15 / 75	growth

3. Exposure and Risk

The Agency's ecological risk assessment for terrestrial wildlife considers exposure to endosulfan from the ingestion of residues on food. Terrestrial estimated environmental concentrations (EECs) were derived for major crops using labeled application rates and intervals between applications. Uncertainties in the terrestrial EECs are primarily associated with a lack of data on interception and subsequent dissipation from foliar surfaces. Exposure estimates for terrestrial animals represent parent endosulfan only and do not take into account residues from the more persistent and assumed to be equally toxic endosulfan sulfate.

Acute high risk, restricted use and endangered species LOCs are exceeded for birds (RQ range: 0.02 - 0.53) and mammals (RQ range: 0.05 - 40) at current application rates for the major crops modeled. Chronic LOCs for birds were exceeded (RQ range: 0.03 - 2.7) following both single and multiple applications on all food items except seeds. Chronic LOCs for mammals were exceeded (RQ range: 0.3 - 5.4) following multiple applications on all food items. Tables 12-14 summarize the risk quotients for terrestrial wildlife.

Table 12. Avian Acute and Chronic Risk Quotients

Use/App. Method	Rate (lbs ai/A) x No. Apps. (Interval, days)	Food Items	Max. EEC (mg/kg)	Avg. EEC (mg/kg)	Acute RQ	Chronic RQ
Single Application						
tobacco, tomatoes, potatoes, lettuce (aerial), cantaloupe (ground)	1 lb./A (1)	Short grass	240	27	0.30	0.9
		Tall grass	110	10	0.14	0.3
		Broadleaf plants/Insects	135	11	0.17	0.4
		Seeds	15	1	0.02	0.03
Multiple Applications						
tobacco (aerial), tomatoes (aerial), cantaloupe (ground)	1 lb./A (3) 7-day interval	Short grass	332	81	0.41	2.7
		Tall grass	152	35	0.19	1.2
		Broadleaf plants/Insects	187	41	0.23	1.4
		Seeds	21	4	0.03	0.1

Use/App. Method	Rate (lbs ai/A) x No. Apps. (Interval, days)	Food Items	Max. EEC (mg/kg)	Avg. EEC (mg/kg)	Acute RQ	Chronic RQ
Apples (air blast), grapes (aerial), pecans (air blast)	1.5 lbs./A (2) 10-day interval	Short grass	424	81	0.53	2.7
		Tall grass	194	34	0.24	1.1
		Broadleaf plants/Insects	238	39	0.30	1.3
		Seeds	26	4	0.03	0.13

Table 13. Acute RQ Values for Small (15 g), Intermediate (35 g) and Large (1,000 g) Mammals Feeding on Short or Tall Grass, Broadleaf Plants/insects, and Seeds

Site (method) Application Rate (number of applications)	Body Weight (grams)	RQ Short Grass	RQ Tall Grass	RQ Broadleaf Plants/Insects	RQ Seeds
tobacco, lettuce, tomatoes potatoes (aerial), cantaloupe (ground) 1 lb a.i./A	15	23	10	13	0.32
	35	16	7.2	8.9	0.22
	1000	3.6	1.6	2.0	0.05
tobacco (aerial), tomatoes (aerial), cantaloupe (ground) 1 lb. a.i./A (3)	15	32	14	18	0.44
	35	22	10	12	0.31
	1000	5	2.3	2.8	0.06
apples (air blast), grapes (aerial), pecans (air blast) 1.5 lbs. a.i./A (2)	15	40	18	23	0.55
	35	28	13	16	0.39
	1000	6.3	2.9	3.6	0.08

Table 14. Chronic RQ Values for Mammals Feeding on Short Grass, Tall Grass, Broadleaf Plants/insects, and Seeds Exposed to Endosulfan Following Multiple Applications

Site (method) Application Rate (number of applications)	RQ Short Grass	RQ Tall Grass	RQ Broadleaf Plants/Insects	RQ Seeds
tobacco (aerial), tomatoes (aerial), cantaloupe (ground) 1 lb. a.i./A (3)	4.4	2.3	2.7	0.3
apples (air blast), grapes (aerial), pecans (air blast) 1.5 lbs. a.i./A (2)	5.4	2.3	2.6	0.3

4. Risk to Aquatic Species

a. Toxicity (Hazard) Assessment

Endosulfan is very highly toxic to freshwater and estuarine/marine fish and invertebrates. Table 15 summarizes the most sensitive endpoints used in the hazard assessment of aquatic animals. Acute aquatic toxicity estimates ranged from 0.1 to 166 ppb for endosulfan. Estuarine/marine organisms generally were more sensitive to the effects of endosulfan than their freshwater counterparts. No chronic toxicity data were available for the most sensitive freshwater species (rainbow trout and scuds) thus acute to chronic ratio (0.1) was used to predict

NOEC values for these species. On species where chronic toxicity data were available, the most sensitive endpoints were reduced growth and survival. Information from the open literature has indicated that amphibians exposed to endosulfan exhibited impaired development of tadpoles into adults. In fish, endosulfan treatment has resulted in the reduction of cortisol secretion by head kidney cells. These data suggest that endosulfan may affect endocrine-mediated pathways.

Available acute toxicity data include an EC_{50} of 0.58 mg/L for endosulfan diol on *Daphnia magna*, indicating that this intermediate degradate is highly toxic to freshwater invertebrates. Acute toxicity testing of endosulfan sulfate (fish LC_{50} = 2.2 ppb; daphnid EC_{50} = 580 ppb) indicates the toxicity of the persistent degradate is comparable to that of technical grade parent.

Table 15. Summary of Acute and Chronic Aquatic Toxicity Estimates

Species	Acute Toxicity			Chronic Toxicity	
	96-hr LC_{50} (ppb)	48-hr EC_{50} (ppb)	Acute Toxicity	NOEC / LOEC (ppb)	Affected Endpoints
Rainbow trout *Oncorhychus mykiss*	0.8	--	very highly toxic	NOEC = 0.1[a]	--
Bluegill sunfish *Lepomis macrochirus*	1.7	--	very highly toxic	--	--
Fathead minnows *Pimephales promelas*	1.5	--	very highly toxic	NOEC = 0.2 LOEC= 0.4	Reduced growth and survival
Scud *Gammurus lacustris*	--	6	very highly toxic	NOEC = 0.07	--
Water flea *Daphnia magna*	--	166	very highly toxic	NOEC = 2 LOEC < 7	reduced survival
Striped bass *Mornone saxatillis*	0.1	--	very highly toxic	0.01[a]	--
Eastern oyster *Crassostrea virginica*	0.45	--	very highly toxic	0.05[a]	--
Grass shrimp	1.3	--	very highly toxic	--	--

[a] chronic value predicted using acute to chronic ratio of 0.1 estimated from fathead minnow data (acute = 1.5 ppb; chronic = 0.2 ppb)

b. Exposure and Risk

To assess potential risk to aquatic animals, the Agency uses a computer model to generate EECs of endosulfan in surface water. However, unlike the drinking water assessment described in the human health risk assessment section of this document, the ecological water resource assessment does not include the index reservoir and percent crop area factor. These refinements are solely used to assess pesticide exposure to humans from drinking water sources since they are used to predict the levels of endosulfan in a drinking water reservoir from use of endosulfan throughout a watershed rather than predicting the potential exposure to non-target organisms at the field level. Hence, the EECs used to assess exposure to aquatic animals are not the same as the EEC values used to assess human dietary exposure from drinking water sources.

Peak EECs were compared to acute toxicity endpoints to derive acute risk quotients and 21-day EECs were compared to chronic toxicity endpoints (NOAEC) to derive chronic risk quotients for freshwater and estuarine/marine organisms. Exposure estimates for aquatic animals

represent parent endosulfan and residues from the more persistent and equally toxic endosulfan sulfate.

At the current maximum application rates used on the major crops where endosulfan is employed, coupled with a 300-ft spray drift buffer, acute high risk, restricted use and endangered species levels of concern are exceeded for both freshwater and estuarine/marine organisms. Acute RQ values ranged from 1.04 to 34.8 for freshwater fish and from 0.15 to 5 for freshwater invertebrates. Estuarine/marine fish and invertebrates were roughly an order of magnitude more sensitive to the effects of endosulfan, with acute RQ values ranging from 8.7 to 289 for fish and 1.9 to 64.2 for invertebrates. Chronic RQ values ranged from 1.5 to 64 for freshwater fish and from 3.6 to 135.3 for freshwater invertebrates. Chronic RQ values for estuarine ranged from 16 to 704 for fish and 1 to 39.5 for invertebrates.

The following tables summarize the RQs for aquatic organisms using maximum labeled rates and accounting for the 300-foot spray drift buffer. Some sections of the tables do not contain entries either because chronic exposures are not compared against acute toxicity, acute exposures are not compared against chronic toxicity, 21-day exposure are not compared against 56-day toxicity value or 56-day exposure not compared against 21-day toxicity value.

Table 16. Acute and Chronic Risk Quotients for Freshwater Fish and Invertebrates

Crop Application Rate (# of apps)	EECs	Acute Risk Quotients		Chronic Risk Quotients	
	Peak / 21-day Average 56-day Average (ppb)	Freshwater Fish LC_{50} = 0.83 ppb	Freshwater Invertebrate LC_{50} = 5.8 ppb	Freshwater Fish NOEC = 0.11 (ppb)	Freshwater Invertebrate NOEC = 0.07 (ppb)
Apples 1.5 (2)	0.87 0.25 0.16	1.04 – --	0.15 – --	-- -- 1.5	– 3.6 –
Cotton 1.5 (2)	11.67 4.9 3.89	14.1 – --	2 – --	– -- 35.4	– 70 --
Lettuce 1.0 (3)	4.64 1.41 0.79	5.6 – --	0.8 – --	– -- 7.2	– 20.1 --
Pecan 1.5 (2)	19.39 6 3.86	23.4 – --	3.4 – --	– -- 35.1	– 85.7 --
Potato 1.0 (3)	6.07 2.14 1.53	7.3 – --	1.1 – --	- -- 13.9	–- 30.6 --
Tobacco 1.0 (3)	9.72 2.8 1.72	11.7 –	1.7 – --	– -- 15.6	– 40 --
Tomato 1.0 (3)	28.9 9.47 7.04	34.8 – --	5 – --	– -- 64	– 135.3 –

Table 17. Acute and Chronic Risk Quotients for Estuarine/marine Fish and Invertebrates

Crop Application Rate (# of apps)	EECs	Acute Risk Quotients		Chronic Risk Quotients	
	Peak 21-day Average (ppb)	Estuarine/marine Fish LC_{50} = 0.1 ppb (EEC/LC_{50})	Estuarine/marine Invertebrate LC_{50} = 0.45 (ppb) (EEC/LC_{50})	Estuarine/marine Fish NOEC = 0.01 (ppb) (EEC/NOEC)	Estuarine/marine Invertebrate NOEC = 0.24 (ppb) (EEC/NOEC)
Apples 1.5 (2)	0.87 0.25 0.16	8.7 – --	1.9 – --	– -- 16	-- 1 --
Cotton 1.5 (2)	11.67 4.9 3.89	116.7 – --	25.9 – --	– -- 389	– 20.4 --
Lettuce 1.0 (1)	4.64 1.41 0.79	46.4 – --	10.3 – --	– -- 79	– 5.87 --
Pecan 1.5 (2)	19.39 6 3.86	193.9 – --	43.1 – --	– -- 386	– 25 --
Potato 1.0 (3)	6.07 2.14 1.53	60.7 – --	13.5 – --	– – 153	– 8.9 --
Tobacco 1.0 (3)	9.72 2.8 1.72	97.2 – --	21.6 – --	– -- 172	– 7.2 --
Tomato 1.0 (3)	28.9 9.47 7.04	289 – --	64.2 – --	– -- 704	– 39.5 –

Endosulfan was the most frequently detected insecticide in tadpole and adult frog tissues in a California study (Sparling et. al. 2001). The frequency of occurrence of endosulfan was higher in samples collected in the Sierra Nevada mountains east of the Central Valley. Concentrations and frequency of detections for the pesticide in amphibian tissue follow north-south and west-east patterns consistent with intensified agriculture upwind of the areas with the most serious declines in amphibian populations, several of which are either listed (red-legged frog [*Rana aurora*]) or proposed for listing (yellow-legged frog [*Rana muscosa*] and Yosemite toad [*Bufo canorus*]) as threatened under the Endangered Species Act.

5. Probabilistic Assessment

The Agency used probabilistic assessment techniques to conduct a more refined risk assessment for aquatic organisms that was based on actual reported application rates in California coupled with a 300-ft spray-drift buffer. The methods used in this assessment and other probabilistic methods are currently under development, and thus this assessment is not definitive and further refinements in the techniques should be expected. However, this assessment does provide some insight into the expected effects of endosulfan on whole aquatic systems.

This assessment compared a range of EEC values (single annual 96-hour maximum concentrations) from models to a range of LC_{50} values for several aquatic species. This analysis provides a first step into probabilistically modeling of overall aquatic effects and provides insights on the range of endosulfan's ecological effects. The assessment estimates that, for the lowest exposure uses (e.g., apples), the use of endosulfan at typical application rates has a 10% probability of detrimentally affecting (LC_{50} values being exceeded by modeled EECs) 10% of the aquatic species in a given year. For higher exposure uses (*e.g.,* tomatoes) the use of endosulfan at typical application rates in a given year resulted in a 90% probability that 60% of the aquatic species will be detrimentally affected, a 50% probability that 75% of the species will be detrimentally affected, and a 10% probability that 90% of the species will be detrimentally affected.

6. Risks to Endangered Species

Endangered species LOCs are exceeded for acute and chronic risks to all taxa fo endangered/threatened animals – birds, mammals, fish, aquatic invertebrates, amphibians, reptiles and terrestrial for all currently registered uses of endosulfan.

In 1989 the U.S. Fish and Wildlife Service (USFWS) issued a biological opinion on endosulfan in response to the U. S. Environmental Protection Agency's request for consultation. In issuing its opinion the USFWS considered the following factors: (1) potential for exposure of the listed species to the pesticide; (2) information on the chemical toxicity relative to estimated environmental concentrations; (3) potential for secondary impacts; and (4) special concerns not specifically addressed in the preceding factors or unique to the situation being evaluated. Given the evaluation criteria, a total of 130 species (6 amphibians, 77 fish, 32 mussels, 6 crustaceans, 4 miscellaneous aquatic invertebrates, and 5 bird species) were considered potentially affected by the use of endosulfan. Of those organisms potentially affected, the USFWS listed 41 aquatic species as jeopardized, of which the majority (54%) were endangered/threatened species of freshwater mussels. Two terrestrial (avian) species were also classified as being in jeopardy. The remaining potentially affected organisms were listed either as having no potential for exposure or as not being in jeopardy.

The Agency's current assessment of ecological risks uses both more refined methods to define ecological risks of pesticides and new data, such as that for spray drift. Therefore, the Reasonable and Prudent Alternatives and Reasonable and Prudent Measures in the Biological Opinion may need to be reassessed and modified based on these new approaches.

The Agency is currently engaged in a Proactive Conservation Review with FWS and the National Marine Fisheries Service under section 7(a)(1) of the Endangered Species Act. The objective of this review is to clarify and develop consistent processes for endangered species risk assessments and consultations. Subsequent to the completion of this process, the Agency will reassess the potential effects of endosulfan use to federally listed threatened and endangered species. At that time the Agency will also consider any regulatory changes recommended in the RED that are being implemented. Until such time as this analysis is completed, the overall

environmental effects mitigation strategy articulated in this document and any County Specific Pamphlets which address endosulfan, will serve as interim protection measures to reduce the likelihood that endangered and threatened species may be exposed to endosulfan at levels of concern.

7. Ecological Incident Reports

A review of the Ecological Incident Information System revealed that since 1971 a total of 91 incidents have been associated with the use of endosulfan. The majority of incidents occurred in California, South Carolina, North Carolina, and Louisiana. The overwhelming majority (96%) of the incidents were associated with the aquatic environment: 82% affected fish while 7% affected aquatic macroinvertebrates. The database indicates that 34% of the endosulfan incidents were a result of either accidental or intentional misuse of the pesticide, 29% resulted from the labeled use of endosulfan and the rest were unspecified. Approximately 32% of the incidents were directly attributable to runoff. However, weather conditions were not specified in the majority of cases, so the contribution of runoff may be underestimated by the reported results.

According to the National Oceanic and Atmospheric Agency's fish-kill database endosulfan was responsible for more fish kills in U.S. estuaries and coastal rivers between 1980 and 1989 than all currently used pesticides at that time. The report noted that endosulfan was one of the most often found of the inventoried pesticides in aquatic biota and in one case affected estuarine biomass.

In 1991, as mentioned earlier, a 300-foot spray drift buffer was put in place on endosulfan labels to address contamination of water bodies. Since this restriction was implemented in 1991 a total of 33 aquatic incidents have been reported, 20 of which were not attributed to misuse. In terms Of these 20 incidents, 7 have been classified as highly probable, 11 have been classified as probable and 3 have been classified as possible. Thus, despite use restrictions to limit degradation of the aquatic environment, endosulfan has continued to access the aquatic environment and result in nontarget mortality.

8. Endocrine Disruption

Exposure to endosulfan has resulted in both reproductive and developmental effects in nontarget animals. Endosulfan exposure resulted in impaired development in amphibians, reduced cortisol secretion in fish, impaired development of the genital tract in birds and reduced hormone levels and sperm production and produced testicular atrophy in mammals. Additionally, endosulfan has been demonstrated to bind to the human estrogen receptor and exhibit significant estrogenic activity. Whether the toxicity endpoints are a result of endocrine disruption is not known. However, it is clear that organisms treated with endosulfan did exhibit some toxic effects that have historically been associated with endocrine disrupting chemicals, *e.g.*, developmental and reproductive effects.

9. Long Range Transport

Endosulfan is a semivolatile and persistent cyclodiene pesticide that can migrate over a long distance through various environmental media such as air, water, and sediment. Once endosulfan is applied to crops, it can either persist in soil as a sorbed phase or be removed through several physical, chemical, and biological processes. Recent studies suggest that secondary emissions of residual endosulfan continue to recycle in the global system while they slowly migrated and were redeposited via wet deposition in the Northern Hemisphere. The occurrence of endosulfan in remote regions like the Great Lakes, the Arctic, and mountainous areas is well documented. Endosulfan can also enter the air as adsorbed phase onto suspended particulate matter, but this process does not appear to be a major contributor long range transport like volatilization.

The presence of endosulfan in the remote areas like Arctic and the Great Lakes requires further understanding of the transport mechanisms from the atmosphere. The potential impact of atmospheric deposition of endosulfan into surface water and its potential effect on water quality and aquatic organisms in the non-use areas is not well documented. Despite the progress made in recent years in estimating the persistence and long-ranged transport of chemicals using models, a validated global model has not been published because of uncertainties involved in the source inventories, chemical fate data, degradative pathways and exposure analyses. Future work will be aimed at developing a comprehensive screening tool that can be used reliably in risk assessments for regulatory purposes.

IV. Risk Management and Reregistration Decision

A. Determination of Reregistration Eligibility

Section 4(g)(2)(A) of FIFRA calls for the Agency to determine, after submission of relevant data concerning an active ingredient, whether products containing the active ingredient are eligible for reregistration. The Agency has previously identified and required the submission of the generic (i.e., an active ingredient specific) data required to support reregistration of products containing endosulfan active ingredients.

The Agency has completed its assessment of the dietary (food and drinking water), ecological and occupational risks associated with the use of currently registered pesticides containing the active ingredient endosulfan. Based on a review of these data and public comments on the Agency's assessments for the active ingredient endosulfan, EPA has sufficient information on the human health and ecological effects of endosulfan to make decisions as part of the tolerance reassessment process under FFDCA and reregistration under FIFRA, as amended by FQPA. The Agency has reassessed all 80 tolerances for endosulfan and can make a FQPA safety determination as detailed below. The Agency has determined that agricultural use of endosulfan, based on the currently approved labeling, pose occupational and ecological risks that constitute unreasonable adverse effects on the environment. However, the Agency believes

that these risks can likely be acceptably mitigated through routine changes to pesticide labeling and formulations. Accordingly, the Agency has determined that endosulfan is eligible for reregistration provided that: (i) additional data that the Agency intends to require confirm this decision for occupational exposures associated with the application of dip treatment to roots or whole plants and ecological risks; and (ii) the risk mitigation measures outlined in this document are adopted, and label amendments are made to reflect these measures. Label changes are described in Section V of this document. Appendix A summarizes the uses of endosulfan that would be eligible for reregistration. Appendix B identifies the generic data requirements that the Agency reviewed as part of its determination of reregistration eligibility of endosulfan, and lists the submitted studies that the Agency found acceptable. The additional data that the Agency intends to require are described in Section V. Further mitigation measures and additional data requirements, however, may be warranted following the completion of the stakeholder process outlined in this document.

Based on its evaluation of endosulfan, the Agency has determined that endosulfan products, unless labeled and used as specified in this document, would present risks inconsistent with FIFRA. Accordingly, should a registrant fail to implement any of the risk mitigation measures identified in this document, the Agency may take regulatory action to address the risk concerns from use of endosulfan.

B. Phase 3 Comments and Responses

When making its reregistration decision, the Agency took into account all comments received during Phases 3, 4 and 5 of the Public Participation Process. These comments in their entirety are available in the docket. Comments, which addressed human health and ecological concerns, were received from the technical registrants, represented by the Endosulfan Task Force(ETF), environmental and advocacy groups such as the Natural Resources Defense Council (NRDC), the Farmworker Justice Fund, Inc., the Pesticide Action Network North America (PANNA) and their affiliate, the Pesticide Action Network Asia and Pacific (PANAP), Respiratory and Environmental Disabilities Association of Hawaii, the Rural Action Safe Pest Control Program (RASPCP), the World Wildlife Federation, and private citizens. Agency responses to comments are available on the Agency's web page: ***http://www.epa.gov/pesticides/reregistration/endosulfan***.

Comment Period on this RED

The Agency is providing a 60-day comment period on this RED. While all comments are welcome, those with specific data or information bearing on the risk and benefit assessments are most useful. For example, the Agency is aware that cotton stakeholders are gathering data on the number of acres treated per day by air in AZ and CA which may be used to characterize handler risks in those areas and may impact the maximum application rate allowed for that crop. The Agency has also recently received comments related to tobacco which will be considered during the comment period.

C. Regulatory Position

1. FQPA Assessment

a. "Risk Cup" Determination

As part of the FQPA tolerance reassessment process, EPA assessed the risks associated with this pesticide. EPA has determined that risk from exposure to endosulfan exceeds its own "risk cup" for pesticidal uses of endosulfan registered by EPA. However, if the use of endosulfan on succulent beans, succulent peas, grapes, pecans and spinach are deleted and the mitigation measures in this document to prevent contamination of surface waters are implemented, the Agency believes that endosulfan will "fit" within its risk cup. Therefore, the Agency has concluded that the tolerances for endosulfan meet the FQPA safety standards, provided the risk mitigation measures outlined in this document are adopted. In reaching this determination, EPA has considered the available information on the special sensitivity of infants and children, as well as the acute and chronic food exposure. An aggregate assessment was conducted for exposures resulting from food and drinking water for pesticidal uses of endosulfan registered by EPA under FIFRA. Results of this aggregate assessment indicate that the human health risks from these combined exposures are considered to be over acceptable levels, but that the combined risks from all exposures to endosulfan do "fit" within the individual risk cup provided the risk mitigation contained in this decision document are fully implemented.

b. Tolerance Summary

Tolerances for residues of endosulfan in/on plant and animal commodities are established under 40 CFR §180.182. Tolerances for residues of endosulfan in processed commodities are established under 40 CFR §185.2600. Endosulfan tolerances are currently expressed in terms of the total residues of endosulfan (6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3-oxide) and its metabolite, endosulfan sulfate (6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-6,9-methano-2,4,3-benzodioxathiepin-3,3-dioxide). The current endosulfan tolerance expression does not specify the two stereo isomers of the parent compound.

The Agency has determined that tolerances for crop and livestock commodities should continue to be expressed as residues of the parent (α and β isomers) and the sulfate metabolite. However, the Agency recommends that the tolerance expression be revised in order to specify the α and β isomers of the parent.

The Agency has recently updated the list of raw agricultural and processed commodities and feedstuffs derived from crops (Table 1, OPPTS GLN 860.1000). As a result of changes to Table 1, endosulfan tolerances for certain commodities which have been removed from Table 1 need to be revoked, and some commodity definitions must be corrected. In addition, tolerances for commodities for which there are currently no registered uses of endosulfan need to be revoked. A summary of endosulfan tolerance reassessments is presented in Table 18.

Tolerances Listed Under 40 CFR §180.182:

Pending label revisions for some crops, sufficient field trial data have been submitted (or were translated when appropriate) to reassess the established tolerances for the following plant commodities, as defined: almonds; almonds, hulls; apples; apricots; beans; blueberries; broccoli; Brussels sprouts; cabbage; carrots; cauliflower; celery; cherries; collards; corn, sweet (K+CWHR); cottonseed; cotton gin byproducts; cucumbers; eggplant; filberts; grapes; kale; lettuce; macadamia nuts; melons; mustard greens; nectarines; peaches; pears; peas, pistachios, succulent; pecans; peppers; pineapples; plums; potatoes; prunes; pumpkins; spinach; squash, summer; squash, winter; strawberries; sweet potatoes; tomatoes; turnips; and walnuts. Additional data is needed for the uses of endosulfan on wheat, oats, rye, and barley.

The available residue data suggest that the established tolerance levels for the following plant commodities should be decreased from 2.0 to 1.0 ppm: apples; cucumbers; eggplant; melons; pineapples; pumpkins; squash, summer; squash, winter; and tomatoes. The Agency proposes a crop group tolerance for Cucurbit Vegetables Group (Crop Group 9) since adequate data are available for cucumbers, melons, and squash which are the representative commodities of this crop group.

The available residue data suggest that the established tolerance levels for the following commodities should be increased: broccoli (from 2.0 to 3.0 ppm); cabbage (from 2.0 to 4.0 ppm); celery (from 2.0 to 8.0 ppm); lettuce, head (from 2.0 to 11.0 ppm); and lettuce, leaf (from 2.0 to 6.0 ppm); Blueberry (from 0.1 to 0.3 ppm); barley grain (from 0.1 to 0.3 ppm); and barley straw (from 0.2 to 0.4); rye grain (from 0.1 to 0.3); and rye straw (from 0.2 to 0.3 ppm); oats grain (from (0.1 to 0.3); and oats straw (from 0.2 to 0.4 ppm); and oats grain (from 0.1 to 0.3); and wheat straw (from 0.2 to 0.4 ppm).

The expected dietary burdens of endosulfan to beef and dairy cattle were re-calculated following tolerance reassessment of livestock feed items. Livestock feeding studies reflecting the re-calculated dietary burden are available. Following evaluation of feeding data, the Agency concluded: (I) the tolerance for milk fat (=N in whole milk) at 0.5 ppm should be increased to 2.0 ppm; (ii) the tolerances for meat byproducts of cattle, goats, hogs, horses, and sheep at 0.2 ppm should be replaced with separate tolerances for meat byproducts (except liver) at 1.0 ppm and liver at 5.0 ppm; and (iii) the tolerance for fat should be increased from 0.2 to 13 ppm.

The available poultry feeding data suggest that it is not possible to establish with certainty whether finite residues of endosulfan will be incurred, but there is no reasonable expectation of finite residues (Category 3 of 40 CFR §180.6). Therefore, tolerances are not required for eggs and poultry tissues.

Tolerance to be Proposed Under 40 CFR §180.182:

Tolerances for the combined residues of endosulfan (α and β isomers) and its metabolite endosulfan sulfate in/on: pearled barley, barley hay, flour, and bran; oats forage, hay, flour and

rolled oats; rye forage, flour and bran; wheat forage, hay, and aspirated grain fractions must be proposed once adequate field residue data, reflecting the maximum registered use patterns, have been submitted and evaluated.

The apple processing study indicates that the combined residues of endosulfan (α and β isomers) and endosulfan sulfate concentrated in dried and wet apple pomace (17x and 6x, respectively); no concentration of endosulfan residues was observed in apple juice. A tolerance for dried apple pomace is not required as it is no longer considered a major livestock feed item and its entry has been deleted from Table 1. A tolerance for apple juice is also not warranted. However, based on the highest average field trial combined residues in/on the RAC and a concentration factor of 6x, the maximum expected endosulfan residues in wet apple pomace is 4.62 ppm. Therefore, a tolerance for the combined endosulfan residues in wet apple pomace must be proposed at 5.0 ppm.

The pineapple processing study indicates that the combined residues of endosulfan (α and β isomers) and endosulfan sulfate concentrated up to 7x in peel and 41x in bran processed from whole pineapples bearing detectable endosulfan residues; no concentration of endosulfan residues was observed in pineapple pulp and juice. According to OPPTS Table 1, residue data are only required for process residue and juice. Pineapple process residue (also known as wet bran) is a waste byproduct from the fresh-cut product line that includes pineapple tops (minus crown), bottoms, peels, any trimmings with peel cut up, and the pulp (left after squeezing for juice). Based on a HAFT combined endosulfan residues of 0.44 ppm in/on the RAC and a concentration factor of 41x, the maximum expected total endosulfan residues in pineapple process residue is 18.04 ppm. Therefore, a tolerance for the combined endosulfan residues in pineapple process residue must be proposed at 20 ppm. A tolerance for pineapple juice is not warranted.

The available tomato processing data indicate that endosulfan residues of concern marginally concentrate (1.2x) in tomato paste processed from treated tomatoes. The concentration of residues in tomato paste is not significant enough to warrant a tolerance for this commodity. A tolerance for tomato puree is also not warranted. Processing data for oats, barley, wheat, and rye are required.

Tolerance Listed Under 40 CFR §185.2600:

Adequate data are available to reassess the established tolerance for dried tea leaves. The established tolerance for dried tea (reflecting less than 0.1 ppm residues in beverage tea) listed under 40 CFR §185.2600 should be moved to 40 CFR 180.182 because the enacted FQPA stipulates that tolerances for pesticide residues in all types of food (raw or processed) be set under the same provisions of the law.

Pending Tolerance Petition:

Hoechst Celanese Corporation proposed the establishment of tolerances for residues of endosulfan and endosulfan sulfate in dried hops and spent hops imported from Germany, each at 10 ppm. The Agency recommends in favor of the proposed tolerances subject to the registrant limiting the number of applications to three.

Table 18. Tolerance Reassessment Summary for Endosulfan

Commodity	Established Tolerance (ppm)	Reassessed Tolerance (ppm)	Comments [*Correct Commodity Definition*]
Tolerance Listed Under 40 CFR §180.182 (a) (1)			
Alfalfa, fresh	0.3	Revoke	No longer a registered use.
Alfalfa, hay	1.0	Revoke	
Almond	0.2 (N)*	0.3	The available data indicate that residues of endosulfan or endosulfan sulfate were nondetectable in/on almond kernels harvested 39 or 58 days following the last of multiple applications of a representative WP formulation at exaggerated (2.4x) seasonal rate ; the reported limits of detection were 0.2 and 0.1 ppm respectively. A preharvest interval for almonds has presently not been established. [*Almond, nutmeat*]
Almond, hulls	1.0	1.0	Following applications of a representative WP formulation reflecting the maximum registered use pattern, the combined endosulfan residues in/on almond hulls ranged from 0.12 to 0.77 ppm. [*Almond, hulls*]
Apple	2.0	1.0	Data reflecting the maximum registered use pattern are unavailable. However, data reflecting applications at exaggerated (2x) seasonal rate indicate that the combined endosulfan residues in/on apples ranged from 0.46 to >0.47 ppm using the EC formulation, and from 0.69 to 0.84 ppm using the WP formulation. The reassessed tolerance is in harmony with the proposed Codex MRL (Step 5/8) of 1.0 ppm for pome fruits. *[Apple]*
Apricot	2.0	2.0	The available data for peaches may be translated to apricots. [*Apricot*]
Artichoke, globe	2.0	Revoke	No longer a registered use.
Barley, grain	0.1 (N)	0.3	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on barley grain ranged from <0.15 to <0.30 ppm..
Barley, straw	0.2 (N)	0.4	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on barley straw ranged from <0.15 to 0.35 ppm.
Bean	2.0	2.0 (*Bean, dry and* ***succulent*****)**	Following applications of a representative WP or EC formulation reflecting the maximum registered use pattern, the combined endosulfan residues were below 2.0 ppm in/on lima beans, snap beans, red kidney beans, string beans, and sutter red beans . The reassessed tolerance only applies to bans, dry since the succulent bean use is being deleted. [Bean, succulent seed]
Beets, sugar, without tops	0.1 (N)	Revoke	No longer a registered use. [Beet, sugar, root]

Commodity	Established Tolerance (ppm)	Reassessed Tolerance (ppm)	Comments [*Correct Commodity Definition*]
Blueberry	0.1 (N)	0.3	Following applications of a representative EC formulation reflecting exaggerated use pattern, no detectable residues (<0.1 ppm) of endosulfan or endosulfan sulfate were detected in/on blueberries . [Blueberry]
Broccoli	2.0	3.0	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on broccoli ranged from 0.16 to 2.41 ppm using the EC formulation, and from 0.26 to 1.92 ppm using the WP formulation. The registrants may elect to retain the current tolerance level by amending the registered broccoli use pattern and by submitting additional residue data in support of any label amendments.
Brussels sprouts	2.0	2.0	Data reflecting the maximum registered use pattern are unavailable. However, data reflecting applications of a representative EC formulation at exaggerated (3.5x) seasonal rate indicate that the combined residues of endosulfan in/on Brussels sprouts were below 2.0 ppm .
Cabbage	2.0	4.0	Following applications of a representative EC formulation reflecting the maximum registered use pattern, the combined endosulfan residues were 3.1 ppm in/on cabbage with wrapper leaves and nondetectable (<0.02 ppm) in/on cabbage without wrapper leaves . The reassessed tolerance is based on data from cabbage with wrapper leaves.
Carrots	0.2	0.2	Following applications of a representative EC formulation reflecting the maximum registered use pattern, the combined endosulfan residues in/on carrots were generally below 0.2 ppm . [*Carro*t]
Cattle, fat	0.2	13	The highest residues obtained in milk and tissue samples collected from the highest feeding level of the combined residues of endosulfan (α and β isomers) and endosulfan sulfate in animal commodities are as follows : Fat of cattle, goats, hogs, horses, and sheep 13.0 ppm Meat byproducts (except liver) of cattle, goats, hogs, and horses 1.0 ppm Liver of cattle, goats, hogs, and horses . . . . . 5.0 ppm Meat of cattle, goats, hogs, and horses . . . . . 2.0 ppm Milk, fat . . . . . 2.0 ppm
Cattle, meat by products	0.2	Cattle, mbyp = 1.0 Cattle, liver = 5.0	[*Cattle, meat byproducts (except liver)*] [*Cattle, liver*]
Cattle, meat	0.2	2.0	
Cauliflower	2.0	2.0	Following applications of a representative EC formulation reflecting the maximum registered as well as exaggerated use patterns, the combined endosulfan residues in/on cauliflower were below 0.78 ppm. Due to the limited number of data points reflecting treatments at 1x, the cauliflower tolerance is reassessed at 2.0 ppm .

Commodity	Established Tolerance (ppm)	Reassessed Tolerance (ppm)	Comments [*Correct Commodity Definition*]
Celery	2.0	8.0	These new residue data reflect application(s) of representative emulsifiable concentrate (EC) and wettable powder (WP) formulations at the respective maximum registered seasonal rates for celery. The combined residues in/on treated untrimmed celery samples ranged from 0.99 to 4.50 ppm following application of the EC formulation, and from 1.18 to 7.0 ppm following application of the WP formulation.
Cherry	2.0	Cherry, sweet = 2.0 Cherry, sour = 2.0	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on **sweet cherries** ranged from <0.17 to 1.46 ppm using the EC formulation, and from <0.15 to 0.33 ppm using the WP formulation. The combined endosulfan residues in/on **sour cherries** ranged from <0.15 to 1.35 ppm using the EC formulation, and from <0.15 to 0.19 ppm using the WP formulation. [*Cherry, sweet*] and [*Cherry, sour*]
Collards	2.0	2.0	The available data reflecting the maximum registered use pattern for collards are very limited. Following application of a representative EC formulation at 0.75x the maximum registered seasonal rates, the combined endosulfan residues in/on collards harvested 20 days posttreatment were 1.591-1.782 ppm . The data submitted for spinach, sugar beet tops, kale, or mustard greens may additionally be used to estimate endosulfan residues in/on collards.
Corn, sweet (K+CWHR)	0.2	0.20	The reassessed tolerance is contingent upon the requested label revisions specifying the parameters of use patterns for which adequate data are available.
Cottonseed	1.0	1.0	Following applications of a representative EC formulation reflecting the maximum registered use pattern, the combined endosulfan residues in/on cottonseed were below 1.0 ppm . [*Cotton, undelinted seed*]
Cotton gin byproducts	-	30	The combined residues of endosulfan (α and β isomers) and endosulfan sulfate ranged from 8.27 to 27.5 ppm in/on cotton gin byproducts harvested 13-14 days following a treatment schedule (**after** bolls open) similar to the one described above for cottonseed. No cotton gin byproducts data reflecting treatments made to cotton plants **until** bolls open have been submitted; however, because residues are expected to be lower from this use pattern, the Agency will not require additional cotton gin byproducts data for reregistration.
Cucumber	2.0	Reassign	Tolerance should be revoked with the concomitant establishment of a tolerance for Cucurbit Vegetables (Crop Group 9). Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on cucumbers ranged from 0.26 to 0.66 ppm using the EC formulation, and from <0.16 to 0.40 ppm using the WP formulation. Adequate data are now available for cucumber, melon, and squash which are the representative commodities of Cucurbit Vegetables Group (Crop Group 9). [*Cucumber*]
Eggplant	2.0	1.0	The available data for tomato may be translated to eggplant.

Commodity	Established Tolerance (ppm)	Reassessed Tolerance (ppm)	Comments [*Correct Commodity Definition*]
Filbert	0.2 (N)	0.20	The available data indicate that residues of endosulfan or endosulfan sulfate were nondetectable in/on filbert nuts harvested 76-88 days following the last of multiple applications of representative WP formulations at 1.3-1.6x the maximum registered seasonal rate. The method's limit of detection was not specified. [*Filbert*]
Goat, fat	0.2	13	The highest residues obtained in milk and tissue samples collected from the highest feeding level of the combined residues of endosulfan (α and β isomers) and endosulfan sulfate in animal commodities are as follows : Fat of cattle, goats, hogs, horses, and sheep 13.0 ppm Meat byproducts (except liver) of cattle, goats, hogs, and horses 1.0 ppm Liver of cattle, goats, hogs, and horses . . . . . 5.0 ppm Meat of cattle, goats, hogs, and horses . . . . . 2.0 ppm Milk, fat . . . . . 2.0 ppm
Goat, meat byproduct	0.2	Goats, mbyp = 1.0 Goats, liver = 5.0	[*Goat, meat byproducts (except liver)*] [*Goat, liver*]
Goat, meat	0.2	2.0	
Grape	2.0	Revoke	Use being deleted as part of dietary risk mitigation.
Hog, fat	0.2	13	
Hog, meat byproduct	0.2	Hog, mbyp = 1.0 Hog, liver = 5.0	[*Hog, meat byproducts (except liver)*] [*Hog, liver*]
Hog, meat	0.2	2.0	
Horse, fat	0.2	13	
Horse meat byproduct	0.2	Horses, mbyp = 1.0 Horses, liver = 5.0	[*Horse, meat byproducts (except liver)*] [*Horse, liver*]
Horse, meat	0.2	2.0	
Kale	2.0	2.0	Following applications of a representative EC formulation reflecting the maximum registered use pattern, the combined endosulfan residues in/on kale were 1.214-1.295 ppm .
Lettuce	2.0	Lettuce, head = 11 Lettuce, leaf = 6.0	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on **head lettuce (with wrapper leaves)** ranged from <0.18 to 4.28 ppm using the EC formulation, and from 0.21 to 10.11 ppm using the WP formulation. The combined endosulfan residues in/on **leaf lettuce** ranged from <0.15 to 4.49 ppm using the EC formulation, and from 0.17 to 5.72 ppm using the WP formulation. In lieu of proposing higher tolerances, the registrants may elect to retain the current tolerance level by amending the registered lettuce use pattern and by submitting additional residue data in support of any label amendments. [*Lettuce, head*] and [L*ettuce, leaf*]

Commodity	Established Tolerance (ppm)	Reassessed Tolerance (ppm)	Comments [*Correct Commodity Definition*]
Nut, Macadamia	0.2 (N)	0.20	Following applications of a representative WP or EC formulation reflecting exaggerated use pattern, no detectable residues of endosulfan or endosulfan sulfate were detected in/on macadamia nuts. The analytical method's limit of detection was not specified. [*Macadamia nut*]
Melon	2.0	Revoke	Tolerance should be revoked with the concomitant establishment of a tolerance for Cucurbit Vegetables (Crop Group 9). Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on cantaloupes ranged from <0.15 to 0.50 ppm using the EC formulation, and from 0.22 to 0.76 ppm using the WP formulation. [*Melon subgroup (crop subgroup 9A]*
Milk, fat (=N in whole milk)	0.5	2.0	[*Milk*]
Mustard greens	2.0	2.0	The available data reflecting the established 21-day PHI for mustard greens are very limited . The data submitted for spinach, collards, kale, or turnip greens may be used to estimate endosulfan residues in/on mustard greens.
Mustard seed	0.2 (N)	Revoke	No longer a registered use.
Nectarine	2.0	2.0	The available data for peaches may be translated to nectarines. [*Nectarine*]
Oat, grain	0.1 (N)	0.3	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on oat grain ranged from <0.15 to <0.30 ppm..
Oat, straw	0.2 (N)	0.4	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on oat straw ranged from <0.15 to <0.32 ppm..
Peach	2.0	2.0	Following applications of a representative WP formulation approximating the maximum registered use pattern, the combined endosulfan residues in/on peaches were below 2.0 ppm .
Pear	2.0	2.0	Following applications of a representative WP formulation approximating the maximum registered use pattern, the combined endosulfan residues in/on pears were 0.95-1.00 ppm. Due to the limited number of data points reflecting treatments at 1x, the pear tolerance is reassessed at 2.0 ppm .
Pea, succulent	2.0	Revoke	Use being deleted as part of dietary risk mitigation.
Pecans	0.2 (N)	Revoke	Use is being deleted.
Pepper	2.0	2.0	Following applications of a representative WP or EC formulations approximating the maximum registered use pattern, the combined endosulfan residues in/on bell and sweet peppers are not expected to exceed 2.0 ppm .
Pineapple	2.0	1.0	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on pineapples ranged from >0.08 to 0.50 ppm. [*Pineapple*]

Commodity	Established Tolerance (ppm)	Reassessed Tolerance (ppm)	Comments [*Correct Commodity Definition*]
Plum, Prune	2.0	2.0	Data reflecting the maximum registered use pattern are unavailable. However, data reflecting applications of a representative WP or EC formulation at an exaggerated seasonal rate indicate that the combined endosulfan residues in/on French prunes were below 2.0 ppm. [*Plum*]
Potato	0.2 (N)	0.2	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on potatoes were mostly nondetectable . The analytical method's limit of detection was not specified. [*Potato*]
Prunes	2.0	2.0	Data reflecting the maximum registered use pattern are unavailable. However, data reflecting applications of a representative WP or EC formulation at an exaggerated seasonal rate indicate that the combined endosulfan residues in/on French prunes were below 2.0 ppm. [*Prune*]
Pumpkin	2.0	Reassign	Tolerance should be revoked with the concomitant establishment of a tolerance for Cucurbit Vegetables (Crop Group 9). The available data for cucumber, melon, and summer squash may be translated to pumpkin and winter squash. [*Pumpkin*]
Rape seed	0.2	Revoke	No longer a registered use.
Raspberry	0.1	Revoke	No longer a registered use.
Rye, grain	0.1 (N)	0.3	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on rye grain ranged from <0.15 to <0.30 ppm.
Rye, straw	0.2 (N)	0.3	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on rye straw ranged from <0.15 to <0.30 ppm..
Safflower, seed	0.2 (N)	Revoke	No longer a registered use.
Sheep, fat	0.2	13	
Sheep, meat byproduct	0.2	Sheep, mbyp = 1.0 Sheep, liver = 5.0	[*Sheep, meat byproducts (except liver)*] [*Sheep, liver*]
Sheep, meat	0.2	2.0	
Spinach	2.0	Revoke	Use being deleted as part of dietary risk mitigation.
Squash, summer	2.0	Reassign	Tolerance should be revoked with the concomitant establishment of a tolerance for Cucurbit Vegetables (Crop Group 9). Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on summer squash ranged from <0.15 to 0.23 ppm using the EC formulation, and from <0.15 to 0.25 ppm using the WP formulation.
Squash, winter	2.0	Reassign	Tolerance should be revoked with the concomitant establishment of a tolerance for Cucurbit Vegetables (Crop Group 9). The available data for cucumber, melon, and summer squash may be translated to pumpkin and winter squash.

Commodity	Established Tolerance (ppm)	Reassessed Tolerance (ppm)	Comments [*Correct Commodity Definition*]
Strawberry	2.0	2.0	Data reflecting the maximum registered use pattern are unavailable. Data reflecting applications of a representative EC formulation at 0.33-0.67x the maximum seasonal rate indicate that the combined residues of endosulfan in/on strawberries without caps were below 0.60 ppm . By extrapolation to the maximum use rate, the Science Chapter to the Endosulfan Reregistration Standard concluded that residues are not likely to exceed the established tolerance. [*Strawberry*]
Sugarcane	0.5	Revoke	No longer a registered use.
Sunflower, seed	2.0	Revoke	No longer a registered use.
Sweet potato	0.2	0.15	The available data indicate that endosulfan residues of concern were each <0.05 ppm (nondetectable) in/on sweet potatoes following treatments at the maximum registered use pattern. [*Sweet potato*]
Tomato	2.0	1.0	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on tomatoes ranged from <0.15 to 0.91 ppm using the EC formulation, and from <0.15 to 0.97 ppm using the WP formulation. [*Tomato*]
Turnip, greens	2.0	2.0	Data reflecting the maximum registered use pattern are unavailable. The data submitted for spinach, collards, kale, or mustard greens may be used to estimate residues in/on turnip greens. [*Turnip, tops*]
Walnut	0.2 (N)	0.2	The available data indicate that residues of endosulfan or endosulfan sulfate were nondetectable in/on walnuts harvested 36-39 days following the last of multiple applications of a representative WP and EC formulations at exaggerated (2.7-3.3x) seasonal rate; the limits of detection were not reported. [*Walnut*]
Watercress	2.0	Revoke	No longer a registered use.
Wheat, grain	0.1 (N)	0.30	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on wheat grain ranged from <0.15 to <0.30 ppm.
Wheat, straw	0.2 (N)	0.40	Following applications reflecting the maximum registered use pattern, the combined endosulfan residues in/on wheat straw ranged from <0.15 to <0.38 ppm.
Tolerance To Be Proposed Under 40 CFR §180.182			
Apple, pomace, wet	None	5.0	The recommended tolerance is based on a HAFT combined endosulfan residue of 0.77 ppm and a concentration factor of 6x.
Corn, sweet, forage	None	12	The submitted data for sweet corn forage and stover indicate that the combined residues of endosulfan (α and β isomers) and endosulfan sulfate were 4.2-12.0 ppm in/on sweet corn forage (n=6 samples) harvested 7 days and 0.76-13.92 ppm in/on sweet corn stover (n=6 samples) harvested 11-45 days following the last of two foliar applications, with a 6- to 7-day retreatment interval of a representative 3 lb/gal EC formulation at 1.0 lb ai/A/application (1x the proposed maximum single and seasonal application rates) using ground equipment.
Corn, sweet, stover	None	14	

Commodity	Established Tolerance (ppm)	Reassessed Tolerance (ppm)	Comments [*Correct Commodity Definition*]
Cotton, gin byproducts	None	30	
Cucurbit Vegetables (Crop Group 9)	None	1.0	Adequate data are available for representative commodities.
Pineapple, process residue	None	18	The recommended tolerance is based on a HAFT combined endosulfan residue of 0.44 ppm and a concentration factor of 41x.
Turnip, root	None	0.2	The recommended tolerance is based on translation of data from carrot and potato.
Vegetables Cucurbit, Group	None	1.0	Adequate data are available for representative commodities.
Tolerance Listed Under 40 CFR §180.182 (a) (2)			
Dried tea	24 (reflecting < 0.1 ppm residues in beverage tea)	24 (reflecting < 0.1 ppm residues in beverage tea)	This tolerance has been moved from 40 CFR §185.2600.

Codex Harmonization

The Codex Alimentarius Commission has established several maximum residue limits (MRLs) for residues of endosulfan in/on various plant and animal commodities. The Codex MRLs are expressed in terms of the sum of α- and β-endosulfan and endosulfan sulfate (fat soluble). When the U.S. tolerance expression is revised to specify the α and β isomers of the parent, Codex MRLs and U.S. tolerances will be harmonized. A numerical comparison of the Codex MRLs and the corresponding reassessed U.S. tolerances is presented in Table 19.

Table 19 indicates that U.S. tolerances and the Codex MRLs for endosulfan are compatible for carrot, cottonseed, fruits, meat, pome fruits (apples), potato, spinach, and sweet potato. For the remainder of commodities listed in Table 19, the U.S. tolerances and the Codex MRLs are incompatible because of differences in registrations or good agricultural practices.

Table 19. Codex MRLs and Applicable U.S. Tolerances for Endosulfan

Codex			Reassessed U.S. Tolerance (ppm)	Comments
Commodity, As Defined	MRL (mg/kg)	Step		
Alfalfa forage (green)	1	5/8	Revoke	No longer a registered use.
Broccoli	0.5	5	3.0	
Cabbages, Head	1	5	4.0	
Cabbages, Savoy	2	5	4.0	
Carrot	0.2	CXL	0.20	Compatibity exists.
Cauliflower	0.5	5	2.0	
Celery	2	5/8	8.0	

(continued; footnotes follow)

Codex			Reassessed U.S. Tolerance (ppm)	Comments
Commodity, As Defined	MRL (mg/kg)	Step		
Chard	2	5	--	No U.S. registrations.
Cherries	1	5/8	2.0	
Chicory leaves	1	5	--	No U.S. registrations.
Clover	1	5/8	--	No U.S. registrations.
Common bean (pods and/or immature seeds)	0.5	5	2.0	
Cotton seed	1	CXL	1.0	Compatibility exists.
Cotton seed oil, crude	0.5	CXL	–	
Endive	1	5	--	No U.S. registrations.
Fruits	2	CXL	2.0 each for apricots, grapes, nectarines, peaches, pears, plums, prunes, and strawberries	Compatibility exists for some fruit crops.
Garden peas (young pods)	0.5	5/8	--	No U.S. registrations.
Kale	1	5/8	2.0	
Lettuce, Head	1	5/8	11.0	
Lettuce, Leaf	1	5/8	6.0	
Meat	0.2 (carcass fat)	CXL	0.20	Compatibility exists.
Milks	0.02 [1]	CXL	0.50	
Onion, Bulb	0.2	CXL	–	No U.S. registrations.
Plums (including Prunes)	1	5/8	2.0	
Pome fruits	1	5/8	1.0	Compatibility exists.
Potato	0.2	CXL	0.20	Compatibility exists.
Rice	0.1	CXL	–	No U.S. registrations.
Spinach	2	5/8	2.0	Compatibity exists.
Sugar beet	0.1	5/8	Revoke	No longer a registered use.
Sugar beet leaves or tops	1	5/8	--	
Sweet potato	0.2	CXL	0.15	Compatibility exists.
Tea, Green, Black	30	CXL	24 (reflecting <0.10 ppm residues in beverage tea)	
Trefoil	1	5/8	--	No U.S. registrations.

[1] The residue is fat-soluble and MRLs for milk and milk products are derived as explained in the introductions to Volume XIII of Codex Alimentarius.

2. Endocrine Disruptor Effects

EPA is required under the FFDCA, as amended by FQPA, to develop a screening program to determine whether certain substances (including all pesticide active and other

ingredients) "may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there were scientific bases for including, as part of the program, the androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use FIFRA and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP).

When the appropriate screening and/or testing protocols being considered under the Agency's EDSP have been developed, endosulfan may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

3. Labels

The following risk mitigation measures are necessary to mitigate the risks identified in the endosulfan risk assessment as a result of dietary exposure from food, to workers who handle endosulfan and workers re-entering fields treated with endosulfan, and for ecological risks to non-target organisms. A number of label amendments, in addition to the existing label requirements, are necessary in order to reflect this mitigation

a. Agricultural Use Exposure Reduction Measures

For agricultural use, the following measures are required, in addition to the existing labeling requirements to address dietary (food), drinking water, occupational handler and ecological risks of concern. See Table 20 for additional information by crop.

<u>Dietary (food)</u>

- Delete use on succulent beans, succulent peas, spinach, and grapes.

<u>Dietary (drinking water) and Ecological</u>

- Delete use on pecans
- Reduce maximum seasonal application rate from 3 lbs./ai/A to 2.5 lbs./ai/A for pome fruit, stone fruit and citrus.
- Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A for melons, cucurbits, lettuce, tomatoes, sweet potatoes, cotton (ground), broccoli, cauliflower, cabbage, kohlrabi, brussels sprouts, strawberries, filberts, walnuts, almonds, macadamia nuts, peppers, eggplant, potatoes, carrots, dry beans, dry peas, and tobacco.
- Reduce maximum seasonal application rate from 3 lbs./ai/A to 1.5 lbs./ai/A for sweet corn, cotton (aerial) and blueberries.

- Reduce maximum seasonal application rate from 3 lbs./ai/A to 1 lb./ai/A for celery.
- Require 100 ft. spray buffer for ground applications between a treated area and water bodies.
- Require 30 ft. maintained vegetative buffer strip between a treated area and water bodies.
- Require all products to be Restricted Use
- Restrict use on cotton to AZ, CA, NM, OK and TX only.
- Restrict use on tobacco to IN, KY, OH, PA, TN and WV only.

Occupational

- Require all wettable powers to be packaged in water soluble bags.
- Cancel use of wettable powders on tomatoes, sweet corn, sweet potatoes, cotton, small grains, alfalfa (seed), carrots, dry beans, dry peas, pineapples, and tobacco.
- Cancel aerial application using the wettable powder formulation on pome fruits, stone fruits, citrus, blueberries, strawberries, collard greens (seed), kale (seed), mustard greens (seed), radish (seed), turnip (seed), rutabaga (seed), broccoli, (seed), cauliflower (seed), kohlrabi (seed), cabbage (seed), filberts, walnuts, almonds, and macadamia nuts.
- Require closed mixing/loading systems for aerial application using the EC formulation on pome fruits, stone fruits, citrus, sweet corn, sweet potatoes, cotton, collard greens (seed), kale (seed), mustard greens (seed), radish (seed), turnip (seed), rutabaga (seed), broccoli, (seed), cauliflower (seed), kohlrabi (seed), cabbage (seed), blueberries, small grains, alfalfa (seed), filberts, walnuts, almonds and macadamia nuts.
- Require closed cabs for airblast applications on pome fruits, stone fruits, citrus, filberts, walnuts, almonds and macadamia nuts.
- Prohibit use of high pressure handwands with rates greater than 0.005 lbs/ai/gal.
- Increase REI to 48 hours for all crops except as noted in the following bullets.`
- Increase REI for WP products to 3 days for melons and cucurbits.
- Increase REI for WP products to 4 days for lettuce, celery, pome fruit, stone fruit, citrus, collard greens, kale, mustard greens, radish, turnip, rutabaga, ornamental trees and shrubs.
- Increase REI for WP products to 5 days for collard greens (seed), kale (seed), mustard greens (seed), radish (seed), turnip (seed) and rutabaga (seed).
- Increase REI for WP products to 9 days for blueberries, broccoli, cauliflower, kohlrabi, cabbage, and brussels sprouts.
- Increase REI for WP products to 12 days for broccoli (seed), cauliflower (seed), kohlrabi (seed), and cabbage (seed).
- Increase REI for EC products to 3 days for sweet potatoes
- Increase REI for EC products to 4 days for broccoli, cauliflower, kohlrabi, cabbage, and brussels sprouts.
- Increase REI for EC products to 6 days for blueberries.
- Increase REI for EC products to 7 days for broccoli (seed), kohlrabi (seed), and cabbage (seed).
- Increase REI for EC products to 17 days for sweet corn.

Occupational and Ecological

- Reduce maximum application rate to 2.5 lbs./ai/A for pome fruit, stone fruit, citrus, ornamental trees and shrubs.
- Reduce maximum application rate to 1.5 lbs/a/A for blueberries and cotton (ground).
- Reduce maximum application rate to 1.0 lb/ai/A for broccoli (not for seed), kohlrabi (not for seed), cabbage (not for seed), cauliflower (not for seed) and strawberries.
- Reduce maximum application rate to 0.75 lbs/ai/A for cotton (aerial) and kale.
- Reduce maximum application rate to 0.005 lbs./ai/gal for all tree bark treatments.

D. Regulatory Rationale

The following is a summary of the rationale and mitigation measures for managing risks associated with the current use of endosulfan. Specific label language is set forth in the summary table in Section V.

1. Human Health Risk Mitigation

a. Dietary (food)

The following discussion addresses risk mitigation measures pertaining to dietary exposure to residues of endosulfan in food.

Acute (Food)

Acute dietary risk from food exceeded the Agency's level of concern for the most highly exposed population subgroup, children 1-6 years old. The risk assessment yielded a percent acute PAD value of 150% for children 1-6 years old. To mitigate the acute dietary risk (food), the registrants have agreed to delete the following uses: succulent beans, succulent peas, spinach and grapes. Based on this mitigation, the acute risk from food exposure falls below the Agency's level of concern with the % aPAD occupied for children 1-6 years old being 80%. Therefore, removal of these uses will fully address acute dietary risk from food.

Chronic (Food)

The chronic dietary risk for endosulfan does not exceed the Agency's level of concern (i.e., is less than 100% of the cPAD) for all sub-populations, including the most highly exposed subgroup, children (1-6 years), whose dietary exposure occupies 17% of the cPAD. No mitigation measures are necessary at this time to address chronic dietary risk from food.

b. Drinking Water

Surface water drinking water estimated concentrations were derived from the PRZM-EXAMS model with the Standard Index Reservoir and percent crop area (PCA). Ground water

estimated concentrations were derived from the SCI-GROW Model. These are screening level models designed to provide high-end estimates of potential pesticide exposure. Such predictions provide a screen to eliminate those chemicals that are not likely to cause concerns in drinking water. Estimated concentrations exceeding the drinking water level of concern (DWLOC) in drinking water risk assessments using the screening model estimates do not necessarily mean a risk of concern actually exists, but may indicate the need for better data (e.g., monitoring studies specific to use patterns and drinking water sources) on which to confirm decisions.

Based on model predictions using currently registered uses, the drinking water EECs for endosulfan and its degradate, endosulfan sulfate, in surface water range from 4.49 ppb (cotton scenario) to 23.86 ppb (apple scenario) for acute exposure, and from 0.53 ppb (cotton scenario) to 1.5 ppb (apple scenario) for chronic exposure. The acute and chronic EEC for endosulfan in groundwater is 0.012 ppb.

The chronic dietary risks from drinking water exposure from ground water and surface water sources do not exceed the Agency's level of concern. The acute dietary risks from drinking water exposure from surface water and ground water sources are above the Agency's level of concern for most subpopulations. The mitigation measures taken to address food risks result in higher DWLOCs and, therefore, more room in the risk cup for water exposures. For the most highly exposed subpopulations the acute DWLOCs following mitigation are 3 ppb for children 1-6 and 2.3 ppb for all infants. When these mitigation measures to reduce the dietary risks from food are considered, the acute dietary risks from drinking water exposure from ground water sources do not exceed the Agency's level of concern. This leaves only acute risks from surface water sources remaining above the Agency's level of concern. The Agency expects that actual exposure from drinking water is unlikely to be as high as the levels used in the development of the surface water estimates based on the rationale discussed below. Therefore, given the anticipated impacts on water resources from implementing the risk reduction measures contained in this document and the characterization of the Agency's water modeling presented below, the Agency believes that the risks from drinking water are not of concern.

The drinking water risk assessments are based on screening level models that are conservative in their estimates of drinking water exposure. Actual exposure is expected to be lower than the EEC's reported in the RED. One reason for this is that the percent cropped area (PCA) assumption for apples used in the model is 0.87, the default assumption. This means the model assumes that 87% of a watershed is planted with apples and that 100% of this crop is treated with endosulfan, which may be unlikely to occur especially considering that the PCA calculated for major crops like corn and cotton using data submitted to the Agency are 0.46 and 0.20 respectively. To add further perspective, the EEC derived from this screening-level model for cotton where a crop-specific PCA has been developed is 4.49 ppb. This is significantly lower than the apple scenario where the default PCA was used and results in risk estimates being below the Agency's level of concern for most subpopulations and nearly so for the most highly exposed subpopulations once food mitigation is considered. Cotton is also the crop where the most endosulfan is used.

The risk reduction measures contained in this RED, including the deletion of the succulent bean, succulent pea, grape, pecan and spinach uses, reductions in maximum application rates, reductions in maximum seasonal application rates , reductions in the maximum number of applications allowed per season, implementation of the 100 ft. setback for ground applications and the implementation of a 30 foot vegetative buffer strip are expected to reduce the amount of endosulfan available to reach surface waters. Buffer strips are expected to be more effective in mitigating acute risk scenarios in the case of endosulfan. This supports the Agency's belief that drinking water risks will be reduced to a level at which the risk cup is not exceeded.

For endosulfan, the Agency is also requiring confirmatory surface water monitoring data to evaluate actual acute concentrations of endosulfan in surface water sources of drinking water. This monitoring data is to be generated from a multi-year sampling program involving community water systems from surface water sources in multiple locations in different regions of the country to represent different use sites, crops, soil types, and rainfall regimes. Water samples are to be analyzed to determine the concentrations of parent endosulfan and each of the environmental degradates of toxicological concern. Also, prior to initiating this sampling program, the registrant is required to submit a study protocol to the Agency to ensure that the sampling locations and procedures are adequate to confirm the drinking water risk management conclusions.

c. Aggregate Risk Mitigation

The Agency's aggregate risk assessment for endosulfan is based on exposure estimates for food and uses a screening-level assessment of modeled estimates for drinking water exposure. Dietary (food) risk estimates are based on a refined assessment that incorporates percent crop treated data, monitoring data, and processing data.

Acute Exposure

The acute aggregate risk assessment for endosulfan combines exposure from food and drinking water sources only. Acute dietary (food) risk estimates are below 100% of the aPAD for the US population and all population subgroups when the use deletions mentioned earlier that are needed to mitigate dietary risks are considered. When this mitigation is considered, all infants are the most highly exposed population subgroup and have an acute drinking water level of comparison (DWLOC) of 2.3 ppb. Based on screening-level model predictions of the remaining supported uses, the acute (peak) drinking water estimated concentration in surface water is 23.9 ppb which is of risk concern to the Agency. The screening-level model predictions of acute concentrations in ground water is 0.0012 ppb, which is less than the DWLOC and not of risk concern to the Agency.

However, given the anticipated impacts on water resources from implementing the risk reduction measures contained in this document and the characterization of the Agency's water modeling presented above, the Agency believes that actual acute concentrations of endosulfan in

surface water are less than the DWLOC and are not of concern. To confirm this, surface water monitoring data is required.

Chronic Exposure

The chronic aggregate risk assessment for endosulfan combines exposure from food and drinking water sources only. Chronic dietary (food) risk estimates are well below 100% of the cPAD for the US population and all population subgroups. Children 1-6 years old are the most highly exposed population subgroup and have in a chronic DWLOC of 5 ppb. Based on screening-level model predictions of the current uses of endosulfan the average (chronic) estimated concentration in surface water is 1.5 ppb, which is not of risk concern to the Agency.

d. Occupational Risk Mitigation

(1) Agricultural Handler Risk Mitigation

It is the Agency's policy to mitigate occupational risks to the greatest extent necessary and feasible with personal protective equipment and engineering controls. In managing these risks, EPA must take into account the economic, social, and environmental costs and benefits of the pesticide's use. A wide range of factors are considered in making risk management decisions for worker risks. These factors include, in addition to the calculated MOEs, incident data, the nature and severity of adverse effects, uncertainties in the risk assessment, the cost, availability and relative risk of alternatives, importance of the chemical in integrated pest management (IPM) programs, and other similar factors.

Handlers

As summarized in Table 8, occupational risks are of concern (i.e., MOEs < 100) for many scenarios, even when maximum PPE (i.e, double layer clothing, gloves, and a respirator) are utilized. Handler risks are also of concern for some scenarios with engineering controls (closed mixing/loading, enclosed cabs). Engineering controls are considered to be the maximum feasible mitigation.

EPA has determined that handler risks from exposure to endosulfan in the scenarios listed below would be adequately mitigated, when other mitigation such as rate reductions are considered, through use of the following PPE: long-sleeved shirt and long pants, shoes, socks, chemical-resistant gloves and an organic vapor respirator.

- Mixing/loading liquids for chemigation.
- Mixing/loading liquids for groundboom application.
- Mixing/loading liquids for airblast applications.
- Mixing/loading liquids for rights-of-way sprayers.
- Mixing/loading liquids for plant and root dips.
- Applying sprays with groundboom equipment.

- Mixing/loading/applying with a low pressure handwand.
- Mixing/loading/applying with a backpack sprayer.

EPA has determined that worker risks from exposure to endosulfan in the scenarios listed below would be adequately mitigated. when other mitigation such as rate reductions are considered, through use of the following PPE: coveralls worn over long-sleeved shirt and long pants, chemical-resistent footwear, chemical-resistant gloves, chemical-resistent apron (for mixing and loading) and a organic vapor respirator.

- Mixing/loading/applying with a high pressure handwand.
- Flagging aerial spray applications.
- Mixing/loading liquid for aerial application for crops with maximum application rates of less than 1.5 lbs/ai/A except for cotton, alfalfa (seed) and small grains.

The mitigation measures needed to address handler risks which are of concern at or above the maximum PPE scenario are outlined, by crop, in Table 20 below. These steps include placing all wettable powder products in water soluble bags, the deletion of some uses from WP products, deletion of aerial application of WP products for crops with maximum application rates greater than or equal to 1.5 lbs/ai/A and for cotton, alfalfa (seed) and small grains, requiring closed mixing/loading systems for aerial applications of the EC formulation for some uses, requiring closed cabs for all airblast applications except for ornamental trees/shrubs, requiring enclosed cockpits for all aerial applications and rate reductions. Scenarios w/ engineering controls for mixing/loading liquids and applying with airblast equipment include the need for baseline clothing plus chemical resistant gloves and a chemical-resistent apron (when mixing and loading). Since all wettable powder products will be packaged in water soluble bags, mixing/loading scenarios for this formulation will also include baseline clothing, chemical resistant gloves and a chemical-resistent apron.

As mentioned earlier there were three scenarios that were not evaluated due to a lack of data available to conduct an assessment. For the mixing/loading/applying wettable powders with backpack sprayer and mixing/loading/applying wettable powders with a high pressure hand wand scenarios, the mitigation to place all wettable powders in water soluble bags will effectively preclude the use of WPs for these equipment types. Therefore, no additional information is required for these scenarios.

Post-Application

EPA completes exposure assessments on postapplication workers for various crops and activities at intervals following the application until risk falls below a target level. For endosulfan, the target level for risk concerns is an MOE of 100.

In order to determine the REI for a crop, EPA calculates the number of days that must elapse after pesticide application until residues dissipate and risk to a worker falls below the target MOE (100 for endosulfan). Occupational risks are regulated under the FIFRA section

3(c)(5) standard of no unreasonable adverse effects which means that both risks and benefits must be considered in making a risk management decision. This standard may be met at a level below the target MOE when there are benefits associated with a specific activity. As the worker exposure database has improved, risk assessments are now conducted for a variety of post application activities based on the level of exposure for each worker activity. For a specific crop/pesticide combination, the duration required to achieve the target MOE can vary depending on the activity assessed.

In general, EPA prefers to set a single REI for all activities related to a crop or crop group without additional activity-based labeling. This approach is favored because handlers and workers are more likely to understand and comply with simpler labels. Also, permitting entry for some activities during the REI could cause confusion and compromise the effectiveness of the Worker Protection Standard (WPS). However, when the consideration of risks and benefits indicate that a single REI is unworkable, EPA may consider either setting an REI with early entry exceptions for one or more critical tasks or establishing an entry prohibition for a specific task after the REI has expired. For endosulfan, no critical activities have been identified to warrant the use of an activity-based exception or prohibition. However, during the 60-day comment period for this RED, EPA will accept further comments from growers regarding needs for additional REI exceptions for specific activities, and will consider such exceptions where needed if there are adequate MOEs and/or benefits associated with such activities.

In weighing worker risks and benefits, the Agency considered the timing of field activities that are critical to crop production. For many of the endosulfan uses discussed below, scouting and irrigation are critical activities in crop production, and these activities routinely need to be performed soon after application. In evaluating the restricted entry intervals, the Agency considered the exceptions to the WPS that could inform the decision. EPA's proposed REIs take into account the flexibility already provided by these exceptions. Scouting is a handler activity under the WPS, so anyone performing this activity may legally enter the treated field during the REI provided they use the personal protective equipment (PPE) specified on the label. In addition, if the scout is a certified crop advisor as defined in the WPS (40 CFR 170.204(b)), the individual can determine the appropriate PPE to be used. For many of these crops, irrigation equipment is not routinely moved by hand, instead, the primary activity involves entering the field to turn the watering equipment on and off. This activity is allowed during the REI if it meets the requirements of the no contact exception to WPS (40 CFR 170.112(b)). Should irrigation equipment need unexpected repairs during the REI, WPS allows workers to enter a treated field for up to one hour provided early entry PPE is used (40 CFR 170.112(c)).

Based on the Worker Protection Standard, CFR 156.208 (c) 2, if a pesticide triggers a Toxicity Category I determination for Primary Eye Irritation, an REI of 48 hours is required for all products. Since endosulfan meets this criteria, a minimum REI of 48 hours is needed for all endosulfan uses.

Table 20. Summary of Mitigation Measures for Occupational and Ecological Risk

Crop*	Risks of Concern	Mitigation
Melons (1 lb/ai/A) Cucumber (1 lb/ai/A) Squash (1 lb/ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 64 at current REI of 24 hours MOE = 100 at 4 days MOE = 86 at 3 days Risks to non-target aquatic organisms for WP and EC	Require all wettable powers to be packaged in water soluble bags. 3-day REI for WP (high exposure hand harvesting, pruning, thinning etc.: MOE = 86) Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 6 per season to 4 per season (except CA where will remain at 3 per season) 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For melons, handler risks are not of concern at the 1 lb. rate provided engineering controls are employed; that is, water soluble bags for wettable powder formulations. Due to the need to re-enter fields often due to frequent harvesting an REI of greater than 3 days is not considered to be feasible. Endosulfan is an important resistance management tool and is an important element of integrated pest management programs in some areas especially considering its relatively low impacts on bees. Therefore, the REI is considered acceptable. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33% and reducing the maximum number of applications per season to four (3 in CA). The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Lettuce (1 lb./ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 64 at current REI of 24 hours MOE = 100 at 4 days Risks to non-target aquatic organisms for WP and EC	Require all wettable powders to be packaged in water soluble bags 4-day REI for WP (high exposure hand harvesting, pruning, thinning etc.: MOE > 100) Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 3 per season to 2 per season (except CA where will remain at 2 per season) 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Crop*	Risks of Concern	Mitigation
Rationale for Worker Risk Mitigation: For lettuce, handler risks are not of concern at the 1 lb. rate provided engineering controls are employed; that is, water soluble bags for wettable powder formulations. For lettuce, post-application risks are not of concern at the 1 lb. rate provided that the REI for the WP formulation is 4 days. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33% and reducing the maximum number of applications per season to two. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Celery (1 lb./ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 64 at current REI of 24 hours MOE = 100 at 4 days Risks to non-target aquatic organisms for WP and EC	Require all wettable powders to be packaged in water soluble bags 4-day REI for WP (high exposure hand harvesting, pruning, thinning etc.: MOE > 100) Reduce maximum seasonal application rate from 3 lbs./ai/A to 1 lbs./ai/A 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For celery, handler risks are not of concern at the 1 lb. rate provided engineering controls are employed; that is, water soluble bags for wettable powder formulations. For celery, post-application risks are not of concern at the 1 lb. rate provided that the REI for the WP formulation is 4 days. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 66%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Apples (3.0 lbs/ai/A) Pears (3.0 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for airblast application Application w/ airblast application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 68 at current REI of 24 hours MOE = 100 at 5 days Risks to non-target aquatic organisms for WP and EC	Reduce maximum application rate to 2.5 lbs./ai/A Require all wettable powders to be packaged in water soluble bags Cancel aerial application using the WP formulation Require closed mixing/loading systems for aerial application using the EC formulation Require closed cabs for airblast applications 4-day REI for WP (high exposure hand harvesting, pruning, thinning etc.: MOE > 100 at 2.5 rate) Reduce maximum seasonal application rate from 3 lbs./ai/A to 2.5 lbs./ai/A 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Crop*	Risks of Concern	Mitigation
Rationale for Worker Risk Mitigation: For apples and pears, handler risks are not of concern at the 2.5 lb. rate provided that aerial application using WP products is canceled and engineering controls are employed; that is, water soluble bags for wettable powder formulations, closed mixing/loading systems are used for aerial applications of EC products and closed cabs are used for airblast applications (designed to provide dermal protection). For apples and pears, post-application risks are not of concern at the 2.5 lb. rate provided that the REI for the WP formulation is 4 days. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate and the maximum single application rate by 17%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Apricots (3.0 lbs./ai/A) Peaches (3.0 lbs./ai/A) Nectarines (3.0 lbs./ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for airblast application Application w/ airblast application	Reduce maximum application rate to 2.5 lbs./ai/A Require all wettable powders to be packaged in water soluble bags Cancel aerial application using the WP formulation Require closed mixing/loading systems for aerial application using the EC formulation Require closed cabs for airblast applications
Plums/Prunes (3.0 lbs./ai/A)	High exposure activities for WP (hand harvesting, pruning, thinning etc.):	4-day REI for WP (high exposure hand harvesting, pruning, thinning etc.: MOE > 100 at 2.5 rate)
Cherries (3.0 lbs./ai/A)	MOE = 68 at current REI of 24 hours MOE = 100 at 5 days	Reduce maximum seasonal application rate from 3 lbs./ai/A to 2.5 lbs./ai/A
Non-Bearing Citrus (3.0 lbs./ai/A)	Risks to non-target aquatic organisms for WP and EC	100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For peaches, apricots, nectarines, plums, prunes, cherries and non-bearing citrus, handler risks are not of concern at the 2.5 lb. rate provided that aerial application using WP products is canceled and engineering controls are employed; that is, water soluble bags for wettable powder formulations, closed mixing/loading systems are used for aerial applications of EC products and closed cabs are used for airblast applications (designed to provide dermal protection). For peaches, apricots, nectarines, plums, prunes, cherries and non-bearing citrus, post-application risks are not of concern at the 2.5 lb. rate provided that the REI for the WP formulation is 4 days. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate and the maximum single application rate by 17%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		

Crop*	Risks of Concern	Mitigation
Bark Treatments (0.4 lbs/ai/gal) Greenhouse Uses (0.1 lbs/ai/gal)	Application with Rights-of-Way sprayer Mixing/Loading/Applying with a high pressure handwand	Reduce maximum application rate to 0.005 lbs./ai/gal for high pressure handwand and Rights-of-Way sprayers.
Rationale for Worker Risk Mitigation: For bark treatment and greenhouse uses, handler risks are not of concern at the 0.005 lb/ai/gal. rate.		
Tomatoes (1 lb./ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application Risks to non-target aquatic organisms for WP and EC	Cancel WP use Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 6 per season to 4 per season 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For tomatoes, handler risks are not of concern at the 1 lb. rate provided that the wettable powder formulation is canceled. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33% and reducing the maximum number of applications per season to four. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Sweet Corn (1.5 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting): MOE = 10 at current REI of 24 hours MOE = 100 at 21days High exposure activities for EC (hand harvesting): MOE = 22 at current REI of 24 hours MOE = 100 at 17days Risks to non-target aquatic organisms for WP and EC	Cancel WP Use Require closed mixing/loading systems for aerial application using the EC formulation 17 day REI for EC (hand harvesting: MOE > 100) Reduce maximum seasonal application rate from 3 lbs./ai/A to 1.5 lbs./ai/A Reduce maximum number of applications from 3 per season to 1 per season 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Crop*	Risks of Concern	Mitigation
Rationale for Worker Risk Mitigation: For sweet corn, handler risks are not of concern at the 1.5 lb. rate provided that the wettable powder formulation is canceled and provided engineering controls are employed; that is closed mixing/loading systems are used for aerial applications of EC products. For sweet corn, post-application risks are not of concern at the 1.5 lb. rate provided the WP formulations are canceled and that the REI for the EC formulation is 17 days. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 50% and reducing the maximum number of applications per season to one. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Sweet Potatoes (2.0 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 32 at current REI of 24 hours MOE = 100 at 9 days Medium exposure activities for WP (scouting and irrigating): MOE = 54 at current REI of 24 hours MOE = 100 at 5 days High exposure activities for EC (hand harvesting, pruning, thinning etc.): MOE = 75 at current REI of 24 hours MOE = 100 at 3days Risks to non-target aquatic organisms for WP and EC	Cancel WP Use Require closed mixing/loading systems for aerial application using the EC formulation 3 day REI for EC (high exposure activities: MOE > 100) Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 3 per season to 2 per season 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For sweet potatoes, handler risks are not of concern at the 2.0 lb. rate provided that the wettable powder formulation is canceled and provided engineering controls are employed; that is closed mixing/loading systems are used for aerial applications of EC products. For sweet potatoes, post-application risks are not of concern at the 2.0 lb. rate provided the WP formulations are canceled and that the REI for the EC formulation is 3 days. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33% and reducing the maximum number of applications per season to two. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		

Crop*	Risks of Concern	Mitigation
Collard Greens (for seed) (2.0 lbs/ai/A) Kale (for seed) (2.0 lbs/ai/A) Mustard Greens (for seed) (2.0 lbs/ai/A) Radish (for seed) (2.0 lbs/ai/A) Turnip (for seed) (2.0 lbs/ai/A) Rutabaga (for seed) (2.0 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 32 at current REI of 24 hours MOE = 100 at 9 days Medium exposure activities for WP (scouting and irrigating): MOE = 54 at current REI of 24 hours MOE = 100 at 5 days High exposure activities for EC (hand harvesting, pruning, thinning etc.): MOE = 75 at current REI of 24 hours MOE = 100 at 3days Risks to non-target aquatic organisms for WP and EC	Require all wettable powders to be packaged in water soluble bags Require closed mixing/loading systems for aerial application using the EC formulation Cancel aerial application using the WP formulation 5-day REI for WP (scouting and irrigating: MOE > 100) 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For collard greens, kale, mustard greens, radish, rutabaga and turnip (all for seed) handler risks are not of concern at the 2.0 lb. rate provided engineering controls are employed; that is, water soluble bags for wettable powder formulations, closed mixing/loading systems are used for aerial applications of EC products, and aerial application using WP products are canceled. For collard greens, kale, mustard greens, radish, rutabaga and turnip (all for seed), post-application risks are not of concern at the 2.0 lb. rate provided that the REI for the WP formulation is 5 days. Endosulfan is generally applied to these seed crops at bloom/post bloom. Intensive hand activities such as thinning are expected to have occurred prior to the time of application and, therefore, high exposure activities are not expected to be relevant for these crops. **Rationale for Ecological Risk Mitigation:** The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Collard Greens (1.0 lbs/ai/A) Kale (1.0 lbs/ai/A) Mustard Greens (1.0 lbs/ai/A) Radish (1.0 lbs/ai/A) Turnip (1.0 lbs/ai/A) Rutabaga (1.0 lbs/ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 64 at current REI of 24 hours MOE = 100 at 4 days Risks to non-target aquatic organisms for WP and EC	Reduce maximum application rate for kale to 0.75 lbs/ai/A Require all wettable powders to be packaged in water soluble bags 4-day REI for WP (hand harvesting, pruning, thinning: MOE > 100) 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Crop*	Risks of Concern	Mitigation
Rationale for Worker Risk Mitigation: For collard greens, mustard greens, radish, rutabaga and turnip, handler risks are not of concern at the 1.0 lb. rate and kale at the 0.75 lb. rate provided engineering controls are employed; that is, water soluble bags for wettable powder formulations. For collard greens, kale, mustard greens, radish, rutabaga and turnip, post-application risks are not of concern at the 1.0 lb. rate provided that the REI for the WP formulation is 4 days. **Rationale for Ecological Risk Mitigation:** The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Broccoli (for seed) (2.0 lbs/ai/A) Cabbage (for seed) (2.0 lbs/ai/A) Kohlrabi (for seed) (2.0 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 16 at current REI of 24 hours MOE = 100 at 14 days Medium exposure activities for WP (scouting and irrigating): MOE = 20 at current REI of 24 hours MOE = 100 at 12 days High exposure activities for EC (hand harvesting, pruning, thinning etc.): MOE = 38 at current REI of 24 hours MOE = 100 at 9days Medium exposure activities for EC (scouting and irrigating): MOE = 47 at current REI of 24 hours MOE = 100 at 7 days Risks to non-target aquatic organisms for WP and EC	Require all wettable powders to be packaged in water soluble bags Require closed mixing/loading systems for aerial application using the EC formulation Cancel aerial application using the WP formulation 12-day REI for WP (scouting and irrigating: MOE > 100) 7-day REI for EC (scouting and irrigating: MOE > 100) 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For broccoli, cabbage and kohlrabi (all for seed) handler risks are not of concern at the 2.0 lb. rate provided that aerial application using WP products are canceled and engineering controls are employed; that is, water soluble bags for wettable powder formulations, closed mixing/loading systems are used for aerial applications of EC products, and aerial application using WP products are canceled. For broccoli, cabbage and kohlrabi (all for seed), post-application risks are not of concern at the 2.0 lb. rate provided that the REI for the WP formulation is 12 days and for the EC formulations is 7 days. Endosulfan is generally applied to these seed crops at bloom/post bloom. Intensive hand activities such as thinning are expected to have occurred prior to the time of application and, therefore, high exposure activities are not expected to be relevant for these crops. **Rationale for Ecological Risk Mitigation:** The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		

Crop*	Risks of Concern	Mitigation
Broccoli (2 lbs/ai/A) Brussels Sprouts (1 lbs/ai/A) Cauliflower (1 lbs/ai/A) Cabbage (2 lbs/ai/A) Kohlrabi (2 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 32 at current REI of 24 hours MOE = 100 at 9 days (1 lb. rate) Medium exposure activities for WP (scouting and irrigating): MOE = 40 at current REI of 24 hours MOE = 100 at 7 days (1 lb. rate) High exposure activities for EC (hand harvesting, pruning, thinning etc.): MOE = 76 at current REI of 24 hours MOE = 100 at 4 days (1 lb. rate) Medium exposure activities for EC (scouting and irrigating): MOE = 94 at current REI of 24 hours MOE = 100 at 2 days (1 lb. rate) Risks to non-target aquatic organisms for WP and EC	Reduce maximum application rate for broccoli, cabbage and kohlrabi to 1 lbs/ai/A Require all wettable powders to be packaged in water soluble bags 9-day REI for WP (hand harvesting, pruning, thinning etc: MOE > 100) 4-day REI for EC (hand harvesting, pruning, thinning etc: MOE > 100) Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 4 per season to 2 per season (CA remains at 2) 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Rationale for Worker Risk Mitigation:
For broccoli, brussels sprout, cauliflower, cabbage and kohlrabi, handler risks are not of concern at the 1.0 lb. rate provided engineering controls are employed; that is water soluble bags for wettable powder formulations.

For broccoli, brussels sprout, cauliflower, cabbage and kohlrabi, post-application risks are not of concern at the 1.0 lb. rate provided that the REI for the WP formulation is 9 days and for the EC formulation is 4 days.

Rationale for Ecological Risk Mitigation:
Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum application rate by 50% for broccoli, cabbage and kohlrabi, the maximum seasonal rate by 33% for each commodity and reducing the maximum number of applications per season to two. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.

Crop*	Risks of Concern	Mitigation
Cotton (2 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Application with aerial equipment High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 16 at current REI of 24 hours MOE = 100 at 14 days Medium exposure activities for WP (scouting and irrigating): MOE = 20 at current REI of 24 hours MOE = 100 at 12 days High exposure activities for EC (hand harvesting, pruning, thinning etc.): MOE = 38 at current REI of 24 hours MOE = 100 at 9 days Risks to non-target aquatic organisms for WP and EC	Cancel WP use Reduce rate for ground application to 1.5 lbs/a/A Reduce rate for aerial application to 0.75 lbs/ai/A Require closed mixing/loading systems for aerial application using the EC formulation Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A (ground) Reduce maximum seasonal application rate from 3 lbs./ai/A to 1.5 lbs./ai/A (aerial) Reduce maximum number of applications from 6 per season to 2 per season Restrict use on cotton to the following states: AZ. CA, NM, OK, and TX. 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Rationale for Worker Risk Mitigation:
For cotton, handler risks are not of concern at the 1.5 lb. rate (ground) and the 0.75 lb. rate (aerial) provided engineering controls are employed; that is closed mixing/loading systems are used for aerial applications of EC products.

Post harvest risks are not of concern provided that labels state that only mechanical harvesting is allowed and hand thinning/pruning is prohibited.

Rationale for Ecological Risk Mitigation:
Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum application rate by 25% for ground applications and 63% for aerial applications, the maximum seasonal rate by 33% (ground) and 50% (aerial), and reducing the maximum number of applications per season to two. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.

By restricting the use on cotton to AZ, CA, NM, OK and TX exposures to aquatic organisms are expected to be reduced. These restrictions remove use in areas of the country where water resources are more abundant and potentially vulnerable.

Crop*	Risks of Concern	Mitigation
Blueberries (2 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 16 at current REI of 24 hours MOE = 100 at 14 days Medium exposure activities for WP (scouting and irrigating): MOE = 81 at current REI of 24 hours MOE = 100 at 3 days High exposure activities for EC (hand harvesting, pruning, thinning etc.): MOE = 38 at current REI of 24 hours MOE = 100 at 9 days Risks to non-target aquatic organisms for WP and EC	Reduce the maximum application rate to 1.5 lbs/ai/A Require all wettable powders to be packaged in water soluble bags Require closed mixing/loading systems for aerial application using the EC formulation Cancel aerial application using the WP formulation 9 day REI for WP (high exposure activities, hand harvesting , pruning, thinning etc.: MOE > 100) 6 day REI for EC (high exposure activities, hand harvesting , pruning, thinning etc.: MOE > 100) Reduce maximum seasonal application rate from 3 lbs./ai/A to 1.5 lbs./ai/A 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For blueberry, handler risks are not of concern at the 1.5 lb. rate provided that aerial application using WP products is canceled and engineering controls are employed; that is, water soluble bags for wettable powder formulations, closed mixing/loading systems are used for aerial applications of EC products and aerial application using WP products are canceled. For blueberry, post-application risks are not of concern at the 1.5 lb. rate provided that the REI for the WP formulation is 9 days and the REI for the EC formulation is 6 days. Since this use is primarily a post-harvest use increasing the REI is not expected to have an impact on use. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum application rate by 25% and reducing the maximum seasonal rate by 50%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Strawberry (2.0 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 54 at current REI of 24 hours MOE = 100 at 5 days Risks to non-target aquatic organisms for WP and EC	Reduce the maximum application rate to 1 lbs/ai/A Require all wettable powders to be packaged in water soluble bags Require closed mixing/loading systems for aerial application using the EC formulation Cancel aerial application using the WP formulation 5 day REI for WP (high exposure activities, hand harvesting , pruning, thinning etc.: MOE > 100) Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 3 per season to 2 per season 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Crop*	Risks of Concern	Mitigation
Rationale for Worker Risk Mitigation: For strawberry, handler risks are not of concern at the 1 lb. rate provided that aerial application using WP products is canceled and engineering controls are employed; that is, water soluble bags for wettable powder formulations, closed mixing/loading systems are used for aerial applications of EC products and aerial application using WP products are canceled. For strawberry, post-application risks are not of concern at the 1 lb. rate provided the REI for the WP formulation is 5 days. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum application rate by 50%, reducing the maximum seasonal rate by 33% and reducing the maximum number of applications per season to two. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Alfalfa (seed) (1 lb/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Application with aerial equipment Risks to non-target aquatic organisms for WP and EC	Cancel WP Use Reduced application rate to 1lb/ai/A Require closed mixing/loading systems for aerial application 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For alfalfa (seed), handler risks are of concern at the 1.0 lb. rate even provided that wettable powder formulations are canceled and provided engineering controls are employed; that is closed mixing/loading systems are used for aerial applications of EC products (MOE = 82). In California, the seed alfalfa acreage has decreased significantly to approximately 20,000 to 35,000 acres Endosulfan use in seed alfalfa is part of an integrated management approach that also benefits cotton producers. The use of endosulfan, when combined with a pyrethroid, is important in the control of *Lygus* bugs. Since seed alfalfa is harvested earlier than cotton, there is potential for *Lygus* bugs to migrate into cotton fields later in the season. Use of sublethal doses of pyrethroid alone could result in resistance and the lower endosulfan rate may be insufficient to guarantee good coverage, especially under heavy infestations or over time. Resistance, which has been observed in other crops, hinders control with another pyrethroid application, the usual method of treatment, and would require use of potentially harsher alternatives. Relatively few other alternatives are available to alfalfa growers. Compared to those that are registered, including the organophosphates, malathion and dimethoate, endosulfan is less toxic to honey bees, which are crucial to the pollination of the alfalfa crop. *Lygus* bugs can also migrate to other crops, including dry beans. The Agency considers this use to be beneficial to both seed alfalfa and cotton growers in California, and minimizes resistance issues that would arise from sole reliance on pyrethroids. In Washington, Oregon, Idaho, and Nevada, the Agency believes that it is unlikely that 1200 acres would be treated in a given day. For instance, in eastern Oregon and southwest Idaho, seed alfalfa fields are usually about 5 to 20 acres in size, while the average farm size in Oregon was 114 acres in 1997. The spotted alfalfa aphid is the main pest treated. Endosulfan applications are generally needed only once per season when there is an outbreak, which may not occur simultaneously on all fields. Endosulfan is used at a range of rates, with lower rates being used at night during bloom to protect bees and at higher rates if the outbreak occurs later in the season. There are concerns that using lower rates of endosulfan for the spotted alfalfa aphid would not result in adequate control and would lead to resistance problems in the future. Given relatively few registered alternatives on alfalfa for seed, this is a plausible scenario. Given the benefits and the characterization of likely acres treated per day presented above, the Agency believes no further mitigation is necessary at this time for alfalfa (seed).		

Crop*	Risks of Concern	Mitigation
Rationale for Ecological Risk Mitigation: Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum application rate by 25%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Small Grains (0.75 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Application with aerial equipment Risks to non-target aquatic organisms for WP and EC	Cancel WP Use Require closed mixing/loading systems for aerial application using the EC formulation Reduce maximum number of applications from 2 per season to 1 per season 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For small grains, handler risks are not of concern at the 0.75 lb. rate provided that wettable powder formulations are canceled and provided engineering controls are employed; that closed mixing/loading systems are used for aerial applications of EC products.. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum number of applications rate by 50%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Filberts (2 lbs/ai/A) Walnuts (2 lbs/ai/A) Almonds (2 lbs/ai/A) Macadamia Nuts (2 lbs/ai/A)	Mixing/Loading Liquid for aerial application Mixing/Loading WP for aerial application Mixing/Loading WP for airblast application Application w/ airblast application Risks to non-target aquatic organisms for WP and EC	Require all wettable powders to be packaged in water soluble bags Cancel aerial application using the WP formulation Require closed mixing/loading systems for aerial application using the EC formulation Require closed cabs for airblast applications Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 2 per season to 1 per season 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Crop*	Risks of Concern	Mitigation
Rationale for Worker Risk Mitigation: For filberts and walnuts, handler risks are not of concern at the 2 lb. rate provided engineering controls are employed; that is, water soluble bags for wettable powder formulations, closed mixing/loading systems are used for aerial applications of EC products, aerial application using WP products are canceled and closed cabs are used for airblast applications (designed to provide dermal protection). **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33% and the maximum number of applications to one. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Peppers (1 lbs/ai/A) Eggplant (1 lbs/ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for airblast application Risks to non-target aquatic organisms for WP and EC	Require all wettable powders to be packaged in water soluble bags Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For eggplant and peppers, handler risks are not of concern at the 1 lb. rate provided engineering controls are employed; that is, water soluble bags for wettable powder formulations. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Potatoes (1 lbs/ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for airblast application Risks to non-target aquatic organisms for WP and EC	Require all wettable powders to be packaged in water soluble bags Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 6 per season to 4 per season 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For potatoes, handler risks are not of concern at the 1 lb. rate provided engineering controls are employed; that is, water soluble bags for wettable powder formulations. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33% and the maximum number of applications to 4. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		

Crop*	Risks of Concern	Mitigation
Carrots (1 lbs/ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 54 at current REI of 24 hours MOE = 100 at 5 days Risks to non-target aquatic organisms for WP and EC	Cancel WP use Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For carrots, handler risks are not of concern at the 1 lb. rate provided that the wettable powder use is canceled. For carrots, post-application risks are not of concern at the 1 lb. rate provided the WP formulations are canceled. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Dry Beans (1 lbs/ai/A) Dry Peas (1 lbs/ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 65 at current REI of 24 hours MOE = 100 at 4 days Risks to non-target aquatic organisms for WP and EC	Cancel WP use Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 3 per season to 2 per season 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For dry beans and dry peas, handler risks are not of concern at the 1 lb. rate provided that the wettable powder use is canceled. For dry beans and dry peas, post-application risks are not of concern at the 1 lb. rate provided the WP formulations are canceled. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33% and the maximum number of applications to two. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		

Crop*	Risks of Concern	Mitigation
Tobacco (1 lb/ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 54 at current REI of 24 hours MOE = 100 at 4 days Medium exposure activities for WP (scouting and irrigating): MOE = 83 at current REI of 24 hours MOE = 100 at 2 days Risks to non-target aquatic organisms for WP and EC	Cancel WP use Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A Reduce maximum number of applications from 6 per season to 2 per season Restrict use on tobacco to the following states: IN, KY, OH, PA, TN and WV. 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For tobacco, handler risks are not of concern at the 1 lb. rate provided that the wettable powder use is canceled. For tobacco, post-application risks are not of concern at the 1 lb. rate provided the WP formulations are canceled. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum seasonal rate by 33% and the maximum number of applications to two. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications. By restricting the use on tobacco to IN, KY, OH, PA, TN and WV exposures to aquatic organisms are expected to be reduced. These restrictions remove use in areas of the country where water resources are more abundant and potentially vulnerable.		
Pineapple (2 lbs/ai/A)	Mixing/Loading WP for aerial application Mixing/Loading WP for ground application High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 81 at current REI of 24 hours MOE = 100 at 3 days Risks to non-target aquatic organisms for WP and EC	Cancel WP use 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies

Crop*	Risks of Concern	Mitigation
Rationale for Worker Risk Mitigation: For pineapple, handler risks are not of concern at the 2 lb. rate provided that the wettable powder use is canceled. For pineapple, post-application risks are not of concern at the 2 lb. rate provided the WP formulations are canceled. **Rationale for Ecological Risk Mitigation:** The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		
Ornamental Trees/Shrubs (3 lbs/ai/A)	High exposure activities for WP (hand harvesting, pruning, thinning etc.): MOE = 68 at current REI of 24 hours MOE = 100 at 5 days Risks to non-target aquatic organisms for WP and EC	Require all wettable powders to be packaged in water soluble bags Reduce maximum application rate to 2.5 lbs/ai/A 4-day REI (high exposure hand harvesting, pruning, thinning etc.: MOE > 100) 100 ft. spray buffer for ground applications between a treated area and water bodies 30 ft. maintained vegetative buffer strip between a treated area and water bodies
Rationale for Worker Risk Mitigation: For ornamental trees and shrubs, post-application risks are not of concern at the 2.5 lb. rate provided that the REI for the WP formulation is 4 days. **Rationale for Ecological Risk Mitigation:** Overall environmental loading and, therefore, exposure to non-target organisms will be reduced by reducing the maximum single application rate by 17%. The vegetative buffer is designed to reduce the potential for endosulfan to contaminate water through runoff from treated fields. The 100 ft. spray buffer will also reduce the potential for contamination through spray drift during ground applications.		

* Rates in parentheses are the rates used in the risk assessment. Unless otherwise noted, these correspond to the maximum application rate to be allowed on labels.

2. Environmental Risk Mitigation

The Agency has ecological risk concerns regarding the acute and chronic risks to terrestrial birds and mammals, freshwater fish, freshwater invertebrates, estuarine/marine fish and estuarine/marine invertebrates. The ecological risk assessments exhibit RQ values which exceed the various target levels of concern (LOCs). As outlined in Section III above, risks are much higher, as evidenced by higher RQ values, for aquatic organisms, and especially for estuarine/marine organisms.

Birds and Mammals

The Agency's assessment suggests the potential for the liquid formulation to cause acute and chronic effects to birds and mammals for broadcast applications. The avian acute RQs range from 0.02 to 0.53. The avian chronic RQs range from 0.03 to 2.7. For the same use patterns, mammalian acute RQs range from 0.06 to 40 while mammalian chronic RQs range from 0.3 to 5.4. The highest avian and mammalian RQs result from two1.5 lb ai/A ground or aerial

applications to several crops. Most use patterns are of concern to the Agency for acute and chronic effects to birds and mammals.

Because of the toxicity of endosulfan, to help protect terrestrial birds and mammals, it is very important to minimize their potential exposure. To minimize risk to birds and mammals, several mitigation measures are needed as outlined in Table 20 above. These measures include reductions in single maximum application rates, reductions in maximum seasonal application rates, reductions in maximum numbers of applications allowed in a single growing season and the deletion of use on pecans, succulent beans, succulent peas, grapes and spinach.

Aquatic Organisms

At the current maximum application rates used on the major crops where endosulfan is employed, coupled with a 300-ft spray drift buffer, acute high risk, restricted use and endangered species levels of concern are exceeded for both freshwater and estuarine/marine organisms. Acute RQ values ranged from 1.04 to 34.8 for freshwater fish and from 0.15 to 5 for freshwater invertebrates. Estuarine/marine fish and invertebrates were roughly an order of magnitude more sensitive to the effects of endosulfan, with acute RQ values ranging from 8.7 to 289 for fish and 1.9 to 64.2 for invertebrates. Chronic RQ values ranged from 1.5 to 64 for freshwater fish and from 3.6 to 135.3 for freshwater invertebrates. Chronic RQ values for estuarine/marine fish ranged from 16 to 704 and 1 to 39.5 for estuarine/marine invertebrates. The highest aquatic RQs result from three 1.0 lb ai/A applications to tomatoes. All use patterns are of concern to the Agency for acute and chronic effects to aquatic organisms.

Because of the toxicity of endosulfan, to help protect aquatic organisms, it is very important to minimize their potential exposure to endosulfan products that have been applied. To reduce risk to aquatic organisms, several mitigation measures are needed as outlined in Table 20 above. These measures include deletion of use on pecans, succulent beans, succulent peas, grapes and spinach, reductions in single maximum application rates, maximum seasonal application rates and maximum numbers of applications allowed in a single growing season. They also include implementing a 100 foot setback from water bodies for ground applications and a 30 foot maintained vegetative buffer between treated fields and water bodies.

3. Public Comment and Stakeholder Process to Address Aquatic Risks and Long Range Transport

Given the toxicity and persistence of endosulfan and potential risks to aquatic organisms, the Agency has developed a number of mitigation measures to reduce the risks to aquatic organisms outlined in this document. While the Agency believes that these measures will reduce the potential for exposures to aquatic organisms and reduce the overall environmental loading of endosulfan, it also believes that in specific geographical areas where conditions exist that make aquatic organisms especially vulnerable (e.g. shallow, leaky aquifers, highly erodible lands, the presence of especially sensitive organisms and high use of endosulfan) additional measures may be identified. In order to more fully evaluate the risks in these vulnerable areas; the risk

management strategies that may be in place or could potentially be implemented in such areas (e.g. use of retention ponds) to reduce exposure; and the benefits of the use of endosulfan in those areas, the Agency is planning to conduct a public comment and stakeholder process.

During the public comment period, commencing with the publishing of a Federal Register Notice, comments and suggestions will be collected and reviewed concerning risks to aquatic organisms in vulnerable areas, risk management strategies for addressing those risks and the benefits of use of endosulfan in vulnerable areas. Further, a stakeholder meeting(s) will be held within 3 months for the issuance of this RED at a location(s) to be determined. For this meeting(s) to be most efficient and successful, all interested parties and viewpoints will be welcomed and considered.

Endosulfan is a semivolatile and persistent cyclodiene pesticide that can migrate over a long distance through various environmental media such as air, water, and sediment. Once endosulfan is applied to crops, it can either persist in soil as a sorbed phase or be removed through several physical, chemical, and biological processes. Recent studies suggest that secondary emissions of residual endosulfan continue to recycle in the global system while they slowly migrated and are redeposited via wet deposition in the Northern Hemisphere. The occurrence of endosulfan in remote regions like the Great Lakes, the Arctic, and mountainous areas is well documented. Endosulfan can also enter the air as adsorbed phase onto suspended particulate matter, but this process does not appear to be a major contributor long range transport like volatilization.

The presence of endosulfan in the remote areas like the Arctic and the Great Lakes requires further understanding of the transport mechanisms from the atmosphere. The potential impact of atmospheric deposition of endosulfan into surface water and its potential effect on water quality and aquatic organisms in the non-use areas is not well documented. Despite the progress made in recent years in estimating the persistence and long-ranged transport of chemicals using models, a validated global model has not been published because of uncertainties involved in the source inventories, chemical fate data, degradative pathways and exposure analyses. Future work will be aimed at developing a comprehensive screening tool that can be used reliably in risk assessments for regulatory purposes. Part of the stakeholder process will include an evaluation of to what extent data related to long range transport may be necessary.

E. Other Labeling

Other use and safety information needs to be placed on the labeling of all end-use products containing endosulfan. For the specific labeling statements, refer to Section V of this document

1. Endangered Species Statement

The Agency has developed the Endangered Species Protection Program to identify pesticides whose use may cause adverse impacts on endangered and threatened species, and to

implement mitigation measures that address these impacts. The Endangered Species Act requires federal agencies to ensure that their actions are not likely to jeopardize listed species or adversely modify designated critical habitat. To analyze the potential of registered pesticide uses to affect any particular species, EPA puts basic toxicity and exposure data developed for REDs into context for individual listed species and their locations by evaluating important ecological parameters, pesticide use information, the geographic relationship between specific pesticide uses and species locations, and biological requirements and behavioral aspects of the particular species. This analysis will take into consideration any regulatory changes recommended in this RED that are being implemented at this time.

The Agency will begin an endangered species effects determination process for all uses of endosulfan that remain registered following completion of the RED. Through this effects determination the Agency will develop use limitations and/or consult with the Fish and Wildlife Service and/or the National Marine Fisheries Service where appropriate.

The Endangered Species Protection Program as described in a Federal Register notice (54 FR 27984-28008, July 3, 1989) is currently being implemented on an interim basis. As part of the interim program, the Agency has developed County Specific Pamphlets that articulate many of the specific measures outlined in the Biological Opinions issued to date. The Pamphlets are available for voluntary use by pesticide applicators on EPA's website at ***http://www.epa.gov/espp***. A final Endangered Species Protection Program, which may be altered from the interim program, will soon be proposed for public comment in the Federal Register.

2. Spray Drift Management

The Agency has been working with the Spray Drift Task Force, EPA Regional Offices, State Lead Agencies for pesticide regulation, and other parties to develop the best spray drift management practices. The Agency has completed its evaluation of the new database submitted by the Spray Drift Task Force and is developing policy on how to appropriately apply the data and the AgDRIFT computer model to its risk assessments for pesticides applied by air, orchard airblast, or ground hydraulic spray. After the policy is in place, the Agency may impose further refinements in spray drift management practices to reduce off-target drift and risks associated with aerial application or other application methods associated with drift, where appropriate.

Based on these analyses, the Agency is in the process of developing more appropriate label statements for spray, and dust drift control to ensure that public health, and the environment are protected from unreasonable adverse effects. In August 2001, EPA published draft guidance for label statements in a pesticide registration (PR) notice ("Draft PR Notice 2001-X" http://www.epa.gov/ PR_Notices/#2001). A *Federal Register* notice was published on August 22, 2001 (http://www.epa.gov/fedrgstr) announcing the availability of this draft guidance for a 90-day public comment period. After review of the comments, the Agency will publish final guidance in a PR notice for registrants to use when labeling their products.

In the interim, registrants may choose to use the proposed statements. Registrants should read and refer to the draft PR notice to obtain a full understanding of the proposed guidance and its intended applicability, exemptions for certain products, and the Agency's willingness to consider other versions of the statements.

Registrants may elect to adopt the appropriate sections of the proposed language below, or a version that is equally protective, for their end-use product labeling for the purpose of complying with the deadlines for label submission outlined in this document. The proposed label language is as follows:

For products applied outdoors as liquids:

"Do not allow spray to drift from the application site and contact people, structures people occupy at any time and the associated property, parks and recreation areas, nontarget crops, aquatic and wetland areas, woodlands, pastures, rangelands, or animals."

"For ground boom applications, apply with nozzle height no more than 4 feet above the ground or crop canopy, and when wind speed is 10 mph or less at the application site as measured by an anemometer. Use _____ (registrant to fill in blank with spray quality, e.g. fine or medium) or coarser spray according to ASAE 572 definition for standard nozzles or VMD for spinning atomizer nozzles."

"For aerial applications, the boom width must not exceed 75% of the wingspan or 90% of the rotary blade. Use upwind swath displacement, and apply only when wind speed is 3 - 10 mph as measured by an anemometer. Use _____ (registrant to fill in blank with spray quality, e.g. fine or medium) or coarser spray according to ASAE 572 definition for standard nozzles or VMD for spinning atomizer nozzles. If application includes a no-spray zone, do not release spray at a height greater than 10 feet above the ground or the crop canopy."

For overhead chemigation:

"Apply only when wind speed is 10 mph or less."

On all product labels:

"The applicator also must use all other measures necessary to control drift."
"For ground rig applications, apply product no more than 4 feet above the ground or the crop canopy, and only when wind speed is 10 mph or less at the application site as measured by an anemometer."

"For aerial applications, use upwind swath displacement, and apply only when wind speed is 3 - 10 mph as measured by an anemometer. If application includes a no-spray

zone, do not release dust at a height greater than 10 feet above the ground or the crop canopy."

Or

"The applicator also must use all other measures necessary to control drift."

For hand-applied products to be applied as sprays:

"Do not allow spray or dust to drift from the application site, and contact people, structures people occupy at any time, and the associated property, parks and recreation areas, nontarget crops, aquatic and wetland areas, woodlands, pastures, rangelands, or animals. Apply only when wind speed is not more than 10 mph. For sprays, apply largest size droplets possible."

Alternatively, registrants may elect to use the following language, which is the current Agency policy on drift labeling:

For products that are applied outdoors in liquid sprays (except mosquito adulticides), regardless of application method, the following must be added to the labels:

"Do not allow this product to drift."

The Agency recognizes that the above option does not address other application types. Registrants may therefore wish to adapt some variation of the old, and proposed new language for their particular products, depending on their application methods.

V. What Registrants Need to Do

The Agency has determined that agricultural use of endosulfan, based on the currently approved labeling, pose occupational and ecological risks that constitute unreasonable adverse effects on the environment. However, the Agency believes that these risks can likely be acceptably mitigated through routine changes to pesticide labeling and formulations. Accordingly, the Agency has determined that endosulfan is eligible for reregistration provided that: (i) additional data that the Agency intends to require confirm this decision for occupational exposures associated with the application of dip treatment to roots or whole plants and ecological risks; and (ii) the risk mitigation measures outlined in this document are adopted, and label amendments are made to reflect these measures. To implement the risk mitigation measures, the registrants must amend their product labeling to incorporate the label statements set forth in the Label Summary Table in Section E below. The additional data requirements that the Agency intends to obtain will include, among other things, submission of the following:

A. Data Call-In Responses

For endosulfan technical grade active ingredient products, registrants need to submit the following items.

Within 90 days from receipt of the generic data call-in (DCI):

(1) completed response forms to the generic DCI (i.e., DCI response form and requirements status and registrant's response form); and

(2) submit any time extension and/or waiver requests with a full written justification.

Within the time limit specified in the generic DCI:

(1) cite any existing generic data which address data requirements or submit new generic data responding to the DCI.

Please contact Stacey Milan at (703) 305-2505 with questions regarding generic reregistration and/or the DCI. All materials submitted in response to the generic DCI should be addressed:

By US mail:
Document Processing Desk (DCI/SRRD)
Stacey Milan
US EPA (7508C)
1200 Pennsylvania Ave., NW
Washington, DC 20460

By express or courier service:
Document Processing Desk (DCI/SRRD)
Stacey Milan
Office of Pesticide Programs (7508C)
Room 266A, Crystal Mall 2
1921 Jefferson Davis Highway
Arlington, VA 22202

B. For products containing the active ingredient endosulfan, registrants need to submit the following items for each product.

Within 90 days from the receipt of the product-specific data call-in (PDCI):

1. Completed response forms to the PDCI (i.e., PDCI response form and requirements status and registrant's response form); and

2. Submit any time extension or waiver requests with a full written justification.

Within eight months from the receipt of the PDCI:

a. two copies of the confidential statement of formula (EPA Form 570-4);

b. a completed original application for reregistration (EPA Form 8570-1). Indicate on the form that it is an "application for reregistration";

c. five copies of the draft label incorporating all label amendments outlined in Table 21 of this document;

d. a completed form certifying compliance with data compensation requirements (EPA Form 8570-34);

e. if applicable, a completed form certifying compliance with cost share offer requirements (EPA Form 8570-32); and

f. the product-specific data responding to the PDCI.

Please contact Karen Jones at (703) 308 - 8047 with questions regarding product reregistration and/or the PDCI. All materials submitted in response to the PDCI should be addressed:

By US mail:
Document Processing Desk (PDCI/PRB)
Karen Jones
US EPA (7508C)
1200 Pennsylvania Ave., NW
Washington, DC 20460

By express or courier service only:
Document Processing Desk (PDCI/PRB)
Karen Jones
Office of Pesticide Programs (7508C)
Room 266A, Crystal Mall 2
1921 Jefferson Davis Highway
Arlington, VA 22202

B. Manufacturing Use Products

1. Additional Generic Data Requirements

The generic data base supporting the reregistration of endosulfan for the above uses has been reviewed and determined to be substantially complete with the exception of the following studies. The following data requirements are necessary to confirm the reregistration eligibility decision documented in this RED.

Studies on endosulfan sulfate

1. OPPTS 850.2100: Avian acute oral toxicity of bobwhite quail and mallard duck.
2. OPPTS 850.2200: Avian subchronic oral toxicity of bobwhite quail and mallard duck.
3. OPPTS 850.2300: Avian reproduction study of bobwhite quail and mallard duck

4. OPPTS 850.1075: Freshwater fish acute toxicity study of bluegill sunfish.
5. OPPTS 850.1500: Freshwater fish full life cycle using rainbow trout.
6. OPPTS 850.1075: Estuarine/marine fish acute toxicity study.
7. OPPTS 850.1035: Estuarine/marine invertebrate acute toxicity study of mysid shrimp
8. OPPTS 850.1300: Early life stage fish
9. OPPTS 850.1350: Life cycle invertebrate

Other Studies

1. OPPTS 850.1735: Whole sediment acute toxicity testing using a freshwater invertebrate.
2. OPPTS 850.1740: Whole sediment acute toxicity testing using a estuarine/marine invertebrate.
3. OPPTS 850.1735S: Whole sediment chronic toxicity testing using a freshwater invertebrate.
4. OPPTS 850.1740S: Whole sediment chronic toxicity testing using an estuarine/marine invertebrate.
5. 164 -2 (Special Study): Vegetative buffer effectiveness study
6. OPPTS 835.7100: Groundwater monitoring study
7. OPPTS 835.7200: Surface drinking water monitoring study
8. OPPTS 870.6200: Subchronic Neurotoxicity - Rat
9. OPPTS 870.6300: Developmental Neurotoxicity Toxicity Study - Rat
10. OPPTS 860.1380: Storage stability (oils seed, non-oily grain and processed commodities)
11. OPPTS 860.1900: Field rotational crop study
12. OPPTS 860.1500: Crop field trials for the following raw agricultural commodities: barley hay, and pearled barley; oat forage, hay, and rolled oats; rye forage; wheat forage, and hay.
13. OPPTS 860.1500: Crop field trials for tobacco and a pyrolysis.
14. OPPTS 860.1520: Magnitude of residue in processed food/feed commodities
15. OPPTS 875.1100: Dermal outdoor exposure for applying dip treatments to trees and roots or whole plants.
16. OPPTS 875.1700: Product use information for applying dip treatments to trees and roots or whole plants.

2. Labeling for Manufacturing Use Products

To remain in compliance with FIFRA, manufacturing use product (MUP) labeling should be revised to comply with all current EPA regulations, PR Notices and applicable policies. The MP labeling should bear the labeling contained in Table 21 at the end of this section.

C. End-Use Products

1. Additional Product-Specific Data Requirements

Section 4(g)(2)(B) of FIFRA calls for the Agency to obtain any needed product-specific data regarding the pesticide after a determination of eligibility has been made. Registrants must review previous data submissions to ensure that they meet current EPA acceptance criteria and if

not, commit to conduct new studies. If a registrant believes that previously submitted data meet current testing standards, then the study MRID numbers should be cited according to the instructions in the Requirement Status and Registrants Response Form provided for each product. A product-specific data call-in, outlining specific data requirements, accompanies this RED.

2. Labeling for End-Use Products

Labeling changes are necessary to implement the mitigation measures outlined in Section IV above. Specific language to incorporate these changes is specified in the Table 21 at the end of this section.

D. Existing Stocks

The Agency has determined that registrant may distribute and sell endosulfan products bearing old labels/labeling for 9 months from the date of issuance of this RED. Persons other than the registrant may distribute or sell such products for 18 months from the date of the issuance of this RED. Registrants and persons other than the registrant remain obligated to meet pre-existing label requirements and existing stocks requirements applicable to products they sell or distribute.

E. Labeling Changes Summary Table

In order to mitigate the risks identified in this document, amend all product labels to incorporate the risk mitigation measures outlined in Section IV. The following table describes how language on the labels should be amended.

Table 21. Summary of Labeling Changes for Endosulfan

Description	Labeling	Placement on Label
	Manufacturing-Use Products	
Formulation instructions required for all MUP labels.	"Only for formulation into an ***insecticide*** for the following use(s)" *[fill blank only with those uses that are being supported by MP registrant*].	Directions for Use
One of these statements may be added to a label to allow reformulation of the product for a specific use or all additional uses supported by a formulator or user group.	"This product may be used to formulate products for specific use(s) not listed on the MP label if the formulator, user group, or grower has complied with U.S. EPA submission requirements regarding support of such use(s)." "This product may be used to formulate products for any additional use(s) not listed on the MP label if the formulator, user group, or grower has complied with U.S. EPA submission requirements regarding support of such use(s)."	Directions for Use
Environmental Hazards Statements Required by the RED and Agency Label Policies	**"Environmental Hazards"** "Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NDPES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your Water Board or Regional Office of the EPA." "This product is extremely toxic to fish and aquatic invertebrates and toxic to birds and mammals. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. See Spray drift management instructions under "Directions for use. Do not contaminate water when disposing of equipment wash waters or rinsate."	Precautionary Statements
	End-Use Products Intended for Occupational Use	
Handler PPE Guidelines (all formulations)	Note the following information when preparing labeling for all end use products: For **sole-active-ingredient** end-use products that contain Endosulfan, the product label must be revised to adopt the handler personal protective equipment (PPE)/engineering control requirements set forth in this section. Any conflicting PPE requirements on the current label must be removed. For **multiple-active-ingredient** end-use products that contain Endosulfan, the handler PPE/engineering control requirements set forth in this section must be compared with the requirements on the current label, and the more protective language must be retained. For guidance on which requirements are considered to be more protective, see PR Notice 93-7. PPE that will be established on the basis of Acute Toxicity testing on end-use products undergoing product reregistration must be compared with the active ingredient PPE specified below by the RED. The more protective PPE must be placed in the product labeling. For guidance on which PPE is considered more protective, see PR Notice 93-7.	Handler PPE Statements

Description	Labeling	Placement on Label
RUP Statement Required for All Formulations	"RESTRICTED USE PESTICIDE" "Due to acute toxicity to humans, aquatic organisms, and avian species." 'For retail sale to and use only by certified applicators or persons under their direct supervision, and only for those uses covered by the certified applicator's certification."	
PPE Established by the RED for liquid formulations.	"Personal Protective Equipment (PPE)" "Some materials that are chemical-resistant to this product are (*registrant inserts correct chemical-resistant material*). "If you want more options, follow the instructions for category" [*registrant inserts A,B,C,D,E,F,G,or H*] "on an EPA chemical-resistance category selection chart." "**All** handlers except those using engineering controls must wear: - Respirator with - an organic-vapor removing cartridge with a prefilter approved for pesticides (MSHA/NIOSH approval number prefix TC-23C), or - a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G), or - a NIOSH approved respirator with an (OV) cartridge or a canister with any N,R,P or HE filter. **IN ADDITION:** Mixers and loaders supporting aerial applications who are not using engineering controls (see engineering requirements below), handlers supporting or using high pressure handwand equipment and flaggers must wear: - Coveralls over long-sleeved shirt and long pants - Chemical resistant footwear plus socks - Chemical resistant gloves (except when flagging) - Chemical resistant head gear when exposed overhead - Chemical resistant apron when mixing and loading All other mixers, loaders applicators and handlers must wear: - Long-sleeved shirt and long pants; - Socks and shoes; - Chemical resistant gloves except, for applicators using enclosed cabs or cockpits, - Chemical resistant apron when mixing and loading, applying dips cleaning up spills or cleaning/repairing equipment. - A respirator of the type specified above for all handlers except for those using engineering controls."	Precautionary Statements: Immediately following/below Hazards to Humans and Domestic Animals

Description	Labeling	Placement on Label
PPE Established by the RED for Wettable Powder Formulation (wettable powder formulations need to be marketed in water soluble packaging.)	"Personal Protective Equipment (PPE)" "Some materials that are chemical-resistant to this product are" (*registrant inserts correct chemical-resistant material*). "If you want more options, follow the instructions for category [*registrant inserts A,B,C,D,E,F,G,or H*] on an EPA chemical-resistance category selection chart." "**All** handlers except for those using engineering controls must wear: - Respirator with - an organic-vapor removing cartridge with a prefilter approved for pesticides (MSHA/NIOSH approval number prefix TC-23C), or - a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14G), or - a NIOSH approved respirator with an (OV) cartridge or a canister with any N,R,P or HE filter. **In addition:** "Handlers supporting or using high pressure handwand equipment and flaggers must wear: - Coveralls over long-sleeved shirt and long pants - Chemical resistant footwear plus socks - Chemical resistant gloves (except when flagging) - Chemical resistant head gear when exposed overhead - Chemical resistant apron when mixing and loading All other mixers, loaders applicators and handlers must wear: - Long-sleeved shirt and long pants; - Socks and shoes; - Chemical resistant gloves except, for applicators using enclosed cabs or cockpits, - Chemical resistant apron when mixing and loading, applying dips cleaning up spills or cleaning/repairing equipment. - A respirator of the type specified above for all handlers except for those using engineering controls.	Precautionary Statements: Immediately following/below Hazards to Humans and Domestic Animals
User Safety Requirements	"Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry." "Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them."	Precautionary Statements: Immediately following the PPE requirements

Description	Labeling	Placement on Label
Engineering Controls for Liquid Formulations	"Engineering Controls" "Mixers and loaders supporting aerial applications at the rate of more than 1.5 lbs/ai per acre or supporting applications to alfalfa, cotton, barley, rye oats and wheat and must use a closed system that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(4)] for dermal and inhalation protection , and must: -- wear long-sleeved shirt, long pants, shoes, socks, chemical resistant gloves and chemical apron, -- wear long-sleeved shirt, long pants, shoes, socks,, and -- be provided and have immediately available for use in an emergency, such as a broken package, spill, or equipment breakdown coveralls, chemical resistant footwear and the type of respirator specified in the PPE." "Applicators using airblast equipment on all crops except ornamental trees and shrubs must use an enclosed cab that meets the definition in the Worker Protection Standard for Agricultural Pesticides [40 CFR 170.240(d)(5)] for dermal protection. In addition, such applicators must: -- wear the personal protective equipment required in the PPE section of this labeling , -- *either* wear the type of respirator specified in the PPE section of this labeling *or* use an enclosed cab that is declared in writing by the manufacturer or by a government agency to provide at least as much respiratory protection as the type of respirator specified in the PPE section of this labeling, -- be provided and must have immediately available for use in an emergency when they must exit the cab in the treated area: coveralls, chemical-resistant footwear, chemical-resistant headgear, if overhead exposure, and, if using an enclosed cab that provides respiratory protection, a respirator of the type specified in the PPE section of this labeling, -- take off any PPE that was worn in the treated area before reentering the cab, and -- store all such PPE in a chemical-resistant container, such as a plastic bag, to prevent contamination of the inside of the cab." "Pilots must use an enclosed cockpit in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(6)];" "When handlers use closed systems and enclosed cabs, in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the WPS."	Precautionary Statements: Immediately following the User Safety Requirements

Description	Labeling	Placement on Label
Engineering Controls for Wettable Powder Formulations	"Engineering Controls" "Water-soluble packets when used correctly qualify as a closed mixing/loading system under the Worker Protection Standard for Agricultural Pesticides [40 CFR 170.240(d)(4)]. Mixers and loaders using water-soluble packets must : -- wear long-sleeved shirt, long pants, shoes, socks, chemical resistant gloves and chemical apron,, and -- be provided and must have immediately available for use in an emergency, such as a broken package, spill, or equipment breakdown coveralls, and the type of respirator specified in the PPE." "Applicators using airblast equipment on all crops except ornamental trees and shrubs must use an enclosed cab that meets the definition in the Worker Protection Standard for Agricultural Pesticides [40 CFR 170.240(d)(5)] for dermal protection. In addition, such applicators must: -- wear long-sleeved shirt, long pants, shoes, socks, -- *either* wear the type of respirator specified in the PPE section of this labeling *or* use an enclosed cab that is declared in writing by the manufacturer or by a government agency to provide at least as much respiratory protection as the type of respirator specified in the PPE section of this labeling, -- be provided and must have immediately available for use in an emergency when they must exit the cab in the treated area: coveralls, chemical-resistant footwear, chemical-resistant headgear, if overhead exposure, and, if using an enclosed cab that provides respiratory protection, a respirator of the type specified in the PPE section of this labeling, -- take off any PPE that was worn in the treated area before reentering the cab, and -- store all such PPE in a chemical-resistant container, such as a plastic bag, to prevent contamination of the inside of the cab." "Pilots must use an enclosed cockpit in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40 CFR 170.240(d)(6)];**"** "When handlers use enclosed cabs, in a manner that meets the requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides (40 CFR 170.240(d)(4-6), the handler PPE requirements may be reduced or modified as specified in the WPS."	
User Safety Recommendations	**"User Safety Recommendations"** "Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet." "Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing." "Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing."	Precautionary Statements: Immediately following Engineering Controls) Must be placed in a box

Description	Labeling	Placement on Label
Environmental Hazards	"Environmental Hazards" "This product is extremely toxic to fish and aquatic invertebrates and toxic to birds and mammals. Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Drift and runoff may be hazardous to aquatic organisms in water adjacent to treated areas. See Spray drift management instructions under "Directions for use. Do not contaminate water when disposing of equipment wash waters or rinsate."	Precautionary Statements: Immediately following the User Safety Recommendations
Restricted Entry Interval (REI).	"Do not enter or allow worker entry into treated areas during the restricted entry interval (REI)."	Directions for Use in the Agricultural Use Requirements Box.
Restricted Entry Intervals (REI) for EC Formulations.	All crops except for the crops listed below have an REI of 48 hours. The following crop has an REI of 3 days: sweet potato. The following crops grown for seed have an REI of 3 days: collard greens, kale, mustard greens, radish, rutabaga, and turnip. The following crops NOT grown for seed have an REI of 4 days: kohlrabi, broccoli and cabbage. The following crops also have an REI of 4 days: brussels sprouts and cauliflower. The following crops have an REI of 6 days: blueberries. The following crops grown for seed have an REI of 7 days: kohlrabi, broccoli and cabbage The following crops have an REI of 17 days: sweet/fresh corn	Directions for Use next to the application instructions for each crop

Description	Labeling	Placement on Label
restricted Entry Intervals (REI) for wettable powder formulations.	All crops except for the crops listed below have an REI of 48 hours. The following crops have an REI of 3 days: cucumbers, melons, pumpkins, and squash. The following crops have an REI of 4 days: celery, lettuce, apple, apricot, cherry, nectarines, peach, pear, plum, and prune, Christmas trees, ornamental trees and shrubs, and non-bearing citrus trees. The following crops NOT grown for seed have an REI of 4 days: collard greens, kale, mustard greens, radish, rutabaga, and turnip. The following crops grown for seed have an REI of 5 days: collard greens, kale, mustard greens, radish, rutabaga, and turnip. The following crops have an REI of 9 days: brussels sprouts, cauliflower The following crops NOT grown for seed have an REI of 9 days: kohlrabi, broccoli, cabbage. The following crops for seed have an REI of 12 days: kohlrabi, broccoli, cabbage.	Directions for Use next to the application instructions for each crop
Early Entry PPE	"PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is: * coveralls, * chemical-resistant gloves made of any waterproof material, * shoes plus socks, * protective eyewear"	Directions for Use in the Agricultural Use Requirements Box.
Double Notification	"Notify workers of the application by warning them orally and by posting warning signs at entrances to treated area."	Directions for Use in the Agricultural Use Requirements Box.
Application Restrictions	"Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application."	Place in the Directions for Use

Description	Labeling	Placement on Label
Other Risk Mitigation	**Reduced Application Rates (maximum a.i. per acre or per gallon per application)** Tree bark application: 0.005 lb/ai gallon Cotton (aerial applications), alfalfa grown for seed, and kale: 0.75 lb ai/acre Broccoli, kohlrabi, cabbage and cauliflower not grown not for seed: 1.0 lb ai/acre Strawberries: 1.0 lb ai/acre Cotton (ground applications) and blueberries: 1.5 lb ai/acre Macadamia nuts: 2.0 lbs ai/acre Pome fruit, stone fruit, nonbearing citrus, pecans and ornamental trees and shrubs: 2.5 ai/acre **Reduce Seasonal Application Rate (maximum amount a.i./acre that can be applied in a single season)** Celery: Reduce to 1.0 lbs ai/acre per season Sweet/fresh corn, cotton (aerial application) and blueberries: Reduce to 1.5 lbs ai/acre per season Melons, cucumbers, squash, pumpkins, lettuce, tomatoes, sweet potato, cotton (ground applications), broccoli, cauliflower, cabbage, kohlrabi, brussels sprouts, strawberries, filberts, walnuts, almonds, macadamia nuts, peppers, egg plant, potatoes, carrots, dried beans, dried peas and tobacco: Reduce to 2.0 lbs ai/acre per season. Pome fruit, stone fruit, nonbearing citrus and pecans: Reduce to 2.5 lbs ai/acre per season. **Reduce Number of Applications/Season (max. # of applications that can be made in one season)** Almonds, filberts, macadamia nuts, walnuts, sweet corn, barley, oats, wheat, and rye: Reduce to 1 application per season. Broccoli, brussels sprouts, cauliflower, cabbage, cotton, dry deans, dry peas, kohlrabi, lettuce, strawberry, sweet potatoes, tobacco: Reduce to 2 applications per season. Melons, cucumber, squash and pumpkins: Reduce to 4 applications per season except for CA where the maximum number of applications per season is 3. Potatoes, tomatoes: Reduce to 4 applications per season.	Directions for Use under application instructions and/or restrictions

Description	Labeling	Placement on Label
Other Risk Mitigation (continued)	**Site/Crop Deletions (remove the following sites or crops from the label)** <u>All formulations:</u> Grapes (all types) Spinach Succulent Beans Succulent Peas Pecans <u>Wettable Powders:</u> Alfalfa (grown for seed only) Pineapple Blueberries Strawberries Carrots Small Grains (barley, oats, rye, and wheat) Cotton Sweet Corn Dry Beans Sweet Potatoes Dry Peas Tobacco Tomato **Application Equipment/Method Deletions:** Revise applications instructions for the below crops to remove and prohibit aerial applications: <u>Wettable powder formulations only:</u> Apricots Radish (grown for seed only) Almonds Peaches Turnip (grown for seed only) Macadamia Nuts Nectarines Rutabaga (grown for seed only) Filberts Plum/Prune Broccoli (grown for seed only) Walnuts Cherries Cabbage (grown for seed only) Kale (grown for seed only) Non-bearing Citrus Kohlrabi (grown for seed only) Collard Greens (grown for seed only) Mustard Greens (grown for seed only) For all formulations, prohibit use of high pressure hand wand on all sites except to bark treatment or tobacco drench.	Directions for Use under application instructions and/or restrictions

Description	Labeling	Placement on Label
Spray Drift Labeling	"Do not allow spray to drift from the application site and contact people, structures people occupy at any time and the associated property, parks and recreation areas, non-target crops, aquatic and wetland areas, woodlands, pastures, rangelands, or animals." "A 30 ft. vegetative buffer strip must be maintained between all areas treated with this product and rivers, natural ponds, lakes, streams, reservoirs, marshes, estuaries and commercial fish ponds." "For ground boom applications, do not apply within 100 feet of rivers, natural ponds, lakes, streams, reservoirs, marshes, estuaries and commercial fish ponds. Apply with nozzle height no more than 4 feet above the ground or crop canopy and when wind speed is 10 mph or less at the application site as measured by an anemometer. Use (registrant to fill in blank with spray quality, e.g. fine or medium) or coarser spray according to ASAE 572 definition for standard nozzles or VMD for spinning atomizer nozzles." "For orchard/vineyard airblast applications, do not apply within 100 feet of rivers, natural ponds, lakes, streams, reservoirs, marshes, estuaries and commercial fish ponds. Direct spray above trees/vines and turn off outward pointing nozzles at row ends and outer rows. Apply only when wind speed is 3 –10 mph at the application site as measured by an anemometer outside of the orchard/vineyard on the upwind side." "For aerial applications, do not apply within 300 feet of rivers, natural ponds, lakes, streams, reservoirs, marshes, estuaries and commercial fish ponds. The boom width must not exceed 75% of the wingspan or 90% of the rotary blade. Use upwind swath displacement and apply only when wind speed is 3 -- 10 mph as measured by an anemometer. Use _____ (registrant to fill in blank with spray quality, e.g. fine or medium) or coarser spray according to ASAE 572 definition for standard nozzles or VMD for spinning atomizer nozzles. If application includes a no-spray zone, do not release spray at a height greater than 10 feet above the ground or the crop canopy." "For overhead chemigation, do not apply within 100 feet of rivers, natural ponds, lakes, streams, reservoirs, marshes, estuaries and commercial fish ponds. Apply only when wind speed is 10 mph or less." "The applicator also must use all other measures necessary to control drift."	Directions for Use under General application instructions and/or restrictions

VI. APPENDICES

Appendix A. **Endosulfan Table of Use Patterns Reflecting Label Changes Based on Mitigation Measures**

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Alfalfa (grown for seed)						
Foliar treatment Ground or aerial	3 lb/gal EC [CA860035]	1.0 lb/A	2	1.0 lb/A	21	Require closed mixing/loading systems for aerial application. Reduce application rate to 1b./ai/A. WP formulation canceled. Use limited to CA. Applications may be made in a minimum of 10 gal/A by ground or 5 gal/A by air. The feeding or grazing of treated foliage, crop residues, or seed millings and the use of treated seed for livestock food or feed are prohibited.
	3 lb/gal EC [NV860005]	1.0 lb/A	2	(NS)	(NS)	Use limited to NV. Applications may be made in a minimum of 10 gal/A by ground or 2 gal/A by air. The feeding or grazing of treated foliage, crop residues, or seed millings and the use of treated seed for livestock food or feed are prohibited.
	3 lb/gal EC [WA880012]	0.5 lb/A	2	NS	21	Use limited to WA. Applications may be made in a minimum of 25 gal/A by ground or 10 gal/A by air. The feeding or grazing of treated foliage, crop residues, or seed screening is prohibited.
Almond						
Delayed dormant or foliar (during popcorn, pink, or petal fall) Ground or aerial	2 lb/gal EC [279-2659]	2.0 lb/A	1	2.0 lb/A	NS	Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial application using the WP formulation. Require closed mixing/loading systems for aerial application using the EC formulation. Require closed cabs for airblast applications. Reduce application rate from 3lbs./ai/A to 21bs./ai/A. Reduce maximum number of applications per season from 2 to 1. Application may be made in a minimum of 200 gal of water/A (dilute) or 40 gal of water/A (concentrate). The grazing of livestock on orchard crops or grasses in treated areas is prohibited*. Treated hulls may be fed to livestock and dairy animals.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Apple						
Delayed dormant and/or foliar (during pink and/or petal fall) Ground or aerial	50% WP [279-1380] [279-3129] [45639-194] [66222-2] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.5 lb/100 gal or 2.5 lb/A	3 (2 per fruiting period)	2.5 lb/A	21	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications. A second application may be made 10 days later. The feeding of pomace from treated apples to livestock, the feeding of cull fruits to animals, or allowing livestock to graze in treated orchards is prohibited.*
Foliar treatment Ground or aerial	50% WP [45639-198]	0.5 lb/100 gal or 2.5 lb/A	3 (2 per fruiting period)	2.5 lb/A	30	Use limited to CA. Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. For EC formulation require closed mixing/loading systems for aerial applications. Require closed cabs for airblast applications. The feeding of pomace from treated apples to livestock, the feeding of cull fruits to animals, or allowing livestock to graze in treated orchards is prohibited.*
	3 lb/gal EC [45639-197]	0.5 lb/100 gal or 2.5 lb/A	2	2.5 lb/A	30	
	3 lb/gal EC [WA880012]	0.5 lb/A	2	2.5 lb/A	21	Use limited to WA. Reduce maximum application rate to 2.5lbs./ai/A. For EC formulation require closed mixing/loading systems for aerial applications. Require closed cabs for airblast applications. Applications may be made in a minimum of 25 gal/A by ground or 10 gal/A by air. The feeding or grazing of treated foliage, crop residues, or seed screening is prohibited.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Foliar treatment Aerial	50% WP [WA780033]	1.5 lb/A	NS	2.5 lb/A	NS	Use limited to WA. Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP Applications may be made in a minimum of 3 gal of water/A using aerial equipment.
Apricot						
Bark treatment Postharvest Ground	50% WP [279-1380] [279-3129] [45639-194] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.75 lb/100 gal (Pacific Northwest) 2.5 lb/100 gal (Southeastern states)	2	2.5 lb/A	21	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited.*
	50% WP [66222-2]	0.75 lb/100 gal (West coast) 2.5 lb/100 gal (Southeastern states)	2	2.5 lb/A	21	
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	30	Reduce maximum application rate to 2.5lbs./ai/A. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited. * Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Barley						
Foliar treatment Ground or aerial	50% WP [279-1380] [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659 [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.5 lb/A	2	1.0 lb/A	NS	Require all wettable powder formulations to be packaged in water soluble bags. Applications may be made in a minimum of 10 gal of water/A using ground equipment. For control of army cutworm, aerial applications may be made in a minimum of 2 gal of crop oil, diesel oil, or water/A. Use limited to IL, IN, MI, and OH for control of cereal leaf beetle, aerial applications may be made in a minimum of 1 gal of water/A. The feeding of treated forage to livestock and application after heads begin to form are prohibited. *
	50% WP [279-1380] [279-3129] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.75 lb/A	2	1.0 lb/A	NS	Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial applications of the EC formulation. Require closed cabs for airblast applications. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. The feeding of treated forage to livestock and application after heads begin to form are prohibited.* Use of the 3 lb/gal EC (EPA Reg. No. 45639-197) formulation is limited to CA.
Bean, succulent						
Foliar treatment Ground or aerial	50% WP [279-1380] [279-3129] [45639-194] [45639-198] [66222-22]	Succulent Green Beans Canceled	Succulent Green Beans Canceled	Succulent Green Beans Canceled	Succulent Green Beans Canceled	Endosulfan use on succulent green beans canceled.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Bean, dry						
Foliar treatment Ground or aerial	2 lb/gal EC [279-2659] [279-2735] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	Dry Beans 1bs./ai/A	Dry Beans 2	Dry Beans 2.0 lb/A	Dry Beans	For dry beans, cancel WP use. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs.ai/A. Reduce maximum number of applications per season from 3 to 2.
	3 lb/gal EC [279-3222]	1.0 lb/A	3	3.0 lb/A	21	Endosulfan use on succulent green beans canceled
Blueberry						
Postharvest treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	1.5 lb/A	2	1.5 lb/A	NS	Reduce maximum seasonal application rate from 3lbs./ai/A to 1.5 lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial applications using the EC formulation. Cancel aerial application using the WP formulation. Applications may be made after harvest in 3 lbs./ai/300 gal of water with a 6- to 8-week pretreatment interval. Application after buds are well formed is prohibited.*

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Broccoli						
Foliar treatment Ground or aerial	50% WP [45639-194] [66222-22] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	2	2.0 lb/A	7	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2.0 lbs./ai/A. Reduce maximum number of applications from 4 per season to 2 per season. Applications may be made in a minimum of 10 gal/A by ground or 1-3 gal/A by air.
Foliar treatment Ground or aerial	50% WP [279-3129] 50% WP [45639-198]	1.0 lb/A	3	2.0 lb/A	7	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2.0 lbs./ai/A. Reduce maximum number of applications from 4 per season to 2 per season. For use on broccoli, including Chinese broccoli. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.
	3 lb/gal EC [45639-197]	1.0 lb/A	2	2.0 lb/A	7	Use limited to CA. Require all wettable powders to be packaged in water soluble bags. Number of applications per season remains at 2. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Brussels sprouts						
Foliar treatment Ground or aerial	50% WP [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2735] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	2	2.0 lb/A	14	Require all wettable powders to be packaged in water soluble bags. Reduce maximum application rate from 3lbs./ai/A to 2.0 lbs./ai/A. Reduce maximum number of applications from 4 per season to 2 per season. Applications may be made in a minimum of 10-25 gal/A by ground or 1-3 gal/A by air.
	50% WP [279-3129]	1.0 lb/A	2	2.0 lb/A	14	Require all wettable powders to be packaged in water soluble bags. Reduce maximum application rate from 3lbs./ai/A to 2.0 lbs./ai/A. Reduce maximum number of applications per season from 4 per season to 2 per season. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.
Foliar treatment Ground or aerial	50% WP [45639-198] 3 lb/gal EC [45639-197]	1.0 lb/A	2	2.0 lb/A	14	Use limited to CA. Require all wettable powders to be packaged in water soluble bags. Number of applications per season remains at 2. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Cabbage						
Foliar treatment Ground or aerial	50% WP [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2735] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	4	2.0 lb/A	7	Require all wettable powders to be packaged in water soluble bags. Reduce maximum application rate from 3lbs./ai/A to 2.0 lbs./ai/A. Reduce maximum number of applications from 4 per season to 2 per season. Applications may be made in a minimum of 10-25 gal/A by ground or 1-3 gal/A by air.
	50% WP [279-3129]	1.0 lb/A	3	2.0 lb/A	7	For use on cabbage, including Chinese cabbage or Napa. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.
	50% WP [45639-198] 3 lb/gal EC [45639-197]	1.0 lb/A	2	2.0 lb/A	7	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2.0 lbs./ai/A. Reduce maximum number of applications from 4 per season to 2 per season. Applications may be made in a minimum of 10-25 gal/A by ground or 1-3 gal/A by air.
	3 lb/gal EC [279-3222]	0.75 lb/A	3	2.0	14	Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Cabbage (grown for seed)						
Foliar treatment Ground or aerial	3 lb/gal EC [WA760012]	2.0 lb/A	2	NS	NS	Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial applications using the EC formulation. Cancel aerial application using the WP formulation. Use limited to WA. Applications may be made in a minimum of 20 gal/A by ground or 5 gal/A by air. The grazing of livestock in treated areas and the use of treated crop or crop residue or screening for food or feed are prohibited.*
	50% WP [WA780029] 3 lb/gal EC [OR770043] [WA770016]	2.0 lb/A	2	NS	NS	Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial applications using the EC formulation. Cancel aerial application using the WP formulation. Use limited to OR and WA on cabbage including Chinese cabbage. Applications may be made in a minimum of 20 gal/A by ground or 5 gal/A by air. Use of treated crops or crop residue or sweepings for food or feed and the grazing of livestock on treated areas are prohibited.*
Carrot						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2735] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	1	2.0 lb/A	7	Cancel WP use. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Applications may be made in a minimum of 10-25 gal/A by ground or 1 gal/A by air. Use of tops for food or feed is prohibited.* Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Carrot, continued						
Foliar treatment Ground or aerial	3 lb/gal EC [279-2149]	1.0 lb/A	1	2.0 lb/A	15	Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Use of tops for food or feed is prohibited.
Cauliflower						
Foliar treatment Ground or aerial	50% WP [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2735] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	4	2.0 lb/A	14	See "Brussels sprouts".
	50% WP [279-3129]	1.0 lb/A	3	2.0 lb/A	14	See "Brussels sprouts".
	3 lb/gal EC [279-2149]	0.75 lb/A	2	2.0 lb/A	14	See "Brussels sprouts".
	50% WP [45639-198] 3 lb/gal EC [45639-197]	1.0 lb/A	2	2.0 lb/A	14	See "Brussels sprouts".

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Celery						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	1	1.0 lb/A	4	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 1lbs./ai/A. Application may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	2	1.0 lb/A	7	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 1lbs./ai/A. Application may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Cherry						
Bark treatment Ground	50% WP [279-3129] 3 lb/gal EC [279-2924]	0.75 lb/100 gal	2	.0005 lbs./ai/gal	21	Reduce maximum application rate to 0.005 lbs./ai/gal for high pressure handwands and rights-of-way sprayer. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited.*
Bark treatment Postharvest Ground	50% WP [45639-194] [66222-22]	0.75 lb/100 gal	2	2.5 lb/A	21	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Cancel aerial application using WP formulation..

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Cherry, continued						
Bark treatment Postharvest Ground	3 lb/gal EC [45639-169]	0.75 lb/100 gal	2	2.5 lb/A	21	Require closed mixing/loading systems for aerial application suing the EC formulation. Require closed cabs for airblast applications. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited.*
Delayed dormant (popcorn or prepink stage) Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	21	Use limited to Pacific Northwest. Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Cancel aerial application using WP formulation. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited.* Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Delayed dormant Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/100 gal	2	3.0 lb/A	21	Use limited to MI. Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Cancel aerial application using WP formulation. Require closed mixing/loading systems for aerial application suing the EC formulation. Require closed cabs for airblast applications. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited.*
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22]	0.5 lb/100 gal	2	3.0 lb/A	21	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Cancel aerial application using WP formulation..

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Cherry (continued)						
Foliar treatment Ground or aerial	3 lb/gal EC [279-2924] [45639-169] [45639-197]	2.5 lb/A	2	3.0 lb/A	21	Require closed mixing/loading systems for aerial application suing the EC formulation. Require closed cabs for airblast applications The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited. * Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Nursery stock dip	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	2 lb/40 gal	NS	NS	Not applicable (NA)	Immerse trees so that the roots and crowns are covered well above the grafting bud scar; plant immediately or dry before returning to storage. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Citrus (nonbearing trees and nursery stock)						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822]	0.25 lb/100 2.5 lb/A	2	2.5 lb/A	NS	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Cancel aerial application using WP formulation. Require closed mixing/loading systems for aerial application suing the EC formulation. Application to bearing trees or trees that will bear fruit within 12 months is prohibited. Use of the 50% WP (EPA Reg. No. 45639-198) formulation is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Citrus (nonbearing trees and nursery stock), continued						
Foliar treatment Ground or aerial	3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 2.5 lb/A	2	2.5 lb/A	NS	Application to bearing trees or trees that will bear fruit within 12 months is prohibited. Use of the 3 lb/gal EC (EPA Reg. No. 45639-197) formulation is limited to CA.
Collards						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2735] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	1	1.0 lb/A	21	Require all wettable powders to be packaged in water soluble bags. Application may be made in a minimum of 10-25 gal/A by ground or 1 gal/A by air.
	50% WP [45639-198] 3 lb/gal EC [45639-197]	0.75 lb/A	1	0.75 lb/A	21	Use limited to CA. Require all wettable powders to be packaged in water soluble bags. Application may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.
Collards (grown for seed)						
Foliar treatment Ground or aerial	50% WP [WA780029] 3 lb/gal EC [OR770043] [WA770016]	2.0 lb/A	2	NS	NS	Require all wettable powders to be packaged in water soluble bags. Require closed mixing/loading systems for aerial applications using the EC formulation. Cancel aerial application using the WP formulation.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Corn, sweet						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.5 lb/A	1	1.5 lb/A	1	Cancel WP use. Reduce maximum seasonal application rate from 3lbs./ai/A to 1.5lbs./ai/A. Require closed mixing/loading systems for aerial application using the EC formulation. Use limited to fresh vegetable; application to sweet corn to be processed is prohibited.* Applications may be made in a minimum of 10 gal/A by ground or 1-5 gal/A by air with a 5-day pretreatment interval. The feeding of treated forage or ensilage to livestock or the grazing of livestock in treated fields is prohibited.* Use of the 3 lb/gal EC (EPA Reg. No. 45639-197) is limited to CA.
Cotton						
Foliar treatment (until bolls open) Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.5 lb/A	2	1.5 lb/A (aerial) 2.0 lb/A (ground)	NS	Cancel WP use. Reduce rate for ground application to 1.5 lbs./ai/A. Reduce rate for aerial application to 0.75 lbs./ai/A Require closed mixing/loading systems for aerial application suing EC formulation. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A (ground) and reduce maximum seasonal application rate from 3lbs./ai/A to 1.5 lbs./ai/A (aerial). Reduce maximum number of applications per season from 6 to 2. Restrict use on cotton to the following states: AZ, CA, NM, OK, and TX. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. The grazing of dairy or meat animals in treated fields and application after bolls open are prohibited.* Use of the 3 lb/gal EC (EPA Reg. No. 45639-197) is limited to CA.
	3 lb/gal EC [279-2149] [279-3222	1.5 lb/A	2	1.5.0 lb/A (aerial) 2.0 lb/A (ground)	NS	Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. The grazing of dairy or meat animals in treated fields and application after bolls open are prohibited.*

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Cotton (continued)						
Foliar treatment (after bolls open) Ground or aerial	2 lb/gal EC [AZ930014] [AZ930016]	0.75 lb/A	NS	1.5.0 lb/A (aerial) 2.0 lb/A (ground)	14	Use limited to AZ. Applications may be made in a minimum of 10 gal/A using ground or aerial equipment.
Cucumber						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	4	2.0 lb/A	2	Require all wettable powders be packaged in water soluble bags. Reduce maximum number of applications per season from 6 to 4. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.
	50% WP [45639-198] 3 lb/gal EC [45639-197]	1.0 lb/A	3	2.0 lb/A	2	Use limited to CA. Require all wettable powders be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Maintain maximum number of applications per season at 3. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Eggplant						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	2	2.0 lb/A	1	Require all wettable powders be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.
Eggplant, continued						
Foliar treatment Ground or aerial	3 lb/gal EC [45639-197]	0.5 lb/A	2	2.0 lb/A	1	Use limited to CA. Require all wettable powders be packaged in water soluble bags. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.
	50% WP [45639-198]	0.5 lb/A	1	2.0 lb/A	1	Use limited to CA. Require all wettable powders be packaged in water soluble bags Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.
Filbert						
Foliar treatment Ground or aerial	50% WP [279-1380] [279-3129] [45639-194] [45639-198] [66222-22]	0.5 lb/100 gal 2.0 lb/A	1	2.0 lb/A	1	Require all wettable powders to be packaged in water soluble bags. Cancel aerial application using the WP formulation. Require closed mixing/loading systems for aerial application using the EC formulation. Require closed cabs for airblast application. Reduce maximum seasonal application rate from 2 per season to 1. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. The grazing of livestock on orchard crops or grasses in treated areas is prohibited. * Use of the 50% WP (EPA Reg. No. 45639-198) formulation is limited to CA.
	50% WP [OR780020]	0.5 lb/100 gal (300 gal/A; dilute) 1.5 lb/A (25 gal/A; concentrate)	NS	NS	NS	Use limited to OR. Application may be made in a minimum of 300 gal of water/A (dilute) or in 25 gal of water/A (concentrate). The grazing of livestock in treated groves is prohibited.* No PHI has been established.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Grape						
Foliar treatment Ground (preferred)	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Endosulfan use on grapes canceled
Foliar treatment Ground	3 lb/gal EC [CA760115]	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Endosulfan use on grapes canceled
Kale						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.75 lb/A	1	0.75 lb/A	21	Reduce maximum application rate to 0.75 lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Kale (grown for seed)						
Foliar treatment Ground or aerial	50% WP [WA780029] 3 lb/gal EC [OR770043] [WA770016]	2.0 lb/A	2	NS	NS	Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial application using EC formulation. Cancel aerial application using the WP formulation.
Kohlrabi (grown for seed)						
Foliar treatment Ground or aerial	50% WP [WA780029] 3 lb/gal EC [OR770043] [WA770016]	2.0 lb/A	2	NS	NS	Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial application using EC formulation. Cancel aerial application using the WP formulation.
Lettuce, head						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	2	2.0 lb/A	14	Require all wettable powder formulations to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Reduce number of applications per season from 3 to 2. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. The feeding of crop refuse to livestock is prohibited. * Remove wrapper leaves at harvest.* Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Lettuce, leaf						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	2	2.0 lb/A	14	Require all wettable powder formulations to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Number of applications per season will remain at 2 in CA. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. The feeding of crop refuse to livestock is prohibited. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Macadamia nut						
Foliar treatment Ground or aerial	2 lb/gal EC [279-2659] [279-2822]	1.0 lb/100 gal	2	2.0 lb/A	1	Require all wettable powders to be packaged in water soluble bags. Cancel aerial application using the WP formulation. Require closed mixing/loading systems for aerial application using the EC formulation. Require closed cabs for airblast application. Reduce maximum seasonal application rate from 2 per season to 1. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. The grazing of livestock on orchard crops or grasses in treated areas is prohibited.
Foliar treatment Ground	50% WP [HI880008]	1.0 lb/100 gal	2	2.0 lb/A	2	Use limited to HI. The grazing of livestock on orchard crops or grasses in treated areas.* Application by aircraft is prohibited.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Melons						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	4	2.0 lb/A	2	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Reduce maximum number of applications per season from 6 to 4 (except in CA where the application per season will remain at 3.
	50% WP [45639-198] 3 lb/gal EC [45639-197]	1.0 lb/A	3	2.0 lb/A	2	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Reduce maximum number of applications per season from 6 to 4 (except in CA where the application per season will remain at 3.
Mustard greens						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.75 lb/A	1	0.75 lb/A	21	Reduce maximum application rate to 0.75 lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags Application may be made in a minimum of 10 gal/A by ground or 1 gal/A by air.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Mustard greens (continued)						
Foliar treatment Ground or aerial	50% WP [45639-198] 3 lb/gal EC [45639-197]	0.75 lb/A	1	0.75 lb/A	21	Reduce maximum application rate to 0.75 lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Application may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
	50% WP [WA780029] 3 lb/gal EC [OR770043]	0.75 lb/A	1	0.75 lb/A	NS	Reduce maximum application rate to 0.75 lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags.
Nectarine						
Bark treatment Postharvest Ground	50% WP [279-3129] [45639-194] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.75 lb/100 gal (Pacific Northwest) 2.5 lb/100 gal (Southeastern states)	2	2.5 lb/A	21	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications.
	50% WP [279-1380]	0.75 lb/100 gal (West coast)	2	2.5 lb/A	21	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Nectarine (Continued)						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	30	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications.
Oats						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924]	0.5 lb ai/A	1	1.0 lb/A	NS	Cancel WP use. Require closed mixing/loading systems for aerial application using EC formulation. Reduce maximum number of applications from 2 per season to 1.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Oats (continued)						
Foliar treatment Ground or aerial	50% WP [279-3129] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.75 lb/A	1	1.0 lb/A	NS	Cancel WP use. Require closed mixing/loading systems for aerial application using EC formulation. Reduce maximum number of applications from 2 per season to 1.
Peach						
Bark treatment Postharvest Ground	50% WP [279-3129] [45639-194] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.75 lb/100 gal (Pacific Northwest) 2.5 lb/100 gal (Southeastern states)	2	2.5 lb/A	21	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications.
	50% WP [279-1380] [66222-22]	0.75 lb/100 gal (West coast) 2.5 lb/100 gal (Southeastern states)	2	2.5 lb/A	21	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Peach (continued)						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	30	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications.
Nursery stock dip	50% WP [27-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.005 lbs./ai/ gal	NS	NS	NA	Reduce maximum application rate to 0.005 lbs lbs.ai/A from 0.4 lbs/ai/gal for high pressure handwand and rights-of way sprayers.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Pear						
Delayed dormant and foliar (during white bud or petal fall) Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	7	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited.*
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	2.5 lb/A	2	2.5 lb/A	7	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Application may be made in a minimum of 10-20 gal of water/A by air, in 40 gal (semi-concentrate), or in 300 gal (dilute). The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited. * Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
	2 lb/gal EC [279-2822]	0.75 lb/100 gal [300 gal of finished spray/A]	2	2.5 lb/A	7	The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited.*

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Pear (continued)						
Soil treatment Prebloom Ground	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal [200-400 gal of finished spray/A]	2	2.5 lb/A	7	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Applications may be made to the orchard floor. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited. * Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Postharvest or dormant Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal	2	2.5 lb/A	7	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. The feeding of cull fruits to animals or allowing livestock to graze in treated orchards is prohibited.* Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Peas, succulent, Dry Peas						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	Succulent Green Peas Canceled Dry Peas 1.0 lb/A	Succulent Green Peas Canceled Dry Peas 2	Succulent Green Peas Canceled Dry Peas 2.0 lb/A	Succulent Green Peas Canceled Dry Peas 3	See "Bean, succulent and dry".
	2 lb/gal EC [279-2659] [279-2822]	1.0 lb/A	2	2.0 lb/A	1	Use limited to the Northwest (EPA Reg. No. 279-2659). Use limited on peas to be harvested by combine only. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. The feeding of treated vines or threshing to livestock or allowing livestock to graze in treated fields is prohibited. *
Dry Peas						
	3 lb/gal EC [279-2924]	1.0 lb/A	2 per fruiting period	2.0 lb/A	5	Use limited on peas to be harvested by combine only. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. The feeding of treated vines or threshing to livestock or allowing livestock to graze in treated fields is prohibited.*
	3 lb/gal EC [WI920007]	1.0 lb/A	2 per fruiting period	2.0 lb/A	NS	Use limited to WI on peas to be harvested by combine only. Applications may be made in a minimum of 10 gal/A by ground or 2 gal/A by air. The grazing of treated fields or the feeding of treated forage or threshing to livestock is prohibited.*

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Pecan						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	Canceled	Canceled	Canceled	Canceled	Endosulfan use on pecans is canceled
Pepper						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	2	2.0 lb/A	4	Require all wettable powders to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Pepper (continued)						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	2	2.0 lb/A	4	Require all wettable powder formulations to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Pineapple						
Foliar treatment Ground or aerial	50% WP [279-3129] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-197]	2.0 lb/A	2	3.0 lb/A	7	Cancel use of WP formulation. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air with a 7- to 10-day pretreatment interval. The feeding of treated forage or pineapple byproducts to livestock is prohibited.* Use of the 3 lb/gal EC (EPA Reg. No. 45639-197) is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Plum						
Delayed dormant (during pre-pink stage) Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	7	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications. Use limited to the Pacific Northwest. The grazing of livestock on treated orchard crops or grasses in treated areas is prohibited.* Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Prebloom or foliar (petal fall) Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	7	Reduce maximum application rate to 2.5lbs./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Cancel aerial applications using WP formulation. Require closed mixing/loading systems for aerial applications using the EC formulation. Require closed cabs for airblast applications The grazing of livestock on treated orchard crops or grasses in treated areas is prohibited. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Plum (continued)						
Foliar treatment Ground or aerial	50% WP [45639-194] [45639-198]	0.75 lb/100 gal 2.5 lb/A	2	2.5 lb/A	7	The grazing of livestock on treated orchard crops or grasses in treated areas is prohibited.* Use of the 50% WP (EPA Reg. No. 45639-198) formulation is limited to CA.
Bark treatment Postharvest Ground	50% WP [279-3129] [45639-194] [45639-198] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [45639-169] [45639-197]	0.75 lb/100 gal 2.5 lb/A	2	0.005 lbs/ai/gal	7	Reduce maximum application rate to 0.005 lbs./ai/gal for high pressure handwand and rights-of-way sprayer scenarios. The grazing of livestock on treated orchard crops or grasses in treated areas is prohibited.* Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Bark treatment Ground	50% WP [66222-22] 3 lb/gal EC [279-2924]	0.75 lb/100 gal 2.5 lb/A	2	0.005 lbs/ai/gal	7	Reduce maximum application rate to 0.005 lbs./ai/gal for high pressure handwand and rights-of-way sprayer scenarios. The grazing of livestock on treated orchard crops or grasses in treated areas is prohibited.*

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Plum (continued)						
Nursery stock dip	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	2 lb/40 gal	NS	NS	NA	Reduce maximum application rate of 0.005 lbs./ai/A fro high pressure handwand and rights-of-way sprayer scenarios.
Potato						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	4	2.0 lb/A	1	Require all wettable powder formulations to be packaged in water soluble bags. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Reduce maximum number of applications per season from 6 to 4. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Chemigation Sprinkler irrigation	3 lb/gal EC [WA900023]	1.0 lb/A	NS	2.0 lb/A	1	Use limited to WA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Prune						
Delayed dormant (during pre-pink stage) Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	7	See "Plum".
Prebloom or foliar (petal fall) Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.5 lb/100 gal 2.5 lb/A	2	2.5 lb/A	7	See "Plum".

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Prune (continued)						
Bark treatment Postharvest Ground	50% WP [279-3129] [45639-194] [45639-198] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [45639-169] [45639-197]	0.75 lb/100 gal 2.5 lb/A	2	0.005 lbs./ai/gal	7	Reduce maximum seasonal application rate to o.oo5 lbs./ai/gal for high pressure handwand and rights-of-way sprayer scenarios.
Bark treatment Ground	50% WP [66222-22] 3 lb/gal EC [279-2924]	0.75 lb/100 gal 2.5 lb/A	2	0.005 lbs./ai/gal	7	Reduce maximum seasonal application rate to o.oo5 lbs./ai/gal for high pressure handwand and rights-of-way sprayer scenarios.
Pumpkin						
Foliar treatment Ground or aerial	50% [279-3129] [45639-194] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	4	2.0 lb/A	2	See "Cucumber".
	3 lb/gal EC [45639-197]	1.0 lb/A	4	2.0 lb/A	2	See "Cucumber".

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Radish (grown for seed)						
Foliar treatment Ground or aerial	50% WP [WA780029] 3 lb/gal EC [OR770043] [WA770016]	2.0 lb/A	2	NS	NS	Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial application using the EC formulation. Cancel aerial application using the WP formulation.
Rutabaga (grown for seed)						
Foliar treatment Ground or aerial	50% WP [WA780029] 3 lb/gal EC [OR770043] [WA770016]	2.0 lb/A	2	NS	NS	Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial application using the EC formulation. Cancel aerial application using the WP formulation.
Rye						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924]	0.75 lb/A	1	1.0 lb/A	NS	Cancel WP use. Require closed mixing/loading systems for aerial application using EC formulation. Reduce maximum number of applications from 2 per season to 1.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
	50% WP [279-3129] [66222-22] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	0.75 lb/A	2	1.0 lb/A	NS	Cancel WP use. Require closed mixing/loading systems for aerial application using EC formulation. Reduce maximum number of applications from 2 per season to 1.
Spinach						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2735] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	Canceled	Canceled	Canceled	Canceled	Endosulfan use on spinach is canceled
	50% WP [45639-198] 3 lb/gal EC [45639-197]	Canceled	Canceled	Canceled	Canceled	Endosulfan use on spinach is canceled

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Squash, summer and winter						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	4	2.0 lb/A	2	Require all wettable powder formulations to be packaged in water soluble bags. Reduce the maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Reduce maximum number of applications per season from 6 to 4.
	50% WP [45639-198] 3 lb/gal EC [45639-197]	1.0 lb/A	4	2.0 lb/A	2	Require all wettable powder formulations to be packaged in water soluble bags. Reduce the maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Reduce maximum number of applications per season from 6 to 4.
Strawberry						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822]	1.0 lb/A	3	2.0 lb/A	4	Reduce maximum application rate to 1 lb./ai/A. Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial application using EC formulation. Cancel aerial application suing WP formulation. Reduce maximum seasonal application rate from 3lbs./ai/A to 2lbs./ai/A. Reduce maximum number of applications from 3 per season to 2 per season. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Do not reapply within 15 days or more than twice during a 35 day period when fruit is present. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
	3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A	3	2.0 lb/A	4	Applications may be made in 400 gal. Do not apply at intervals less than 35 days when fruit is present. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Dip treatment	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924]	1.0 lb/100 gal	NS	NS	NA	Use limited to Northwest. Immerse bundles of plants; drain and allow plants to dry before setting them out in the field. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Sweet potato						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [66222-22] 3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A	32	1.0 lb/A	1	Cancel WP use. Require closed mixing/loading systems for aerial application using the EC formulation. Reduce maximum seasonal applications rate from 3lbs./ai/A to 2lbs./ai/A. Reduce maximum number of applications per season from 3 to 2. The feeding of cull potatoes to livestock or the grazing of livestock in treated fields is prohibited.*
	50% WP [45639-198] 3 lb/gal EC [45639-197]	1.0 lb/A	2	1.0 lb/A	1	Use limited to CA. The feeding of cull potatoes to livestock or the grazing of livestock in treated fields is prohibited.*
	50% WP [MS810036] 3 lb/gal EC [MS810035]	0.5 lb/A	NS	NS	NS	Use limited to MS. The feeding of treated potatoes to livestock is prohibited. *

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Sweet potato (continued)						
Soil band or broadcast Ground or aerial	50% WP [279-3129] [66222-22] 3 lb/gal EC [279-2924] [45636-169]	2.0 lb/A (broadcast) 0.67-0.75 lb/A based on a 16 inch band with a 48 inch row spacing	2	2.0 lb/A	1	Use limited to South central states and PR. The feeding of cull potatoes to livestock or the grazing of livestock in treated fields is prohibited.*
Soil treatment Ground or aerial	50% WP [MS8100036]	2.0 lb/A	NS	NS	NS	Use limited to MS. The feeding of treated potatoes to livestock is prohibited.*
	3 lb/gal EC [MS810035]	1.5 lb/A	NS	NS	NS	
Tobacco						
Foliar treatment Seed bed Ground	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.5 lb/100 gal [6 gal of finished spray/100 sq. yd]	2	2.0 lb/A	5	Cancel WP use. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Reduce maximum number of applications per season from 6 to 2. Restrict use on tobacco to the following states: IN, KY, OH, PA, and WV.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Drench treatment Plant bed Ground	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822] 3 lb/gal EC [279-2924] [45639-169]	0.25 lb/100 gal [1 gal of finished spray/sq. yd]	2	2.0 lb/A	5	Cancel WP use. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Reduce maximum number of applications per season from 6 to 2. Restrict use on tobacco to the following states: IN, KY, OH, PA, and WV.
Tobacco (continued)						
Foliar treatment Field Ground	50% WP [279-3129] [45639-194] [66222-22] 2 lb/gal EC [279-2659] [279-2822]	1.0 lb/A 1.5 lb/100 gal	2	2.0 lb/A	5	Cancel WP use. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A. Reduce maximum number of applications per season from 6 to 2. Restrict use on tobacco to the following states: IN, KY, OH, PA, and WV.
	3 lb/gal EC [279-2924] [45639-169]	1.0 lb/A 0.5 lb/100 gal	2	1.0 lb/A	5	

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Tomato (field)						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A 0.5 lb/100-200 gal	2	2.0 lb/A	2	Cancel WP use. Reduce maximum seasonal application rate from 3 lbs./ai/A to 2 lbs./ai/A. Reduce maximum number of applications per season from 6 to 4. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.
Tomato (greenhouse)						
Foliar treatment Ground	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2735] [279-2822] 3 lb/gal EC [279-2924] [45639-169] [45639-197]	1.0 lb/A 0.5 lb/100-200 gal	4	0.005 lbs/ai/gal	2	Reduce maximum application rate to 0.005 lbs./ai/gal for high pressure handwand and rights-of-way sprayers. Applications may be made in a minimum of 10-25 gal/A by ground. Use of the 50% WP (EPA Reg. No. 45639-198) and the 3 lb/gal EC (EPA Reg. No. 45639-197) formulations is limited to CA.

Site Application Type Application Timing Application Equipment	Formulation [EPA Reg. No.]	Maximum Single Application Rate (ai)	Maximum Number of Applications Per Season	Maximum Seasonal Rate (ai)	Preharvest Interval (Days)	Use Directions and Limitations
Turnip						
Foliar treatment Ground or aerial	2 lb/gal EC [279-2659] [279-2822]	0.75 lb/A	1	0.75 lb/A	21	Reduce maximum application rate to 0.75 lbs/ai/A. Require all wettable powders to be packaged in water soluble bags. Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. Application to turnips grown for roots is prohibited.*
Turnip (grown for seed)						
Foliar treatment Ground or aerial	50% WP [WA780029] 3 lb/gal EC [OR770043] [WA770016]	2.0 lb/A	2	NS	NS	Require all wettable powder formulations to be packaged in water soluble bags. Require closed mixing/loading systems for aerial application using the EC formulation. Cancel aerial application using the WP formulation.
Walnut						
Foliar treatment Ground or aerial	50% WP [279-3129] [45639-194] [45639-198] [66222-22] 2 lb/gal EC [279-2659] [279-2822]	2.0 lb/A	2	2.0 lb/A	NS	Require all wettable powders to be packaged in water soluble bags. Cancel aerial application using the WP formulation. Require closed mixing/loading systems for aerial application using the EC formulation. Require closed cabs for airblast application. Reduce maximum seasonal application rate from 2 per season to 1. Reduce maximum seasonal application rate from 3lbs./ai/A to 2 lbs./ai/A Applications may be made in a minimum of 10 gal/A by ground or 1 gal/A by air. The grazing of livestock on orchard crops or grasses in treated areas and application after husk split are prohibited.* Use of the 50% WP (EPA Reg. No. 45639-198) formulation is limited to CA.
	3 lb/gal EC [279-2924] [45639-169]	2.0 lb/A	2	2.0 lb/A	NS	

NS = Not Specified

Appendix B. Table of Generic Data Requirements and Studies Used to Make the Reregistration Decision

GUIDE TO APPENDIX B

Appendix B contains listing of data requirements which support the reregistration for active ingredients within case #0014 (endosulfan) covered by this RED. It contains generic data requirements that apply to endosulfan in all products, including data requirements for which a "typical formulation" is the test substance.

The data table is organized in the following formats:

1. Data Requirement (Column 1). The data requirements are listed in the order in which they appear in 40 CFR part 158. The reference numbers accompanying each test refer to the test protocols set in the Pesticide Assessment Guidance, which are available from the National technical Information Service, 5285 Port Royal Road, Springfield, VA 22161 (703) 487-4650.

2. Use Pattern (Column 2). This column indicates the use patterns for which the data requirements apply. The following letter designations are used for the given use patterns.

   A. Terrestrial food
   B. Terrestrial feed
   C. Terrestrial non-food
   D. Aquatic food
   E. Aquatic non-food outdoor
   F. Aquatic non-food industrial
   G. Aquatic non-food residential
   H. Greenhouse food
   I. Greenhouse non-food
   J. Forestry
   K. Residential
   L. Indoor food
   M. Indoor non-food
   N. Indoor medical
   O. Indoor residential

3. Bibliographic Citation (Column 3). If the Agency has acceptable data in its files, this column list the identify number of each study. This normally is the Master Record Identification (MIRD) number, but may be a "GS" number if no MRID number has been assigned. Refer to the Bibliography appendix for a complete citation of the study.

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Endosulfan

New Guideline Number	Old Guideline Number	Requirement	Use Pattern	Bibliographic Citation(s)
PRODUCT CHEMISTRY				
830.1550	61-1	Product Identity and Composition	A,B,C,H	00128650, 42932001, 42932002, 42932003, 42932004, 42932005, 42932006, 42932007
830.1600	61-2A	Start. Mat. & Mfg. Process	A,B,C,H	00128650, 42932001, 42932002, 42932003, 42932004, 42932005, 42932006, 42932007
830.1670	61-2B	Formation of Impurities	A,B,C,H	00128650, 42932001, 42932002, 42932003, 42932004, 42932005, 42932006, 42932007
830.1700	62-1	Preliminary Analysis	A,B,C,H	00128662, 42919102
830.1750	62-2	Certification of limits	A,B,C,H	00128650, 42932001, 42932002, 42932003, 42932004, 42932005, 42932006, 42932007
830.1800	62-3	Analytical Method	A,B,C,H	00128662, 42932001, 42932002, 42932003, 42932004, 42932005, 42932006, 42932007
830.6302	63-2	Color	A,B,C,H	00128650, 00128657
830.6303	63-3	Physical State	A,B,C,H	00128650, 00128657
830.6304	63-4	Odor	A,B,C,H	00128650, 00128657
830.7200	63-5	Melting Point	A,B,C,H	00128657
830.7220	63-6	Boiling Point	A,B,C,H	00128657
830.7300	63-7	Density	A,B,C,H	00128657
830.7840 830.7860	63-8	Solubility	A,B,C,H	00128657
830.7950	63-9	Vapor Pressure	A,B,C,H	00128657
830.7370	63-10	Dissociation Constant		Not Applicable
830.7550	63-11	Octanol/Water Partition Coefficient	A,B,C,H	00128657
830.7000	63-12	pH	A,B,C,H	00128657
830.6313	63-13	Stability	A,B,C,H	00128657
830.6314	63-14	Oxidizing/Reducing Action	A,B,C,H	00128650
830.6314	63-15	Flammability	A,B,C,H	00128650
830.6316	63-16	Explodability	A,B,C,H	00128650
830.6316	63-17	Storage Stability	A,B,C,H	00128650
830.7100	63-18	Viscosity	A,B,C,H	00128650
830.6319	63-19	Miscibility	A,B,C,H	00128650
830.6320	63-20	Corrosion Characteristics	A,B,C,H	00128650
830.7050	None	UV/Visible Absorption		Not Applicable
ECOLOGICAL EFFECTS				
850.2100	71-1 A	Avian Acute Oral Toxicity (Quail or Duck)	A,B,C	137189, 00136998, 00137189
850.2100	None	Avian Acute Oral Toxicity of Bobwhite Quail and Mallard Duck (Endosulfan Sulfate)	A,B,C	DATA GAP

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Endosulfan

New Guideline Number	Old Guideline Number	Requirement	Use Pattern	Bibliographic Citation(s)
850.2200	71-2A	Avian Dietary Toxicity - Quail	A,B,C	22923
850.2200	None	Avian Subchronic Oral Toxicity of Bobwhite Quail and Mallard Duck (Endosulfan Sulfate)	A,B,C	DATA GAP
850.2200	71-2B	Avian Dietary Toxicity - Duck	A,B,C	22923
850.2400	71-3	Wild Mammal Toxicity	A,B,C	00038307, 00148264
850.2300	71-4A	Avian Reproduction - Quail	A,B,C	40261303
850.2300	71-4B	Avian Reproduction - Duck	A,B,C	40261302, 40335001, 40335002, 146843
850.2300	71-4 (A)	Avian Reproduction - Quail (Endosulfan Sulfate)	A,B,C	DATA GAP
850.2300	71-4 (B)	Avian Reproduction - Duck (Endosulfan Sulfate)	A,B,C	DATA GAP
850.1075	72-1A	Fish Toxicity Bluegill	A,B,C	38806, 40094602,
850.1075	None	Freshwater Fish Acute Toxicity Bluegill Sunfish (Endosulfan Sulfate)	A,B,C	DATA GAP
850.1075	72-1C	Fish Toxicity Rainbow Trout	A,B,C	40098001, 00136998
850.1010	72-2A	Invertebrate Toxicity	A,B,C	5008271, 40098001, 40094602
NONE	72-3A	Estuarine/Marine Toxicity - Fish	A,B,C	40228401
850.1075	None	Estuarine /Marine Fish Acute Toxicity Study (Endosulfan Sulfate)	A,B,C	DATA GAP
850.1025	72-3B	Estuarine/Marine Toxicity - Mollusk	A,B,C	40228401, 128688
850.1035	72-3C	Estuarine/Marine Toxicity - Shrimp	A,B,C	40228401, 128688
850.1300	72-4A	Fish- Early Life Stage	A,B,C	DATA GAP
850.1350	72-4B	Estuarine/Marine Invertebrate Life Cycle	A,B,C	DATA GAP
850.1035	None	Estuarine/Marine Invertebrate Acute Toxicity Study of Mysid Shrimp (Endosulfan Sulfate)	A,B,C	DATA GAP
850.1500	72-5	Life Cycle Fish	A,B,C	DATA GAP

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Endosulfan

New Guideline Number	Old Guideline Number	Requirement	Use Pattern	Bibliographic Citation(s)
850.1500	None	Freshwater Fish Full Life Cycle Using Rainbow Trout (Endosulfan Sulfate)	A,B,C	DATA GAP
850.1735	None	Whole Sediment Acute Toxicity Testing Using Freshwater Invertebrate	A,B,C	DATA GAP
850.1740	None	Whole Sediment Acute Toxicity Testing Using Estuarine/Marine Invertebrate	A,B,C	DATA GAP
850..1735S	None	Whole Sediment Chronic Toxicity Testing Using Freshwater Invertebrate	A,B,C	DATA GAP
850.1740S	None	Whole Sediment Chronic Toxicity Testing Using Estuarine/Marine Invertebrate	A,B,C	DATA GAP
Special Study	None	Tissue Residue Toxicity Study in Fish	A,B,C	RESERVE
Special Study	None	Tissue Residue Toxicity Study in Amphibians	A,B,C	RESERVE
164-2SS	None	Vegetative Buffer Effectiveness Study	A,B,C	DATA GAP
835.7100	None	Groundwater Monitoring	A,B,C	DATA GAP
835.7200	None	Surfacewater Monitoring	A,B,C	DATA GAP
850.4230	123-1	Non-target Terrestrial Plant Phytotoxicity	A,B,C	Not Applicable
850.4400	123-2	Aquatic Plant Growth	A,B,C	Not applicable
OCCUPATIONAL/RESIDUE EXPOSURE				
875.2100	132-1(a)	Foliar Residue Dissipation	A,B,C	44403102
875.2200	132-1B	Soil Residue Dissipation	A,B,C	Not Applicable
875.2400	133-3	Dermal Passive Dosimet	A,B,C	Not Applicable
NONE	133-4	Inhalation Passive Dosimet		WAIVED
NONE	201-1	Droplet Size Spectrum	A,B,C	Not Applicable
NONE	202-1	Drift Field Evaluation	A,B,C	Not applicable
NONE	231	Estimation of Dermal Exposure	A,B,C	41715201, 44939101
NONE	232	Estimation of Inhalation Exposure	A,B,C	41715201
NONE	85-3	Dermal Absorption	A,B,C	40223601, 41048503, 41048504

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New Guideline Number	Old Guideline Number	Requirement	Use Pattern	Bibliographic Citation(s)
875.1100	None	Dermal Outdoor Exposure For Applying Dip Treatments to Trees, Roots, and Whole Plants	A,B,C	DATA GAP
875.1700	None	Product Use Information for Applying Dip Treatments to Trees, Roots, and Whole Plants	A,B,C	DATA GAP
TOXICOLOGY				
870.1100	81-1	Acute Oral Toxicity-Rat	A,B,C,H	00038307, 41183502
870.1100	81-1	Acute Oral Toxicity-Rat	A,B,C,H	00038307, 41183502
870.1200	81-2	Acute Dermal Toxicity-Rabbit/Rat	A,B,C,H	41183503
870.1300	81-3	Acute Inhalation Toxicity-Rat	A,B,C,H	41183504
870.2400	81-4	Primary Eye Irritation-Rabbit	A,B,C,H	255157, 41183505
870.2500	81-5	Primary Skin Irritation	A,B,C,H	00038309, 00128649, 41183506
870.2600	81-6	Dermal Sensitization	A,B,C,H	00136994, 41183507
870.6100	81-7	Acute Delayed Neurotoxicity - Hen	A,B,C,H	00147181, 44403101, 44560701, 44560702
870.6200	81-8	Acute Neurotoxicity Screen	A,B,C,H	44403101
870.6200	82-7	Subchronic Neurotoixicity - Rat	A,B,C,H	DATA GAP
870.6300	83-6	Developmental Neurotoxicity Study - Rat	A,B,C,H	DATA GAP
870.3100	82-1A	90-Day Feeding - Rodent	A,B,C,H	00257932, 00257727, 00147299, 40767601, 41775501
870.3150	82-1B	90-Day Feeding - Non-rodent	A,B,C,H	00147182, 40648801
870.3200	82-2	21-Day Dermal - Rabbit/Rat	A,B,C,H	00146841, 00147744, 41048505, 41048506
NONE	82-4	90 Day Inhalation-Rat	A,B,C,H	00147183, 41667501, 41667502, 41667503
NONE	82-5A	90 Day Neurotox -Hen		RESERVED
NONE	82-5B	90 Day Neurotox - Mammal		RESERVED
870.4100	83-1A	Chronic Feeding Toxicity - Rodent	A,B,C,H	41099502
870.4100	83-1B	Chronic Feeding Toxicity - Non-Rodent	A,B,C,H	41099501
870.4200	83-2A	Oncogenicity - Rat	A,B,C,H	41099501, 41099502
870.4200	83-2B	Oncogenicity - Mouse	A,B,C,H	40792401
870.3700	83-3A	Developmental Toxicity - Rat	A,B,C,H	43129101

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Endosulfan

New Guideline Number	Old Guideline Number	Requirement	Use Pattern	Bibliographic Citation(s)
870.3700	83-3B	Developmental Toxicity - Rabbit	A,B,C,H	00094837
870.3800	83-4	2-Generation Reproduction - Rat	A,B,C,H	00256126, 00256127, 00257727, 00148264
870.4300	83-5	Combined Chronic Toxicity/ Carcinogenicity	A,B,C,H	41099502
870.5140	84-2A	Gene Mutation (Ames Test)	A,B,C,H	00147199, 00148266
870.5375	84-2B	Structural Chromosomal Aberration	A,B,C,H	00147197, 00148265
	84-4	Other Genotoxic Effects	A,B,C,H	00147198
870.7485	85-1	General Metabolism	A,B,C,H	00004257
ENVIRONMENTAL FATE				
835.2120	161-1	Hydrolysis	A,C,H	00150714, 00142649, 00128661, 00128557, 00128659, 41412901
835.2240	161-2	Photodegradation - Water	A,C,H	00253395, 41415701, 41490101
835.2410	161-3	Photodegradation - Soil	A,C,H	00128660, 00142640, 00150714, 41430701
835.2370	161-4	Photodegradation - Air	A,C,H	WAIVED
835.4100	162-1	Aerobic Soil Metabolism	A,C,H	00148993, 41412902, 43812801
835.4200	162-2	Anaerobic Soil Metabolism	A,C,H	00136884, 41412903, 41412904
835.1240	163-1	Leaching/Adsorption/Desorption	A,C,H	00137002, 00137162, 00137446, 41412905, 44346901
NONE	163-2	Volatility-Lab	A,C,H	00252043, 40060601
835.6100	164-1	Terrestrial Field Dissipation	A,C,H	00137003, 00137161, 41309701, 41309702, 41468601, 43069701
860.1850	165-1	Confined Rotational Crop	A,C,H	44393001
860.1900	165-2	Field Rotational Crop	A,C,H	DATA GAP
NONE	165-4	Bioaccumulation in Fish	A,C,H	41421503
RESIDUE CHEMISTRY				
NONE	171-2	Chemical Identity		Not Applicable
860.1300	171-4A	Nature of Residue - Plants	A,B	00003600, 00003642, 00003654, 05002565, 05003004, 05003085, 05003336, 05003801, 05004385, 05004620, 05018169, 44082701, 44082702, 44099101
860.1300	171-4B	Nature of Residue - Livestock	A,B	00003742, 00003743, 00003838, 00003840, 05003222, 05003877, 44082703, 44099101, 440099102, 44427601
860.1340	171-4C	Residue Analytical Method -plants	A,B	00003588, 00003612, 00003795, 00003959, 05003395, GS014024, 00146842, 00157147, 00157148, 44346902
860.1340	171-4D	Residue Analytical Method-Animal	A,B	00003703, 00003840, 44427601
860.1360	171-4M	Multiresidue Methods	A,B	44427601
860.1380	171-4E	Storage Stability	A,B	44396301, 44599600, 44599601, 44637800

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Endosulfan

New Guideline Number	Old Guideline Number	Requirement	Use Pattern	Bibliographic Citation(s)
860.1380	171-4E	Storage Stability	A,B	DATA GAP - oils seed, non-oily grain and processed commodities
860.1480	171-4J	Meat, Milk, Poultry, Eggs Milk and the Fat, Meat, and Meat Byproducts of Cattle, Goats, Hogs, Horses and Sheep Eggs and the Fat, Meat, and Meat Byproducts of Poultry	A,B	44843702 00003742, 00003743, 00003838, 05003222, 05003877, 05013696 00003840, 44843702
860.1500	171-4K	Crop Field Trials (Carrot)	A,B	00003796
860.1500	171-4K	Crop Field Trials (Potato)	A,B	00003709
860.1500	171-4K	Crop Field Trials (Sweet Potato)	A,B	00003642, 00003669, 44346912
Leaves of Root and Tuber Vegetables Group				
860.1500	171-4K	Turnip, Tops	A,B	00003796
Leafy Vegetables (except Brassica) Vegetables Group				
860.1500	171-4K	Crop Field Trials (Celery)	A,B	00003796, 44346906, 44701201
860.1500	171-4K	Crop Field Trials (Lettuce, Leaf)	A,B	00003722, 00003790, 44346904, 44701202
860.1500	171-4K	Crop Field Trials (Spinach)	A,B	00003796
Brassica (Cole) Vegetables Group				
860.1500	171-4K	Crop Field Trials (Broccoli)	A,B	00003796, 44346908
860.1500	171-4K	Crop Field Trials (Brussels Sprouts)	A,B	00003796
860.1500	171-4K	Crop Field Trials (Cabbage)	A,B	00003790
860.1500	171-4K	Crop Field Trials (Cauliflower)	A,B	00003796
860.1500	171-4K	Crop Field Trials (Collards)	A,B	00003796
860.1500	171-4K	Crop Field Trials (Collards, Grown for Seed)	A,B	Not Applicable
860.1500	171-4K	Crop Field Trials (Kale)	A,B	00003796
860.1500	171-4K	Crop Field Trials (Mustard Greens)	A,B	00003796
Legume Vegetables Group				
860.1500	171-4K	Crop Field Trials (Bean, Dry and Succulent)	A,B	00003796
860.1500	171-4K	Crop Field Trials (Eggplant)	A,B	00003796
860.1500	171-4K	Crop Field Trials (Pea, Succulent)	A,B	00003917, 00003949

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Endosulfan

New Guideline Number	Old Guideline Number	Requirement	Use Pattern	Bibliographic Citation(s)
860.1500	171-4K	Crop Field Trials (Pea, Grown for Seed)	A,B	00003917, 00003949
860.1500	171-4K	Crop Field Trials (Pepper)	A,B	00003864
860.1500	171-4K	Crop Field Trials (Tomatoes)	A,B	00003783, 00146842, 44346905
Cucurbit Vegetables Group				
860.1500	171-4K	Crop Field Trials (Cucumber)	A,B	00146842, 44346909
860.1500	171-4K	Crop Field Trials (Melons, Cantaloupe)	A,B	00146842, 44346903
860.1500	171-4K	Crop Field Trials (Melons, Musk)	A,B	00146842, 44346903
860.1500	171-4K	Crop Field Trials (Melons, Water)	A,B	00146842, 44346903
860.1500	171-4K	Crop Field Trials (Pumpkin)	A,B	00146842, 44346909, 44346903, 44346907
860.1500	171-4K	Crop Field Trials (Squash, Summer)	A,B	00146842, 44346907
860.1500	171-4K	Crop Field Trials (Squash, Winter)	A,B	00146842, 44346907
Pome Fruits Group				
860.1500	171-4K	Crop Field Trials (Apple)	A,B	00003787
860.1500	171-4K	Crop Field Trials (Pear)	A,B	00003862
Stone Fruits Group				
860.1500	171-4K	Crop Field Trials (Cherry)	A,B	00003782, 44346910, 44346911
860.1500	171-4K	Crop Field Trials (Peach)	A,B	00003784, 00003789
860.1500	171-4K	Crop Field Trials (Plume, Fresh Prune)	A,B	00003786, 00003791
Berries Group				
860.1500	171-4K	Crop Field Trials (Blueberry)	A,B	00003587, 00003843
Tree Nuts Group				
860.1500	171-4K	Crop Field Trials (Almond, Nutmeat and Hulls)	A,B	00003713, 00004254
860.1500	171-4K	Crop Field Trials (Filbert)	A,B	00004254
860.1500	171-4K	Crop Field Trials (Macadamia Nut)	A,B	00004254
860.1500	171-4K	Crop Field Trials (Pecan)	A,B	00004254
860.1500	171-4K	Crop Field Trials (Walnut)	A,B	00004254
Cereal Grains Group				
860.1500	171-4K	Crop Field Trials (Barley, Grain)	A,B	00003710

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Endosulfan

New Guideline Number	Old Guideline Number	Requirement	Use Pattern	Bibliographic Citation(s)
860.1500	171-4K	Crop Field Trials (Corn, Sweet, K + CWHR)	A,B	00003634, 00003760, 44457001
860.1500	171-4K	Crop Field Trials (Oats, Grain)	A,B	00003710
860.1500	171-4K	Crop Field Trials (Rye, Grain)	A,B	00003710
860.1500	171-4K	Crop Field Trials (Wheat, Grain and Aspirated Grain Fractions)	A,B	00003710
Forage, Fodder, and Straw of Cereal Grains Group				
860.1500	171-4K	Crop Field Trials Barley, Hay and Straw	A,B	00003710, DATA GAP
860.1500	171-4K	Crop Field Trials (Corn, Sweet, Forage and Stover)	A,B	44457001
860.1500	171-4K	Crop Field Trials (Oats, Forage, Hay and Straw)	A,B	00003710
860.1500	171-4K	Crop Field Trials (Rye, Forage and Straw)	A,B	00003710, DATA GAP
860.1500	171-4K	Crop Field Trials (Wheat, Forage, Hay, and Straw)	A,B	00003710, 44762901
Non-Grass Animal Feeds (Forage, Fodder, Straw, and Hay) Group				
860.1500	171-4K	Crop Field Trials (Alfalfa, Forage and Hay)	A,B	00003834, 00003835, 00003836, 00003841, 00004258, 00157148
Miscellaneous Commodities				
860.1500	171-4K	Crop Field Trials (Cotton, Seed and Gin Byproducts)	A,B	00003725, 00003777, 44854101, 44854102, 44854103
860.1500	171-4K	Crop Field Trials (Grape)	A,B	00003788
860.1500	171-4K	Crop Field Trials (Pineapple)	A,B	00003797, 00003798, 00003799
860.1500	171-4K	Crop Field Trials (Rape, Seed and Forage)	A,B	00003724
860.1500	171-4K	Crop Field Trials (Strawberry)	A,B	00003785
860.1500	171-4K	Crop Field Trials (Tobacco)	A,B	05003004, 05003801, DATA GAP
Processed Food/Feed				
860.1520	171-4L	Processed Food (Apple)	A,B	00156259, 44933001
860.1520	171-4L	Processed Food (Barley)	A,B	DATA GAP
860.1520	171-4L	Processed Food (Cotton Seed)	A,B	00003726

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Endosulfan				
New Guideline Number	**Old Guideline Number**	**Requirement**	**Use Pattern**	**Bibliographic Citation(s)**
860.1520	171-4L	Processed Food (Grapes)	A,B	00156259, 44346915
860.1520	171-4L	Processed Food (Oats)	A,B	DATA GAP
860.1520	171-4L	Processed Food (Pineapple)	A,B	00146997, 00156259, 00157147
860.1520	171-4L	Processed Food (Potato)	A,B	44346913
860.1520	171-4L	Processed Food (Rye)	A,B	DATA GAP
860.1520	171-4L	Processed Food (Tomato)	A.B	00146842, 44346914
860.1520	171-4L	Processed Food (Wheat)	A,B	44762901
OTHER				
860.1850	NONE	Confined Rotational Crops	A,B,C	44933001
860.1900	NONE	Field Rotational Crops	A,B,C	44972301

Appendix C. Technical Support Documents

Additional documentation in support of this RED is maintained in the OPP Public Regulatory Docket, located in Room 119, Crystal Mall #2, 1921 Jefferson Davis Highway, Arlington, VA 22202-4501. It is open Monday through Friday, excluding legal holidays, from 8:30 AM to 4 PM.

The docket initially contained preliminary human health & ecological effects risk assessments and related documents as of 09/13/2001. The public comment period closed sixty (60) days later on 11/13/2001. The EPA then considered comments, reevaluated the retention of the FQPA 10x Safety Factor and revised the occupational risk assessment. The Agency also reevaluated the toxicological endpoint selection for dermal and inhalation risk assessments and the 3x safety factor for bioaccumulation. The following documents were added to the docket and posted to the webpage on 3/15/2002. All documents, in hard copy form, may be viewed in the OPP docket room or downloaded/viewed via the Agency's website at ***http://www.epa.gov/pesticides/reregistration/endosulfan/***. These documents include:

Health Effects Risk Assessment Documents:

1. Re-Evaluation of Toxicology Endpoint Selection for Dermal and Inhalation Risk Assessments and 3X Safety Factor for Bioaccumulation, February 7, 2002.
2. Revised Residue Chemistry Chapter For The Endosulfan Reregistration Eligibility Decision (RED) Document, February 14, 2002.
3. Report of the FQPA Safety Factor Committee, February 14, 2002.
4. Third Revision of Occupational and Residential Exposure Assessment and Recommendations for the Reregistration Eligibility Decision Document, February 26, 2002.
5. Anticipated Residues and Revised Chronic Dietary Exposure Analyses, February 28, 2002.
6. New FQPA and PDP Data, Anticipated Residues, and Revised Acute and Chronic Dietary Exposure Analyses, April 22, 2002.
7. Response to Registrant Comments on the Data Supporting the FQPA Safety Factor Rationale for Endosulfan

Health Effects Risk Assessment Documents Added to the Endosulfan Docket on 09/30/2002:

8. Response to Comments. Response to comments on EPA's Human Health Risk Assessment of Endosulfan dated 01/31/2001.
9. Endosulfan. Agency Response to the 60-Day Response by the Endosulfan Task Force to the Revised Residue Chemistry Chapter dated January 31, 2002.
10. Revised Residue Chemistry Chapter for the Endosulfan Reregistration Eligibility Decision (RED) Document, 2/14/2002.

11. Supporting documentation for findings of FQPA Safety Committee on February 11, 2002, May 9, 2002
12. Endosulfan. Review of Endosulfan Task Force Response to the Health Effects Division February 28, 2002 Dietary Exposure Assessment dated, 6/14/2002
13. New FQPA, PDP, and Processing Data, Anticipated Residues, and Revised Acute and Chronic Dietary Exposure Analyses, July 19, 2002
14. Response to Registrant Comments on the Data Supporting the FQPA 10x Safety Factor Rationale for Endosulfan, August 12, 2002.

Environmental Fate and Ecological Effects

15. Final EFED Risk Assessment for the Reregistration Eligibility Decision on Endosulfan, February 26, 2002.
16. Endosulfan and Endosulfan Sulfate: Drinking Water EECs in Surface Water for Use in the Human Health Risk Assessment, July 3, 2002.
17. EFED Response to the ETF "60-Day Response by the Endosulfan Task Force to the Environmental Fate and Effects Drafted Risk Assessment for the Reregistration Eligibility Decision on Endosulfan (EFED Memorandum dated July 12, 2001)"
18. EFED Response to Comments by the World Wildlife Federation on the Environmental Fate and Ecological Risk assessment for the Reregistration Eligibility Decision on Endosulfan
19. EFED Response to Comments by the National Resource Defense Council Environmental Fate and Ecological Risk assessment for the Reregistration Eligibility Decision on Endosulfan

Biological and Economic Analysis of Endosulfan Benefits Assessments

20. Benefits Assessment for Endosulfan Use in Sweet Potato, 4/15/2002
21. Biological And Economic analysis of Endosulfan on Pears: Impacts from Changes in the Re-entry Interval, 4/18/2002
22. Benefits Assessment for Endosulfan Use on Broccoli: Impacts from Changes in the Re-entry Interval, 4/18/2002
23. Biological and Economic Analysis of Endosulfan on Peaches: Impacts from Changes in the Re-entry Interval, 4/24/2002
24. Biological and Economic Analysis of Endosulfan on Grapes: Impacts from Changes in the Re-entry Interval, 5/30/2002
25. Biological and Economic Analysis of Endosulfan on Blueberries: Impacts from Changes in the Re-entry Interval, 5/23/2002
26. Biological and Economic Analysis of Endosulfan on Fresh Sweet Corn: Impacts from Changes in the Re-entry Interval, 6/27/2002

27. Biological and Economic Analysis of Endosulfan Benefits on Selected Crops: Impacts of Cancellation, 7/12/2002
28. Assessment of Endosulfan Use in Seed Alfalfa: Application Rate Reduction to Reduce Risks to Mixers/Loaders, 7/26/2002
29. Biological and Economic Analysis of Endosulfan on Cabbage: Impacts from Changes in the Re-entry Interval, 8/8/2002

Appendix D. Citations Considered to be Part of the Data Base Supporting the Reregistration Decision (Bibliography)

GUIDE TO APPENDIX D

1. CONTENTS OF BIBLIOGRAPHY. This bibliography contains citations of all studies considered relevant by EPA in arriving at the positions and conclusions stated elsewhere in the Reregistration Eligibility Document. Primary sources for studies in this bibliography have been the body of data submitted to EPA and its predecessor agencies in support of past regulatory decisions. Selections from other sources including the published literature, in those instances where they have been considered, are included.

2. UNITS OF ENTRY. The unit of entry in this bibliography is called a "study." In the case of published materials, this corresponds closely to an article. In the case of unpublished materials submitted to the Agency, the Agency has sought to identify documents at a level parallel to the published article from within the typically larger volumes in which they were submitted. The resulting "studies" generally have a distinct title (or at least a single subject), can stand alone for purposes of review and can be described with a conventional bibliographic citation. The Agency has also attempted to unite basic documents and commentaries upon them, treating them as a single study.

3. IDENTIFICATION OF ENTRIES. The entries in this bibliography are sorted numerically by Master Record Identifier, or "MRID" number. This number is unique to the citation, and should be used whenever a specific reference is required. It is not related to the six-digit "Accession Number" which has been used to identify volumes of submitted studies (see paragraph 4(d)(4) below for further explanation). In a few cases, entries added to the bibliography late in the review may be preceded by a nine character temporary identifier. These entries are listed after all MRID entries. This temporary identifying number is also to be used whenever specific reference is needed.

4. FORM OF ENTRY. In addition to the Master Record Identifier (MRID), each entry consists of a citation containing standard elements followed, in the case of material submitted to EPA, by a description of the earliest known submission. Bibliographic conventions used reflect the standard of the American National Standards Institute (ANSI), expanded to provide for certain special needs.

   a Author. Whenever the author could confidently be identified, the Agency has chosen to show a personal author. When no individual was identified, the Agency has shown an identifiable laboratory or testing facility as the author. When no author or laboratory could be identified, the Agency has shown the first submitter as the author.

b. Document date. The date of the study is taken directly from the document. When the date is followed by a question mark, the bibliographer has deduced the date from the evidence contained in the document. When the date appears as (1999), the Agency was unable to determine or estimate the date of the document.

c. Title. In some cases, it has been necessary for the Agency bibliographers to create or enhance a document title. Any such editorial insertions are contained between square brackets.

d. Trailing parentheses. For studies submitted to the Agency in the past, the trailing parentheses include (in addition to any self-explanatory text) the following elements describing the earliest known submission:

(1) Submission date. The date of the earliest known submission appears immediately following the word "received."

(2) Administrative number. The next element immediately following the word "under" is the registration number, experimental use permit number, petition number, or other administrative number associated with the earliest known submission.

(3) Submitter. The third element is the submitter. When authorship is defaulted to the submitter, this element is omitted.

(4) Volume Identification (Accession Numbers). The final element in the trailing parentheses identifies the EPA accession number of the volume in which the original submission of the study appears. The six-digit accession number follows the symbol "CDL," which stands for "Company Data Library." This accession number is in turn followed by an alphabetic suffix which shows the relative position of the study within the volume.

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00003587 Shuttleworth, J.M. (1971) Determination of Endosulfan I, Endosulfan II, and Endosulfan Sulfate Residues in or on Blueberries. Method M-2908 dated Aug 17, 1971. (Unpublished study received Aug 27, 1971 under 1F1034; submitted by FMC Corp., Philadelphia, Pa.; CDL:093343-A)

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00003634 Stanovick, R.P. (1967) Determination of Thiodan I, II and Sulfate Residues in or on Sweet Corn (Husk, Cob and Kernels): M-2129. Includes undated method. (Unpublished study received Jun 14, 1967 under 279-1182; submitted by FMC Corp., Philadelphia, Pa.; CDL:008892-A)

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00003724	Winterlin, W. (1968) Residues Found on Mustard and Rape Seed. Includes undated method. (Unpublished study received Aug 11, 1972 under 3E1300; prepared by Univ. of California--Davis, Dept. of Environmental Toxicology, submitted by Interregional Research Project No. 4, New Brunswick, N.J.; CDL:092201-B)
00003725	FMC Corporation (1966) [Residue Data of Endosulfan on Cotton]. (Unpublished study received Jun 8, 1970 under 0F0929; CDL:091584-B)
00003726	FMC Corporation (1969) Endosulfan Cotton: Processing Studies. (Unpublished study received Jun 8, 1970 under 0F0929; prepared in cooperation with Texas A & M Univ., Cottonseed Products Laboratory, CDL:091584-D)
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Appendix E. Generic Data Call-In

Note that a complete Data Call-In (DCI), with all pertinent instructions, will be sent to registrants under separate cover.

Appendix F. Product Specific Data Call-In

Note that a complete Data Call-In (DCI), with all pertinent instructions, will be sent to registrants under separate cover.

Appendix G. EPA'S Batching of Endosulfan Products for Meeting Acute Toxicity Data Requirements for Reregistration

In an effort to reduce the time, resources and number of animals needed to fulfill the acute toxicity data requirements for reregistration of products containing ENDOSULFAN as the active ingredient, the Agency has batched products which can be considered similar for purposes of acute toxicity. Factors considered in the sorting process include each product's active and inert ingredients (identity, percent composition and biological activity), type of formulation (e.g., emulsifiable concentrate, aerosol, wettable powder, granular, etc.), and labeling (e.g., signal word, use classification, precautionary labeling, etc.). Note that the Agency is not describing batched products as "substantially similar" since some products within a batch may not be considered chemically similar or have identical use patterns.

Using available information, batching has been accomplished by the process described in the preceding paragraph. Notwith-standing the batching process, the Agency reserves the right to require, at any time, acute toxicity data for an individual product should the need arise.

Registrants of products within a batch may choose to cooperatively generate, submit or cite a single battery of six acute toxicological studies to represent all the products within that batch. It is the registrants' option to participate in the process with all other registrants, only some of the other registrants, or only their own products within a batch, or to generate all the required acute toxicological studies for each of their own products. If a registrant chooses to generate the data for a batch, he/she must use one of the products within the batch as the test material. If a registrant chooses to rely upon previously submitted acute toxicity data, he/she may do so provided that the data base is complete and valid by today's standards (see acceptance criteria attached), the formulation tested is considered by EPA to be similar for acute toxicity, and the formulation has not been significantly altered since submission and acceptance of the acute toxicity data. Regardless of whether new data is generated or existing data is referenced, registrants must clearly identify the test material by EPA Registration Number. If more than one confidential statement of formula (CSF) exists for a product, the registrant must indicate the formulation actually tested by identifying the corresponding CSF.

In deciding how to meet the product specific data requirements, registrants must follow the directions given in the Data Call-In Notice and its attachments appended to the RED. The DCI Notice contains two response forms which are to be completed and submitted to the Agency within 90 days of receipt. The first form, "Data Call-In Response," asks whether the registrant will meet the data requirements for each product. The second form, "Requirements Status and Registrant's Response," lists the product specific data required for each product, including the standard six acute toxicity tests. A registrant who wishes to participate in a batch must decide whether he/she will provide the data or depend on someone else to do so. If a registrant supplies the data to support a batch of products, he/she must select one of the following options:

Developing Data (Option 1), Submitting an Existing Study (Option 4), Upgrading an Existing Study (Option 5) or Citing an Existing Study (Option 6). If a registrant depends on another's data, he/she must choose among: Cost Sharing (Option 2), Offers to Cost Share (Option 3) or Citing an Existing Study (Option 6). If a registrant does not want to participate in a batch, the choices are Options 1, 4, 5 or 6. However, a registrant should know that choosing not to participate in a batch does not preclude other registrants in the batch from citing his/her studies and offering to cost share (Option 3) those studies.

Forty-two products were found which contain Endosulfan as the active ingredient. These products have been placed into eight batches in accordance with the active and inert ingredients and type of formulation.

Batching Instructions:

Batch 6: EPA Reg. No. 7401-317 may cite data from EPA Reg. No. 70-126 or EPA Reg. No. 3342-94.

Batch 7: EPA Reg. No. 7401-316 cite data from EPA Reg. No. 16-133.

Batch 1	EPA Reg. No.	Percent Active Ingredient
	264-637	96.0%
	279-2306	95.0%
	10163-223	95.0%
	11678-05	95.0%
	19713-319	94.0%
	34704-799	95.0%

Batch 2	EPA Reg. No.	Percent Active Ingredient
	264-656	50.0%
	267-659	50.0%
	279-1380	50.4%
	279-3129	50.0%
	10163-98	50.0%
	10163-130	50.0%
	51036-91	50.8%
	51036-209	50.0%
	66222-02	51.3%

Batch 3	EPA Reg. No.	Percent Active Ingredient
	264-638	34.4%
	264-658	34.4%
	5905-418	33.3%
	10163-110	34.0%
	11678-25	35.6%
	19713-399	34.3%
	34704-21	33.3%
	34704-516	34.0%

Batch 4	EPA Reg. No.	Percent Active Ingredient
	279-2924	34.0%
	51036-92	34.0%

Batch 5	EPA Reg. No.	Percent Active Ingredient
	70-142	24.0%
	19713-99	24.6%

Batch 6	EPA Reg. No.	Percent Active Ingredient
	70-126	4.0%
	3342-94	4.0%
	7401-317	4.0%

Batch 7	EPA Reg. No.	Percent Active Ingredient
	16-133	3.0%
	7401-316	2.0%

No Batch	EPA Reg. No.	Percent Active Ingredient
	16-141	9.0%
	279-3222	Endosulfan ..... 31.25% Methyl Parathion 20.88%
	802-516	9.2%
	1327-35	15.0%
	1386-338	23.8%
	3342-102	10.2%
	5481-278	26.0%
	5481-296	24.0%
	5481-316	Endosulfan ..... 1.5% Sevin 1.5%
	9779-330	Endosulfan ..... 22.50% Pyrethrins ..... 4.75% Piperoyl Butoxide 0.45%

Appendix H. List of Registrants Sent this Data Call-In Notice

Case # and Name				
0014 Endosulfan				
Chemical # and Name				
079401 Hexachloro-1, 5, 5a, 6, 9, 9a - hexahydro - 6, 9 - methano - 2, 4				
Company Number	**Company Name**	**Address**	**City & State**	**Zip**
00254	BAYER CROPSCIENCE	2 T.W. ALEXANDER DRIVE, P.O. BOX 12014	RESEARCH TRIANGLE PARK, NC	27709
019713	DREXEL CHEMICAL COMPANY	P.O. BOX 13327	MEMPHIS , TN	38113
011678	MAKHTESHIM CHEMICAL WORKS, LTD C/O MAKHTESHIM-AGAN OF N. AMERICA, INC.	551 FIFTH AVENUE, SUITE 1100	NEW YORK, NY	10176

Appendix I. List of Available Related Documents and Electronically Available Forms

Pesticide Registration Forms are available at the following EPA internet site:

http://www.epa.gov/opprd001/forms/.

Pesticide Registration Forms (These forms are in PDF format and require the Acrobat reader)

Instructions

1. Print out and complete the forms. (Note: Form numbers that are bolded can be filled out on your computer then printed.)

2. The completed form(s) should be submitted in hardcopy in accord with the existing policy.

3. Mail the forms, along with any additional documents necessary to comply with EPA regulations covering your request, to the address below for the Document Processing Desk.

   DO NOT fax or e-mail any form containing 'Confidential Business Information' or 'Sensitive Information.'

   If you have any problems accessing these forms, please contact Nicole Williams at (703) 308-5551 or by e-mail at williams.nicole@epamail.epa.gov.

The following Agency Pesticide Registration Forms are currently available via the internet: at the following locations:

8570-1	Application for Pesticide Registration/Amendment	http://www.epa.gov/opprd001/forms/8570-1.pdf.
8570-4	Confidential Statement of Formula	http://www.epa.gov/opprd001/forms/8570-4.pdf.
8570-5	Notice of Supplemental Registration of Distribution of a Registered Pesticide Product	http://www.epa.gov/opprd001/forms/8570-5.pdf.
8570-17	Application for an Experimental Use Permit	http://www.epa.gov/opprd001/forms/8570-17.pdf.
8570-25	Application for/Notification of State Registration of a Pesticide To Meet a Special Local Need	http://www.epa.gov/opprd001/forms/8570-25.pdf.
8570-27	Formulator's Exemption Statement	http://www.epa.gov/opprd001/forms/8570-27.pdf.

8570-28	Certification of Compliance with Data Gap Procedures	http://www.epa.gov/opprd001/forms/8570-28.pdf.
8570-30	Pesticide Registration Maintenance Fee Filing	http://www.epa.gov/opprd001/forms/8570-30.pdf.
8570-32	Certification of Attempt to Enter into an Agreement with other Registrants for Development of Data	http://www.epa.gov/opprd001/forms/8570-32.pdf.
8570-34	Certification with Respect to Citations of Data (in PR Notice 98-5)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-5.pdf.
8570-35	Data Matrix (in PR Notice 98-5)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-5.pdf.
8570-36	Summary of the Physical/Chemical Properties (in PR Notice 98-1)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-1.pdf.
8570-37	Self-Certification Statement for the Physical/Chemical Properties (in PR Notice 98-1)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-1.pdf.

Pesticide Registration Kit www.epa.gov/pesticides/registrationkit/.

Dear Registrant:

For your convenience, we have assembled an online registration kit which contains the following pertinent forms and information needed to register a pesticide product with the U.S. Environmental Protection Agency's Office of Pesticide Programs (OPP):

1. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Federal Food, Drug and Cosmetic Act (FFDCA) as Amended by the Food Quality Protection Act (FQPA) of 1996.

2. Pesticide Registration (PR) Notices

   a. 83-3 Label Improvement Program--Storage and Disposal Statements
   b. 84-1 Clarification of Label Improvement Program
   c. 86-5 Standard Format for Data Submitted under FIFRA
   d. 87-1 Label Improvement Program for Pesticides Applied through Irrigation Systems (Chemigation)
   e. 87-6 Inert Ingredients in Pesticide Products Policy Statement
   f. 90-1 Inert Ingredients in Pesticide Products; Revised Policy Statement
   g. 95-2 Notifications, Non-notifications, and Minor Formulation Amendments
   h. 98-1 Self Certification of Product Chemistry Data with Attachments (This document is in PDF format and requires the Acrobat reader.)

Other PR Notices can be found at http://www.epa.gov/opppmsd1/PR_Notices.

3. Pesticide Product Registration Application Forms (These forms are in PDF format and will require the Acrobat reader.)

   a. EPA Form No. 8570-1, Application for Pesticide Registration/Amendment
   b. EPA Form No. 8570-4, Confidential Statement of Formula
   c. EPA Form No. 8570-27, Formulator's Exemption Statement
   d. EPA Form No. 8570-34, Certification with Respect to Citations of Data
   e. EPA Form No. 8570-35, Data Matrix

4. General Pesticide Information (Some of these forms are in PDF format and will require the Acrobat reader.)

   a. Registration Division Personnel Contact List
   B. Biopesticides and Pollution Prevention Division (BPPD) Contacts
   C. Antimicrobials Division Organizational Structure/Contact List
   d. 53 F.R. 15952, Pesticide Registration Procedures; Pesticide Data Requirements (PDF format)
   e. 40 CFR Part 156, Labeling Requirements for Pesticides and Devices (PDF format)
   f.. 40 CFR Part 158, Data Requirements for Registration (PDF format)
   g.. 50 F.R. 48833, Disclosure of Reviews of Pesticide Data (November 27, 1985)

Before submitting your application for registration, you may wish to consult some additional sources of information. These include:

1. The Office of Pesticide Programs' Web Site

2. The booklet "General Information on Applying for Registration of Pesticides in the United States", PB92-221811, available through the National Technical Information Service (NTIS) at the following address:

   National Technical Information Service (NTIS)
   5285 Port Royal Road
   Springfield, VA 22161

The telephone number for NTIS is (703) 605-6000. Please note that EPA is currently in the process of updating this booklet to reflect the changes in the registration program resulting from the passage of the FQPA and the reorganization of the Office of Pesticide Programs. We anticipate that this publication will become available during the Fall of 1998.

3. The National Pesticide Information Retrieval System (NPIRS) of Purdue University's Center for Environmental and Regulatory Information Systems. This service does charge a fee for subscriptions and custom searches. You can contact NPIRS by telephone at (765) 494-6614 or through their Web site.

4. The National Pesticide Telecommunications Network (NPTN) can provide information on active ingredients, uses, toxicology, and chemistry of pesticides. You can contact NPTN by telephone at (800) 858-7378 or through their Web site: ace.orst.edu/info/nptn.

The Agency will return a notice of receipt of an application for registration or amended registration, experimental use permit, or amendment to a petition if the applicant or petitioner encloses with his submission a stamped, self-addressed postcard. The postcard must contain the following entries to be completed by OPP:

Date of receipt
EPA identifying number
Product Manager assignment

Other identifying information may be included by the applicant to link the acknowledgment of receipt to the specific application submitted. EPA will stamp the date of receipt and provide the EPA identifying File Symbol or petition number for the new submission. The identifying number should be used whenever you contact the Agency concerning an application for registration, experimental use permit, or tolerance petition.

To assist us in ensuring that all data you have submitted for the chemical are properly coded and assigned to your company, please include a list of all synonyms, common and trade names, company experimental codes, and other names which identify the chemical (including "blind" codes used when a sample was submitted for testing by commercial or academic facilities). Please provide a CAS number if one has been assigned.

Documents Associated with this RED

The following documents are part of the Administrative Record for this RED document and may be included in the EPA's Office of Pesticide Programs Public Docket. Copies of these documents are not available electronically, but may be obtained by contacting the person listed on the respective Chemical Status Sheet.

a. Health and Environmental Effects Science Chapters.
b. Detailed Label Usage Information System (LUIS) Report.