United States Environmental Protection Agency | Prevention, Pesticides and Toxic Substances (7508C) | October 2005

Reregistration Eligibility Decision

Thiophanate-Methyl

United States
Environmental Protection
Agency

Prevention, Pesticides
And Toxic Substances
(7508C)

October 2005

R.E.D. FACTS

Thiophanate-Methyl

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 2680, thiophanate-methyl (TM) and its primary metabolite carbendazim (methyl 2-benzimidazole carbamate) or MBC.

Use Profile

TM is a systemic fungicide used on a variety of tree, vine, and root crops, as well as on canola and wheat. Residential homeowners may use TM on lawns and ornamentals. MBC is registered as a systemic fungicide in paints in residential settings, but has no registered food uses in the US, nor import tolerances. TM formulations include dust, granular, wettable powder, water-dispersible granular, and flowable concentrate. TM may be applied with aerial, chemigation or ground equipment (airblast, broadcast, band, or soil drench); as a dip treatment for cut flowers, rose budwood, or nursery stock; and as a seed treatment for peanuts and potato pieces. Handheld equipment may be used on turf and ornamentals. The majority of the crops are treated with postemergent broadcast applications.

Regulatory History

TM was first registered as a pesticide in the U.S. in 1973 for use as a fungicide. EPA issued a Registration Standard for TM in March, 1996. Subsequent Data Call-Ins (DCIs) were issued in 1991, 1995, and 1996 for TM. There are Section 3 registrations, Section 18 emergency exemptions, and Section 24(c) Special Local Needs registrations concurrently registered under FIFRA.

Human Health Assessment

Toxicity

TM generally has been shown to have low acute oral/dermal/inhalation toxicity (toxicity categories III/IV). TM is not an irritant to the skin and only a slight occular irritant (toxicity category IV) and is a skin sensitizer. MBC generally has been shown to also have low acute oral/dermal/inhalation toxicity (toxicity categories III/IV). MBC is only a slight irritant to skin (toxicity category IV) and minimal to no irritation (toxicity category III) and is not a skin sensitizer.

The liver and thyroid are the primary target organs of TM and MBC in several species following subchronic or chronic dietary exposure. The testes is also a known target organ of MBC. TM is classified as "likely to be carcinogenic to humans based on dose-dependent increases in liver tumors in male and female mice. MBC is classified as a possible human carcinogen based on hepatocellular tumors in female mice. Developmental toxicity based on decreased fetal body weight and increases in skeletal variations was observed in the fetuses of rabbits exposed to TM. MBC was associated with adverse reproductive effects in rats.

Dietary Exposure (Food and Water)

People may be exposed to residues of TM or MBC through the diet. Tolerances or maximum residue limits have been established for almond, apple, apricot, banana, bean, blueberry, canola seed, cattle, cherry, cucumber, egg, garlic, goat, grape, hog, horse, melon, milk, nectarine, onion, pecan, peach, peanut, pistachio, pear, plum, potato, poultry, pumpkin, sheep, soybean, squash, strawberry, sugar beet, and wheat.

EPA has assessed the dietary risk posed by TM and MBC.

For the overall U.S. population and all subgroups as measured by the Population Adjusted Dose (PAD), all acute and chronic food risks are below the EPA's level of concern for all population subgroups for both TM and MBC. The lifetime cancer risk estimates range are generally below the EPA's level of concern.

Occupational and Residential Exposure

Based on current use patterns, occupational handlers (mixer/loader/applicators) can become exposed while mixing, loading and applying TM formulations (e.g., dry flowables, dusts, granular, liquid flowables, and wettable powders) to a variety of agricultural crops, turf and ornamental plants. Handlers are not expected to be exposed to MBC, because MBC is formed during the environmental degradation of TM. Workers can also become exposed

to TM and MBC residues from treated foliage from re-entering treated fields, orchards, nurseries, greenhouses, or golf courses. Some potential re-entry exposure or postapplication scenarios of concern include: scouting, irrigation, harvesting, pruning, transplanting, thinning, and handling treated seed and seed pieces.

Occupational handler exposure assessments are completed by EPA using a baseline exposure scenario and, if required, increasing levels of mitigation (PPE and engineering controls) to achieve an adequate margin of exposure (MOE). For the case of TM, the level of is 100. Many scenarios are at acceptable levels of risk with the addition of a single layer of PPE (which includes chemical resistant gloves). However, mixing/loading wettable powder formulations for aerial/chemigation application requires the use of engineering controls (i.e., water soluble bags) to reach an acceptable risk level. Based on the cancer risk estimates, all handler risk estimates were in the acceptable range at below 1×10^{-4} and most were below 3×10^{-6} when adding either protective equipment or engineering controls.

For occupational postapplication activities, EPA calculates the number of days that must elapse after pesticide application until residues dissipate and risk (either non-cancer or cancer) to a worker falls below the target risk level. To address potential postapplication cancer risks to TM, the Agency has to adjust some of the REIs.

Residential handlers can apply TM formulated products to lawn and ornamentals. Residential risk mitigation for lawn and ornamental products was implemented before publication of this RED. MOEs and cancer risks are not of concern using the new label rates proposed. Therefore, no further risk mitigation is necessary.

Residential handlers may become exposed to MBC in paints, adhesives, and caulks. For the three painting scenarios assessed, all short-term dermal risks exceeded EPA's level of concern (i.e., MOEs<1,000) for residential handlers, with dermal MOEs ranging from 620-750. Mitigation to reduce the concentration of MBC in indoor paints is required to reduce the dermal exposure. Inhalation risk exposure for painters were initially of concern for airless sprayer. However, using the latest registrant submitted inhalation study indicate that MOEs are below EPA's level of concern (i.e., MOEs>1,000). It should be noted however that the Agency will include label amendments to reduce the concentration of MBC in paint based on dermal MOE which exceed the Agency's level of concern (i.e, MOEs<1,000). All residential cancer risk estimates for residential handlers were less than 1×10^{-6} and therefore not of concern. Postapplication risks (dermal and inhalation) were all below EPA's level of concern.

For residential postapplication to TM, two short-term MOEs for children playing on treated turf were less than 300 and therefore, exceed EPA's level of concern (MOEs range from 31 to 250) for hand to mouth activities and incidental granular ingestion based on a screening level assessment. Dermal MOEs are acceptable, however. The aggregate MOE for children based on combined dermal

and oral exposures are also below 300 (total MOE= 170 for treated turf). Application rates to turf are being reduced to address these risks.

Human Risk Assessment

TM and MBC are of low acute toxicity, but cause liver and thyroid effects in animal studies and has been classified as a probable human carcinogen. MBC has also been shown to cause adverse testicular effects. However, dietary exposure to TM residues in food and water is extremely low as is the cancer risk posed to the general population.

Of greater concern is the risk posed to pesticide workers, particularly mixers/loaders/applicators, and field workers who come into contact with treated foliage/crops/lawns/turf/etc. following application of this pesticide. Exposure and risk to workers will be mitigated by the use of PPE required by the WPS, supplemented by mitigation measures as required by this RED.

For post-application reentry, workers will be required to observe a 3-day Restricted Entry Intervals (REIs) for almonds and peanuts; 2-day REIs for apples, cherries, peaches, nectarines, apricots, and plums/prunes; 24-hour REIs for strawberries, blueberries, wheat, cucurbits, soybeans, and green beans and 12-hour REIs for woody ornamentals.

FQPA Considerations

As part of the FQPA tolerance reassessment process, EPA assessed the risks associated with this pesticide. EPA has determined that risk from dietary exposure to TM is within it own "risk cup". An aggregate assessment was conducted for exposures through food, drinking water, and residential uses. The Agency has determined that the human health risks from these combined exposures are within acceptable levels. In other words, EPA has concluded that the tolerances for TM meet the FQPA safety standards. In reaching this determination, EPA has considered the available information on the special sensitivity of infants and children, as well as the chronic and acute food exposure.

Some of the tolerance limits will change because recent residue data may indicate that either a lower or higher value for the tolerance is needed. In addition, some tolerances have been revoked because they were either no longer a regulated commodity or significant livestock feed item, some of the tolerances were voluntarily canceled, some of the registered products used to establish tolerances were canceled and some of the older tolerances have been reassigned into a group tolerance.

Environmental Assessment

EPA's ecological risk assessment suggests that TM dose not pose a high acute risk to terrestrial or aquatic organisms. Acute high risk levels of concern (LOCs) are not exceeded for any registered uses except for use on golf course, which may present acute risk to small animals. Golf course uses of TM also appear to generate acute concerns for endangered species.

TM is not stable or persistent in the environment, but transforms to MBC within a matter of days whether on foliage, in soil, or in water. Both photolysis and hydrolysis are important routes of degradation. MBC is persistent and mobile in the environment. Metabolism of MBC under aerobic and anaerobic conditions in both soil and water proceed at a very slow rate. Because of the rapid transformation of TM to MBC, MBC residue values were used in the TM chronic ecological risk assessment. EPA's ecological risk assessment suggests that TM/MBC is expected to pose a chronic risk to endangered birds, mammals, aquatic animals, and aquatic plants under most of the registered use scenarios. The acute risks to small mammals from golf course use and chronic risks to endangered species listed here are based on EPA's screening level assessment do not constitute "may affect" findings under the ESA.

Risk Mitigation

To mitigate human health risks of concern posed by TM, EPA is requiring the following risk mitigation measures:

- Reduce turf application rates in residential/public areas (e.g. parks, athletic fields, lawns) to 2.74 lbs ai/acre, maximum of 10.88 lbs ai/acre per year, 14 day retreatment interval.
- Reduce golf course turf application rates to 8.16 lbs ai/acre/application. 21.8 lbs ai/acre/year, 14 day retreatment interval for tees and greens.
- Reduce golf course turf application rates to 5.45 lbs ai/acre/year, except in Florida, which has a maximum annual rate of 2.72 lbs ai/acre on fairways.
- Require wettable powder formulations labeled for aerial/chemigation applications to be packaged in **water soluble bags**.
- Require wettable powder formulations <u>not</u> packaged in water soluble bags to specifically prohibit aerial/chemigation use.
- Require an **enclosed cab** for planters/operators while planting potato seed that has been treated with dust
- Require **double-layer PPE, chemical-resistant gloves, and a chemical-resistant apron** to be worn when applying dip treatment and mixing/loading/applying dip treatment.
- **Single-layer PPE (Baseline) and chemical-resistant gloves** must be worn when handlers are performing certain tasks (see section IV of the RED).
- **Single-layer PPE (Baseline)** must be worn by handlers during certain tasks (see section IV of the RED)
- The Agency has determined that significant risk reduction would occur by **reducing the maximum allowable rate on cut flowers to 0.5 lb ai/acre**. which is currently the typical rate at which TM is applied to cut flowers.
- For post-application reentry, workers will be required to observe a 3-day Restricted Entry Intervals (REIs) for almonds and peanuts; 2-day REIs for apples, cherries, peaches, nectarines, apricots, and plums/prunes; 24-hour REIs for strawberries, blueberries, wheat, celery, cucurbits, soybeans, and green beans and 12-hour REIs for woody ornamentals.

- The maximum single application rate for ornamentals is 1.8 lb ai/acre for homeowners using spray products.
- Only granular formulations are now available to residents for broadcast lawn treatment. Use of liquid formulations for broadcast turf/lawn use is restricted to commercial pest control operators (PCOs).
- Product labels were revised to specifically prohibit belly grinder and hand application methods.
- PCO treatment of backyard fruit trees will be allowed only up to fruit set.
- As a result of ecological mitigation activities, application rates and applications per year have been reduced as follows: aerial application of grapes and apples 0.7 lb ai/acre and 4 applications per year; aerial application of soybeans 0.7 lb ai/acre and 2 applications per year; ground application of golf course fairways 5.45 lb ai/acre and 1 application per year; aerial application of potatoes 0.93 lb ai/acre and 3 allowable applications per year; and ground application of onions 1.4 lb ai/acre and 1 application per year.
- Reduce the concentration of MBC in paint from 0.5% to 0.35% based on dermal MOEs which exceed the Agency's level of concern (i.e, MOEs<1,000).

Additional Data Required

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

Toxicology Data

TM:

OPPTS GLN 870.6200 - Rat Acute and Subchronic Neurotoxicity Screening Studies

OPPTS GLN 870.6300 - Developmental Neurotoxicity Study 'Reserved' pending the results of the above studies.

OPPTS GLN 870.3465 - 90-day Subchronic Inhalation Toxicity Test, Rat

MBC:

OPPTS GLN 870.3200 - Repeated Dose Dermal Toxicity Test (21 Day - rat)

OPPTS GLN 870.6300 - Developmental Neurotoxicity Study in rats

OPPTS GLN 870.3800 - 2-Generation Reproduction and Fertility Effects, Rat

Product Chemistry Data

OPPTS GLN 830.1620 - Starting Materials and Manufacturing Process

OPPTS GLN 830.1670 - Discussion of Formation of Impurities

OPPTS GLN 830.6313 - Stability

OPPTS GLN 830.7050 - UV/Visible Absorption

Residue Chemistry Data

OPPTS GLN 860.1200 - Directions for Use

OPPTS GLN 860.1340 - Residue Analytical Methods

OPPTS GLN 860.1360 - Multiresidue Method Testing

OPPTS GLN 860.1380 - Storage Stability Data

OPPTS GLN 860.1500 - Magnitude of the Residue in Plants

OPPTS GLN 860.1520 - Magnitude of the Residue in Processed Food/Feed

Occupational Exposure Data

Handlers:

OPPTS GLN 875.1100 - Dermal Exposure: Outdoor (Mixing/loading/applying WP/DF solution as a seedling or bulb treatment)

OPPTS GLN 875.1200 - Dermal Exposure: Indoor (Mixing/loading/applying wettable powder; greenhouse use)

OPPTS GLN 875.1300 - Inhalation Exposure: Outdoor (Mixing/loading/applying WP/DF solution as a seedling or bulb treatment)

OPPTS GLN 875.1400 - Inhalation Exposure: Indoor (Mixing/loading/applying wettable powder; greenhouse use)

Post-application Workers:

OPPTS GLN 875.2400 - Dermal Exposure - Handling treated seed & seedlings; sorting, packing crops; cultivating, transplanting in treated soil.

OPPTS GLN 875.2800 - Descriptions of human activity - Handling treated seed & seedlings; sorting, packing crops; cultivating, transplanting in treated soil.

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

Product Labeling Changes Required

All TM and MBC end-use products must comply with EPA's current pesticide product labeling requirements and with the following. For a comprehensive list of labeling requirements, please see the TM RED document.

Regulatory Conclusion

The use of currently registered products containing TM in accordance with approved labeling will not pose unreasonable risks or adverse effects to humans or the environment. Therefore, all uses of these products are eligible for reregistration. TM/MBC products will be reregistered once the required product-specific data, revised Confidential Statements of Formula, and revised labeling are received and accepted by EPA.

For More Information

EPA is requesting public comments on the Reregistration Eligibility Decision (RED) document for TM 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 703-305-5805. Electronic copies of the RED and this fact sheet are available on the Internet. See

http://www.epa.gov/pesticides/reregistration/status.htm

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 TM 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 TM RED, or reregistration of individual products containing TM, 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

August 10, 2005

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

Dear Reader:

The Reregistration Eligibility Decision (RED) document for Thiophanate-Methyl (TM) was signed on March 28, 2003. Since that date the supporting appendices were generated, additional toxicological data (a 5-day inhalation study on the TM degradate) were submitted to the Agency, and a public comment period was provided post-signature. The TM Data-Call-In was issued in January, 2005. A final post-signature comment period opened November 24, 2004 and closed January 24, 2005. The risk assessments, benefit assessments, and public comments can be found on the EPA EDOCKET system, available at http://www.epa.gov/edocket (docket # OPP-2004-0265). The Environmental Protection Agency has reviewed and responded to the public comments. These responses are also available for viewing on the EDOCKET system (docket # OPP-2004-0265). As a result of its review of the public comments, the Agency revised the TM RED, where appropriate. This letter points out changes which were made to the March 2003 version of the RED; these changes are incorporated in this May 2005 version.

A major revision from the March 28, 2003 RED occurred as a result of the review of a 5-day inhalation study submitted by the registrant on the TM degradate carbendazim (methyl 2-benzimidazole carbamate) or MBC. The review of this study was finalized after the RED was signed. Based on the review of the 5-day inhalation study, the Agency revised the initially proposed interim risk reduction measures to prohibit the use of the TM degradate carbendazim (methyl 2-benzimidazole carbamate) or MBC use in indoor paints. Based on the review of the study, the Agency identified a new inhalation **NOAEL of 0.178 mg/L/day**, which was used to re-evaluate the inhalation risks to residential handlers using an airless sprayer. This scenario was previously identified in the RED to be of potential concern. The Agency calculated a new inhalation MOE of 9600 which does not exceed the existing level of concern (i.e, MOE<1,000). Because of the newly calculated inhalation MOE, the Agency will **not** require the removal of indoor paint use. It should be noted that only inhalation risks to residential handlers using an airless sprayer have been recalculated since this was the only scenario which was initially identified as exceeding the existing level of concern.

Other revisions to the March 28, 2003 document are documented below:

- Revised the language of the cumulative section to clarify that the Agency has not made a cumulative finding with thiophanate methyl and any other compound (see page iv);

- Added a statement to the endangered species section to emphasize that the ecological risk assessment is a screening level assessment and that the Agency is not making a "may effect" finding with the results of the chronic ecological risk assessment;

- Attached all the appendices to the decision document;

- Deleted all references to "celery" in the RED because EPA canceled the use of celery on June 22, 1998 based on a request from Cerexgri, Inc.;

- Added "garlic" to the list of confirmed crops and "airblast" as a confirmed application method;

- Revised the states of use for wheat to include only Idaho, Oregon, and Washington. Based on current labels, no other states allow thiophanate methyl use on wheat.

- Revised the Reentry Interval (REI) table (Table 38) to include grapes, pears, dry beans, onions, peanuts, pistachios, potatoes, and sugar beets;

- Corrected the application rate for peanut seeds to 0.04 lb ai/100 lb of seed, which was consistent with the rate used in the initial risk assessment.

Label Table Revisions:

- Revised the instructions for storage and disposal description; and

- Added the maximum application rate for use on Florida golf courses to make it consistent with the seasonal rate application rate; and

- Revised the label table for fruit trees.

The revised document attached to this letter represents the EPA's reregistration decision for TM. If you have questions on the TM RED or any of the revisions listed above, please contact the Chemical Review Manager, Nathan Mottl, at (703) 305-0208. For questions about product reregistration, please contact Jane Mitchell at (703) 308-8061.

Sincerely,

Debra Edwards, Ph.D.
Director, Special Review and Reregistration Division

Attachment

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

March 28, 2003

OFFICE OF
PREVENTION, PESTICIDES
AND TOXIC SUBSTANCES

CERTIFIED MAIL

Dear Registrant:

This is to inform you that the 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 preliminary risk assessment for the fungicide thiophanate-methyl. 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 from the registrant. Based on the Agency's revised risk assessments for thiophanate-methyl, EPA has identified risk mitigation measures that the Agency believes are necessary to address the human health and environmental risks associated with the current use of thiophanate-methyl. EPA is now publishing its reregistration eligibility, risk management, and tolerance reassessment decisions for the current uses of thiophanate-methyl, and its associated human health and environmental risks. The Agency's decision on the individual chemical thiophanate-methyl can be found in the attached document entitled, "Reregistration Eligibility Decision for Thiophanate-methyl" which was approved on March 28, 2003.

A Notice of Availability for the Reregistration Eligibility Decision for Thiophanate-methyl is being published in the *Federal Register*. To obtain copies of the RED document, please contact the Pesticide Docket, Public Response and Program Resources Branch, Field and External Affairs Division (7506C), Office of Pesticide Programs (OPP), USEPA, Washington, DC 20460, telephone (703) 305-5805. Electronic copies of the RED and all supporting documents are available on the Internet. See 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. During the public comment period, comments on the risk assessment were submitted by Cerexagri, Inc., the technical registrant, as well as other registrants of end-use products. EPA also received letters from growers, extension agents, and commodity organizations testifying to the importance of thiophanate-methyl as a fungicide. The World Wildlife Fund, Natural Resources Defense Council, and other advocacy groups raised concern that a full 10X FQPA safety factor should be applied to thiophanate-methyl because of its endocrine disruption. A close-out conference call with interested stakeholders was conducted on March 4, 2003 to discuss the risk management decisions and resultant changes to the thiophanate-methyl labels.

Please note that the thiophanate-methyl risk assessment and the attached RED concern only this particular pesticide and its metabolites. 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." Thiophanate-methyl and its metabolite MBC, are structurally related to several other benzimidazole compounds (primarily veterinary drugs) that are suspect carcinogens including albendazole, fenbendazole, mebendazole, oxfendazole, and thiabendazole. Most of the benzimidazole compounds are regulated by the Center for Veterinary Medicine, Food and Drug Administration (FDA) as animal drugs. At this time, the Agency has not made a decision as to whether thiophanate-methyl shares a common mechanism of toxicity with these other benzimidazole compounds or any other pesticide. A careful evaluation of all the available data is still needed, as well as peer review by the FIFRA Science Advisory Panel, before a formal decision is made. Therefore, for the purposes of this risk assessment, the Agency has assumed that thiophanate-methyl does not share a common mechanism of toxicity, and if the Agency determines that a cumulative assessment is necessary, the Agency will address any outstanding risk concerns at that time.

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 registrants of thiophanate-methyl must respond to DCIs issued by the Agency within 90 days of receipt of this letter. This RED also contains labeling requirements for thiophanate-methyl products. End-use product labels must be revised by the manufacturer to adopt the changes set forth in Section IV of this document. Instructions for registrants on submitting revised labeling and the time frame established to do so can be found in Section V of this document.

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 thiophanate-methyl. 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. At that time, any affected person(s) may challenge the Agency's action.

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.

If you have questions on this document or the proposed label changes, please contact the Special Review and Reregistration Division representative, Beth Edwards at (703) 305-5400. For questions about product reregistration and/or the Product DCI that accompanies this document, please contact Jane Mitchell at (703) 308-8061.

Lois A. Rossi, Director
Special Review and
Reregistration Division

Attachment

Reregistration Eligibility Decision

for

Thiophanate-methyl

List B

Case 2680

Table Of Contents

Thiophanate-methyl Reregistration Eligibility Decision Team

Office of Pesticide Programs:

Biological and Economic Analysis Assessment

Frank Hernandez
Richard Michell
Leonard Yourman

Environmental Fate and Effects Risk Assessment

Faruque Khan
Rick Petrie
Rodolfo Pisigan
Alan Vaughan

Health Effects Risk Assessment

Gary Bangs
Jose Morales
Sheila Piper
Debbie Smegal

Registration Support

Lisa Jones
Mary Waller

Risk Management

Deanna Scher
Beth Edwards
John Leahy

Glossary of Terms and Abbreviations

AGDCI	Agricultural Data Call-In
ai	Active Ingredient
aPAD	Acute Population Adjusted Dose
AR	Anticipated Residue
BCF	Bioconcentration Factor
CFR	Code of Federal Regulations
cPAD	Chronic Population Adjusted Dose
CSF	Confidential Statement of Formula
CSFII	USDA Continuing Surveys for Food Intake by Individuals
DCI	Data Call-In
DEEM	Dietary Exposure Evaluation Model
DFR	Dislodgeable Foliar Residue
DWLOC	Drinking Water Level of Comparison.
EC	Emulsifiable Concentrate Formulation
EEC	Estimated Environmental Concentration
EPA	Environmental Protection Agency
EUP	End-Use Product
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
GLN	Guideline Number
HAFT	Highest Average Field Trial
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.
LOC	Level of Concern
LOD	Limit of Detection
LOAEL	Lowest Observed Adverse Effect Level
MATC	Maximum Acceptable Toxicant Concentration
µg/g	Micrograms Per Gram
µg/L	Micrograms Per Liter
mg/kg/day	Milligram Per Kilogram Per Day
mg/L	Milligrams Per Liter
MOE	Margin of Exposure
MRID	Master Record Identification (number). EPA's system of recording and tracking studies submitted.
MUP	Manufacturing-Use Product
NA	Not Applicable
NAWQA	USGS National Water Quality Assessment
NPDES	National Pollutant Discharge Elimination System
NR	Not Required
NOAEL	No Observed Adverse Effect Level
OP	Organophosphate
OPP	EPA Office of Pesticide Programs
OPPTS	EPA Office of Prevention, Pesticides and Toxic Substances
PAD	Population Adjusted Dose
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
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
RED	Reregistration Eligibility Decision
REI	Restricted Entry Interval
RfD	Reference Dose
RQ	Risk Quotient
SCI-GROW	Tier I Ground Water Computer Model
SAP	Science Advisory Panel
SF	Safety Factor
SLC	Single Layer Clothing
SLN	Special Local Need (Registrations Under Section 24©) of FIFRA)
TCPSA	2,3,3-trichloroprop-2-ene sulfonic acid (Thiophanate-methyl Metabolite)
TGAI	Technical Grade Active Ingredient
TRR	Total Radioactive Residue
USDA	United States Department of Agriculture
USGS	United States Geological Survey
UF	Uncertainty Factor
UV	Ultraviolet
WPS	Worker Protection Standard

Executive Summary

EPA has completed its review of public comments on the preliminary risk assessments and is issuing its risk management decision for thiophanate-methyl. 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. After considering the risks identified in the revised risk assessment and comments and mitigation suggestions from interested parties, EPA developed its risk management decision for uses of thiophanate-methyl that pose risks of concern. Risks from carbendazim (methyl 2-benzimidazole carbamate) or MBC, the primary metabolite of thiophanate-methyl, are also considered in the assessment. The decision is discussed fully in this document.

Thiophanate-methyl is a systemic fungicide used on a variety of tree, vine, and root crops, as well as on canola and wheat. Residential homeowners may use thiophanate-methyl on lawns and ornamentals. Thiophanate-methyl was first registered in 1973. Approximately 700,000 pounds of thiophanate-methyl active ingredient are applied annually. Sites on which thiophanate-methyl has the highest percent of crop treated include strawberries, blueberries, pistachios, apples, and melons. MBC is registered as a systemic fungicide in paints in residential settings, but has no registered food uses in the US, nor import tolerances.

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." Thiophanate-methyl is structurally related to other benzimidazole compounds (primarily veterinary drugs) that are suspect carcinogens including albendazole, fenbendazole, mebendazole, oxfendazole and thiabendazole. However, unlike other pesticides for which EPA has followed a cumulative risk approach based on a common mechanism of toxicity, EPA has not made a common mechanism of toxicity finding for thiophanate-methyl and any other substances. For the purposes of this action, therefore, EPA has assumed that thiophanate-methyl does not have a common mechanism of toxicity with other substances. For information regarding EPA's efforts to determine which chemicals have a common mechanism of toxicity and to evaluate the cumulative effects of such chemicals, see the policy statements released by EPA's Office of Pesticide Programs concerning common mechanism determinations and procedures for cumulating effects from substances found to have a common mechanism on EPA's website at http://www.epa.gov/pesicides/cumulative/.

Dietary Risk - Food

EPA's dietary risk analysis evaluated acute, chronic (non-cancer) and cancer risk for thiophanate-methyl and MBC. Anticipated residues were calculated using both USDA Pesticide Data Program (PDP) monitoring data for benomyl, measured as MBC, and field trial residue data, considering percent crop treated.

Based on this analysis, the acute dietary risk estimates are less than EPA's level of concern at the 99.9th percentile of exposure for all population subgroups for both TM and MBC. The acute dietary risk estimates range from 5% to 22% for TM and 4% to 89% for MBC of the acute PAD at 99.9th percentile exposure, with infants (<1 year) being the highest exposed population

subgroup. The chronic non-cancer dietary analysis indicates all risk estimates are below EPA's level of concern for all population subgroups for either TM or MBC. The highest chronic dietary risk estimates are 2% and 26% of the chronic PAD, for TM and MBC, respectively, for the highest exposed population subgroup, children (1-6 years). The lifetime cancer risk estimates range from $6.4x10^{-7}$ to $1.1x10^{-6}$ for TM, and $7.7x10^{-8}$ to $9.3x10^{-8}$ for MBC, depending on the uses and whether field trial or PDP data were used. Generally, EPA is concerned when cancer risk estimates exceed $1x10^{-6}$ or one-in-one million.

Dietary Risk - Drinking Water

Drinking water exposure to pesticides can occur through groundwater and surface water contamination. Since there are no drinking water monitoring data on TM or MBC, EPA used modeling to estimate the potential exposures and risks from TM and MBC residues in drinking water. To determine the maximum allowable contribution from water allowed in the diet, EPA first looks at how much of the overall allowable risk is contributed by food and then determines a "drinking water level of comparison" (DWLOC) to determine whether modeled or monitoring estimated environmental concentration (EEC) levels exceed this level. EECs that are above the corresponding DWLOC exceed the Agency's level of concern.

EECs are lower than the acute DWLOCs for all subpopulations except infants <1 year old. Although the highest EEC of 28.3 ppb is higher than the DWLOC of 18, EPA believes that this risk is not of concern because field trial data were used to calculate food exposures from the citrus section 18 use and therefore, results in an overly conservative estimation.

Chronic non-cancer DWLOCs (18 ppb) are greater than the surface water EECs (12.2 ppb) indicating that chronic dietary (food + water) risks are below EPA's level of concern.

The chronic (cancer) DWLOC (2.1 ppb) is lower than the EEC (12.2 ppb) indicating that chronic dietary (food + water) risks may be of concern; however, EPA believes that this risk is not of concern for the following reasons. The screening-level model assumes maximum application rates are used every year for 70 years, which is a worst case assumption. The highest surface water EEC of 12.2 ppb translates into a cancer risk of $8.3x10^{-7}$ for surface water alone. This risk combined with the cancer risk from food of $8.5x10^{-7}$ results in a combined cancer risk of $1.7x10^{-6}$ which is still within the range considered acceptable by the Agency.

Residential Risk

Potential exposures are anticipated as a result of homeowner and commercial applications in residential areas. Applications can be made to lawns, ornamentals and "backyard" orchards. In addition to residential areas, there are also potential postapplication exposure scenarios that may occur in public areas such as parks, recreational areas and golf courses. The Agency evaluated TM exposures to residential handlers during mixing, loading and application to turf/ornamentals and TM postapplication exposure to residues by adults and children on treated turf.

In response to risk concerns identified in the preliminary risk assessment, all registrants of thiophanate-methyl turf products have requested changes to their thiophanate-methyl registrations that are intended to mitigate drinking water and residential risks of concern. The

registrants have effectively mitigated all residential risks with these label amendments, mainly through rate reductions, except short-term risks from incidental oral exposures to young children on the day of treatment. The exposure scenarios with risk estimates that exceed EPA's level of concern (i.e., MOEs<300) are: children playing on treated lawns for hand to mouth activities and incidental granular ingestion with MOEs ranging from 31 to 250. The scenarios with MOEs above 300 for TM that are not of concern are: high dermal contact to adults (such as hand weeding, and playing), mowing activities, golfing, spot treatments of ornamentals, and broadcast lawn treatment with a push-type spreader. Residential cancer risks are not of concern; residential handler cancer risk estimates range from $4.7x10^{-9}$ to $2.8x10^{-8}$, while post-application residential cancer risk estimates range from $1.3x10^{-9}$ to $1.3x10^{-7}$.

MBC is used as a fungicide/preservative in paints, coatings, plaster and adhesives. For the three painting scenarios assessed, all short-term dermal risks exceeded EPA's level of concern (i.e., MOEs<1,000) for residential handlers, with dermal MOEs ranging from 620-750. Inhalation exposure is not of concern except for an initial potential concern for painting with an airless sprayer, which was initially identified as a concern using a conservative NOAEL. Registrants of MBC paints submitted a 5-day inhalation study in February 2003 which was reviewed by EPA after publishing the RED on March 28, 2003. The Agency identified a new inhalation NOAEL of 0.178 mg/L/day from this study and used the NOAEL to re-evaluate the inhalation risks to residential handlers using an airless sprayer. The Agency calculated a new inhalation MOE of 9600 based on the new inhalation NOAEL of 0.178 mg/L/day which does not exceed the existing level of concern (i.e, MOE>1,000). Based on the new inhalation MOE, the Agency will not require the removal of indoor indoor paint use which was initially required in the March 28, 2003 RED document.

Based on dermal MOEs which exceed the Agency's level of concern (i.e, MOEs<1,000), label amendments were submitted to specifically prohibit MBC use in indoor paints and to reduce the concentration of MBC in paint from 0.5% to 0.35%. All cancer risk estimates for residential handlers were less than $1x10^{-6}$ and are therefore not of concern. Postapplication exposure to MBC-treated paints, coatings, and sealants is anticipated to be only by the inhalation route, as the treated materials will have dried and have low potential for dermal transfer. Postapplication inhalation risks for toddlers and adults are below EPA's level of concern, (i.e., the inhalation MOEs are greater than 1,000 and the cancer risk estimates are less than $1x10^{-6}$).

Aggregate Risk

An aggregate risk assessment looks at the combined risk from dietary exposure (food and drinking water pathways) as well as exposures from non-occupational sources (e.g., residential uses).

Acute Aggregate Risk. The acute aggregate risk assessment addresses exposure to thiophanate-methyl residues in food and water only. As discussed previously, comparison of the acute DWLOCs with the environmental concentrations of thiophanate-methyl shows that estimated surface and groundwater concentrations are substantially less than the DWLOCs for all populations, except infants <1 year. Because field trial data were used to calculate exposures from the citrus section 18 use (and thus overestimate the risk), the Agency has concluded that

residues of thiophanate-methyl in food and drinking water do not result in an acute aggregate risk of concern.

Short-term Aggregate Risk. Short-term aggregate exposure takes into account residential exposure plus chronic exposure to food and water. Thiophanate-methyl and MBC are currently registered for use that could result in short-term residential exposure, and the Agency has determined that it is appropriate to aggregate chronic food and water and short-term exposures for thiophanate-methyl and MBC. The aggregate short-term exposure to MBC and TM resulting from food, water and residential use exceeds the Agency's level of concern for children (infants, and 1-6 years of age) and females 13-50 years, due primarily to TM post-application exposures on turf and MBC's use as a paint additive. Registrants have agreed to rate reductions for both turf and paint uses, and to conduct a hand press study to help refine this assessment. Based on these mitigation measures, and the conservative method of exposure estimation, the risks do not exceed the Agency's level of concern.

Chronic (Non-cancer) Aggregate Risk. The chronic (non-cancer) aggregate risk assessment addresses exposure to thiophanate-methyl and MBC residues in food and water; there are no TM uses that could result in chronic residential exposure. The lowest DWLOC is 18 ppb for children 1-6. Using screening-level models, the highest long-term surface water EEC is 12.2 ppb. Therefore, the chronic non-cancer DWLOCs are greater than the surface water EECs indicating that chronic dietary (food + water) risks are below EPA's level of concern. Therefore, chronic aggregate risk is also below EPA's level of concern.

Chronic (Cancer) Aggregate Risk. The total TM and MBC dietary cancer risk estimate from food alone is 8.5×10^{-7}. The cancer DWLOC is 2.1 ppb. Using screening-level models, the highest long-term surface water EEC (mean 36 year annual concentration) is 11.5 ppb, adjusted to reflect TM + MBC as an MBC equivalent. This EEC is greater than the DWLOC, indicating that chronic dietary (food and water) risk may be of concern. Because the surface water assessment is based on a screening-level model that assumes maximum application rates are used every year for seventy years, this is a worst-case estimate. Finally, when combining conservative cancer risk estimates from food and from water (assuming the surface water estimated concentration is equivalent to the concentration that could be found in drinking water), the resultant risk is still within the range considered acceptable by the Agency. The highest surface water EEC of 12.2 ppb translates into a cancer risk of 8.3×10^{-7}. When combined with the cancer risk from food of 8.5×10^{-7}, this results in a cancer risk of 1.7×10^{-6}. Including cancer risks from residential exposures does not significantly increase these risks. Adding cancer risk from treating ornamentals (the worst-case residential handler scenario with a cancer risk of 2.8×10^{-8}) and dermal postapplication lawn exposure (the worst-case cancer risk of 1.3×10^{-7}) results in a total food, drinking water, and residential cancer risk of 1.9×10^{-6}. Considering the conservative nature of the aggregate scenarios, this is still within the range considered acceptable to the Agency.

Cancer risk to residential handlers during painting and to vapors following painting is 2.2×10^{-7}. Added to the TM + MBC cancer risk of 1.9×10^{-6} from food, drinking water, and TM residential exposures, the total cancer risk is 2.1×10^{-6}. EPA considers this cancer risk within the range considered negligible. Also, this cancer risk is considered worst-case because the drinking water cancer risk is based on the highest modeled surface water EEC, which assumes the maximum

application rate is used every year for seventy years in an area vulnerable to surface water contamination, and does not reflect dilution from source to tap. Also, it is unlikely that a person would use TM to treat their ornamentals each year, perform high-exposure activities on the lawn immediately following application of TM, and also apply paint containing MBC every year. Finally, the cancer estimates for MBC use as a paint additive are conservative, because they are based on high end assumptions for occupancy, air exchange rates used in the air model, and assume no degradation or matrix effects of the paint.

Occupational Risk

Cancer risk to workers is of greater concern than non-cancer risk. In response to risk concerns identified in the preliminary risk assessment, stakeholders provided updated use information which allowed the Agency to significantly refine the risk estimates. Based upon revised assumptions, all handler (with either protective equipment or engineering controls) and postapplication worker risk estimates were below $1x10^{-4}$ and most were below $1x10^{-6}$. EPA believes these risks can be mitigated for handlers to a level closer to $1x10^{-6}$ by requiring the following actions: (1) engineering controls (i.e., water soluble packaging) for wettable powder formulations labeled for aerial/chemigation application on food crops, (2) enclosed cabs for planting potato seed that has been treated with dust, (3) double-layer PPE, chemical-resistant gloves, and an apron while using dips, and (4) single-layer PPE and chemical-resistant gloves for various scenarios.

At current labeled thiophanate-methyl application rates, cut flower harvesters would have both short-term and cancer risks of concern when contacting plants after application. The Agency believes that significant risk reduction would occur by reducing the maximum allowable application rate on cut flowers to 0.5 lb ai/acre which is currently the typical use rate.

In addition, restricted entry intervals (REIs) are being modified for certain food crops which exceeded the Agency's level of concern.

There are insufficient data to adequately assess the seedling or dip applications, and additional data are requested to support these uses.

Post-application worker exposure scenarios were also assessed for MBC. Risks were not of concern.

Ecological Risk

The implementation of the mitigation measures described above (i.e., rate reductions), resulted in decreases in exposure values, leading to much lower RQs for both terrestrial and aquatic organisms. There are a few scenarios which still show LOC exceedances; however, all of these exceedances are slight and therefore, EPA has determined that no further risk mitigation is necessary for environmental concerns.

Conclusions

The Agency is issuing this Reregistration Eligibility Document (RED) for thiophanate-methyl, as

announced in a Notice of Availability published in the *Federal Register*. This RED document includes guidance and time frames for complying with any required label changes for products containing thiophanate-methyl. With the addition of the label restrictions and amendments detailed in this document, the Agency has determined that all currently registered uses of thiophanate-methyl are eligible for reregistration.

The risk assessments for thiophanate-methyl are based on the best scientific data currently available to the Agency and are adequate for regulatory decision making.

There was a 60-day public comment period for this document which was from November 24, 2004 to January 24, 2005. Comments can be found in edocket number OPP-2004-0265.

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 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 or not 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 during reregistration. 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 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.

Thiophanate-methyl is a benzimidazole fungicide structurally related to albendazole, fenbendazole, mebendazole, oxfendazole and thiabendazole. At this time, the Agency has not made a decision as to whether thiophanate-methyl shares a common mechanism of toxicity with these other benzimidazole or any other pesticides. An evaluation of all the available data is still needed, as well as peer review by the FIFRA Science Advisory Panel, before a formal decision is made. Therefore, for the purposes of this risk assessment, the Agency has assumed that thiophanate-methyl does not share a common mechanism of toxicity with other pesticides. After a decision is made regarding common mechanism of toxicity, and if the Agency determines that a cumulative assessment is necessary, the Agency will address any outstanding risk concerns at that time.

The implementation of FQPA requires 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. The TRAC identified the following science policy issues it believed were key to the implementation of FQPA and tolerance reassessment:

- Applying the FQPA 10-fold safety factor
- Whether and how to use probabilistic analyses in dietary exposure assessments
- How to interpret “no detectable residues” in dietary exposure assessments
- Refining dietary (food) exposure estimates
- Refining dietary (drinking water) exposure estimates
- Assessing residential exposure
- Aggregating exposure from all non-occupational sources
- How to conduct a cumulative risk assessment for organophosphate or other pesticides

with a common mechanism of toxicity
- Selection of appropriate toxicity endpoints for risk assessments of organophosphates
- Whether and how to use data derived from human studies

The process developed by the TRAC calls for EPA to provide one or more documents for public comment on each of the policy issues described above. Each of these issues is evolving and in a different stage of refinement. Some issue papers have already been published for comment in the Federal Register and others will be published shortly.

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 reregistration eligibility and risk management decisions. Section V summarizes required label changes based on 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 www.epa.gov/pesticides, and in the Public Docket.

II. Chemical Overview

A. Regulatory History

Thiophanate-methyl (TM) has been registered in the United States since 1973 for use as a fungicide. On December 7, 1977, EPA initiated a Special Review for TM because its metabolite, methyl 2-benzimidizole carbamate (MBC), has the potential to cause mutagenic effects and TM has the potential to cause adverse effects to nontarget organisms (earthworms). In the preliminary determination concluding Special Review in 1979, EPA stated that the available evidence did not clearly demonstrate a risk to humans or the environment as a result of uses registered at that time. Significant local population reduction in earthworms was not expected since "the toxic effects were limited to the site of application, the impact of earthworm loss did not extend to adjacent areas, the populations could rebound to normal within a few years after termination of thiophanate-methyl treatments, and the sites of application were reasonably limited". Prior to the publication of EPA's final TM regulatory decision concluding the Special Review, new data were received by the Agency indicating that MBC was carcinogenic. The Agency issued its final regulatory decision on TM on October 20, 1982. In the Notice and position document supporting the decision, the Agency determined that the potential oncogenic and mutagenic risks of TM were "exceeded by the benefits associated with its use".
EPA conducted a thorough review of the scientific data base on TM and reassessed the Agency's earlier regulatory position in 1986, when a Registration Standard for TM was released. The Registration Standard involved a thorough review of the scientific data base underlying pesticide registrations and an identification of essential but missing studies which may not have been required when the product was initially registered or studies that were considered insufficient. The Registration Standard concluded that TM and MBC should not be placed in Special Review again, the benefits outweighed the risks from TM use, and EPA should continue to approve new uses for registration [Section 3, Section 24(c) and Section 18] on a case-by-case basis.

Subsequent Data Call-Ins (DCIs) were issued in 1991, 1995, and 1996 for thiophanate-methyl. This Reregistration Eligibility Decision (RED) reflects a reassessment of all data to date.

In April 2001, the registrant of benomyl, a widely-used, related benzamidazole compound, requested voluntary cancellation of all benomyl-containing products, with sales and distribution proposed to cease by December 31, 2001. The fungicidal activity of both TM and benomyl depends on conversion to MBC; therefore, similar disease control is expected. As a result of the benomyl cancellation, EPA received several petitions from Cerexagri, a technical registrant of TM, and from IR-4 for registrations to replace benomyl. Namely, Section (3) petitions to establish permanent tolerances on canola[1] and pistachios. Earlier Section (3) petitions had also been received in 1996 to establish tolerances on grapes and pears, and to add a foliar application to potatoes (a tolerance for potato seed pieces already existed). Due to the regulatory impact of FQPA in 1996, Cerexagri decided not to pursue registration on these crops. However, with the cancellation of benomyl, Cerexagri requested that the petitions for pears, grapes, and potatoes be considered and therefore, they were also evaluated in this RED document. Following rate reductions to reduce exposure through drinking water, tolerances were established for residues of thiophanate-methyl in/on canola, grapes, pears, pistachios, and potatoes (foliar) on August 28, 2002 (67FR55137).

Also as a result of the benomyl cancellation, Section 18 Emergency Exemption Petitions were submitted by Florida and Louisiana to allow use of TM on citrus, and by several other states to permit use of TM on blueberries. The Section 18 uses were granted on February 22, 2002 through February 22, 2003 (citrus); and on May 5, 2002 through September 30, 2002 (blueberries). The Section 18 for citrus has been reissued for the 2003 use season. Section 18's in various states were also granted on February 5, 2003 for the use of thiophanate-methyl on mushrooms.

This Reregistration Eligibility Decision document evaluates risks from all currently registered uses, including grapes, pears, pistachios, canola, potato foliar use, and the 1-year Section 18's for blueberries and citrus.

In an effort to promote transparency of the reregistration process and public acceptance of regulatory decisions, the Agency, in cooperation with the U.S. Department of Agriculture (USDA), is working to modify the reregistration process. An interim process has been established to provide opportunities for stakeholders to ask questions and provide input on the risk assessment and risk mitigation strategies, via conference calls and other formats. See Chapter IV Section B for a detailed description of the modified process. Consistent with this process, a conference call was conducted on June 1, 2001 with EPA, USDA, the registrants, and other stakeholders (e.g., growers, commodity groups, land grant universities) to discuss the basis

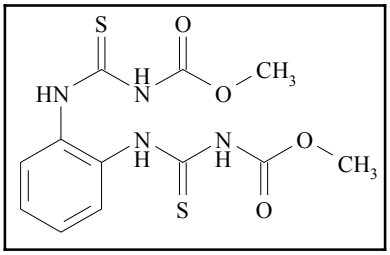
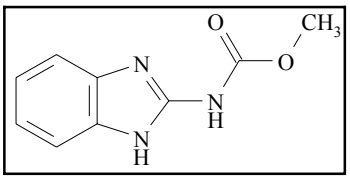
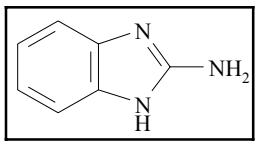
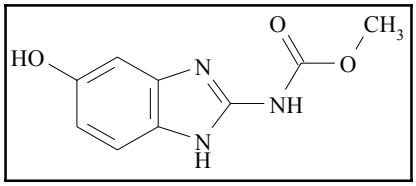
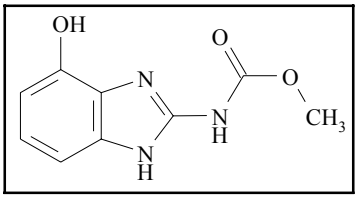
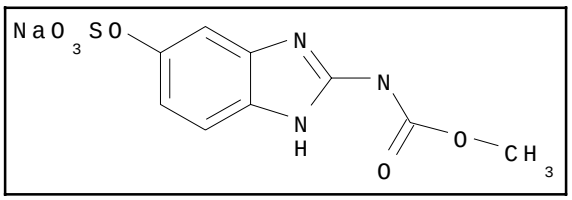
[1] IR-4 submitted a tolerance petition for thiophanate-methyl on canola. Although benomyl was never registered on canola, it was the fungicide designated by the US Canola Association as a high priority need. Upon cancellation of benomyl, the US Canola Association replaced benomyl with TM on it's "urgently needed" list.

of the calculated risks of thiophanate-methyl, the Agency's risk concerns, and the benomyl registrant's voluntary cancellation and phase-out proposal. Risk mitigation meetings were held with stakeholders on September 12, 2002 and January 23, 2003. Stakeholders provided new information regarding use rates, acreage, application frequency, etc., which enabled EPA to significantly refine the occupational risk assessment. Also, a close-out conference call was conducted on March 4, 2003 with stakeholders, to discuss the risk management decisions and resultant changes to the thiophanate-methyl labels.

B. Chemical Identification

EPA has concluded that the residues to be regulated in plant and animal commodities for purposes of tolerance enforcement will consist of TM and its metabolite methyl 2-benzimidazolyl carbamate (MBC). For purposes of dietary risk assessment, the residues of concern in plants will include TM, MBC, and 2-aminobenzimidazole (2-AB). In animal commodities, the residues of concern will include TM, MBC, and the hydroxylated metabolites of MBC (4-OH-MBC, 5-OH-MBC, and 5-OH-MBC-S). The chemical names and structures of these compounds are depicted in Figure A.

Figure A. Chemical structures of thiophanate-methyl residues of concern.

 Thiophanate-methyl; dimethyl [(1,2-phenylene)bis (iminocarbonothioyl)]bis(carbamate)	 MBC: methyl-2-benzimidazole carbamate
 2-AB: 2-amine-1H-benzimidazole	 5-OH-MBC: Methyl 2-(5-hydroxybenzimidazolyl) carbamate
 4-OH–MBC: Methyl 2-(4-hydroxybenzimidazolyl) carbamate	 5-OH-MBC-S: sodium 5-(2-methoxycarbonylamino) benzimidazolyl sulfate

- **Common Name:** Thiophanate-methyl
- **Chemical Name:** dimethyl [(1,2-phenylene)bis(iminocarbonothioyl)] bis(carbamate)
- **Chemical Family:** benzimidazole fungicide
- **CAS Registry Number:** 23564-05-8
- **OPP Chemical Code:** 102001
- **Empirical Formula:** $C_{12}H_{14}N_4O_4S_2$

- **Vapor Pressure:** $1.3x10^{-5}$ mmHg

- **Basic Manufacturers:** Cerexagri Corporation, Micro Flo Company, Nations Ag, and Gowan Pacific

Pure TM is a colorless crystalline solid with a melting point of 168 °C with decomposition. Technical TM is a pale brown powder which begins to decompose at ~163 °C. Thiophanate-methyl is slightly soluble in water (21.8 ppm) and sparingly soluble in most organic solvents at 25 °C (2.9 g/100 mL acetone; $7.8x10^{-1}$ g/100 mL methanol; $8.4x10^{-1}$ g/100 mL ethyl acetate; $7.3x10^{-2}$ g/100 mL dichloromethane; $1.8x10^{-2}$ g/100 mL n-octanol; $1.1x10^{-2}$ g/100 mL xylene; and $4.7x10^{-5}$ g/100 mL n-hexane). TM is a semi-volatile compound based on its vapor pressure of $1.3x10^{-5}$ mmHg.

C. Use Profile

The following is information on the currently registered uses including an overview of use sites and application methods. A detailed table of the uses of thiophanate-methyl eligible for reregistration is contained in Appendix A.

Type of Pesticide
Thiophanate-methyl is a systemic fungicide used to control various diseases caused by fungal pathogens. Thiophanate-methyl inhibits fungi growth by interfering in the biosynthesis of DNA in the fungal cell division process.

Use Sites
Thiophanate-methyl is registered for use on the following food/feed crops: almonds, apples, apricots, canola, dry beans, garlic, grapes, green beans, cantaloupes, cherries, cucumbers, garlic, melons, nectarines, onions, peaches, peanuts, pears, pecans, pistachios, plums, potatoes, pumpkins, soybeans, squash, strawberries, sugar beets, watermelons, and wheat. A tolerance has been established with no U.S. registration to permit importation of thiophanate-methyl-treated bananas. Non-food/feed uses include ornamentals (greenhouses, interiorscapes, landscaping, and nursery (including forest nurseries) and turf (sod farms, residential and recreational lawns).

Use Limitations
Use on canola restricted to MN, ND, and MT.
Use on fall-seeded wheat restricted to ID, OR, and WA.

Target Pests
Species of *Botryosphaeria, Botrytis, Cercospora, Cladosporium, Coccomyces, Colletotrichum, Corynespora, Cristulariella, Dendrophoma, Diaporthe, Dibotryon, Didymella, Diplodia, Fusicladium, Gloeodes, Gnomonia, Erysiphe, Fusarium, Monilinia, Mycosphaerella, Phaecryptopus, Phomopsis, Podosphaera, Pseudocercosporella, Puccinia, Rhizoctonia, Scirrhia, Sclerotium, Septoria, Sphaerotheca, Venturia,* and *Zygophiala,*

Formulation Types
Thiophanate-methyl formulations include dust, granular, wettable powder, water-dispersible granular, and flowable concentrate, ranging from 1.5% to 90% active ingredient. Common trade names: Topsin®, Banrot®, Systec®, Fungo® , Duosan®.

Method and Rates of Application
Thiophanate-methyl may be applied with aerial, chemigation or ground equipment (airblast, broadcast, band, or soil drench); as a dip treatment for cut flowers, rose budwood, or nursery stock; and as a seed treatment for peanuts and potato pieces. Handheld equipment may be used on turf and ornamentals. The majority of crops are treated with postemergent broadcast applications.

Single maximum application rates vary widely depending on the crop as follows:

Food crops: 0.35-1.4 lbs ai/acre/application (these rates reflect risk reduction measures agreed to in this RED); *peanut seeds:* 0.04 lb ai/100 lb*; potato seed pieces*: 0.025 lb ai/100 lb. of seed; *greenhouse bulbs*: 0.34 lb ai/100 gal dip; *horticultural/greenhouse*: 0.5 lb ai/100 gal, 0.03-0.87 lb ai/1000 ft^2; *turf*: 10.88 lb ai/acre/year (this rate reflects risk reduction measures agreed to in this RED).

Timing of Application
One to four applications are allowed per season depending on the crop. Typically one or two applications are made.

D. Estimated Usage of Pesticide

Table 1 below summarizes the best available estimates for the pesticide usage of thiophanate-methyl.

Previously, annual estimates of thiophanate-methyl total domestic usage averaged approximately 450,000 pounds active ingredient for about 750,000 acres treated. These estimates were derived from a variety of published and proprietary sources available to the Agency. However, use of TM is expected to increase considerably in coming years due to the recent cancellation of benomyl-containing products. Total annual domestic usage of thiophanate-methyl over the next few years is expected to average about 700,000 pounds of active ingredient on about 1,000,000 acres treated (excluding use on onions, turf, and ornamentals for which EPA has no comprehensive usage data). These estimates, presented below in Table 1, consider the ***anticipated*** use of thiophanate-methyl, based on current usage information for thiophanate-methyl and a wide-spread survey of the grower community regarding alternatives to benomyl, conducted by USDA in 2001. Largest markets in terms of total pounds active ingredient are expected to include apples, citrus, canola, dry beans, green beans, potatoes, and wheat. Crops with a high percentage treated of total U.S. planted acres is expected to include strawberries (32%), blueberries (23%), pistachios (22%), apples (21%), and melons (14%).

Table 1. Thiophanate-methyl Crop Usage Summary

Site	Acres Grown (000)	Acres Treated (000)		% of Crop Treated		LB AI Applied (000)		Average Application Rate			States of Most Usage
		Wtd Avg	Est Max	Wtd Avg	Est Max	Wtd Avg	Est Max	lb ai/ acre/yr	# appl/yr	lb ai/ A/appl	(% of total lb ai used on this site)
Almonds	430	47	71	10.9	16.4	37	56	0.8	1.1	0.7	CA 100%
Apples	520	108	189	20.8	36.3	71	122	0.7	2.7	0.2	WA NY MI CA PA 90%
Apricots	21	1	2	6.0	10.0	1	2	0.8	1.0	0.8	CA 96%
Beans, Dry	1,802	89	182	4.9	10.1	90	184	1.0	1.0	1.0	ND MI MN NE ID 88%
Beans, Green	304	43	72	14.0	23.8	56	95	1.3	1.0	1.3	WI FL MI NY OR GA 91%
Blueberries	62	14	18	22.8	28.8	14	18	1.0	2.0	0.5	ME MI NJ GA NC 85%
Canola	1,520	152	228	10.0	15.0	90	137	0.6	1.0	0.6	ND MN MT WA 80%
Cantaloupes	102	13.5	20	13.2	19.7	8	12	0.6	1.5	0.4	IN MI TX 75%
Cherries	128	5	9	3.8	7.2	2	3	0.3	1.0	0.3	MI WA OR CA 86%
Citrus	1,250	66	481	5.3	38.5	65	492	1.0	1.0	1.0	FL CA TX 100%
Cucumbers	131	15	48	11.2	37.1	16	57	1.1	1.3	0.9	MI NC FL GA 86%
Garlic	32	1	3	4.3	8.6	0	0	0.2	1.2	0.1	CA OR 90%
Grapes	1,100	2	34	0.2	3.1	1	23	0.6	1.0	0.4	CA 90%
Melons	36	5	14	14.2	40.5	3	6	0.5	1.2	0.4	CA TX AZ FL 75%
Nectarines	36	1	1	1.5	3.0	1	1	1.1	1.0	1.1	CA 90%

Site	Acres Grown (000)	Acres Treated (000)		% of Crop Treated		LB AI Applied (000)		Average Application Rate			States of Most Usage
		Wtd Avg	Est Max	Wtd Avg	Est Max	Wtd Avg	Est Max	lb ai/ acre/yr	# appl/yr	lb ai/ A/appl	(% of total lb ai used on this site)
Onions	143	0	0	0.1	0.2	0	1	2.4	1.2	2.0	CA CO GA TX WA 70%
Peaches	135	2	4	1.5	3.0	3	5	1.4	2.6	0.6	CA SC GA TX NJ 90%
Peanuts	1,508	6	19	0.4	1.3	5	21	0.7	1.0	0.7	GA TX AL NC 84%
Pears	74	8	12	10.3	16.7	9	16	1.2	2.4	0.5	CA NY OR 82%
Pecans	452	13	36	2.9	8.1	10	30	0.7	1.3	0.5	GA TX NM AZ LA 83%
Pistachios	90	20	35	21.8	38.8	24	42	1.2	1.4	0.8	CA 100%
Plums/Prunes	144	2	4	1.3	2.9	1	2	0.4	1.0	0.4	CA 89%
Potatoes	1,373	139	282	10.1	20.5	56	118	0.4	1.0	0.4	ID WA ND WI ME OR 75%
Pumpkins	61	3	11	4.8	18.9	1	6	0.5	1.2	0.4	IL NY CA PA MI OH 83%
Soybeans	64,371	33	90	0.1	0.1	17	48	0.5	1.0	0.5	IL IA MN IN MO OH 81%
Squash	59	7	26	12.5	44.0	6	19	0.8	1.2	0.7	FL CA GA MI NJ 78%
Strawberries	50	16	36	31.9	70.8	21	58	1.3	2.7	0.5	CA FL 82%
Sugar Beets	1,473	74	147	5.0	10.0	31	59	0.4	1.0	0.4	MN ND MI ID 85%
Watermelons	215	22	50	10.3	23.2	5	11	0.2	1.0	0.2	FL IN AZ 82%
Wheat	62,407	85	266	0.1	0.4	51	160	0.6	1.0	0.6	ID OR WA 75%
Total		1,000	1,704			700	1,260				

COLUMN HEADINGS

Wtd. Avg. = Weighted average--the most recent years and more reliable data are weighted more heavily.
Est. Max. = Estimated maximum, which is estimated from available data.
Average application rates are calculated from the weighted averages.

NOTES ON TABLE DATA

Usage data primarily covers 1991 - 2000. USDA conducted a survey of growers in 2001 on the expected future usage of thiophanate methyl after the cancellation of benomyl.
Calculations of the above numbers may not appear to agree because they are displayed as rounded to the nearest 1,000 for acres treated or lb. a.i. (therefore 0 = < 500), and rounded to one decimal percentage point for % of crop treated.
SOURCES: EPA, USDA , and National Center for Food and Agricultural Policy.

III. Summary of Thiophanate-methyl Risk Assessment

The following is a summary of EPA's human health and ecological risk findings and conclusions for the fungicide thiophanate-methyl, as presented fully in the documents, "HED Human Health Risk Assessment for the Reregistration Eligibility Decision" dated April 25, 2002, "Revised EFED RED document for thiophanate-methyl and its major degradate, MBC" dated May 9, 2001, and "Addendum to EFED RED chapter (revised) for thiophanate-methyl fungicide (TM) and its major degradate, MBC" dated June 12, 2002. Since the completion of the assessments, the Agency has calculated new water concentrations for TM and MBC based on thiophanate-methyl's recently modified use pattern. The Agency has also revised the risk estimates for residential applicators exposed to MBC in paint (see D295437 available in docket OPP-2004-0265). Also, new information provided by stakeholders enabled the Agency to refine worker cancer risk estimates. The new cancer assessment for workers is found in the document "Thiophanate-methyl: Updated HED Occupational Handler and Postapplication Worker Cancer Risk Estimates" dated December 3, 2002.

The purpose of this decision document is to summarize the key features and findings of the risk assessment in order to help the reader better understand the risk management decisions reached by the Agency. While the risk assessments and related addenda are not included in this document, they are available in the public docket.

A. Human Health Risk Assessment

Risks from dietary exposure (food and drinking water), residential exposure, aggregate exposures, and occupational exposures have been evaluated for thiophanate-methyl. Risks from exposure to MBC have also been evaluated since thiophanate-methyl rapidly degrades to MBC in the environment. Therefore, MBC residues may be present in food, drinking water, on lawns, etc., following thiophanate-methyl use. MBC is not only the primary metabolite of thiophanate-methyl, it is also a registered fungicide for use in tree injection[1] and as a fungicide/preservative in paints, coatings, plaster and adhesives (which may be used in residential settings).

1. Dietary Risk From Food

a. Toxicity

Although there are sufficient data to support a reregistration eligibility determination for all currently registered uses of TM, the toxicology database for TM is considered incomplete. EPA is requesting that rat acute and subchronic neurotoxicity screening studies be submitted on TM and that a developmental neurotoxicity study on TM be placed in 'reserve' status pending the results of these studies and a developmental neurotoxicity study with MBC. The Agency is also

[1]Tree injection products are restricted to ornamental trees only; labels specify product is not to be used on trees which will produce food within the year following treatment.

requesting a 90-day rat inhalation study because an unacceptable 14-day inhalation study showed possible respiratory effects from TM exposure at lower concentrations than those associated with developmental effects and because occupational exposures are potentially long-term in green houses.

Toxicology data for carbendazim (Methyl 2-Benzimidazole Carbamate) or MBC, the primary metabolite and environmental breakdown product of TM, are also considered in this assessment, and are incomplete. Two toxicity studies with MBC are being requested; a 21-day dermal toxicity study in rats, and a developmental neurotoxicity study in rats. In addition, the 2-generation rat reproduction and subchronic studies for MBC fail to meet the Subdivision F Guidelines and must be repeated.

Acute Toxicity. Both TM and MBC are of low toxicity following acute oral, dermal and inhalation exposures (toxicity categories III/IV). TM is classified as a skin sensitizer, while MBC is not a skin sensitizer. Acute toxicity values and categories for the technical grade of TM and MBC are summarized in Tables 2 and 3, respectively.

Table 2. Acute Toxicity of Thiophanate-methyl

Guideline No.	Study Type	MRID #	Results	Toxicity Category
870.1100 (81-1)	Acute Oral, Rat	41644301	LD_{50} = >5000 mg/kg,	IV
870.1200 (81-2)	Acute Dermal, Rabbit	41644302	LD_{50} = >2000 mg/kg,	III
870.1300 (81-3)	Acute Inhalation, Rat	41482804	LC_{50} >1.7 mg/L males LC_{50} >1.9 mg/L females	III
870.2400 (81-4)	Primary Eye Irritation, Rabbit	40095501	slight ocular irritant	IV
870.2500 (81-5)	Primary Skin Irritation, Rabbit	40095502	Non-irritant	IV
870.2600 (81-6)	Dermal Sensitization, Guinea Pig	41482805	dermal sensitizer	N/A

Table 3. Acute Toxicity of MBC

Guideline No.	Study Type	% a.i.	MRID or Accession No.	Results	Toxicity Category
870.1100 (81-1)	Acute Oral, Rat	98	256025 (Acc No)	LD_{50} = >10,000 mg/kg,	IV
870.1200 (81-2)	Acute Dermal, Rabbits	75 INE 965	256025 (Acc No)	LD_{50} = >2,000 mg/kg formulation	III

Guideline No.	Study Type	% a.i.	MRID or Accession No.	Results	Toxicity Category
870.1300 (81-3)	Acute Inhalation, Rat	75 INE 965	256025 (Acc No)	LC_{50} >5 mg/L	IV
870.2400 (81-4)	Primary Eye Irritation, Rabbit	>98	256025 (Acc No)	minimal to no irritation	III
870.2500 (81-5)	Primary Skin Irritation, Rabbit	75 INE 965	256025 (Acc No)	slight irritation at 24 hr, normal by 72 hr	IV
870.2600 (81-6)	Dermal Sensitization, Guinea Pig	98	256025 (Acc No)	not a dermal sensitizer	N/A

Subchronic/Chronic Systemic Toxicity: The liver and thyroid are the primary target organs of TM and MBC in several species following subchronic or chronic dietary exposure. Adverse testicular effects were observed in two chronic rat studies. The testes is a known target organ of MBC. In addition to liver and thyroid effects, TM also appeared to cause mild anemia at the higher dose levels in rats, dogs and mice following subchronic or chronic exposure.

Carcinogenicity. TM is classified as "likely to be carcinogenic to humans". A Q1* of $1.16x10^{-2}$ $(mg/kg/day)^{-1}$ was assigned based on the dose-dependent increases in liver tumors in male and female mice. MBC is classified in group C (possible human carcinogen). A Q1* of $2.39x10^{-3}$ $(mg/kg/day)^{-1}$ was assigned based on hepatocellular (adenoma and/or carcinoma) tumors in female mice.

Developmental/Reproductive Toxicity: Developmental toxicity was observed in the fetuses of rabbits exposed to 40 mg/kg/day TM and included increased incidence of supernumerary ribs and decreased fetal weight. These findings occurred at a dose that also caused maternal toxicity based on decreases in body weight gain and food consumption.

MBC was associated with adverse reproductive effects (decreased birth weight at weaning) in an unacceptable reproductive toxicity study in rats. MBC also caused adverse testicular effects characterized by premature release of immature germ cells, atrophy of a few seminiferous tubules and significant decrease in seminiferous tubule diameter following a single gavage dose with 50 mg/kg (Nakai et al. 1992). In addition, evidence of testicular effects was observed in the unacceptable 90-day subchronic dog study with MBC.

Genotoxicity. Although the acceptable submitted genotoxicity studies (*in vitro* CHO cytogenetic and rat liver unscheduled DNA synthesis assays) were negative, two published reports (mouse bone marrow micronucleus and BALB/c 3T3 cell transformation assays) demonstrated that TM is aneugenic (abnormal chromosome number). Although weak equivocal positive results were observed in a published Ames assay, TM was negative in a recently reviewed bacterial reverse gene mutation study.

Neurotoxicity. No acute or subchronic rodent neurotoxicity screening studies (§81-8 and §82-7) were submitted for TM. EPA determined that these studies should be submitted based on (1) potential clinical signs of neurotoxicity in the chronic dog study (transient tremors) and (2) existence of a common metabolite, MBC, with benomyl. Also, it was determined that benomyl showed potential signs of neurotoxicity in the acute and subchronic rat neurotoxicity screening studies. In addition, in the rat developmental toxicity studies, both MBC and benomyl caused developmental neurotoxic effects. Developmental neurotoxicity studies (§83-6) were therefore requested for benomyl (now canceled) and MBC. A developmental neurotoxicity study for TM is in 'reserve' status pending the receipt/evaluation of neurotoxicity studies and development of a policy on the need for a developmental neurotoxicity study for pesticides that cause thyroid toxicity. The Agency has concern for potential effects on the development of the nervous system if TM has antithyroid activity. MBC was not demonstrated to cause delayed neurotoxicity in hens. Developmental CNS malformations were noted in the MBC prenatal developmental toxicity study in rats, which included exencephaly, domed head, anophthalmia, microophthalmia and bulged eyes.

Dermal Absorption. EPA estimated a dermal absorption rate of 7% for TM based on the results of an oral developmental toxicity study (LOAEL of 20 mg/kg/day) and a 21-day dermal toxicity study (LOAEL of 300 mg/kg/day) in the same species (rabbit) with similar endpoints (decreased food consumption). EPA estimated a dermal absorption rate of 3.5% for MBC based on a dermal absorption study with benomyl. Benomyl was selected as a surrogate chemical because of similarities in toxicological effects and structure between benomyl and MBC.

b. FQPA Safety Factor

The FQPA safety factor (as required by the Food Quality Protection Act of August 3, 1996) is intended to provide up to an additional 10-fold safety factor (10X), to protect for special sensitivity in infants and children to specific pesticide residues in food or to compensate for an incomplete database. The FQPA Safety Factor is necessary for TM due to an incomplete toxicity database (acute and subchronic neurotoxicity studies are required due to potential neurotoxicity) and the requirement for a developmental neurotoxicity study has been ‘reserved’. However, the FQPA safety factor can be reduced to 3X because (1) the Agency evaluated the new 1997 prenatal developmental toxicity study in rabbits and classified this study as acceptable for assessment of susceptibility; (2) the dietary prenatal developmental toxicity study in the rat was considered to be acceptable for assessment of susceptibility; (3) the available data provided no indication of increased susceptibility *in utero* in the developmental studies in rats and rabbits or following pre-/postnatal exposure in the multi-generation reproduction studies in rats; and (4) the dietary (food and drinking water) and non-dietary exposure assessments will not underestimate the potential exposure for infants and children from the use of TM. The 3X FQPA safety factor for TM is applicable to all population subgroups for dietary and non-dietary exposure assessments of all durations since the toxicology database for TM is incomplete and the requirement for a developmental neurotoxicity study has been ‘reserved’.

For MBC (the primary metabolite of TM), the FQPA safety factor was retained at 10X for two reasons. First, there was evidence of increased susceptibility following *in utero* exposure of MBC in the prenatal developmental toxicity study in rats and rabbits. In the rat study, developmental anomalies (decreased fetal body weight and increases in skeletal variations and a threshold for malformations of the CNS) occurred at doses which were not maternally toxic. In the rabbit study, developmental toxicity was manifested as decreased implantations and live litter size and increased resorptions at a dose that did not cause maternal toxicity. Second, there is a need for developmental neurotoxicity studies in rats for MBC because in a prenatal developmental toxicity study in rats with MBC, treatment-related malformations of the CNS were observed. Also, there is increased sensitivity of rat and rabbit fetuses as compared to maternal animals following *in utero* exposure to MBC in prenatal developmental toxicity studies. Lastly, in mutagenicity studies with MBC, there is evidence of aneuploidy induction following oral dosing in mice. Mutagenicity data support the evidence of developmental anomalies in rats. The 10x FQPA safety factor for MBC is applicable for all risk assessments for females 13-50 years, infants, and children (1- 6 years and 7-12 years).

c. Population Adjusted Dose (PAD)

Dietary exposure estimates are expressed in mg/kg body weight/day and as a percent of the acute/chronic Population Adjusted Dose (a/cPAD) which is the RfD taking into account the FQPA safety factor. This calculation is performed for each population subgroup. A risk estimate that is less than 100% of the acute or chronic PAD does not exceed EPA's risk concern.

d. Endpoints and Doses for Risk Assessment

The doses, toxicity endpoints selected and supporting studies for various exposure scenarios are summarized in Tables 4 and 5.

Table 4. Summary of Doses and Toxicological Endpoints for Thiophanate-methyl

Exposure Scenario	Dose Used in Risk Assessment, UF	FQPA SF* and Endpoint for Risk Assessment	Study and Toxicological Effects
Acute Dietary, Females 13-50 yrs	NOAEL=20 mg/kg/day UF = 100 Acute RfD= 0.2 mg/kg/day	FQPA SF = 3 aPAD= acute RfD / FQPA SF = 0.067 mg/kg/day	1997 Rabbit Developmental Study LOAEL=40 mg/kg/day based on supernumerary ribs in fetuses of exposed dams and decreased fetal weight.
Acute Dietary, General Population	NOAEL=40 mg/kg/day UF = 100 Acute RfD= 0.4 mg/kg/day	FQPA SF = 3 aPAD= acute RfD / FQPA SF = 0.13 mg/kg/day	Chronic oral toxicity dog study LOAEL= 200 mg/kg/day based on tremors 2-4 hours post-dosing in 7 of 8 dogs.
Chronic Dietary	NOAEL=8 mg/kg/day UF = 100 Chronic RfD= 0.08 mg/kg/day	FQPA SF = 3 cPAD= chronic RfD / FQPA SF = 0.027 mg/kg/day	Chronic oral toxicity dog study LOAEL= 40 mg/kg/day based on thyroid and liver effects and decreased body weight.

Exposure Scenario	Dose Used in Risk Assessment, UF	FQPA SF* and Endpoint for Risk Assessment	Study and Toxicological Effects
Short- & Intermediate Term Incidental Ingenstion	NOAEL = 10 mg/kg/day UF = 100	LOC for MOE = 300 for all residential populations LOC for MOE = 100 for occupational workers	1997 Rabbit Developmental Study LOAEL = 20 mg/kg/day based on decreased maternal body weight and food consumption.
Cancer	$Q1^* = 1.16 \times 10^{-2}$ $(mg/kg/day)^{-1}$	$Q1^* = 1.16 \times 10^{-2}$ $(mg/kg/day)^{-1}$	78-week mouse study based on male mouse liver adenoma and/or carcinoma and/or hepatoblastoma combined tumor rates

* The reference to the FQPA Safety Factor refers to any additional safety factor retained due to concerns unique to the FQPA.
UF = Uncertainty Factor
PAD = Population Adjusted Dose (includes UF and FQPA safety factor)
LOC= Level of Concern
MOE = Margin of Exposure

Table 5. Summary of Doses and Toxicological Endpoints for MBC

Exposure Scenario	Dose Used in Risk Assessment, UF	FQPA SF* and Endpoint for Risk Assessment	Study and Toxicological Effects
Acute Dietary, Females 13-50 years	NOAEL=10 mg/kg/day UF = 100 Acute RfD= 0.1 mg/kg/day	FQPA SF = 10 aPAD= acute RfD / FQPA SF = 0.01 mg/kg/day	Rat Developmental Study with MBC LOAEL= 20 mg/kg/day based on decreased fetal body weight and increases in skeletal variations and a threshold for malformations in fetuses of exposed dams
Acute Dietary, General Population, including infants and children	LOAEL=50 mg/kg/day UF = 300 Acute RfD= 0.17 mg/kg/day	FQPA SF = 10 for infants and children FQPA SF=1 general pop. aPAD= acute RfD / FQPA SF = 0.017 mg/kg/day (infants and children) = 0.17 (general pop.)	Single Dose Rat Study (Nakai et al. 1992) LOAEL= 50 mg/kg/day based on adverse testicular effects including sloughing (premature release) of immature germ cells 2 days post exposure, atrophy of a few seminiferous tubules in one testicle, significant decrease in seminiferous tubule diameter, and slight abnormal growth of the efferent ductules at 70 days post exposure.
Chronic Dietary	NOAEL=2.5 mg/kg/day UF = 100 Chronic RfD= 0.025 mg/kg/day	FQPA SF = 10 for children and females 13-50 yrs FQPA SF=1 general pop. cPAD= chronic RfD / FQPA SF = 0.0025 mg/kg/day (children and females) = 0.025 (general pop.)	2 year dog study with MBC LOAEL= 12.5 mg/kg/day based on histopathological lesions of the liver characterized as swollen, vacuolated hepatic cells, hepatic cirrhosis and chronic hepatitis in both sexes.
Short-Term Incidental Ingestion	Oral NOAEL = 10 mg/kg/day	LOC for MOE = 1000 for all residential populations LOC for MOE = 100 for occupational workers	1997 Rabbit Developmental Study with thiophanate-methyl LOAEL = 20 mg/kg/day based on decreased maternal body weight and food consumption.
Intermediate-Term Incidental Ingestion	Oral NOAEL = 11 mg/kg/day (rounded to 10 mg/kg/day)	LOC for MOE = 1000 for all residential populations LOC for MOE = 100 for occupational workers	90 day dog feeding study with MBC LOAEL = 35 mg/kg/day based on adverse liver effects.
Cancer	$Q1^* = 2.39 \times 10^{-3}$ $(mg/kg/day)^{-1}$	$Q1^* = 2.39 \times 10^{-3}$ $(mg/kg/day)^{-1}$	2 year mouse study with MBC based on hepatocellular (adenoma and/or carcinoma) tumors in female CD-1 mice

* The reference to the FQPA Safety Factor refers to any additional safety factor retained due to concerns unique to the FQPA.
UF = Uncertainty Factor
PAD = Population Adjusted Dose (includes UF and FQPA safety factor)
LOC= Level of Concern
MOE = Margin of Exposure

e. Toxic Equivalency Factors

In this assessment, risk estimates for TM and MBC plus other metabolites of concern were added together where appropriate to account for total risk estimates for target organs of concern. This is considered appropriate because both chemicals have aPADs that are based on the similar

developmental effects for females and identical endpoints for short-term incidental oral exposures, and because the liver is a target organ of chronic exposure. In addition, individuals may be exposed to both TM and MBC residues simultaneously on a given food commodity. A toxic equivalency factor (TEF) approach was used to sum risk estimates from TM and MBC as MBC equivalents consistent with USEPA (1999) guidance. Using the TEF approach, all TM dietary exposure estimates were adjusted upwards to account for differences in aPADs and cPADs between TM and MBC. A TEF was not estimated for the aPADs for the general population because the target organs are different for TM (tremors) and MBC (testicular effects), nor for short- and intermediate-term dermal exposures. The TEFs were estimated for the cPADs because both TM and MBC cause adverse liver effects following chronic exposure. The TEFs used in this assessment are shown on Table 6 below.

Table 6. Toxic Equivalency Factors (TEFs) Used to Convert Thiophanate-methyl Exposures into MBC Equivalents

Toxicological Endpoint/ Population Subgroup	PAD or NOAEL/ Uncertainty Factor		Toxic equivalency Factor
	Thiophanate Methyl (mg/kg/day)	MBC (mg/kg/day)	
Acute PAD, females 13-50 years	0.067	0.01	0.15 (developmental effects)
Acute PAD, general population	0.13 (tremors)	0.17 (testicular effects)	N/A
Short-term incidental oral	10/300(UF)=0.03	10/1000 (UF)=0.01	0.3 (Decreased body weight and food consumption)
Intermediate-term incidental oral	10/300(UF)= 0.03 (Decreased body weight and food consumption)	10/1000 (UF)=0.01 (liver)	N/A
Short- and intermediate-term dermal	100 /300(UF)=0.33 (dermal study) (Decreased body weight and food consumption)	10 / 1000(UF)= 0.01 (oral study) (developmental)	N/A
Chronic PAD, females, infants and children	0.027 (thyroid/liver)	0.0025 (liver)	0.093
Chronic PAD, gen population		0.025(liver)	0.93
Cancer (Q_1*)	$1.16x10^{-2}$	$2.39x10^{-3}$	4.85 (liver tumors)

f. Exposure Assumptions

The Agency conducted highly refined probabilistic acute, chronic and cancer dietary risk assessments for all current uses of TM. The acute, chronic and cancer dietary exposure assessments were conducted using the Dietary Exposure and Evaluation Model (DEEM^{TM})

system. DEEM™, developed by Novigen Sciences, Inc., calculates acute and chronic dietary exposure and risk estimates to residues in food for the U.S. general population and various population subgroups. The software contains food consumption data from the USDA Continuing Survey of Food Intake by Individuals (CFSII) from 1989-1992. For chronic and cancer dietary risk assessments, the 3-day average of the consumption data for each subpopulation is combined with average residues in commodities to determine the average exposure in mg/kg/day. For acute dietary risk assessment, the entire distribution of single day food consumption events is combined with a distribution of residues in a probabilistic analysis (referred to as a "Monte Carlo" analysis) to obtain a distribution of exposures in mg/kg/day.

Exposure assessments were separately performed for TM and the sum of the metabolites MBC and 2-AB for plant commodities, and TM and the sum of the metabolites of concern (MBC, 4-OH-MBC, 5-OH-MBC and 5-OH-MBC-S) in livestock commodities. Anticipated residues (ARs) (based on maximum supported use patterns) used in dietary risk assessment are calculated using both USDA Pesticide Data Program (PDP) monitoring program data, and field trial residue data submitted by the registrant. In addition, percent crop treated data were used.

The Agency conducted two exposure assessments for TM. The first assessment relied exclusively on TM field trial data. Field trial residue data are considered by the Agency as an upper-bound estimate of possible residues, and are more suited to the requirements of tolerance setting than to the requirements of dietary risk assessment. Field trial results reflect treatments at the maximum rates, the maximum number of applications and shortest pre-harvest intervals, and do not necessarily reflect residues at the time of food consumption. For commodities assessed using field trial data, actual residue data for TM and MBC, in conjunction with data derived from metabolism studies were used to estimate exposures. For animal commodities, the ratios of hydroxylated metabolites to MBC or TM in various commodities were based on livestock studies.

The Agency conducted a second TM dietary assessment using PDP monitoring data for benomyl, measured as MBC to estimate TM residues. MBC is a common metabolite of benomyl and TM. PDP data were available for apples, bananas, beans, cucurbits, peaches and strawberries. The PDP analytical method employs a hydrolysis step that converts any benomyl present to MBC. MBC is then quantitated and corrected for molecular weight, and results are measured as the sum of benomyl and MBC. Therefore, using MBC data to estimate TM residues may be a conservative approach in that it may overestimate TM residues. However, there is more uncertainty with this exposure analysis because it is extrapolated from limited plant metabolism studies. Therefore, overall, this analysis may be considered a lower bound estimate of risk from TM residues in food, relative to using field trial data.

Percent crop treated data were available for almonds, apples, apricots, beans (succulent or dried), green beans, bananas, blueberries, canola, celery, cherries, citrus, cucurbits (cantaloupe, cucumbers, melons, pumpkins, squash, watermelons), garlic, grapes, nectarines, onions (bulb and green), peaches, peanuts, pears, pecans, pistachios, plums/prunes, potatoes, soybeans, strawberries, sugar beets, and wheat. These data were used for the acute and chronic dietary

assessments. Where percent crop treated estimates indicated no TM use, a default minimum assumption of 1% crop treated was applied. Where residues were nondetectable, one-half the limit of quantitation was assumed for treated commodities.

Surrogate field trial data from similar crops were used, if necessary, to assess crops without field trial data. Examples include: onions used as a surrogate to assess green onions; watermelon data used to assess pumpkins, peach data used to assess nectarines; and plum data used to assess apricots.

TM residues may be either concentrated or reduced by activities such as drying (dried fruits), processing (juice, catsup, etc.), washing, peeling, and cooking. Processing studies were available for apples, potatoes, plums (prunes) and soybeans. All other processed commodities used default DEEM processing factors.

The Agency expresses dietary risk estimates as a percentage of the acute and chronic PAD. Exposures less than 100% of the PAD do not exceed the Agency's level of concern. For this analysis, it was assumed that the metabolites 2-AB, 5-OH-MBC, 4-OH-MBC and 5-OH-MBC-S have the same toxicity as MBC.

In addition, cancer risks were estimated using a cancer unit risk estimate of 1.16×10^{-2} $(mg/kg/day)^{-1}$ for TM and 2.39×10^{-3} $(mg/kg/day)^{-1}$ for MBC and other metabolites of concern. Cancer risks are calculated by multiplying the 70 year exposure estimate for the U.S. population by the Q_1^*, and are expressed as a probability of developing cancer.

For more information on the parameters and assumptions used for assessing dietary risks, see the *Food Exposure* section of the April 25, 2002 memo entitled, *Thiophanate-Methyl: HED Human Health Risk Assessment for the Reregistration Eligibility Decision (RED) Document*.

g. Dietary (Food) Risk Assessment

(1) Acute Dietary Risk

Table 7 summarizes the acute probabilistic dietary risk estimates for the U.S. population and the most highly exposed subpopulations. For the U.S. population and all subpopulations, exposure estimates for either TM or MBC are less than 100% of the aPADs, and therefore, are not of concern for all TM registered uses, including the new uses and the two Section 18s on citrus and blueberries. Additionally, a recent Section 18 on mushrooms did not change the aPAD. As shown in Table 7, the highest exposed population, infants, had MBC exposure estimates that result in 89% of the aPAD. A critical exposure analysis showed citrus as the major contributor (45%) for infants. Residues for citrus were from field trial data, which are considered conservative.

In addition, risk estimates for TM and MBC and other metabolites of concern were added together for females (13-50 years) to account for total risk estimates for developmental effects.

This is considered appropriate because both chemicals have aPADs that are based on developmental effects for females, and because individuals may consume both residues simultaneously on a given food commodity. Both TM and MBC caused adverse effects on the developing fetal skeletal system and decreased fetal body weight. The dietary risks for TM and MBC were not combined for children or the general population because the aPADs are based on different effects (i.e., tremors for TM, and testicular effects for MBC). A toxic equivalency factor (TEF) approach was used to sum dietary risk estimates from TM and MBC as MBC equivalents. Exposure estimates are based on the use of benomyl PDP monitoring data where available. The total dietary risk estimate for females (13-50 years) for TM and MBC is 51% and is below EPA's level of concern.

Table 7. Summary of Acute Dietary Exposure and Risk for Thiophanate-methyl and MBC

Population	Thiophanate-methyl Estimate			MBC+other metabolites Estimate (from Thiophanate-methyl Use)		Thiophanate-methyl and MBC	Total Risk Estimate for TM and MBC
	Exposure (mg/kg/day) (a)	% aPAD PDP (b)	% aPAD Field Trial (b)	Exposure (mg/kg/day) (a)	% aPAD (b)	Total Exposure in MBC Equivalents (mg/kg/day) (c)	% aPAD (d)
U.S. Population	0.006886	5	10	0.006007	4	NA	NA
All Infants <1 year	0.028839	22	25	0.015175	89	NA	NA
Children 1-6 years	0.015613	12	24	0.011348	67	NA	NA
Children 7-12 years	0.007845	6	11	0.006829	40	NA	NA
Females 13-50	0.004665	7	14	0.003680	37	0.0044 - 0.00505	44 - 51

NA= Not appropriate due to different toxicological endpoints for TM and MBC.

(a) 99.9th percentile of exposure.

(b) Percent of aPAD = (Exposure ÷ aPAD) x 100%. aPAD for the general population = 0.13 and 0.17 mg/kg/day for TM and MBC, respectively, aPAD for females (13-50) = 0.067 and 0.01 mg/kg/day for TM and MBC, respectively and aPAD for children subgroups = 0.13 and 0.017 mg/kg/day for TM and MBC, respectively.

(c) TM dietary exposure adjusted using the toxic equivalency factor (TEF) of 0.15 for females 13-50 years to account for the differences in the aPADs for TM and MBC. Example, TM exposure = 0.009167 mg/kg/day * 0.15 = 0.00138 mg/kg/day (in MBC equivalents) + 0.00368 = 0.00505 mg/kg/day.

(d) Percent of MBC aPAD = (Total exposure in MBC equivalents ÷ aPAD for MBC) x 100%. This is also equivalent to: %aPAD from TM + %aPAD from MBC. This is considered appropriate because the aPADs are based on developmental effects for females 13-50 years.

(2) Chronic (Non-Cancer) Dietary Risk

As shown in Table 8, non-cancer chronic risk estimates for all population subgroups are below the Agency's level of concern (<100% cPAD), even when considering all existing, and new TM uses, and the Section 18s for citrus and blueberries. Additionally, a recent Section 18 on mushrooms did not change the cPAD. As with the acute dietary assessment, exposure estimates

are based on the use of benomyl PDP monitoring data where appropriate. The most highly exposed population subgroups are children (1-6 years) for MBC and other metabolites of concern at 26% of the cPAD, and for TM at 2% of the cPAD. Similar to the acute dietary risks, a total dietary risk estimate was calculated, because of similar adverse effects, and the potential for simultaneous exposure to these chemicals on food commodities[1]. A TEF approach was used to sum dietary risk estimates from TM and MBC as MBC equivalents. As shown in Table 8, the highest total dietary risk estimate of 28% for children 1-6 years, was also below the cPADs, and therefore, does not exceed EPA's level of concern.

Table 8. Summary of Chronic Dietary Exposure and Risk for Thiophanate-methyl and MBC

Population	Thiophanate-methyl Estimate		MBC +other metabolites (from Thiophanate-methyl Use)		TM and MBC Total Exposure in MBC Equivalents (mg/kg/day) (c)	Total Risk for TM and MBC
	Exposure (mg/kg BW/day)	%cPAD PDP (a)	Exposure (mg/kg BW/day)	%cPAD (a)	Benomyl/MBC PDP Data	%cPAD (b)
US Population	0.000194	0.7	0.000258	1	0.000435	1.7
All infants (< 1 yr)	0.000306	1.1	0.000295	12	0.000326	13
Children (1-6 years)	0.000499	1.8	0.000662	26	0.000706	28
Children (7-12 years)	0.000295	1.1	0.000404	16	0.00043	17
Females 13-50	0.000151	0.6	0.000200	8	0.00021	8.5
Males (13-19 yrs)	0.000161	0.6	0.000239	1	0.00039	1.6

(a) Percent of cPAD = (Exposure ÷ cPAD) x 100%. cPAD for TM = 0.027 mg/kg/day. cPAD for MBC= 0.025, 0.0025 and 0.0025 mg/kg/day for the general population, females 13-50 yrs and children, respectively.

(b) Percent of MBC cPAD = (Total exposure in MBC equivalents ÷ cPAD for MBC) x 100%. This is also equivalent to the sum of the %cPAD for TM and MBC+2-AB. This is considered appropriate because the cPADs are based on the same adverse effect (liver) for TM and MBC.

(c) TM dietary exposure adjusted using the toxic equivalency factors (TEFs) of 0.093 for females and children, and by a TEF of 0.93 for the general population to account for the differences in the cPADs for TM and MBC. Example, TM exposure = 0.000194 mg/kg/day * 0.93 = 0.00018 mg/kg/day in MBC equivalents + 0.0001255 = 0.000435 mg/kg/day.

(3) Cancer Dietary Risk

[1]Although the cPAD for thiophanate-methyl is based specifically on thyroid effects, the liver is a primary target organ of this chemical. In addition, in the chronic dog and rat studies, there is only minor difference between the 40 and 54 mg/kg/day LOAELs for thyroid and liver effects respectively, where the corresponding NOAELs were 8 and 8.8 mg/kg/day respectively.

Cancer risk was calculated using the average consumption values for food and average residue values for those foods over a 70-year lifetime. The chronic exposure value was combined with a linear low-dose approach (Q1*) to determine the lifetime (cancer) risk estimate. Table 9 presents the lifetime (70 year) cancer risk estimates for the U.S. general population. As noted previously, this assessment incorporates the existing uses of TM, in addition to several new uses and includes the use of benomyl PDP monitoring data where available. The citrus use was only evaluated for 1 year (length of the Section 18), and therefore, exposure was amortized over a 70 year lifetime. The cancer risk estimate for TM is 7.6×10^{-7}, when considering existing and new uses and the 1 year Section 18 for citrus. For MBC, the cancer risk estimate is 9.3×10^{-8}. It is appropriate to add the cancer risk estimates from TM and MBC because both chemicals cause mouse liver tumors, and because both chemicals are found concurrently on food items treated with TM. The total TM and MBC dietary cancer risk estimate is 8.5×10^{-7} for existing and new uses, and the Section 18 emergency exemptions (citrus for 1 year only). This cancer risk is below EPA's level of concern (1×10^{-6}).

Table 9 . Summary of TM and MBC Cancer Dietary Exposure and Risk

Population Subgroup/ Use Scenario	Thiophanate-methyl Estimate		MBC +other metabolites (from Thiophanate-methyl)		Thiophanate-methyl and MBC	Total Risk for TM and MBC
	Exposure (mg/kg BW/day)	Lifetime Cancer Risk Estimate (a)	Exposure (mg/kg BW/day)	Lifetime Cancer Risk Estimate (a)	Total Exposure in MBC Equivalents (mg/kg/day) (b)	Lifetime Cancer Risk Estimate (c)
US Population						
Existing and new uses, and Section 18 (1 yr citrus)	0.000066	7.6×10^{-7}	0.000039	9.3×10^{-8}	0.000359-0.000505	8.5×10^{-7}

(a) Lifetime cancer risk = Exposure x Q1*.
(b) TM dietary exposure adjusted using the toxic equivalency factors (TEFs) of 4.85 to estimate MBC equivalents.
(c) Total lifetime cancer risk estimate is the sum of TM and MBC cancer risks. Both chemicals cause mouse liver tumors.

(4) Uncertainties in the Dietary Risk Assessments

The Tier 3 dietary risk assessment is the most refined to date for acute dietary exposure to TM and MBC. However, there are some uncertainties as follows. Overall, EPA considers the risk estimates to be conservative and health protective.

- The consumption database used in the dietary exposure analysis (CSFII, 1989-1992) has a limited number of individuals in the age group infants less than one year old.
- Relative amounts of TM and MBC were determined from plant metabolism studies. Because TM degrades to MBC, over time more MBC and less TM may be present in food at the time of consumption. In addition, for the acute dietary assessment, it is conservative to add the 99.9th percentile exposure estimates for TM and MBC, because

as TM residues decline, MBC residues increase. Consequently, individuals could be exposed to high-end (i.e., 99.9th) residues of either TM or MBC, not both at the same time. This uncertainty only affects the total acute dietary risk estimates for females (13-50 years), because the TM and MBC dietary risk estimates for children were not combined due to lack of common toxicological endpoints.

- There are uncertainties in estimating TM residues based on PDP monitoring data for benomyl/MBC. The PDP analytical method employs a hydrolysis step that converts any benomyl present to MBC. MBC is then quantitated and corrected for molecular weight, and PDP results were measured as the sum of benomyl and MBC. Therefore, using MBC data to estimate TM residues may be a conservative approach in that it may overestimate TM residues. However, there is also uncertainty with this analysis because it is based on extrapolation from limited plant metabolism studies, and overall, may provide a lower bound estimate of TM residues in food relative to field trial data. Dietary risks based solely on field trial data were also calculated for comparison and result in slightly higher risk estimates. These risks are considered "upper-bound" because residues based on field trial data may not represent residues potentially present at the time of consumption.
- Data reflecting possible reduction of residues by washing or peeling commodities are not available for all food items. These data may lead to lower dietary exposure estimates. Note also that PDP samples are washed prior to analysis. Also, no cooking factors were incorporated in this dietary exposure analysis. If reduction of residues is noted upon cooking, this could lead to lower acute dietary exposure estimates.
- In the absence of adequate toxicity data for the metabolites 2-aminobenzimidazole (2-AB) 5-OH-MBC, 4-OH-MBC and 5-OH-MBC-S it was assumed that all four metabolites are toxicologically equivalent to MBC on a per weight basis.
- Data from four plant metabolism studies (apple, sugar beets, wheat and lima beans) were used to extrapolate to all other registered plant uses to estimate the ratio of TM:MBC residues.

2. Dietary Risk from Drinking Water

Drinking water exposure to pesticides can occur through ground and surface water contamination. EPA considers acute (one day) and chronic (lifetime) drinking water risks and uses either modeling or actual monitoring data, if available, to estimate those risks. The PRZM-EXAMS model was used to estimate surface water concentrations, and SCI-GROW was used to estimate groundwater concentrations. Both of these models are considered to be screening tools, with the PRZM-EXAMS model being somewhat more refined than SCI-GROW.

Neither TM nor its primary degradate, MBC, are regulated under the Safe Drinking Water Act. As a result, neither Maximum Contaminant Levels (MCLs) nor drinking water health advisories (HAs) for these chemicals have been established by the EPA Office of Water. No other sources of information on monitored concentrations of TM or MBC in surface water or ground water are known to exist. In the absence of monitoring data for TM and MBC, estimated environmental concentrations (EECs) of TM and MBC in surface and ground water are based on modeling. Modeling is generally considered to be an unrefined assessment that may provide high-end

estimates. These models take into account the use patterns and environmental profile of a pesticide. The primary use of these models by the Agency at this stage is to provide a screen for assessing whether a pesticide is likely to be present in raw drinking water at concentrations that would exceed human health levels of concern.

In the preliminary risk assessment for TM, surface and groundwater concentrations were modeled based on application to turf and onions, the crops with the highest application rates. An application rate of 11-19.3 lbs ai/acre could be applied unlimited times to turf and up to 15 lbs ai/acre, once per season could be used on onions as per the labels. Based on the results of the preliminary drinking water assessment, the TM registrants have submitted label amendments to lower rates. Use of thiophanate-methyl on commercial sod farms has been cancelled, and the use rates for turf and agricultural crops were reduced. Risks were recalculated using the lower rates.

The available environmental fate data suggest that TM rapidly degrades to MBC following application to agricultural crops, turf, and ornamentals. TM degrades primarily to MBC whether on foliage, in soil, or in water, although the degradation rate is slower on foliage than in the aquatic environment. Both photolysis and hydrolysis are important routes of degradation. TM degrades relatively easily in soil and is expected to be mobile. The available data indicate that MBC is less mobile and significantly more persistent than TM, especially under anaerobic conditions. MBC metabolism under aerobic and anaerobic conditions in both soil and water proceeds at a very slow rate; the aerobic soil half-life is 320 days, while the aerobic and anaerobic aquatic metabolism half-lives are 61 and 743 days, respectively. MBC is stable to aqueous photodegradation, stable to hydrolysis at pH values ranging from 5 to 7, with hydrolytic stability decreasing within this range of pH values as pH increases, and stable to soil photolysis. MBC has a low potential to leach to groundwater in measurable quantities from most typical uses based on its high soil organic carbon partition coefficient (Koc) of 2,100 l/kg.

a. Surface Water

Thiophanate-methyl can be transported to surface water at application via run-off and spray drift from aerial and ground applications. The Pesticide Root Zone Model/Exposure Analysis Modeling System (PRZM/EXAMS) was used to estimate surface water concentrations from use of thiophanate-methyl. The surface water modeling was conducted based on the environmental profile and the maximum seasonal application rate for TM use based on the product label for Oregon pears (2.8 lbs ai/season), and proposed turf rates based on rate reductions as required in this RED (5.45 lbs ai/A/season on fairways and 21.8 lb ai/A/season on greens and tees). These scenarios represent high application rates (e.g., pears has one of the highest seasonal maximum rates) and areas vulnerable to surface water contamination (e.g.,Oregon). The PRZM/EXAMS model takes into account the use patterns and environmental profile of a pesticide to provide a concentration estimate in unfinished water.

b. Ground Water

In the absence of monitoring data, the Screening Concentration in Ground Water (SCI-GROW)

model was used to estimate potential ground water concentrations. SCI-GROW estimates likely groundwater concentrations if the pesticide is used at the maximum allowable rate in areas where groundwater is exceptionally vulnerable to contamination. In most cases, a large majority of the use area will have groundwater that is less vulnerable to contamination than the areas used to derive the SCIGROW estimate. Application of TM to turf in Florida and pears in Oregon was modeled. These scenarios represent high application rates and areas vulnerable to ground water contamination.

Estimated groundwater concentrations were not re-calculated based on rate reductions required in this RED. Even assuming this worst-case scenario, the modeled groundwater concentrations are still significantly less than surface water concentrations and therefore, EPA does not consider groundwater contamination to be a significant risk of concern.

For more information on drinking water risks and the DWLOC calculations, see the Water Exposure section of the April 25, 2002 Human Health Risk Assessment and the April 2, 2002 memo entitled, "Tier II Estimated Drinking Water Concentrations for Human Health Risk of Thiophanate-methyl and its Degradate MBC".

c. Drinking Water Risk Estimates

To determine the maximum allowable contribution of pesticide residues in water, EPA first looks at how much of the overall allowable risk is contributed by food and 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 exposure, does not exceed a level of concern.

The results of the Agency's drinking water analysis are summarized here. Details of the drinking water analysis are found in the Human Health Risk Assessment for Thiophanate-methyl dated April 25, 2002.

Acute Dietary Risk (Food + Drinking Water)

The acute DWLOC for Females 13-50 is based on simultaneous dietary exposure to both TM and MBC (as MBC equivalents) and is estimated using the aPAD for MBC, and by combining the 99.9th percentile dietary exposure for both chemicals for Females 13-50. Values for other populations are based on MBC alone due to different endpoints.

As shown in Table 10, the EECs are lower than the DWLOCs for all subpopulations except infants < 1 year old. Although the highest EEC of 28.3 ppb is higher than the DWLOC of 18, EPA believes that this risk is not of concern. The 1-year citrus Section 18 use significantly contributes to the food exposure estimate for infants, adding 45% to the %aPAD. If "citrus only" is removed from food exposure, the DWLOC becomes 94 ppb, which is well above the

highest EEC. The exposure contribution from citrus is unrefined because it is based on field trial residues. Exposure estimates base on PDP monitoring are expected to be much lower based on the fact that there are PDP monitoring data available for benomyl/MBC that indicate 0 detects out of 689 samples for orange juice (Florida mainly grows citrus for juice). The benomyl PDP data could not be used in this assessment, because the application rate previously allowed for benomyl (3.0 lbs ai/acre/season) was slightly lower than the rate allowed by the TM emergency exemption (4.2 lbs ai/acre/season). However, due to the late issuance of the Section 18 in relation to the citrus season and the dry weather during the 2002 growing season, it is not expected that many Florida growers used the maximum 4.2 lbs ai/acre/season allowed for TM, and the impact of those few growers who may have used the maximum labeled rate is lessened by the fact that juice is blended. This Section 18 was reissued for the 2003 use season and the rates were reduced to match the benomyl use pattern, and thus the Agency is able to use the available PDP data mentioned above.

Table 10. Acute DWLOC and Surface Water EEC Comparisons for TM and MBC (From TM Use)

Population Subgroup	Acute DWLOC (ppb) MBC	EECs (ppb) (MBC Equivalents)	
		Surface Water	Ground Water*
U.S. Population	5,700	28.3 (turf)	3.03 (turf)
All Infants (<1 year)	18		
Children (1-6 years)	57		
Females (13-50 years)	170		

* Ground water EECs are unrefined since they are based on old application rates (pre-mitigation).

Chronic (Non-Cancer) Dietary Risk (Food + Drinking Water)

Average chronic dietary food risk estimates are below the Agency's level of concern. The total dietary exposure to TM and MBC for the highest exposed population subgroup, children 1-6 years, is 28% of the cPAD for liver/thyroid effects, leaving 72% of the cPAD available for exposure through drinking water. As noted previously, all TM dietary (food) exposures were converted to MBC equivalents using the TEF approach.

DWLOCs were then estimated using the cPAD for MBC. As shown in Table 11, the lowest DWLOC is 18 ppb for children 1-6. Using screening-level models, the highest long-term surface water EEC is 12.2 ppb (1 in 10 year average EEC, including TM + MBC as MBC equivalent, using toxic equivalency factor for females 13-50 and children). Therefore, the non-cancer DWLOCs are greater than the surface water EECs (as MBC equivalents) for infants and children (1-6 years), indicating that chronic dietary (food + water) risks are below EPA's level of concern.

Table 11. DWLOCs for Chronic (Non-Cancer and Cancer) Dietary Exposure and Risk Assessment (U.S. Population)

Population Subgroup	DWLOC (ppb) MBC		EECs (ppb) (MBC Equivalents)	
	Chronic	Cancer	Surface Water	Ground Water*
U.S. Population	860	2.1	12.2 (pears)	3.03
All Infants (<1 year)	22	N/A		
Children 1-6	18	N/A		
Females 13-50	69	N/A		

* Ground water EECs are unrefined since they are based on old application rates (pre-mitigation).

Cancer Dietary Risk (Food + Drinking Water)

It is appropriate to add the cancer risk estimates from TM and MBC because both chemicals cause mouse liver tumors, and because both chemicals are found concurrently on food items treated with TM. The total TM and MBC dietary cancer risk estimate from food is 8.5×10^{-7}. This cancer risk estimate is below 1×10^{-6} for TM existing uses, new uses, and considering the amortized Section 18 use for citrus (but not other Section 18s). The citrus use was only granted for 1 year, and therefore, exposure was amortized over a 70 year lifetime. The cancer DWLOC is 2.1 ppb. Although a second year was granted for the citrus use, PDP monitoring data were used as mentioned above, and residues were negligible.

Using screening-level models, the highest long-term surface water EEC (mean 36 year annual concentration) is 12.2 ppb, adjusted to reflect TM + MBC as an MBC equivalent. Therefore, this EEC is greater than the DWLOC, indicating that chronic cancer dietary (food and water) risks may be of concern (Table 11).

3. Residential Exposure and Risk: Thiophanate-methyl

Potential residential exposures are anticipated as a result of applications of thiophanate-methyl to residential lawns and gardens by homeowners and professional lawn/ornamental applicators. Applications are made to lawns, ornamentals, and "backyard" orchards. For more details about the residential risk assessment, see the May 2, 2002 memo entitled, "Revised Thiophanate-methyl Occupational and Residential Exposure Assessment and Recommendations for the Reregistration Eligibility Decision Document" located in the public docket.

Residential risk mitigation has already been implemented at the time of publication of this RED. Upon release of the risk assessments, a series of meetings were held with the registrants of TM products for use in the residential environment to discuss ways to reduce residential risks to levels below the Agency's level of concern. All registrants have submitted revised labels to the Agency and these label changes are in place for new production for the 2003 sales season

(October – December 2002). The assessment has been revised to reflect these risk reduction measures. The inputs and results of this risk assessment are presented below.

a. Toxicity

Table 12 details the results of the hazard assessment of the non dietary risk assessment for thiophanate-methyl.

Table 12. Toxicity Endpoints Selected for Assessing Residential Risks for Thiophanate-methyl

Exposure Scenario	Dose Used in Risk Assessment, UF	FQPA SF and Endpoint for Risk Assessment	Study and Toxicological Effects
Short- and Intermediate-Term Dermal	Dermal NOAEL = 100	LOC for MOE = 300 for all residential populations FQPA SF = 3	21-Day Rabbit Dermal Toxicity Study LOAEL = 300 mg/kg/day based on decreased body weight (28%) and food consumption (15%).
Short-and Intermediate Term Inhalation	Oral NOAEL =10 mg/kg/day (inhalation absorption rate=100% relative to oral absorption)	LOC for MOE = 300 for all residential populations FQPA SF = 3	1997 Rabbit Developmental Study LOAEL= 20 mg/kg/day based on decreased maternal body weight and food consumption.
Short-and Intermediate Term Incidental Ingestion	Oral NOAEL =10 mg/kg/day	LOC for MOE = 300 for all residential populations FQPA SF = 3	1997 Rabbit Developmental Study LOAEL= 20 mg/kg/day based on decreased maternal body weight and food consumption.
Cancer	Q1* = 1.16 x 10^{-2} $(mg/kg/day)^{-1}$ (dermal absorption rate =7% relative to oral absorption; inhalation absorption rate=100% relative to oral absorption)	Q1* = 1.16 x 10-2 $(mg/kg/day)^{-1}$	78-week mouse study based on male mouse liver adenoma and/or carcinoma and/or hepatoblastoma combined tumor rates

SF = Safety Factor
UF = Uncertainty Factor
PAD = Population Adjusted Dose (includes UF and FQPA safety factor)
LOC= Level of Concern
MOE = Margin of Exposure

b. Residential Handler Risk

(1) Exposure Scenarios, Data, & Assumptions

Potential residential exposures can occur as a result of residential application of liquid formulations to ornamentals and granular formulations to lawns. There are several granular home lawn products for residential application to lawns, ranging from 2 to 5% TM by weight. It should be noted that the current labels do not permit residents to treat home orchards, although a pest control operator (PCO) may treat home orchards. The following four residential handler scenarios were evaluated:

(1) Applying with a ready-to-use hose-end sprayer (ornamental treatment only);

(2) Mixing/Loading/Applying liquids with a low pressure hand wand (ornamental treatment only);

(3) Mixing/Loading/Applying with a backpack sprayer (ornamental treatment only); and

(4) Loading/Applying granular formulations with a push type spreader.

Application of granules with a belly grinder and by hand were excluded because as part of risk reduction, the registrant agreed to modify the labels to specifically preclude these application methods. In addition, as part of risk reduction, residents will no longer be permitted to apply liquid formulations of TM for broadcast lawn treatment. Use by residents will be restricted to granular products for broadcast turf treatment, and liquid treatments for ornamentals. The labels have been revised to prohibit residential use of liquid formulations for broadcast turf treatment.

The duration of exposure is expected to be short-term (1-30 days) for residential handlers of TM products. Intermediate- and long-term exposures of residential applicators are not anticipated based on TM's use pattern showing typically 1-3 applications per year. Based on toxicological criteria and potential for exposure, the Agency has conducted dermal and inhalation exposure assessments. For handlers, only exposures to TM were evaluated, because MBC is formed during environmental degradation of TM.

Residential use patterns were based on the revised labels agreed to as part of mitigation, and standard assumptions. See the Revised Thiophanate-methyl Occupational and Residential Exposure Assessment dated May 2, 2002 for details.

No chemical-specific data were submitted for residential handler risk assessment, so values from the Pesticide Handler Exposure Database (PHED) and the Outdoor Residential Exposure Task Force (ORETF) were used. See the Occupational section for a full description of PHED. For all residential scenarios, the exposure estimates assume that individuals wear short pants, short sleeves and no gloves. EPA estimated cancer risks based on the number of years typically working in the home garden (50 years). Therefore, cancer risks are based on 50 applications in a lifetime (70 years). While the number of years of use (50) is considered conservative, the use of a single application/year, on average, yields a lifetime exposure based on 50 applications, so the overall handler cancer risk estimate is considered realistic rather than conservative.

(2) Residential Handler Risk Characterization

A summary of the short-term and cancer risk estimates for residential handlers is presented in Table 13. As noted previously, non-cancer risk estimates are expressed in terms of the MOE. Residential application of TM products to lawns and ornamentals at the new maximum label rate resulted in risk estimates that are below the Agency's level of concern (i.e., total MOE > 300). Total dermal and inhalation MOEs range from 5,800 to 35,000 for both broadcast (granular) and ornamental treatment scenarios for all equipment types. Lifetime cancer risk estimates for applying TM formulated products once per year for 50 years are well below EPA's level of concern, and range from $4.7x10^{-9}$ to $2.8x\ 10^{-8}$ for ornamental treatment using a backpack sprayer and a ready-to-use hose-end sprayer, respectively. Cancer risk estimates for the other application methods are in between these ranges.

Table 13. Short-Term and Cancer Exposure and Risk Estimates for Homeowner Lawn /Garden Application with Thiophanate-methyl

Equipment Type	Dermal MOE (a)	Inhalation MOE (b)	Total MOE (c) (Target 300)	Cancer Risk Estimate (50 applications per lifetime)
(1) Applying with a RTU hose-end sprayer (ORETF data)	6,000	140,000	5,800	2.8E-8
(2) Mixing/Loading/Applying Liquids with a Low Pressure Handwand	1,900	620,000	1,900	8.5E-8
(3) Mixing/Loading/ Applying with a Backpack Sprayer	37,000	620,000	35,000	4.7E-9
(4) Loading/Applying with a Push-type Spreader (ORETF data)	7,600	570,000	7,500	2.1E-8

(a) Dermal MOE = NOAEL (100 mg/kg/day) / Daily Dermal Dose mg/kg/day). Dermal NOAEL from a dermal study, therefore, no adjustment is made for dermal absorption.

(b) Inhalation MOE = NOAEL (10 mg/kg/day) / Daily Inhalation Dose (mg/kg/day).

(c) Total MOE = 1/ (1/MOE dermal + 1/MOE inhalation).

c. Residential Postapplication Risk Characterization

(1) Exposure Scenarios, Data, & Assumptions

Potential residential postapplication exposures to adults and children may occur as a result of residential application or professional lawn care operator application of TM products. Specifically, adult and child exposures were evaluated as a result of ornamental, golf course, and recreational turf and home lawn uses. Guidance from the Agency's Residential SOPs was used to address the exposures of children contacting recently treated turf. The SOPs use a high contact activity to represent the exposures of an actively playing child. All residential scenarios, where possible, utilized the TM specific study data, which were adjusted for the new reduced application rates based on recently adopted risk mitigation measures.

The following residential postapplication scenarios were evaluated:

(1) Dermal exposure to adults and young children involved in a high exposure activity, such as heavy yard work or playing on treated turf;

(2) Dermal exposure to adults mowing or other moderate contact activity for 2 hours;

(3) Dermal exposure to adults involved in a low exposure activity, such as golfing or walking on treated turf;

(4) Incidental oral exposure to children (1-6 years) playing on treated turf

(4a) object to mouth (i.e., turf mouthing),
(4b) hand to mouth,
(4c) granular ingestion, and
(4d) incidental soil ingestion.

Note that postapplication exposure to backyard fruit trees is no longer considered in the residential postapplication risk assessment. Registrants have submitted label amendments prohibiting professional treatment to fruit trees in residential areas after "fruit set". Therefore, fruit harvesting would be more than a month later and no significant residues are anticipated.

The following assumptions were also used:

- TM exposures are of short-term duration and can occur over a single day or up to one month.

- MBC risks from treated turf were not evaluated because they are considered to be negligible relative to TM risks (i.e., at least ten fold lower), based on chemical-specific Turf Transferable Residue (TTR) data.

- Inhalation exposures are not considered in the post-application exposure assessment because inhalation exposures are thought to be negligible in outdoor post-application scenarios relative to dermal and oral exposures because of the low vapor pressure of TM ($1.3x10^{-5}$ mmHg) and MBC ($1x10^{-7}$ mmHg) and because the uses (and primary exposures) are outdoors allowing for significant dilution.

- Mouthing behaviors in children can also contribute to overall exposure. The Agency considered these exposures by using the guidance in its SOPs for residential exposure assessments to calculate exposures from hand-to-mouth behavior, mouthing objects, and ingesting small quantities of sod. These exposures were added to the dermal dose levels to calculate the overall burden for children.

- Dermal contact with treated turf residues was evaluated for both adults and young children (1-6 years). The standard SOP-recommended assumptions were used, including 2 hours/day for yardwork and/or playing, 2 days/year for mowing, 14 days/year for dermal contact, and short-term transfer coefficients of 14,500 and 5,200 cm^2/hour for adults and children, respectively. Chemical-specific turf transfer residue (TTR) data for the day of treatment were also used for the non-cancer assessment. The golfing scenario assumed adults could contact treated turf on the day of treatment (DAT 0 residues), 4 hours/day for 3 days/year based on the number of applications per year. The SOP-recommended transfer coefficient of 500 cm^2/hour was used.

- The body weights used in the assessment are 15 kg and 70 kg for children (1-6 years), and adults, respectively. For the cancer assessment, it was assumed that individuals could contact TM residues over a 50 year period based on the Residential SOPs.

- Residential risk estimates utilized the turf transfer study, as well as the EPA's SOPs for Residential Exposure Assessment. Wherever available, reported usage data are used in this process to define the application frequency. As noted previously, the application rates are based on recent risk reduction measures to reduce turf application rates from 11-19.3 lb ai/acre to 2.7 lb ai/acre on residential lawns, and 5.45-8.16 lb ai/acre on golf courses. All non-cancer risks (i.e., MOEs) for turf exposure were based on the new maximum label application rate of 2.72 lb ai/acre for residential turf, except for golf course exposures, which were assessed at a maximum rate of 5.45 lb ai/acre for fairways.

(2) Residential Postapplication Risk Characterization

A summary of the short-term risk estimates for residential/recreational postapplication dermal and incidental oral exposures is presented in Table 14. MOEs > 300 for exposures to TM do not exceed EPA's level of concern for residents, children or other non-occupationally exposed individuals (i.e., golfers). Cancer risk estimates are expressed as a probability of developing cancer over a lifetime. The level of concern for cancer risks for the general population is greater than one in one million.

The median frequency of postapplication exposure to golf course turf is based on data provided by golfing associations. Therefore, the risk estimates associated with golfing are believed to be average, or not over-estimated. The residential exposure to treated lawns is based upon exposure to transferable residues at the earliest possible opportunity and high transfer coefficients. While this is a high-end scenario, it is not worst-case because the time of exposure is short, based on behavioral data, and the risk estimate is based on actual data supplied by the registrant, which did not use the highest rate or number of applications for turf.

As shown (in bold) on Table 14, two short-term MOEs for children playing on treated turf were less than 300 and therefore, exceed EPA's level of concern (MOEs range from 31 to 250) for hand to mouth activities and incidental granular ingestion. Consequently, the aggregate MOE for children based on combined dermal and oral exposures is also below 300 (total MOE=170 for treated turf). All other short-term MOEs were greater than 300 for adults and children during high dermal contact (such as hand weeding, playing etc), and adults involved in mowing and golf activities, and therefore, do not exceed EPA's level of concern. These MOEs were based on TTR data provided by the registrant for the day of treatment, and transfer rates recommended in the EPA Residential SOPs.

The Residential SOPs are considered to be conservative scenarios for determining exposures. The adult and toddler transfer coefficients are based on the Jazzercise protocol and an upper percentile exposure duration value. Where study data were used with the SOP formulae, these risk estimates were better refined, and hence, less conservative. Therefore, the dermal exposure estimates related to lawn skin contact (which were based on study data) are more refined than the estimates of incidental ingestion of TM residues.

EPA also estimated cancer risks using the same residential exposure scenarios. The lifetime cancer risk estimates ranged from $1.3x10^{-9}$ to $1.3x10^{-7}$ for the scenarios evaluated (mowing and dermal contact, respectively). These cancer risks are below the Agency's level of concern (generally one in one million or $1x10^{-6}$). The highest cancer risk estimates are based on dermal contact with treated turf 2 hours/day, 14 days per year for 50 years, which yields a cancer risk estimate of $1.3x10^{-7}$ for contact with 14-day average residues following turf treatment.

Table 14. Potential Post-Application Exposures and Risks for Residential/Non-Occupational Uses of Thiophanate-methyl

Exposure Scenario	Application Rate lb ai/A	TM MOE Target MOE 300		TM Cancer Risk Estimate (c)
		Child 1-6 years	Adult	
(1) Dermal Contact with Treated Turf	2.72	1000	1700	1.3E-7
(2) Dermal Contact During Mowing Treated Turf	2.72	NA	49,000	1.3E-9
(3) Dermal Contact During Golfing	5.45	NA	12,000	7.6E-9
(4) Object to Mouth	2.72	990	NE	
(4b) Hand to Mouth	2.72	**250**	NE	
(4c) Granular Ingestion	2.7 (1.6% ai)	**31**	NE	
(4d) Incidental Soil Ingestion	2.72	73,000	NE	
Aggregate MOE		170	NE	

NA = Not applicable
NE = Not evaluated, because scenario not applicable to this population.

4. Residential Exposure and Risk: MBC

In addition to being a degradate/metabolite of TM, MBC (carbendazim) is also a separately registered fungicide used as a fungicide/preservative in paints, coatings, plaster and adhesives. After commercial formulation, MBC-containing paints can be applied by brush, rollers, low-pressure hand wand and airless sprayers by professional or residential users. MBC is added to paints at a maximum concentration of 0.5 % ai (5 lbs ai/1000 lb paint) and sealants at 1.5% (15 lbs ai/1000 lb sealant).

For more details on the residential risk assessment for MBC, see the March 21, 2001 memo entitled, "Revised Occupational and Residential Exposure Assessment and Recommendations for the Risk Assessment Document for Carbendazim (MBC)".

a. Toxicity

MBC is of low acute toxicity. Guideline studies for acute toxicity indicate that MBC is classified as category III for acute dermal toxicity and primary eye irritation, category IV for acute oral and inhalation toxicity, and category IV for primary skin irritation. MBC is not a skin sensitizer, and there is no evidence of delayed neurotoxicity in hens.

For short-term dermal exposures, a developmental NOAEL of 10 mg/kg/day for MBC was selected, based on decreased fetal body weight and increases in skeletal variations and a threshold for malformations in dams exposed to 20 mg/kg/day (LOAEL). A dermal absorption factor of 3.5 percent was selected for extrapolation from the oral dose, based on dermal

absorption of benomyl. A short- and intermediate-term inhalation NOAEL of 0.96 mg/kg/day was selected based on adverse respiratory tract effects. The lung absorption factor of 100 percent is used in the calculations. Because the dermal and inhalation endpoints are based on different studies with different toxic effects, it is not appropriate to aggregate the dose via different routes of entry, e.g., oral and inhalation. MBC is also classified as a Group C (possible human) carcinogen with a Q_1^* of 2.39×10^{-3} $(mg/kg/day)^{-1}$.

The endpoints and associated uncertainty factors used in assessing the residential risks for MBC are presented in Table 15. For MBC, the FQPA Safety Factor of 10 was retained for dietary and residential risk assessments for females 13-50, infants, and children.

Table 15. Summary of Doses and Toxicological Endpoints for MBC

Exposure Scenario	Dose Used in Risk Assessment	Endpoint for Risk Assessment	Study and Toxicological Effects
Short-Term Dermal	Oral NOAEL = 10 mg/kg/day (dermal absorption rate = 3.5%)	LOC for MOE = 1000 for children and females FQPA SF = 10	Rat Developmental Study with MBC LOAEL = 20 mg/kg/day based on decreased fetal body weight and increases in skeletal variations and a threshold for malformations in fetuses of exposed dams
Short- and Intermediate-Term Inhalation	Inhalation NOAEL = 0.96 mg/kg/day (10 mg/m^3)	LOC for MOE = 1000 for children and females FQPA SF = 10	90 day rat inhalation study with benomyl LOAEL = 4.8 mg/kg/day (50 mg/m^3) based on olfactory degeneration in the nasal cavity
Short- and Intermediate-Term Inhalation*	Inhalation NOAEL = 27.9 mg/kg/day (0.178 mg/L/day)	LOC for MOE = 1000 for children and females FQPA SF = 10	5-day rat inhalation study with MBC LOAEL>0.178 mg/L/day
Cancer	Q1* = 2.39×10^{-3} $(mg/kg/day)^{-1}$ (dermal absorption rate = 3.5%; inhalation absorption rate = 100%)	Q1* = 2.39×10^{-3} $(mg/kg/day)^{-1}$	2 year mouse study with MBC based on hepatocellular (adenoma and or carcinoma) tumors in female CD-1 mice

* The LOAEL for short- and intermediate-term inhalation NOAEL of 0.178 mg/L/day was only used for exposures using airless sprayer application equipment.
LOC = Level of Concern
MOE = Margin of Exposure

b. Residential Handler Exposure to MBC

(1) Exposure Scenarios

Based on the use patterns, EPA has identified six major MBC exposure scenarios for residential handlers of ready-to-use products:

(1) applying paint/coating with a brush,
(2) applying paint/coating with an airless sprayer,
(3) applying paint with a roller,
(4) applying plaster formulation with a trowel,
(5) applying ready-to use sealant formulation by hand, and
(6) applying ready-to-use paint/coating using a low-pressure hand wand.

Residential handlers are anticipated to have only short-term (one week or less) dermal and inhalation exposures to MBC as a fungicidal additive in ready-to-use products (see assumptions below). The formulation is not labeled for consumers to add on-site, but only for manufacturing in 1000 lb lots. Although several tree-injection products are also manufactured containing MBC, all labels specifically restrict use to trained professionals.

No chemical-specific handler exposure data or studies were submitted. Therefore, handler exposure estimates were developed using the Pesticide Handler Exposure Database (PHED). The PHED contains exposure studies of brush, outdoor airless sprayer painting, and of low-pressure handwand spraying, which are reasonable surrogates for a fungicidal paints and coatings. However, no roller painting data are available, so that exposure is assumed to be similar to the range of exposures established for paintbrush and airless sprayer application. Data submitted by the Chemical Manufacturers Association on antimicrobial exposure, and reviewed by EPA, were compared to PHED data for similar scenarios. Dermal and inhalation unit exposures for workers performing the same kinds of tasks were within one order of magnitude between the two data sets. However, EPA chose to use PHED data because of the low number of replicates and low quality control in the CMA data, relative to PHED.

(2) Assumptions

Residential handler assumptions are as follows:

- Application rate: 2 gallons of paint or coating per day for brush or roller applications (indoors); and 5 gallons per day for airless sprayer application (outdoor). For cancer risk estimates, residential applicators are anticipated to apply paint or coatings 4 days per year

- Typical homeowner clothing indoors is represented by short pants, short sleeve shirt, no gloves.

- Average body weight of an adult handler is 60 kg (females 13 and older) for the short-term dermal exposures as the dose was based on a developmental endpoint.

- A body weight of 70 kg was used for inhalation exposures as the doses were based on non-developmental endpoints.

- A body weight of 70 kg is used for cancer assessments as the dose is based on an oral non-developmental endpoint. Dermal absorbed doses were adjusted before calculating lifetime cancer risk estimates.

The maximum formulation rate for paint products (0.5% * 10 lb/gal for latex paint = 0.05 lb ai/gal) is used as a high-end for both paints and stains. The surrogate data for these estimates come from actual paint/stain application studies. The exposure for airless sprayers is assumed to be similar to that for compressed-air type paint/stain sprayers, and greater than paint roller application (for which there are no data). Therefore, the airless sprayer is a reasonable worst-case representative for all other types of paint/stain sprayers.

(3) Non-Cancer Risk Estimates

All of the dermal MOEs for short-term exposures failed to meet the target MOE of 1000 for non-occupational handlers. The residential handler exposure and risk estimates are summarized in Table 16. The dermal MOE was 750 for applying paints and coatings with a paint brush. For painting with an airless sprayer, the risk estimates were greater, i.e., the dermal MOE was 620. Loading and applying 5 gallons of liquid with a low-pressure hand wand resulted in a dermal MOE of 690. There were no data available to determine exposure or risk from paint roller application or plaster and sealant application, although the estimates for brush and airless sprayer are assumed to be protective for all uses.

Table 16. Short-Term Residential Applicator Dermal and Inhalation Exposures to MBC Formulated Paint and Coatings

Exposure Scenario (Scenario #)	Dermal MOE (a)	Inhalation MOE (b)
Applying Ready-to-Use Paint/Coating Product with a Paint Brush (1)	750	2400
Applying Ready-to-Use Paint/Coating Formulation with an Airless Sprayer (2)	620	9600(c)
Loading & Applying Ready-to-Use Formulation or Paint Product with a Paint Roller (3)	no data	no data
Applying Plaster Formulation with a Trowel (4)	no data	no data
Applying Sealant Formulation (5)	no data	no data
Loading/Applying Ready-to-Use Paint/Coating Product with a Low-Pressure Handwand (6)	690	9000

(a) MOE (dermal) = NOAEL dermal (10 mg/kg/day)/absorbed daily dermal dose (mg/kg/day)
(b) MOE (inhalation) = NOAEL inhalation (0.96 mg/kg/day)/absorbed daily inhalation dose (mg/kg/day)
(c) MOE of 9600 recalculated using a NOAEL of 0.178 mg/L/day from a 5-day inhalation study.

(4) Cancer Risk Estimates

Table 17 shows the cancer risk estimates for residential handlers of MBC-containing formulations. There are no data available to evaluate cancer risks for use of MBC treated paints with a roller, or in a plaster or sealant compound.

Table 17. Cancer Risk Estimates for Residential Handlers of MBC-Containing Formulations

Exposure Scenario (Scenario #)	Number of Treatments per year (a)	Total Cancer Risk Estimate (b)
Applying Ready-to-Use Formulation or Paint Product with a Paint Brush (1)	4 (rooms)	2.2E-07
Applying Ready-to-Use Paint/Stain Formulation with an Airless Sprayer (2)	1 (house)	8.4E-08
Applying Ready-to-Use Formulation or Paint Product with a Paint Roller (3)	no data	no data
Applying Ready-to-Use Plaster Formulation with Trowel (4)	no data	no data
Applying Ready-to-Use Sealant Formulation by Hand (5)	no data	no data
Applying Ready-to-Use Liquid Sealant using Handwand (6)	5 gallons	6.0E-08

(a) Number of treatments per year are based on EPA's best estimate
(b) Cancer Risk Estimate= Total LADD(mg/kg/day)*(Q^1*). Where Q^1* = 2.39×10^{-3} $(mg/kg/day)^{-1}$.

(5) Data Gaps and Confidence in Exposure and Risk Estimates

There is uncertainty surrounding the use of the 90-day rat inhalation study with benomyl to evaluate inhalation risks from MBC in paint because the study is based on long-term exposure while residential exposure to MBC in paints is not expected to occur longer than a few days. Also, the study was conducted with benomyl, rather than MBC. However, the use of the 90-day benomyl inhalation study is considered the most appropriate in the absence of chemical-specific data because (1) olfactory lesions were seen during the 45-day evaluation, and therefore this study is also applicable to short-term (1-30 day) exposure; (2) benomyl is an appropriate surrogate and may be even less toxic or irritating than MBC; and (3) the inhalation NOAEL is lower than the oral NOAEL from the rat developmental study and is therefore more protective.

Troy Corporation, the sole registrant of MBC for use in paints and sealants, submitted on February 5, 2003, a 5-day inhalation study with MBC which was reviewed by the Agency after signing the RED as an acceptable non-guideline study. Using the toxicity data from this study the Agency developed a NOAEL of 0.178 mg/L/day. Using this NOAEL, the Agency recalculated the MOEs for applying using an airless sprayer. The recalculated MOEs were now

judged to be acceptable (e.g. MOEs>1000). Previous MOEs generated using the NOAEL from the 90-day benomyl study were previously judged as a potential risk concern (e.g. MOEs<1000).

c. Residential Post-application Exposures and Risks to MBC

Post-application exposure to MBC-treated paints, coatings, and sealants is anticipated to be only by the inhalation route, as the treated materials will have dried and be relatively inert. It is anticipated that very low exposures to MBC would result from inhalation of vapors in a treated room, due to the inhalation MOE of 2400 for a residential brush-painting 2 gallons of paint, and also owing to the very low vapor pressure of MBC. However, a quantitative assessment of potential inhalation exposure was conducted by modeling the emission rate of the active ingredient from the product.

The Multi-Chamber Concentration and Exposure Model (MCCEM) was used to estimate post application inhalation exposures for occupants after painting one room (2 gallons of paint) in a home. The model-estimated air concentration in the remainder of the house for one year following the painting of a bathroom was used to determine occupant exposure. The following assumptions and considerations were used:

(1) Adults are assumed to weigh 70 kg. Toddlers (3 years old), used to represent the 1 to 6 year old age group, are assumed to weigh 15 kg.

(2) A mean inhalation rate of 13.3 m^3/day for all adults and 8.7 m^3/day for children 3-6 years old were used to calculate daily exposures.

(3) Adults are assumed to reside in the home 16.4 hours/day, while children are assumed to spend 21 hours per day in the home.

The maximum concentration in paints per label instructions is 0.5% (sealants may contain up to 1.5%) ai but there are no data on use patterns or exposures, and paints are commonly used in much greater quantity than sealants. This estimate uses the maximum air concentration predicted by MCCEM and assumes exposure every day for 50 years. Therefore, this is considered a conservative, or high-end risk estimate.

(1) Residential Post-Application Risks from MBC

Post-application MOEs for toddlers and adults are 1,100,000 and 4,600,000 respectively, using the MCCEM calculated air concentration. The cancer risk estimates for the same scenario are $3.6x10^{-10}$ for adults. These are believed to be high-end, conservative estimates.

The occupant's exposure during paint application, described in the section above, would be additive to their post-application exposure, but compared to applicator exposure, the postapplication exposure is considered negligible. While the Residential SOPs combine median values for population attributes with conservative assumptions, the MCCEM estimate is

characterized as high-end because the generic house option was selected per the Residential SOPs. Users are unlikely to repaint the same rooms annually as is assumed in the model, nor will they be exposed 365 days per year. Also, MBC has a very low vapor pressure ($7.5x10^{-10}$ mmHg at 25˚ C). Therefore, although there are no chemical-specific data available for this chemical, the most conservative assessment indicates exposures will not create risks of concern.

5. Aggregate Risk

The Food Quality Protection Act amendments to the Federal Food, Drug, and Cosmetic Act (FFDCA, Section 408(b)(2)(A)(ii)) require "that there is reasonable certainty that no harm will result from aggregate exposure to pesticide chemical residue, including all anticipated dietary exposures and other exposures for which there are reliable information." Aggregate exposure will typically include exposures from food, drinking water, residential uses of a pesticide, and other non-occupational sources of exposure. For thiophanate-methyl and MBC, aggregate risk assessments were conducted for acute (one day), short-term (one to thirty days), and chronic (several months to lifetime) exposures. The aggregate risk assessments for chronic exposures include a non-cancer and a cancer risk assessment. No intermediate-term aggregate risks were assessed because there are no expected intermediate-term residential exposures. In all, four aggregate risk assessments were conducted.

EPA conducted the aggregate assessments under two scenarios: one that considered TM and MBC exposures resulting exclusively from TM uses and, a second that considered exposure to TM and MBC from all uses, including TM and registered MBC uses. These aggregate assessments are referred to as Aggregate 1 and Aggregate 2, respectively. The level of concern for the margin of exposure is 1000 for both assessments.

a. Acute Aggregate Risk

The acute aggregate risk estimate to TM and MBC addresses exposure from food and water. For the Tier III acute dietary exposure analysis, dietary exposures based on both PDP monitoring data and field trial data were used in conjunction with percent crop treated data to assess dietary exposures.

(1) Aggregate 1: Thiophanate-methyl and MBC (from TM use)

The DWLOCs are shown in Table 10 and reflect new use rates for agricultural uses. The EECs are lower than the DWLOCs for all subpopulations except infants <1 year old. As explained under Drinking Water Risk Estimates above, EPA believes that this risk is not of concern.

(2) Aggregate 2: Thiophanate-methyl and MBC from all Uses

MBC has no registered food uses in the U.S. and no import tolerances are established. Therefore, the Agency did not conduct an aggregate assessment of all MBC acute dietary exposure resulting from registered uses of both TM and MBC.

b. Short-Term Aggregate Risk

(1) Aggregate 1: Thiophanate-methyl and MBC (from Thiophanate-methyl Uses)

Short-term aggregate risk estimates were not conducted for TM and MBC because most of the short-term non-occupational exposures for children during post-application activities result in MOEs less than 300 for TM, and therefore already exceed the Agency's level of concern based on a screening-level assessment using the residential SOPs. Any additional short-term exposures through food and drinking water would result in MOEs that would further exceed the Agency's level of concern. Therefore, DWLOCs for short-term exposures to TM and MBC in drinking water were not calculated, because the DWLOCs are effectively zero.

(2) Aggregate 2: Thiophanate-methyl and MBC from All Uses

Aggregate potential MBC exposures, along with the estimated EECs are presented in Table 18. The long-term MBC EECs range from 8.8 to 23.4 µg/L from TM use. As shown, the combined potential short-term exposure to MBC from food and residential use alone exceed the Agency's level of concern for children 1-6 years and females 13-50 years, and therefore any water exposure would only contribute to the exposures of concern. For these subpopulations, the short-term DWLOCs are effectively zero. In conclusion, aggregate potential short-term exposure to MBC and TM resulting from food, water and residential use due to TM, and MBC uses exceeds the Agency's level of concern for children (infants, and 1-6 years of age) and females 13-50 years, due primarily to TM post-application exposures on turf and MBC's use as a paint additive. This analysis is considered reasonable because EPA aggregated some (but not all) of the possible residential/recreational use scenarios associated with TM uses (i.e., excluded potential exposures to golfers, individuals mowing treated lawns) with dietary exposures to ensure this analysis is as realistic as possible. When considering the conservative method of exposure estimation previously discussed, and the negotiated risk mitigation whereby the registrant has agreed to conduct hand-press studies to help refine this assessment, EPA believes the risks will not exceed the Agency's level of concern.

Table 18. Aggregate MBC DWLOCs for Short-Term Exposures

Population Subgroup	Aggregate Risk MOE (MBC Equivalents)	Long-Term Surface Water EEC (ppb)	Long-Term Ground Water EEC (ppb)	Short-Term MBC DWLOC (ppb)
Children (1-6 years)	630	8.8 to 23.4 (MBC)	0.51 to 3 (MBC)	zero (no room)
Females (13-50 years)	620	0.92 to 1.13 (TM)	0.006 to 0.003 (TM)	zero (no room)

c. Chronic (Non-Cancer) Aggregate Risk

(1) Aggregate 1: Thiophanate-methyl and MBC (from Thiophanate-methyl Use)

As shown in Table 19, the lowest DWLOC is 18 ppb for children 1-6. Using screening-level models, the highest long-term surface water EEC is 12.2 ppb. Therefore, the non-cancer DWLOCs are greater than the surface water EECs (as MBC equivalents) for infants and children (1-6 years), indicating that chronic dietary (food + water) risks are below EPA's level of concern. Therefore, chronic aggregate risk is also below EPA's level of concern.

Table 19 . DWLOCs for Chronic Non-Cancer and Cancer Aggregate Dietary Exposure Aggregate 1: Thiophanate-methyl and MBC (from Thiophanate-methyl Use)

Population Subgroup	Surface Water EECs (ppb)	Chronic MBC DWLOC (ppb)
Non-Cancer		
U.S. Population	12.2 (pears) (MBC equivalents)	858
All Infants (< 1 Year)		22
Children (1-6 years)		18
Females (13-50 years)		69
Cancer --U.S. Population		
Existing TM uses	11.5 (pears) (MBC equivalents)	zero (g)

(2) Aggregate 2: Thiophanate-methyl and MBC From All Uses

While there are potentially chronic inhalation exposures to MBC vapors from use of MBC as a paint additive, these exposures were not considered in the non-cancer aggregate assessment because the endpoint of concern (respiratory effects) is different from the chronic oral endpoint of concern (liver effects). Therefore, the aggregate 2 assessment is not applicable. However, these potential chronic inhalation exposures are assessed in the cancer aggregate assessment below.

d. Cancer Aggregate Risk

(1) Aggregate 1: Thiophanate-methyl and MBC (from Thiophanate-methyl Use)

The cancer aggregate 1 risk assessment includes chronic dietary exposures from TM and MBC residues estimated in food and water, and residential uses of TM. Cancer risk estimates using benomyl/MBC PDP monitoring data to estimate TM residues are below $1x10^{-6}$ for TM existing uses, new uses, and considering the amortized Section 18 use for citrus. The total TM and MBC dietary cancer risk estimate from food alone is $8.5x10^{-7}$. The cancer DWLOC is 2.1 ppb. Using screening-level models, the highest long-term surface water EEC (mean 36 year annual concentration) is 11.5 ppb, adjusted to reflect TM + MBC as an MBC equivalent. This EEC is

greater than the DWLOC, indicating that chronic dietary (food and water) risk may be of concern. There is uncertainty to the cancer risk because the surface water assessment is based on a screening-level model that assumes maximum application rates are used every year for seventy years. This is a worst-case assumption. Also, these concentrations do not account for dilution, i.e., the expected reduction in concentrations from the reservoir to the tap. Finally, when combining cancer risks from food and from water (assuming the surface water estimated concentration is equivalent to the concentration that could be found in finished drinking water), the resultant risk is still within a range considered acceptable by the Agency. The highest surface water EEC of 12.2 ppb translates into a cancer risk of $8.3x10^{-7}$. When combined with the cancer risk from food of $8.5x10^{-7}$, this results in a cancer risk of $1.7x10^{-6}$. Including cancer risks from residential exposures does not significantly increase the risk from food and drinking water. Cancer risk from treating ornamentals (the worst-case cancer risk of $2.8x10^{-8}$) and dermal postapplication lawn exposure (the worst-case cancer risk of $1.3x10^{-7}$) combined is $1.6x10^{-7}$. This brings the total food, drinking water, and residential cancer risk to $1.9x10^{-6}$, which based on the conservative factors noted above, does not exceed EPA's level of concern.

(2) Aggregate 2: Thiophanate-methyl and MBC From All Uses

As shown in Table 20, cancer risk to residential handlers during painting and to vapors following painting is $2.2x10^{-7}$. Added to the TM + MBC cancer risk of $1.9x10^{-6}$ from food, drinking water, and TM residential exposures, the total cancer risk is $2.1 x10^{-6}$. As described above, this cancer risk is considered worst-case because the drinking water cancer risk is based on the highest modeled surface water EEC, which assumes the maximum application rate is used every year for seventy years in an area vulnerable to surface water contamination, and does not reflect dilution from source to tap nor water treatment. Also, it is unlikely that a person would use TM to treat their ornamentals each year, perform high-exposure activities on the lawn immediately following application of TM, and also apply paint containing MBC every year. Finally, the cancer estimates for MBC use as a paint additive are conservative, because they are based on high end assumptions for occupancy, air exchange rates used in the air model, and assume no degradation or matrix effects of the paint. Therefore, EPA considers this cancer risk within the range considered negligible.

Table 20. Summary of Cancer Aggregate 2 Risk

Population Subgroup	Thiophanate-methyl as MBC equivalents	MBC (from MBC use as paint additive)	Total Thiophante-Methyl and MBC
	Lifetime Cancer Risk Estimate	Lifetime Cancer Risk Estimate	Lifetime Cancer Risk Estimate
US Population			
Food Uses	$7.6x10^{-7}$-$1.1x10^{-6}$	None	$8.5x10^{-7}$ to $1.2x10^{-6}$
Residential	$1.5x10^{-7}$	$2.2x10^{-7}$	
Total	$7.9x10^{-7}$ to $1.3x10^{-6}$	$2.2x10^{-7}$	$1.1x10^{-6}$ to $1.6x10^{-6}$ (TM and MBC use)

6. Occupational Risk

Occupational workers can be exposed to a pesticide through mixing, loading, and/or applying a pesticide, or re-entering treated sites. Occupational handlers of TM include: workers in agricultural environments, greenhouses, nurseries, turf farms, golf courses, and lawn care professionals. Non-cancer 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 No Observed Adverse Effect Level (NOAEL). In the case of thiophanate-methyl, MOEs greater than 100 do not exceed the Agency's level of concern. Cancer risks greater than $1.0x10^{-4}$ (on in ten thousand) for the occupational population exceeds the Agency's level of concern. EPA closely examines occupational cancer risks in the $1x10^{-4}$ to $1x10^{-6}$ range and seeks cost effective ways to reduce occupational cancer risks to the greatest extent feasible, preferably $1x10^{-6}$ or less. Occupational exposure to MBC in paint is not included in this assessment because FQPA requires the Agency to aggregate only exposures from food, drinking water, residential and other non-occupational uses of a pesticide. The occupational exposures of MBC in paint will be addressed in a future registration review of the chemical.

a. Toxicity

The acute toxicity profiles for thiophanate-methyl and MBC are listed previously in Tables 2 and 3. Tables 21 and 22 detail the toxicity endpoints used in the occupational risk assessment for thiophanate-methyl and MBC.

Table 21: Toxicity Endpoints for Thiophanate-methyl Occupational Risk Assessment

Exposure Route	Dose Used in Risk Assessment	Study and Toxicological Effects
Short- and Intermediate-Term Dermal	NOAEL=100 mg/kg/day	21-day dermal toxicity study in rabbits; decreased body weight and consumption at 300 mg/kg/day.
Short- and Intermediate-Term Inhalation	Oral NOAEL = 10 mg/kg/day	Developmental toxicity study in rabbits; decreased maternal body weight and food consumption at 20 mg/kg/day.
Lifetime Cancer Risk	Q1* = 1.16×10^{-2} $(mg/kg/day)^{-1}$	Chronic dietary study in mice; liver tumors in male mice. Dermal absorption = 7%

Table 22. Toxicity Endpoints for MBC Occupational Risk Assessment

Exposure Route	Dose Used in Risk Assessment	Study and Toxicological Effects
Short- and Intermediate-Term Dermal	Oral NOAEL=10 mg/kg/day	Rat developmental study with MBC; LOAEL = 20 mg/kg/day based on decreased fetal body weight and increases in skeletal variations and a threshold for malformations in fetuses of exposed dams. Dermal absorption = 3.5%
Short- and Intermediate-Term Inhalation	Inhalation NOAEL = 0.96 (10 mg/m3)	90 day rat inhalation study with benomyl; LOAEL = 4.8 mg/kg/day (50 mg/m3) based on olfactory degeneration in the nasal cavity.
Short- and Intermediate-Term Inhalation*	Inhalation NOAEL = 27.9 mg/kg/day (0.178 mg/L/day)	LOAEL>0.178 mg/L/day. Based on no compound related effects in mortality, clinical chemistry and hematological analysis and histopathological evaluations.
Lifetime Cancer Risk	Q1* =2.39×10^{-3} $(mg/kg/day)^{-1}$	2 year mouse study with MBC based on hepatocellular (adenoma and /or carcinoma) tumors in female mice.

* The LOAEL for short- and intermediate-term inhalation NOAEL of 0.178 mg/L/day was only used for exposures using airless sprayer application equipment.

b. Handler Exposure

Based on the registered use patterns, EPA has identified 23 major exposure scenarios for which there is potential occupational handler exposure during mixing, loading, and applying products containing TM to agricultural crops and turf/ornamentals. These scenarios are as follows:

(1) mixing/loading wettable powders for : (a) aerial/chemigation, (b) groundboom, (c) airblast, (d) lawn handgun, and (e) dip application;
(2) mixing/loading dry flowable/WDG for: (a) aerial/chemigation, (b) groundboom, (c) airblast, (d) lawn handgun, and (e) dip application;
(3) mixing/loading liquid flowable concentrates for: (a) aerial/chemigation, (b) groundboom, (c) airblast, (d) lawn handgun, and (e) dip application;
(4) loading granular formulations for: (a) mechanical ground application for turf and ornamental broadcast;
(5) loading dusts for seed treatment;
(6) applying sprays aerially;
(7) applying with a groundboom sprayer;
(8) applying with an airblast sprayer;
(9) applying sprays with a handgun sprayer;
(10) applying granular products to turf with tractor-drawn spreader;
(11) applying dip treatments;
(12) applying dust as a potato seed treatment;
(13) mixing/loading/applying liquids using a high pressure handwand;
(14) mixing/loading/applying wettable powder using a low pressure handwand;
(15) mixing/loading/applying liquids using a low pressure handwand;
(16) mixing/loading/applying dry flowables using a low pressure handwand;
(17) mixing/loading/applying with a backpack sprayer;
(18) mixing/loading/applying: (a) liquids, (b) dry flowables (WDG), and (c) wettable powders using a handgun sprayer;
(19) loading/applying granules to turf and ornamentals using a belly grinder;
(20) loading/applying granules to turf using a push-type spreader;
(21) loading/applying dust as a seed treatment (dry) in planter box (i.e., peanuts);
(22) loading/applying wettable powder/DF solution as a seedling or bulb dip treatment; and
(23) flagging aerial spray applications.

For agricultural handlers, the estimated exposures initially are assessed assuming handlers are using baseline attire (i.e., long-sleeve shirt, long pants, shoes, and socks). If risk estimates exceed the level of concern for a given scenario with baseline attire, then exposures are assessed with the addition of personal protective equipment (i.e., chemical-resistant gloves, double-layer body protection, and/or a respirator) as required. In general, the Agency uses the least PPE necessary to achieve risk estimates that do not exceed the level of concern. If the risk estimates exceed the Agency's level of concern (i.e., if MOE < 100) for a given scenario even with the addition of PPE, then the risks are assessed with the use of engineering controls (i.e., closed system mixing/loading and enclosed cabs or cockpits for applying and flagging).

Handler Data Sources

The majority of analyses were performed using the Pesticide Handlers Exposure Database (PHED), Version 1.1. Two thiophanate-methyl handler exposure studies have been reviewed and the results from the chemical-specific studies have been added to the PHED data to calculate

unit exposure values to allow exposure and risk assessments to be conducted with a much larger number of observations than would be available from one or two exposure studies.
PHED was designed by a task force of representatives from the US EPA, Health Canada, the California Department of Pesticide Regulation, and member companies of the American Crop Protection Association. It is a software system consisting of two parts - a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates). The quality of the data and exposure factors represents the best sources of data currently available to the Agency for completing these kinds of assessments.

Handler Exposure Assumptions

The following assumptions and factors were used in order to complete the exposure and risk assessments for occupational handlers/applicators:

- The average work day was 8 hours.
- Maximum application rates and daily acreage were used to evaluate non-cancer occupational risk.
- Average application rates and daily acreage were used to evaluate cancer occupational risk.
- The average body weight of an adult used in all occupational handler short- and intermediate-term non-cancer risk assessments for thiophanate-methyl was 70 kg.
- Baseline PPE includes long sleeved shirts, long pants, shoes, and socks.
- Single Layer PPE includes baseline PPE with gloves.
- Double Layer PPE includes coveralls over single layer PPE.
- 35 year working life.

Anticipated use patterns and application methods, range of application rates, and daily amount of acres treated were derived from current product labeling.

The duration of exposure is expected to be short-, and intermediate-term for occupational handlers. The exposure duration for short-term assessments is 1 to 30 days, while intermediate-term durations are 1 to 6 months.

Information recently provided by stakeholders and verified by EPA enabled the Agency to refine cancer risk estimates. For details regarding the information provided by the stakeholders, refer to the document entitled “Updated HED Occupational Handler and Postapplication Worker Cancer Risk Estimates” dated December 3, 2002. Further refinement of risk was accomplished by generating more detailed estimates of exposure using crop-specific “typical” application rates. All available updated NASS (National Agricultural Statistics Service) data, including the nursery survey of agricultural chemical usage (April 2002) and data submitted from other sources (including the American Nursery & Landscape Association (ANLA), Society of American

Florists (SAF), and registrants) and confirmed by EPA were utilized to update the thiophanate-methyl worker risk estimates.

Cancer risks were estimated for the various handler scenarios using two categories of handlers: private and commercial. "Private" handlers are assumed to mix, load, apply, or otherwise handle TM as part of their duties on a single agricultural establishment of a typical size. "Commercial" handlers are assumed to be either custom "for-hire" applicators or individuals who handle TM on a very large agricultural establishment. The Agency assumes that private handlers would handle TM less frequently than commercial handlers. Except where specific information is available (such as greenhouses and golf courses), commercial handlers are assumed to handle TM ten days for each one day that private handlers are assumed to handle it. Tables 23 & 24 reflect only commercial handler risks since mitigation to address these risks will also address risks to private handlers. Private handlers' risks can be found in the document entitled "Updated HED Occupational Handler and Postapplication Worker Cancer Risk Estimates" dated December 3, 2002.

c. Handler Cancer Risk

Cancer risk estimates are presented as a probability of developing cancer. For occupational risks between $1x10^{-6}$ and $1x10^{-4}$, the Agency will pursue risk mitigation where feasible and cost effective to reduce the risks to $1x10^{-6}$ or less. A summary of the cancer risks of concern for baseline, PPE and engineering controls is presented in Table 23. Only exposures to TM were assessed for occupational handlers. Handlers are not expected to be exposed to MBC, because MBC is formed during the environmental degradation of TM.

All handler risk estimates were below $1x10^{-4}$ and most were below $1x10^{-6}$ with either protective equipment or engineering controls. Because of the information provided by stakeholders that enabled EPA to refine the cancer risk estimates, these risk estimates are generally lower than the findings in the May 2002 HED assessment. Whereas engineering controls resulted in cancer risk estimates close to $1x10^{-6}$ in the May 2002 document, the cancer risk estimates were significantly reduced for scenarios requiring use of PPE in this refined assessment. Mixing and loading of wettable powder formulations, treating large acreage crops and use of hand application methods still represent disproportionately higher risks. While chemical use data have resulted in refinements, the reduced risk estimates are still considered protective due to the conservative assumptions in the cancer risk equation.

Table 23. Thiophanate-methyl: Summary of Occupational Handler Cancer Risks of Concern for Commercial Applicators*

Exposure Scenario	Cancer Risk Baseline (i.e., single layer)	Cancer Risk (single layer + gloves)	Cancer Risk (double layer + gloves + respirator)	Cancer Risk Engineering Controls
Mixer/Loader				
(1a) Mixing/ Loading Wettable Powder for Aerial/ Chemigation Application	3.6E-04 - 5.1E-05	6.5E-05 - 9.3E-06	2.1E-05 - 3.0E-06	1.1E-06 - 1.6E-06

Exposure Scenario	Cancer Risk Baseline (i.e., single layer)	Cancer Risk (single layer + gloves)	Cancer Risk (double layer + gloves + respirator)	Cancer Risk Engineering Controls
(1b) Mixing/ Loading Wettable Powder for Groundboom Application	2.2E-04 - 1.1E-05	4.1E-05 - 2.0E-06	4.8E-06 - 6.4E-07	6.9E-07 - 3.4E-08
(1c) Mixing/ Loading Wettable Powder for Airblast Application	8.2E-05 - 8.2E-06	1.5E-05 - 1.5E-06	4.8E-06 - 4.8E-07	2.5E-07 - 3.5E-08
(1d) Mixing/ Loading Wettable Powders for Lawn Handgun Application	2.2E-04 - 2.8E-05	4.1E-05 - 5.1E-06	1.3E-05 - 1.6E-06	6.9E-07 - 8.6E-08
(1e) Mixing/Loading Wettable Powder for Dip Application	2.5E-06 - 1.4E-06	4.5E-07 - 2.6E-07	1.4E-07 - 8.4E-08	7.6E-09 - 4.4E-09
(2a) Mixing/Loading Dry Flowable/WDG for Aerial/Chemigation Application	6.4E-06 - 9.2E-07	6.4E-06 - 9.2E-07	4.1E-06 - 5.9E-07	1.1E-06 - 1.6E-07
(2b) Mixing/Loading Dry Flowable/WDG for Groundboom Application	4.0E-06 - 1.8E-07	4.0E-06 - 1.8E-07	2.5E-06 - 1.2E-07	6.9E-07 - 3.2E-08
(2c) Mixing/Loading Dry Flowable/WDG for Airblast Application	8.8E-07 - 1.5E-07	8.8E-07 - 1.5E-07	5.6E-07 - 9.4E-08	1.5E-07 - 2.5E-08
(2d) Mixing/Loading Dry Flowable/WDG for Lawn Handgun Application	2.0E-06 - 5.0E-07	2.0E-06 - 5.0E-07	1.3E-06 - 3.2E-07	3.4E-07 - 8.6E-08
(2e) Mixing/Loading Dry Flowable/WDG for Dip Application	4.4E-08 - 2.6E-08	4.4E-08 - 2.6E-08	2.8E-08 - 1.6E-08	7.6E-09 - 4.4E-09
(3a) Mixing/ Loading Liquid Flowable Concentrates for Aerial/ Chemigation Application	2.9E-04 - 2.8E-05	4.0E-06 - 3.8E-07	2.0E-06 - 1.9E-07	9.8E-07 - 9.3E-08
(3b) Mixing /Loading of Liquid Flowable Concentrates for Groundboom Application	1.5E-04 - 7.4E-06	2.1E-06 - 1.0E-07	1.1E-06 - 5.2E-08	5.1E-07 - 2.5E-08
(3c) Mixing/ Loading of Liquid Flowable Concentrates for Airblast Application	3.3E-05 - 5.6E-06	4.6E-07 - 7.7E-08	2.3E-07 - 3.9E-08	1.1E-07 - 1.9E-08
(3d) Mixing/ Loading Liquid Flowable Concentrates for Lawn Handgun Application	7.6E-05 - 1.9E-05	1.0E-06 - 2.6E-07	5.3E-07 - 1.3E-07	2.5E-07 - 6.4E-08
(3e) Mixing/Loading Liquid Flowable Concentrates for Dip Application	1.7E-06 - 9.7E-07	2.3E-08 - 1.3E-08	1.2E-08 - 6.8E-09	5.6E-09 - 3.3E-09
(4) Loading Granular Formulation For Mechanical Ground Application	1.3E-06 - 6.4E-08	1.2E-06 - 6.1E-08	3.2E-07 - 1.6E-08	2.5E-08 - 1.3E-09
(5) Loading Dusts (Exposure studies used for Unit Exposure values)	No Data	2.1E-05 - 5.5E-07	No Data	No Data
Applicator				
(6) Applying Sprays Aerially	See Engineering Controls	See Engineering Controls	See Engineering Controls	5.0E-07 - 3.0E-08
(7) Applying with Groundboom	1.3E-06 - 1.2E-07	1.3E-06 - 1.2E-07	6.4E-07 - 6.3E-08	2.9E-07 - 2.7E-08
(8) Applying with an Airblast Sprayer	4.9E-06 - 1.0E-06	3.5E-06 - 7.3E-07	2.7E-06 - 5.6E-07	2.9E-07 - 6.1E-08
(9) Applying with a Handgun Sprayer (ORETF Data)	6.1E-06 - 4.5E-07	4.4E-06 - 3.3E-07	2.3E-06 - 1.7E-07	NF
(10) Applying Granular Formulations with a Tractor-Drawn Spreader	4.2E-07 - 5.3E-08	3.8E-07 - 4.7E-08	1.2E-07 - 1.5E-08	8.2E-08 - 1.0E-08

Exposure Scenario	Cancer Risk Baseline (i.e., single layer)	Cancer Risk (single layer + gloves)	Cancer Risk (double layer + gloves + respirator)	Cancer Risk Engineering Controls
(11) Applying Dip Treatment	No Data	No Data	No Data	No Data
(12) Applying Dust as a Potato Seed Treatment (Exposure study Stevens/Davis, 1981)	9.0E-07 potato planter/observer	1.4E-06 potato cutting/sorting	No Data	1.1E-06 potato planter/operator
Mixer/Loader/Applicator				
(13) Mixing/ Loading/ Applying Liquids using High Pressure Handwand	No Data - See PPE	1.0E-05	4.6E-06	NF
(14) Mixing/ Loading/ Applying WP using Low Pressure Handwand	No Data - See PPE	1.6E-05 - 2.3E-06	6.1E-06 - 8.9E-07	NF
(15) Mixing/ Loading/ Applying Liquid Formulations using Low Pressure Handwand	6.5E-05 - 9.6E-06	5.6E-07 - 8.2E-08	3.0E-07 - 4.3E-08	NF
(16) Mixing/ Loading/ Applying Dry Flowables using Low Pressure Handwand	No Data	No Data	No Data	NF
(17) Mixing/ loading/ Applying with a Backpack Sprayer	See PPE	1.9E-06 - 2.8E-07	1.3E-06 - 1.9E-07	NF
(18a) Mixing/Loading/Applying Liquid Formulations with a Handgun Sprayer (ORETF Data)	4.6E-06 - 4.3E-07	3.3E-06 - 3.0E-07	1.7E-06 - 1.5E-07	NF
(18b) Mixing/Loading/Applying Dry Flowables/WDG with a Handgun Sprayer (ORETF data)	7.4E-06 - 5.4E-07	5.5E-06 - 4.0E-07	2.2E-06 - 1.6E-07	NF
(18c) Mixing/ Loading/ Applying Wettable Powders with a Handgun Sprayer (ORETF data)	1.2E-05 - 1.1E-06	1.0E-05 - 9.6E-07	3.6E-06 - 3.3E-07	2.7E-06 - 2.5E-07
(19) Loading/ Applying Granules to Turf using Belly Grinder	1.4E-04 - 1.4E-05	1.3E-04 - 1.3E-05	7.6E-05 - 7.6E-06	NF
(20) Loading/Applying Granules to Turf using Push-Type Spreader (ORETF data)	5.9E-06 - 5.9E-07	4.2E-06 - 4.2E-07	1.7E-06 - 1.7E-07	NF
(21) Loading/ Applying Dust as a Seed Treatment (dry) in planter box (Fenske et al., 1990 used for unit exposure value)	No Data	4.7E-06	No Data	No Data
(22) Mixing/ Loading/ Applying a Dip Treatment	No Data	No Data	No Data	No Data
(23) Flagging Aerial Spray Applications	1.6E-06 - 3.6E-07	NA	1.1E-06 - 2.4E-07	5.6E-07 - 1.2E-07

NF = Not feasible

* Cancer risk ranges are due to different risks between crops.

d. Handler Non-cancer Risk

Non-cancer risk estimates are expressed in terms of the Margin of Exposure (MOE). For occupationally exposed workers, MOEs greater than or equal to 100 do not exceed EPA's level of concern. A summary of the non-cancer risk estimates for baseline, PPE and engineering controls is presented in Table 24.

Table 24. Thiophanate-methyl: Summary of Occupational Handler Non-Cancer Risks of Concern*

Exposure Scenario	Total MOE Baseline (i.e., single layer)	Total MOE single layer + gloves	Total MOE double layer + gloves + respirator	Total MOE engineering controls
Mixer/Loader				
(1a) Mixing/Loading Wettable Powder for Aerial/Chemigation Application	1 - 74	6.9 - 94	19 - 1400	340 - 25000
(1b) Mixing/Loading Wettable Powder for Groundboom Application	4.4 - 74	30 - 420	84 - 1400	1500 - 25000
(1c) Mixing/Loading Wettable Powder for Airblast Application	18 - 74	48 - 420	350 - 1400	6200 - 25000
(1d)Mixing/Loading Wettable Powders for Lawn Handgun Application	6.2 - 23	43 - 150	120 - 430	2100 - 7700
(1e) Mixing/Loading Wettable Powder for Dip Applications	1400 - 2400	11000 - 14000	27000 - 46000	480000 - 820000
(2a) Mixing/Loading Dry Flowable /WDG for Aerial/Chemigation Application	57 - 4100	57 - 1800	86 - 6300	340 - 25000
(2b) Mixing/Loading Dry Flowable/WDG for Groundboom Application	250 - 4100	260 - 3400	370 - 6300	1500 - 25000
(2c) Mixing/Loading Dry Flowable/WDG for Airblast Application	1000 - 4100	830 - 3900	1600 - 6300	6200 - 25000
(2d) Mixing/Loading Dry Flowable/WDG for Lawn Handgun Application	350 - 1300	350 - 1300	530 - 1900	2100 - 7700
(2e) Mixing/Loading Dry Flowable/WDG for Dip Application	79000 - 140000	79000 - 140000	120000 - 210000	480000 - 820000
(3a) Mixing/Loading Liquid Flowable Concentrates for Aerial/Chemigation Application	1.4 - 100	120 - 1700	210 - 16000	440 - 32000
(3b) Mixing/Loading of Liquid Flowable Concentrates for Groundboom Application	6.2 - 100	520 - 8800	940 - 16000	1900 - 32000
(3c) Mixing/Loading of Liquid Flowable Concentrates for Airblast Application	26 - 100	1200 - 7200	3900 - 1600	8100 - 32000
(3d) Mixing/Loading Liquid Flowable Concentrates for Lawn Handgun Application	8.8 - 32	730 - 2600	1300 - 4800	2700 - 9900
(3e) Mixing/Loading Liquid Flowable Concentrates for Dip Application	2000 - 34000	190000 - 230000	300000 - 520000	620000 - 1100000
(4) Loading Granular Formulation For Mechanical Ground Application	130 - 3400	140 - 2900	480 - 13000	6400 - 170000
(5) Loading Dusts (Exposure studies used for Unit Exposure values) (m)	no data	200 - 7500	no data	no data
Applicator				
(6) Applying Sprays Aerially	see engineering controls	see engineering controls	see engineering controls	730 - 10000
(7) Applying with Groundboom	850 - 14000	890 - 12000	1500 - 24000	3300 - 56000
(8) Applying with an Airblast Sprayer	190 - 750	200 - 970	330 - 1300	3200 - 13000
(9) Applying with a Handgun Sprayer	91 - 1900	130 - 2700	240 - 5200	NF
(10) Applying Granular Formulations with a Tractor-Drawn Spreader	300 - 24000	340 - 27000	980 - 78000	1500 - 120000
(11) Applying Dip Treatment	no data	no data	no data	no data
(12) Applying Dust as a Potato Seed Treatment (Exposure study Stevens/Davis, 1981) (k)	no data - see PPE	2900 (for cutting/sorting)	see engineering controls	3600 (for planter operator)
Mixer/Loader/Applicator				

Exposure Scenario	Total MOE Baseline (i.e., single layer)	Total MOE single layer + gloves	Total MOE double layer + gloves + respirator	Total MOE engineering controls
(13) Mixing/Loading/Applying Liquids using High Pressure Handwand	see PPE	260	510	NF
(14) Mixing/Loading/Applying WP using Low Pressure Handwand	see PPE	75 - 1200	200 - 2800	NF
(15) Mixing/Loading/Applying Liquid Formulations using Low Pressure Handwand	17 - 230	2000 - 33000	4000 - 54000	NF
(16) Mixing/Loading/Applying Dry Flowables using Low Pressure Handwand	no data	no data	no data	NF
(17) Mixing/loading/Applying with a Backpack Sprayer	see PPE	590 - 8400	930 - 13000	NF
(18a) Mixing/Loading/Applying Liquid Formulations with a Handgun Sprayer (ORETF Data)	240 - 2600	340 - 3600	680 - 7200	NF
(18b) Mixing/Loading/Applying Dry Flowables/WDG with a Handgun Sprayer (ORETF Data)	160 - 1700	210 - 2400	530 - 5600	NF
(18c) Mixing/Loading/Applying Wettable Powders with a Handgun Sprayer (ORETF data)	110 - 1100	110 - 1300	340 - 3600	NF
(19) Loading/Applying Granules to Turf using Belly Grinder (j)	24 - 240	26 - 260	45 - 440	NF
(20) Loading/Applying Granules to Turf using Push-type Spreader (ORETF Data)	120 - 1200	180 - 1700	410 - 4100	NF
(21) Loading/Applying Dust as a Seed Treatment (dry) in planter box (Fenske et al., 1990 used for unit exposure value) (h)	no data	710	no data	no data
(22) Mixing/Loading/Applying a Dip Treatment	no data	no data	no data	no data
(23) Flagging Aerial Spray Applications	990 - 3900	NA	1300 - 5300	2600 - 11000

* MOE ranges are due to different risks between crops.

e. Postapplication Occupational Risk

The postapplication occupational risk assessment considered exposure to thiophanate-methyl, and MBC, from entering treated fields, orchards, nurseries, greenhouses, or golf courses. Given the nature of activities in these locations, and that thiophanate-methyl is applied at various times during plant growth, contact with treated surfaces is likely. Some potential exposure scenarios of concern include: scouting, irrigation, harvesting, pruning, transplanting, thinning, and handling treated seed and seed pieces.

Only dermal exposures were evaluated in the postapplication worker assessment; EPA believes that postapplication inhalation exposure will be minimal because of the high dilution one would expect outdoors and the relatively low vapor pressure of thiophanate-methyl. In addition, the Worker Protection Standard for Agricultural Pesticides prohibits entry by workers until at least 4 hours following application and until any ventilation or inhalation requirements have been met.

In the Worker Protection Standard, a restricted entry interval (REI) is defined as the duration of time which must elapse before residues decline to a level so entry into a previously treated area and engaging in any task or activity would not result in exposures which are of concern.

Typically, the activity with the highest risk will drive the selection of the appropriate REI for the crop.

(1) Data Sources

Postapplication dislodgeable foliar residue (DFR) data were submitted for apples, strawberries, and cut flowers (greenhouse), as well as transferable residue data from treated turf. All of these data were used in this assessment along with standard transfer coefficients based on EPA Science Advisory Council for Exposure guidance to assess potential exposures to workers reentering treated sites.

There were no chemical-specific data submitted to determine foliar transfer coefficients for thiophanate-methyl or its MBC degradate. EPA found TM-specific data in a 1992 cut-flower worker study by Brouwer, et al. For all other postapplication activities, EPA used the EPA Science Advisory Council for Exposure (Exposure SAC) policy on agricultural transfer coefficients.

(2) Assumptions

The following assumptions were made regarding postapplication occupational exposure:

- Most postapplication worker exposures to thiophanate-methyl and MBC are assumed to be of short- to intermediate-term duration, based on the available use data. Owing to the slow dissipation rate of thiophanate-methyl seen in submitted studies, however, it is possible that some workers may be exposed over a period greater than 180 days per year. This is most likely to happen in an enclosed greenhouse situation, where residues decline slowest, or in picking strawberries. The average application rate based on EPA estimates is once per season per crop, but labels allow repeated application when needed. Also, greenhouses may produce several "crops" per year and rotate or sell plants as they grow.
- For postapplication exposures, both the parent compound and the metabolite (MBC) may be present. Based on the residue dissipation data, long-term exposures to MBC are not anticipated.
- Inhalation exposures were not calculated for the postapplication scenarios.
- For most occupational exposures, an 8-hour exposure day was assumed.
- For assessing short- and intermediate-term exposures associated with non-cancer risks, the maximum application rate by crop is assumed.
- For assessing exposures associated with cancer risks, the typical application rate, if known, for a crop is assumed.

(3) Reentry Worker Cancer Risk

Risk estimates for short- and intermediate-term dermal exposures are assessed based on the DFR data on day 0 or day 1, whichever is greater. Cancer risk estimates are assessed based on the average DFR data in the range of day 1 to day 14, since in general, TM can be reapplied at 14-day intervals. This means that if the restricted-entry interval were set at day 1, EPA estimates that workers would enter treated areas on days 1 through day 14, with the average exposure

being the average of DFRs between days 1 and 14. If cancer risk estimates are of concern based on the average DFR between days 1 and 14, then risks are assessed using the average day 2 to day 14, day 3 to day 14, etc., to show the risk reduction resulting from longer REIs.

Cancer risk estimates for reentry workers, based upon the best estimate of average application rates and an exposure to the average foliar residues over a two week period are presented in tables 25 and 26 below. Most postapplication practices result in cancer risk estimates below $1x10^{-6}$ and all are below $1x10^{-4}$. These risk estimates are lower than in the previous May 2002 assessment.

Table 25: Thiophanate-methyl Occupational Postapplication Cancer Risk Estimates For Crops Using Apple DFR Data*

Crop	Activity	Cancer Risk on Day 1 After Treatment
apples	pruning-hand, propping, harvest-hand	4.6E-06 - 9.6E-06
cherries, plums/prunes	thinning, pruning-hand, propping, harvest-hand	3.4E-06 - 7.2E-06
nectarines, apricots	thinning, pruning-hand, propping, harvest-hand	1.1E-05 - 2.4E-05
peaches	thinning, pruning-hand, propping, harvest-hand	6.9E-06 - 1.4E-05
almonds, pistachios	hand-harvesting, hand-pruning	1.5E-05 - 3.2E-05
pecans	hand-harvesting, hand-pruning, thinning	4.8E-06 - 1.0E-05
woody ornamentals	hand-harvesting, hand-pruning, pinching, transplanting	no data
	scouting, irrigating	no data
	pruning, staking	5.8E-07 - 8.8E-07
	pinching	9.3E-07 - 1.4E-06
	moving pots and flats	2.1E-06 - 3.2E-06

Table 26. Thiophanate-methyl Occupational Postapplication Cancer Risk Estimates For Crops Using Strawberry DFR Data

Crop	Activity	Cancer Risk DAT 1-14
strawberries	harvesting-hand, pinching, hand-pruning, training	7.8E-06
blueberries (lowbush)	harvesting-hand, pinching, hand-pruning, training	2.6E-06
blueberries (highbush)	harvesting-hand, pruning-hand, thinning	8.6E-06
wheat	irrigating, scouting	7.8E-07
celery	harvesting-hand	2.6E-06
	irrigating, scouting	1.7E-06

Crop	Activity	Cancer Risk DAT 1-14
cucurbits	hand-harvesting, leaf puling, hand-pruning	3.0E-06
		2.0E-06
sugar beets	irrigating, scouting	1.0E-06
soybeans	irrigating, scouting	1.3E-06
beans, green	hand-harvesting	6.5E-06
potatoes	hand-harvesting	2.6E-06
	irrigating, scouting mature plants	1.6E-06
herbaceous ornamentals	hand harvesting, hand pruning, thinning, transplanting	no data
	scouting, irrigating	no data
	moving pots, flats	4.5E-06
	pruning, staking	1.2E-06

* MOEs are presented in a range for different states.

Postapplication cut flower and other herbaceous ornamentals cancer risks are shown in Table 27.

Table. 27. Thiophanate-methyl Occupational Postapplication Cancer Risk Estimates Using Cut Flower DFR Data (Average of Roses and Mums Data)

Crop	Activity	Cancer Risk (DAT)
Cut Flowers	“typical activities”; also irrigating, scouting at NASS Avg Application Rate = 0.47 lb.	3.6E-05 (1-14)
herbaceous ornamentals other than cut flowers	'typical activities'; also irrigating, scouting	no data
	greenhouse harvesting	1.2E-05 (1-14)
	greenhouse pinching	5.4E-06 (1-14)

Postapplication turf cancer risks are shown in Table 28.

Table 28. Thiophanate-methyl Occupational Postapplication Turf Exposure Cancer Risk Estimates

Crop	Activity	Cancer Risk (DAT)
turf - golf courses (fairways, tees, greens)	seeding, scouting, mechanical weeding, aerating, fertilizing, hand pruning, irrigating, mowing	2.3E-07 (1-14)

(4) Reentry Worker Non-Cancer Risk

Using the NASS typical rate for cut flowers of 0.47 lb ai/acre and using the expected time spent harvesting (high exposure activity) of 4 hours resulted in raising the MOE above the target of 100 at the reentry interval of 24 hours after treatment.

Table 29.Thiophanate-methyl Occupational Postapplication Short/Intermediate and Long Term Non-Cancer Risk Estimates Using Cut Flower DFR Data

Crop	Activity	Maximum Application Rate	DAT (days) (a)	Short-Intermediate-term MOE (b)	Long Term MOE (c)
cut flowers (TC = 7000)	hand-harvesting, pinching, thinning, hand-pruning	3.8	0	8	8.6
			1	8	8.9
			30	24	28
			67	**100**	**120**
	NASS Avg Rate & 4 hrs/day	0.5	1	**110**	**120**
herbaceous ornamentals other than cut flowers	scouting, irrigating	3.8			
	greenhouse harvesting		0	**130**	**150**
	greenhouse harvesting		0	**130**	**150**
	greenhouse pinching		0	**300**	**340**

Footnotes:

(a) DAT = days after treatment. DAT extended beyond current REI of 12 hours to achieve MOE ≥ 100.
(b) Short/Intermediate-term MOE = NOAEL (100 mg/kg/day) / daily dermal dose (mg/kg/day).
(c) Long-term MOE = NOAEL (8 mg/kg/day)/absorbed dermal dose (mg/kg/day).

(5) Uncertainties

The occupational postapplication assessments are believed to be reasonable representations of TM uses. While some individual's exposure may exceed these estimates, the Agency believes that most workers in each group would have fewer than the 180 days of exposure that is assumed for the indicator crops. There are, however, many uncertainties in these assessments. The uncertainties include the following:

- not all of the exposure data are of high confidence because of the lack of replicates and/or inadequate QA/QC in the studies; and

- application timing in comparison to actual potential postapplication exposure scenarios.

These uncertainties are inherent in most pesticide exposure assessments. The conservative nature of the assessments, however, is believed to be protective of the worker. For example, conservative assumptions (e.g., maximum application rates, high daily acreages, 35-year exposure period, and first day-after-treatment residues) were used to estimate exposures and risks to workers.

f. Human Incident Data

The Agency reviewed sources of information on health incidents involving human exposure. The majority of significant symptoms were respiratory or eye irritation. The three sources of information are OPPs Incident Data System (IDS), California Department of Pesticide Regulation (CDPR), and the National Pesticides Telecommunication Network.

The Incident Data System included 2 incidents in 1994. In the first, a male was exposed to thiophanate-methyl that was sprayed on school playing fields. After the spraying, the wind blew the chemical towards his garden and exacerbated his emphysema. In the second incident, a woman was exposed to spray drift from thiophanate-methyl from an adjacent orchard. She experienced eye irritation.

There were 37 cases submitted to the California Pesticide Illness Surveillance Program (1982-1994). In 11 of these cases, thiophanate-methyl was judged to be responsible for the health effects. A total of 5 persons had systemic illnesses that involved skin, eye, or respiratory effects. Three of these cases occurred in 1990 and the workers were diagnosed with chemical bronchitis. A total of three persons had skin illnesses. None of the persons were hospitalized. Thiophanate-methyl ranked 110th as a cause of systemic poisoning in California.

Spray and dust application methods were associated with the majority of the exposures. The majority of the systemic illnesses occurred due to a crew of workers sprinkling thiophanate-methyl from coffee cans onto seed potatoes that were cut. Symptoms included shortness of breath, chest pains, burning eyes, dizziness, and fatigue. The two eye illnesses occurred due to the workers being exposed to residue from the thiophanate-methyl that blew into their eyes. Symptoms experienced were eye irritation which included swollen and burning eyes.

Examination of the top 200 chemicals for which the National Pesticide Telecommunications Network received calls from 1984-1991, inclusively, indicated that thiophanate-methyl was not involved in human incidents. The incident data was not updated from the 1997 review due to overall low incidence of reported health effects from thiophanate-methyl.

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 the Revised EFED RED Chapter for thiophanate-methyl and its major degradate, MBC dated May 9, 2001 and the Addendum to EFED Red Chapter (revised) dated June 12, 2002.

1. Environmental Fate and Transport

Thiophanate-methyl degrades primarily to MBC whether on foliage, in soil, or in water. Both photolysis and hydrolysis are important routes of degradation. While the TM degradation rate is slower on foliage than in the aquatic environment, conversion to MBC is expected to be rapid under most normal agricultural conditions.

Based on data from studies that meet Agency guidelines, MBC is stable to aqueous photodegradation, stable to hydrolysis at pH values ranging from 5 to 7, with hydrolytic stability decreasing within this range of pH values as pH increases, and stable to soil photolysis. Metabolism under aerobic and anaerobic conditions in both soil and water proceeds at a very slow rate.

TM degrades relatively easily in soil and is expected to be mobile. MBC has the potential to leach on sandy soils with low organic matter content. Otherwise, MBC is unlikely to leach through the soil column.

2. Ecological Risk Assessment

The Agency's terrestrial ecological risk assessment compares toxicity endpoints from ecological toxicity studies to estimated environmental concentrations (EECs) that were determined using the Environmental Fate model (ELL-FATE). The Environmental Fate model estimates maximum concentrations of pesticide residues in food items consumed by birds and mammals and accounts for data regarding the half-life of the chemical being modeled. Detailed information regarding the ELL-FATE model can be found in the EFED memorandum dated June 24, 2002 "Addendum to EFED RED chapter (revised) for thiophanate-methyl fungicide (TM) and its major degradate, MBC (methyl 2-benzimidazolycarbamate)." To evaluate the potential risk to nontarget organisms from the use of thiophanate-methyl products, the Environmental Fate model also estimates risk quotients (RQs), which is the ratio of the estimated exposure concentration to the toxicity endpoint values, from EECs, LC50 values (the concentration of a substance which causes death to 50% of the test animals), and NOAELs. The RQ is simply a means of integrating the results of ecological exposure and ecological toxicity. These RQ values are compared to levels of concern (LOCs), given in Table 30 which provide an indication of the relative risk the particular pesticide and/or use may pose for nontarget organisms. If the RQ does not exceed the LOC, it is unlikely that the pesticide will pose a significant risk. Similarly, when RQs are equal to or greater than the LOC, then the Agency does have concerns. These concerns may be addressed by further refinements of the risk assessment or by mitigation. Use, toxicity, fate, and exposure are considered to characterize the risk as well as the level of certainty and uncertainty in the assessment. EPA further characterizes ecological risk based on any

reported aquatic or terrestrial incidents to nontarget organisms in the field (e.g., fish or bird kills).

EECs used to determine acute and chronic risks to aquatic organisms were estimated using selected crops and turf scenarios and Tier II PRZM/EXAMS model. A complete discussion of these models and the associated input parameters and output for each scenario is presented in the Revised EFED RED document dated May 8, 2001. Acute risk quotients were estimated based on LC50s and peak EEC values. Chronic risk quotients were estimated from NOAELs, 21-day average EECs for invertebrates, and 56-day average EECs for fish.

Table 30. Risk Presumptions for Terrestrial and Aquatic Animals

Risk Presumption	LOC terrestrial animals	LOC aquatic animals
Acute Risk - there is potential for acute risk; regulatory action may be warranted in addition to restricted use classification.	0.5	0.5
Acute Restricted Use - there is potential for acute risk, but may be mitigated through restricted use classification.	0.2	0.1
Acute Endangered Species - endangered species may be adversely affected; regulatory action may be warranted.	0.1	0.05
Chronic Risk - there is potential for chronic risk; regulatory action may be warranted.	1	1

Specific uses chosen for modeling include grapes, apples, soybean, golf course fairways, potatoes, and onions.

3. Risk to Terrestrial Organisms

a. Toxicity (Hazard) Assessment

Toxicity values for risk calculations for all terrestrial assessments are given in Table 31.

Table 31. Summary of toxicity values for terrestrial risk assessments

Test Species	% a.i.	Endpoint	Toxicity Category and/or Most Sensitive Endpoint	MRID
Acute Avian and Mammalian				
Mallard duck	94	LC50 > 10,000 ppm	practically nontoxic	00083014
Laboratory rat	96.55	LD50 > 5,000 mg/kg	practically nontoxic	416443-01
Chronic (reproductive) Avian and Mammalian				
Mallard duck	96	NOAEC = 103 ppm	eggs & body weight	424748-01

Test Species	% a.i.	Endpoint	Toxicity Category and/or Most Sensitive Endpoint	MRID
Laboratory rat	96.55	NOAEL = 195 ppm	practically nontoxic	416443-01

b. Exposure and Risk

For pesticides applied as liquids, the estimated environmental concentrations (EECs) on food items following product application are compared to LC50 values to assess risk with a Risk Quotient (RQ) method. For birds and mammals, estimates of maximum residue levels of TM on wildlife food were based on the model of Hoerger and Kenega (1972), as modified by Fletcher et al. (1994). EECs resulting from multiple applications are calculated from the maximum number of applications, minimum application interval, and foliar half-life data. The Agency does not calculate chronic risk from granular applications. For terrestrial and semi-aquatic plants, the exposure model incorporates runoff and spray drift.

For the purposes of this risk assessment, EECs were estimated for both TM and its primary degradate, MBC. Based on environmental fate data for TM and MBC, it appears as though TM degrades fairly rapidly in the terrestrial environment to form MBC. As a result, acute effects to terrestrial organisms were assumed to result primarily from TM and chronic effects were assumed to result from MBC. Consequently, estimated acute risk quotients were derived from LC50 and EEC values for TM and chronic risk quotients were derived from NOAEL and EEC values for MBC. The half-life used to determine terrestrial EECs and RQ values for TM was the terrestrial field dissipation half-life of 4 days. Half-life for MBC was assumed to be 35 days, a default used in the absence of foliar dissipation half-life data for this chemical. The maximum amount of MBC formed from thiophanate-methyl is approximately 82.7 percent of TM initially applied based on the results from the aerobic soil metabolism study.

The avian acute risk quotients cannot be calculated for TM because the LD50 was higher than the highest dose tested. TM is practically nontoxic on an acute basis.

Table 32 presents estimated MBC chronic risk quotients for birds. Chronic risk quotients are estimated to exceed the Chronic LOC of 1.0 for most sites, application rates, and frequencies considered in this risk assessment for birds that consume short grass. Consumption of short grass leads to the highest chronic risk estimates for birds, with successively lower risks estimated for birds that consume broadleaf plants/insects, tall grass, and seeds.

Table 32. Summarized Chronic Avian Risk Quotients Estimated from the Environmental Fate Model for Spray Applications

Crop (Site)	TM/MBC Max Single App. Rate (lbs ai/A)	Max No. of Apps.	Chronic MBC RQ			
			short grass	tall grass	broadleaf plant/insect	seeds
grapes/aerial	0.7 / 0.31	4	**2.00**	0.92	**1.12**	0.12
apples/aerial	0.7 / 0.31	4	**2.51**	**1.15**	**1.41**	0.16
soybean/aerial	0.7 / 0.31	2	**1.35**	0.62	0.76	0.08
golf course fairways/ground	5.45 / 2.52	1	**5.87**	**2.69**	**3.30**	0.37
potatoes/aerial	0.93 / 0.43	3	**2.63**	**1.21**	**1.48**	0.16
onions/ground	1.4 / 0.65	1	**1.51**	0.69	0.85	0.09

The mammalian acute risk quotients cannot be calculated for TM because the LD50 was higher than the highest dose tested. TM is practically nontoxic on an acute basis.

Table 33 provides the chronic mammalian RQ values. Chronic risk quotients exceed the chronic LOC of 1.0 for 15-gram, 35-gram, and 1000-gram mammals when TM is applied at the maximum annual application rates for the following scenarios:

- four annual aerial applications to grapes at 0.7 lb ai/acre;
- four annual aerial applications to apples at 0.7 lb ai/acre;
- one annual ground application to golf course fairways at 5.45 lb ai/acre; and,
- three annual aerial applications to potatoes at 0.93 lb ai/acre.

Table 33. Summarized Chronic Mammalian Risk Quotients for 15, 35, and 1000 gram Mammal Estimated from the Environmental Fate Model for Spray Applications

Crop (Site)	TM/MBC Max Single App. Rate (lbs ai/A)	Max No. of Apps.	Chronic MBC RQ			
			short grass 15g, 35g, and 1000g	tall grass 15g, 35g, and 1000g	broadleaf plant/insect 15g, 35g, and 1000g	seeds 15g, 35g, and 1000g
grapes/aerial	0.7 / 0.31	4	**1.06**	0.48	0.59	0.07
apples/aerial	0.7 / 0.31	4	**1.32**	0.61	0.74	0.08
soybean/aerial	0.7 / 0.31	2	0.71	0.33	0.40	0.04
golf course fairways/ground	5.45 / 2.52	1	**3.10**	**1.42**	**1.74**	0.19
potatoes/aerial	0.93 / 0.43	3	**1.39**	0.64	0.78	0.09

Crop (Site)	TM/MBC Max Single App. Rate (lbs ai/A)	Max No. of Apps.	Chronic MBC RQ			
			short grass 15g, 35g, and 1000g	tall grass 15g, 35g, and 1000g	broadleaf plant/insect 15g, 35g, and 1000g	seeds 15g, 35g, and 1000g
onions/ground	1.4 / 0.65	1	0.80	0.37	0.45	0.05

4. Risk to Terrestrial Invertebrates, Insects, and Terrestrial Plants

Based on information in the literature, the primary degradate of TM, MBC is very highly toxic to earthworms on an acute basis, and has inhibited earthworm reproduction and growth in acute and chronic laboratory tests from foliar residues. Build up of MBC residues in apple orchard soils from repeated TM applications may potentially inhibit growth and reproduction of earthworms in the top soil horizon (WHO, 1993).

Risks to non-target insects were not assessed. Results of acceptable studies are used for recommending appropriate label precautions.

Tier I (122-1) terrestrial plant toxicity tests indicate low potential for toxicity to 7 of the 10 crop plants tested in seedling emergence and vegetative vigor tests at up to 1.4 lb ai per acre. The maximum single label dosage allowed on TM labels is 8.16 lbs ai per acre (golf course tees and greens), therefore, additional tests are needed at the higher label dosage. Tier II (123-1) dose response tests for the most sensitive plants onion, soybean, and cucumber must be repeated due to poor germination or other insufficiencies of the test.

5. Risk to Aquatic Animals

a. Toxicity (Hazard) Assessment

Toxicity values for risk calculations for all aquatic assessments are given in Table 34. Based on toxicity studies with aquatic species submitted by the registrant, thiophanate-methyl is "moderately toxic" to freshwater fish and invertebrates as well as estuarine and marine invertebrates. Thiophanate-methyl is "slightly toxic" to estuarine and marine fish.

Table 34. Summary of toxicity values for aquatic risk assessments.

Test Species	% a.i.	Endpoint	Toxicity Category and/or Most Sensitive Endpoint	MRID
Acute Freshwater				
Rainbow trout	97.57	96-hr LC50 = 8.3 ppm	moderately toxic	000505-16
Daphnia magna	97.57	48-hr LC50 = 5.4 ppm	moderately toxic	42298101
Acute Estuarine/Marine				
Sheepshead minnow	97.6	96-hr LC50 =17 ppm	slightly toxic	421235-03
Mysid shrimp	97.5	96-hr LC50 = 1.1 ppm	moderately toxic	421235-02
Chronic Freshwater				
Channel catfish	99.3 MBC	NOAEC = 0.002 ppm	larvae survival	438728-01
Daphnia magna	99 MBC	NOAEC = 0.003 ppm	survival	429881-01
Mysid shrimp	99.3 MBC	NOAEC = 0.025 ppm	survival	427237-01

b. Exposure and Risk

For exposure to aquatic animals, EPA considers surface water only since most organisms are not found in ground water. Surface water models are used to estimate exposure to freshwater aquatic animals since monitoring data are generally not targeted studies on small water bodies and primary streams where many aquatic animals are found. The modeling results used in risk calculations are detailed in the EFED chapter.

The Agency used PRZM-EXAMS to calculate refined EECs. The Pesticide Root Zone Model (PRZM, version 3.12) simulates pesticides in field runoff and erosion, while the Exposure Analysis Modeling System (EXAMS, version 2.7.95) simulates pesticide fate and transport in an aquatic environment (one hectare body of water, two meters deep). EECs were calculated for

surface water using the highest application rates on grapes, apples soybeans, golf course fairways, potatoes, and onions.

The environmental fate data of TM suggest that TM has the potential to be converted to MBC within short periods of time ranging from 24 to 96 hours. Because the duration of the acute aquatic toxicity studies ranges from 48 to 96 hours, it is assumed that conversion of TM to MBC occurred and that fish and invertebrates are, therefore, exposed to both TM and MBC during the course of the acute toxicity studies. The chronic aquatic toxicity studies were performed at durations ranging from 21 to 56 days; it is assumed that fish and invertebrates are exposed primarily to MBC during the course of these chronic studies.

Estimates of acute and chronic risk quotients for aquatic species are presented in Table 35. Acute RQs for all scenarios for fish and invertebrates are <0.01 and therefore not of concern. For freshwater fish, chronic levels of concern based on a risk quotient of 1.0 were exceeded for all crops and locations modeled.

For freshwater invertebrates, acute LOCs were not exceeded under any of the use scenarios. Chronic LOCs based on a risk quotient of 1.0 were exceeded for all crops and locations modeled.

For estuarine and marine fish, acute LOCs were not exceeded under any of the use scenarios. Chronic levels of concern based on a risk quotient of 1.0 were exceeded for all crops and locations modeled. Endpoints from a freshwater fish chronic toxicity test on channel catfish were used in this assessment based on the assumption that the channel catfish and sheepshead minnow, the species typically used for tests of chronic toxicity to marine and estuarine organisms, have the same sensitivity to TM. A chronic sheepshead minnow study can be performed to rebut this assumption.

For estuarine and marine invertebrates, acute LOCs were not exceeded under any of the use scenarios. Chronic LOCs based on a risk quotient of 1.0 were exceeded for the following scenarios:

- four annual aerial applications to grapes at 0.7 lb ai/acre; and
- three annual aerial applications to potatoes at .093 lb ai/acre.

Table 35. Acute/Chronic Risk Quotients for Aquatic Species

Crop (Site)	TM/MBC Application Rate (lb ai/acre)	Max No. of Apps.	Freshwater		Estuarine/Marine	
			Chronic RQ		Chronic RQ	
			Fish	Invert	Fish	Invert.
Grapes	0.7 / 0.31	4	**11**	**8**	**11**	**1**
Apples	0.7 / 0.31	4	**9**	**7**	**9**	<1
Soybeans	0.7 / 0.31	2	**6**	**5**	**6**	<1

Crop (Site)	TM/MBC Application Rate (lb ai/acre)	Max No. of Apps.	Freshwater		Estuarine/Marine	
			Chronic RQ		Chronic RQ	
			Fish	Invert	Fish	Invert.
Golf course fairways	5.45 / 2.52	1	**2**	**1**	**2**	<1
Potatoes	0.93 / 0.43	3	**17**	**13**	**17**	**2**
Onions	1.4 / 0.65	1	**9**	**7**	**9**	<1

6. Risk to Aquatic Plants

Aquatic plant toxicity dose response data (123-2) were available for five aquatic plant species. Of the five aquatic plant species evaluated, the freshwater diatom, *Navicula pelliculosa,* was determined to be the most sensitive. Exposure to non-target aquatic plants may occur through runoff or spray drift from adjacent treated sites. An aquatic plant risk assessment for acute high risk and acute endangered species risk is conducted with endpoints from the most sensitive aquatic plant. To date there are no known non-vascular plant species on the endangered species list. Surface water concentrations from runoff and spray drift are estimated using the GENEEC model for turf and ornamentals and the PRZM/EXAMS model for onions. The acute risk quotient for non-target plants is determined by dividing the peak concentration of TM in surface water by the EC50 value for the most sensitive aquatic plant species. The acute endangered species risk quotient is determined by dividing the peak concentration of TM in surface water by the NOAEC.

Acute RQs for aquatic plants were all <0.1 and are therefore not of concern under any of the use scenarios. Methods are not currently available to assess chronic risks to aquatic plants.

7. Endangered Species

With regard to endangered species, acute risk assessments for all species and scenarios resulted in RQs which are below the endangered species level of concern. Thiophanate Methyl has "no effect" from direct acute exposures to any aquatic listed species.

Use of thiophanate-methyl is expected to exceed the Agency's level of concern for chronic effects to endangered birds, mammals, aquatic animals under most of the registered use scenarios. This is because, as noted previously, TM breaks down rapidly to MBC, which is toxic, persistent, and mobile in the environment. These findings are based solely on EPA's screening level assessment and do not constitute "may affect" findings under the ESA for any specific listed species.

Thiophanate methyl was included in the reinitiated Biological Opinion of 1989 from the US Fish and Wildlife Service for its use on several field crops. In this opinion, the Service found jeopardy to three amphibian species, six species of freshwater fish and one freshwater shrimp

species. Reasonable and Prudent Alternatives were given for each jeopardized species. Reasonable and Prudent Measures were also given for 35 non-jeopardized species to minimize incidental take of these species. This consultation and the findings expressed in the Opinion are based on old labels and application methods and less refined risk assessment procedures which have recently been revised through interagency collaboration.

EPA'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 scientific analysis underlying the Biological Opinion is outdated and the Reasonable and Prudent Alternatives and Reasonable and Prudent Measures in the Biological Opinion may therefore need to be reassessed and, as appropriate, modified, in consultation with the Services, based on these new approaches. The agency is assessing how best to validate these measures and alternatives. Until this analysis is completed, or other pesticide use limitations are identified based on a refined endangered species assessment, the overall environmental effects mitigation strategy articulated in this document will serve as interim protection measures to reduce the likelihood that endangered and threatened species may be exposed to thiophanate methyl at levels of concern.

8. Ecological Incidents

There were no reported incidents in the incident database.

IV. Risk Management, Reregistration and Tolerance Reassessment

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 or not products containing the active ingredient are eligible for reregistration. The Agency has previously identified and required the submission of the generic (i.e., active ingredient-specific) data required to support reregistration of products containing the active ingredient thiophanate-methyl.

The Agency has completed its assessment of the occupational, residential, and ecological risk associated with the use of pesticide products containing the active ingredient thiophanate-methyl, as well as a thiophanate-methyl specific dietary risk assessment. Based on a review of these data and on public comments on the Agency's assessments for the active ingredient thiophanate-methyl, EPA has sufficient information on the human health and ecological effects of thiophanate-methyl to make decisions as part of the tolerance reassessment process under FFDCA and reregistration process under FIFRA, as amended by FQPA. The Agency has determined that thiophanate-methyl products are eligible for reregistration provided that: (i) current data gaps and confirmatory data needs are addressed; (ii) the risk reduction measures outlined in this document are adopted; and (iii) label amendments are made to reflect these measures. Label changes are described in Section V. Appendix A summarizes the uses of thiophanate-methyl that are eligible for reregistration. Appendix B identifies the generic data

requirements that the Agency reviewed as part of its determination of reregistration eligibility of thiophanate-methyl, and lists the submitted studies that the Agency found acceptable. Data gaps are identified as generic data requirements that have not been satisfied with acceptable data.

Based on its evaluation of thiophanate-methyl, the Agency has determined that thiophanate-methyl 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 thiophanate-methyl. If all changes outlined in this document are incorporated into the product labels, then all current risks for thiophanate-methyl will be adequately mitigated for the purposes of this determination.

B. Public Comments and Responses

When making its reregistration decision, the Agency took into account all comments received after opening of the public docket. These comments in their entirety are available in the docket (OPP#34243). Comments on the risk assessment were submitted by four registrants, Cerexagri, Inc., Scotts Company, Nations Ag, and Gowan. A formal Agency response to these comments can be found in the following document which is available in the public docket: "HED Response to Public Comments on the Thiophanate-Methyl Preliminary Risk Assessment" dated November 29, 2001.

EPA also received a group comment from the World Wildlife Fund, Natural Resources Defense Council, Center for Conservation Innovation, Consumers Union, and Benbrook Consulting Services regarding the FQPA safety factor. They believe that the full 10X FQPA safety factor should be applied to thiophanate-methyl because of its endocrine disruption. The Agency believes that the FQPA Safety Factor is necessary for TM due to an incomplete toxicity database because acute and subchronic neurotoxicity studies are required due to evidence of neurotoxicity. However, the FQPA safety factor can be reduced to 3X because the available data provided no indication of increased susceptibility *in utero* in the developmental studies in rats and rabbits or following pre-/postnatal exposure in the multi-generation reproduction studies in rats and the dietary (food and drinking water) and non-dietary exposure assessments will not underestimate the potential exposure for infants and children from the use of TM.

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 dietary (food sources only) exposure to thiophanate-methyl is within its own "risk cup." An aggregate assessment was conducted for exposures through food, drinking water, and residential uses. The Agency has determined that

the human health risks from these combined exposures are within acceptable levels. In other words, EPA has concluded that the tolerances for thiophanate-methyl meet the FQPA safety standards. In reaching this determination, EPA has considered the available information on the special sensitivity of infants and children, as well as the chronic and acute food exposure.

Therefore, there are no changes in thiophanate-methyl tolerances due to risk concerns. Some tolerances will change because the data indicate either that a lower or higher tolerance is needed. Some will be revoked because they are no longer a regulated commodity or significant livestock feed items. Some will be reassigned because a crop group tolerance will be established.

b. Determination of Safety for U.S. Population

EPA has determined that the established tolerances for thiophanate-methyl, with amendments and changes as specified in this document, meet the safety standards under the FQPA amendments to section 408(b)(2)(D) of the FFDCA, that there is a reasonable certainty of no harm for the general population. In reaching this determination, EPA has considered all available information on the toxicity, use practices, and scenarios, and the environmental behavior of thiophanate-methyl. As discussed in chapter 3, the total acute dietary (food alone) risk from TM and MBC is below the level of concern as is the chronic (non-cancer) and cancer dietary risk from food alone. Risks from drinking water exposures are not of concern based on rate reductions on certain agricultural crops and turf and the cancellation of commercial sod farm turf. Although the projected surface water concentrations exceed the Agency's cancer concern level, the Agency believes that those projections are conservative and over-estimate the human exposure to thiophanate-methyl that will result from drinking water sources from surface water (See Regulatory Rationale under Drinking Water in section IV.D.1.a.iv.). Risks from residential exposures are also not of concern based on rate reduction and other mitigation measures.

c. Determination of Safety for Infants and Children

EPA has determined that the established tolerances for thiophanate-methyl, with amendments and changes as specified in this document, meet the safety standards under the FQPA amendments to section 408(b)(2)(C) of the FFDCA, that there is a reasonable certainty of no harm for infants and children. The safety determination for infants and children considers the factors noted above for the general population, but also takes into account the possibility of increased dietary exposure due to the specific consumption patterns of infants and children, as well as the possibility of increased susceptibility to the toxic effects of thiophanate-methyl residues in this population subgroup.

In determining whether or not infants and children are particularly susceptible to toxic effects from thiophanate-methyl residues, EPA considered the completeness of the database for developmental and reproductive effects, the nature of the effects observed, and other information. The FQPA Safety Factor is necessary for TM due to an incomplete toxicity database (acute and subchronic neurotoxicity studies are required due to potential neurotoxicity) and the requirement for a developmental neurotoxicity study has been 'reserved'. However, the

FQPA safety factor can be reduced to 3X because (1) the Agency evaluated the new 1997 prenatal developmental toxicity study in rabbits and classified this study as acceptable for assessment of susceptibility; (2) the dietary prenatal developmental toxicity study in the rat was considered to be acceptable for assessment of susceptibility; (3) the available data provided no indication of increased susceptibility *in utero* in the developmental studies in rats and rabbits or following pre-/postnatal exposure in the multi-generation reproduction studies in rats; and (4) the dietary (food and drinking water) and non-dietary exposure assessments will not underestimate the potential exposure for infants and children from the use of TM. The 3X FQPA safety factor for TM is applicable to all population subgroups for dietary and non-dietary exposure assessments of all durations since the toxicology database for TM is incomplete and the requirement for a developmental neurotoxicity study has been 'reserved'.

For MBC, the FQPA safety factor was retained at 10X for two reasons. First, there was evidence of increased susceptibility following *in utero* exposure of MBC in the prenatal developmental toxicity study in rats and rabbits. In the rat study, developmental anomalies (decreased fetal body weight and increases in skeletal variations and a threshold for malformations of the CNS) occurred at doses which were not maternally toxic. In the rabbit study, developmental toxicity was manifested as decreased implantations and live litter size and increased resorptions at a dose that did not cause maternal toxicity. Second, there is a need for developmental neurotoxicity studies in rats for MBC because in a prenatal developmental toxicity study in rats with MBC, treatment-related malformations of the CNS were observed. Also, there is increased sensitivity of rat and rabbit fetuses as compared to maternal animals following *in utero* exposure to MBC in prenatal developmental toxicity studies. Lastly, in mutagenicity studies with MBC, there is evidence of aneuploidy induction following oral dosing in mice. Mutagenicity data support the evidence of developmental anomalies in rats. The FQPA safety factor for MBC is applicable for all risk assessments for females 13-50 years, infants, and children (1-6 years and 7-12 years).

d. 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 endocrine effects as the Administrator may designate." Following recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there was scientific basis 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 EPA include evaluations of potential effects in wildlife. For pesticides, 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 EDSP have been developed, thiophanate-methyl may be subject to additional screening and/or testing to better characterize effects related to endocrine disruption.

e. Cumulative Risks

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." Thiophanate-methyl is a benzimidazole fungicide structurally related to albendazole, fenbendazole, mebendazole, oxfendazole and thiabendazole. Although chemical class is not necessarily synonymous with a common mechanism of toxicity, structurally similar chemical substances do frequently exhibit common modes of toxicity. However, at this time, EPA has not made a common mechanism of toxicity finding for thiophanate-methyl with any other benzimidazole fungicides or any other pesticide. Therefore, for the purposes of this risk assessment, the Agency has assumed that thiophanate-methyl does not share a common mechanisms of toxicity with other pesticides. After a decision is made regarding common mechanism of toxicity, and if the Agency determines that a cumulative assessment is necessary, the Agency will address any outstanding risk concerns at that time.

f. Tolerances Summary

A summary of the thiophanate-methyl tolerance reassessment is presented in Table 36. A full description of the tolerance reassessment can be found in the Residue Chemistry Chapter for Thiophanate-methyl dated April 3, 2002. In the assessment, tolerances for residues of thiophanate-methyl in/on plant and livestock raw agricultural commodities are currently expressed in terms of TM, its oxygen analogue [dimethyl-4,4'-o-phenylene bis(allophanate)], and its benzimidazole-containing metabolites, (calculated as TM) [40 CFR § 180.371]. However, EPA has concluded that the residues to be regulated in plant and animal commodities for the purposes of tolerance enforcement consist of TM and its metabolite methyl 2-benzimidazolyl carbamate (MBC). Accordingly, the tolerance definition listed under 40 CFR § 180.371 will be amended to read as follows:

Tolerances are established for the combined residues of thiophanate-methyl (dimethyl [(1,2-phenylene) bis (iminocarbonothioyl)] bis(carbamate)) and its metabolite methyl 2-benzimidazolyl carbamate (MBC), calculated as thiophanate-methyl in or on the following commodities:

Table 36. Tolerance Reassessment Summary for Thiophanate-methyl

Commodity	Current Tolerance (ppm)	Tolerance Reassessment[a] (ppm)	Comment/*Correct Commodity Definition*
Tolerances Listed Under 40 CFR § 180.371(a)			

Commodity	Current Tolerance (ppm)	Tolerance Reassessment[a] (ppm)	Comment/*Correct Commodity Definition*
Almond	0.2(N)	0.1	Residue data indicate the tolerance for residues in/on *almond* and *almond, hulls* can be lowered.
Almond, hulls (PRE-H)	1.0	0.5	
Apple, dry pomace	40.0	Revoke	Dried apple pomace is no longer a regulated commodity.
Apple, postharvest	7.0	2.0	The available residue data indicate that the tolerance can be reduced.
Apricot, postharvest	15.0	TBD[b]	Residue data are required.
Banana	2.0	2.0	*Banana*
Banana, pulp	0.2	Revoke	Banana pulp is not a regulated commodity
Bean (snap and dry)	2.0	0.2	The available data indicate the tolerance can be lowered./*Bean, dry, seed*
		2.0	The available lima and snap bean residue data support a 2.0 ppm tolerance for residues in/on *bean, snap, succulent*
Bean (forage and hay)	50.0	Revoke	With the exception of cowpea forage and hay, bean forage and hay are no longer considered significant livestock feed items.
Cattle, fat	0.1	0.15	The available ruminant feeding study indicates that tolerances of 0.15 ppm are appropriate for meat and fat and that a single tolerance of 0.15 ppm should be established for residues in *cattle, meat byproducts*. Therefore, liver and kidney tolerances can be reassigned.
Cattle, kidney	0.2(N)	Reassign	
Cattle, liver	2.5	Reassign	
Cattle, meat byproducts, except kidney and liver	0.1(N)	0.15	
Cattle, meat	0.1(N)	0.15	
Celery	3.0	Revoke	Use on celery was voluntarily canceled by the registrant (62FR67365). Data are required to support the use on celery.
Cherry, postharvest	15.0	20.0	The available residue data indicate that the tolerance should be increased.

Commodity	Current Tolerance (ppm)	Tolerance Reassessment[a] (ppm)	Comment/*Correct Commodity Definition*
Cucumber	1.0	Reassign	Individual tolerances for cucumber, melon, pumpkin, and squash should be reassigned and a crop group tolerance should be established for *vegetable, cucurbit, group 9*.
Egg	0.1(N)	Revoke	40 CFR § 180.6(a)(3)
Goat, fat	0.1(N)	0.15	The available ruminant feeding study indicates that tolerances of 0.15 ppm are appropriate and that a single tolerance for residues in *goat, meat byproducts* should be established.
Goat, kidney	0.2	Reassign	
Goats, liver	2.5	Reassign	
Goat, meat byproducts, except kidney and liver	0.1(N)	0.15	
Goat, meat	0.1(N)	0.15	
Grape	5.0	5.0	

Commodity	Current Tolerance (ppm)	Tolerance Reassessment[a] (ppm)	Comment/*Correct Commodity Definition*
Hog, fat	0.1(N)	Revoke	Based upon the maximum theoretical dietary burden for swine and data from the ruminant feeding study, a Category 3 [40 CFR § 180.6(a)(3)] situation exists for thiophanate-methyl residues in hog commodities.
Hog, liver	1.0		
Hog, meat byproducts, except liver	0.1(N)		
Hog, meat	0.1(N)		
Horse, fat	0.1(N)	Reassign	The available ruminant feeding study indicates that tolerances of 0.15 ppm are appropriate for meat and fat and that a single tolerance should be established for residues in *horse, meat byproducts*.
Horse, liver	1.0	Reassign	
Horse, meat byproducts, except liver	0.1(N)	0.15	
Horse, meat	0.1(N)	0.15	
Melon	1.0	Reassign	Individual tolerances for cucumber, melon, pumpkin, and squash should be reassigned and a crop group tolerance should be established for *vegetable, cucurbit, group 9.*
Milk	1.0	1.5	Data from the ruminant feeding study indicates that the tolerance can be lowered.
Nectarine, postharvest	15.0	Reassign	In accordance with 40 CFR § 180.1(h) residues in/on nectarines are covered by the tolerance for residues in/on *peach*.
Onion , dry	3.0	0.5	The available data indicate that the tolerance can be lowered./*Onion, dry bulb*
Onion, green	3.0	TBD	Residue data required.
Pecans	0.2	0.1	Residue data indicate that the tolerance can be lowered. *Pecan*.
Peach, postharvest	15.0	3.0	Residue data indicate that the tolerance can be lowered.
Peanut	0.2(N)	0.1	Residue data indicate that the tolerance can be lowered.
Peanut (forage and hay)	15.0	Revoke	Peanut forage is no longer considered a significant livestock feed item.

Commodity	Current Tolerance (ppm)	Tolerance Reassessment[a] (ppm)	Comment/*Correct Commodity Definition*
		5.0	Residue data indicate that the tolerance can be lowered./*Peanut, hay*
Pistachio	0.1	0.1	
Pear	3.0	3.0	
Plum, postharvest	15.0	0.5	Available residue data indicate that the tolerance can be lowered.
Plum, prune, postharvest	15.0	Reassign	The tolerance for residues in/on plums covers residues in prunes as residues do not concentrate in prunes processed from treated plums.
Potato	0.1	0.1	
Poultry, fat	0.1(N)	Revoke	40 CFR § 180.6(a)(3)
Poultry, liver	0.2(N)		
Poultry, meat byproducts, except liver	0.1(N)		
Poultry, meat	0.1(N)		
Pumpkin	1.0	Reassign	Individual tolerances for cucumber, melon, pumpkin, and squash should be reassigned and a crop group tolerance should be established for *vegetable, cucurbit, group 9*.
Sheep, fat	0.1(N)	0.15	The available ruminant feeding study indicates that tolerances of 0.15 ppm are appropriate for meat and fat and that a single tolerance of 0.15 ppm should be established for residues in *sheep, meat byproducts*.
Sheep, kidney	0.2	Revoke	
Sheep, liver	2.5	Revoke	
Sheep, meat byproducts, except kidney and liver	0.1(N)	0.15	
Sheep, meat	0.1(N)	0.15	
Soybean	0.2	0.2	

Commodity	Current Tolerance (ppm)	Tolerance Reassessment[a] (ppm)	Comment/*Correct Commodity Definition*
Squash	1.0	Reassign	Individual tolerances for cucumber, melon, pumpkin, and squash should be reassigned and a crop group tolerance should be established for *vegetable, cucurbit, group 9*.
Strawberry	5.0	7.0	Residue data indicate that the tolerance should be increased./*Strawberry*
Sugar beet, roots	0.2	TBD	An additional field trial in CA is required. However, the available data indicates that the established tolerance of 0.2 ppm for residues in/on sugar beet roots is adequate, and that the current tolerance of 15 ppm for residues in/on sugar beet tops is too high.
Sugar beet, tops	15.0		
Sugarcane, seed piece treatment PRE-H	0.1(N)	Revoke	Sugarcane registration was canceled by the registrant.
Wheat, grain	0.05	0.1	The tolerance should be increased as the LOQ for the combined residue is 0.1 ppm..
Wheat, hay	0.1	TBD	Additional data are required, available data indicates that tolerance will need to be increased.
Wheat, straw	0.1		
Tolerances to be established under 40 CFR § 180.371(a)			
Vegetable, cucurbit, group 9	-	1.0	Individual tolerances for cucumber, melon, pumpkin, and squash should be reassigned and a crop group tolerance for cucurbit vegetables (Crop Group 9: cucumber, gherkin, watermelon, pumpkin, melon, and squash) should be established at 1.0 ppm.
Soybean, hulls	-	1.5	Based upon HAFT residues of 0.2 ppm in/on soybeans and the observed 6.5x concentration factor for hulls. A separate tolerance is required for soybean, hulls.
Soybean, aspirated grain factions	-	TBD	Residue data are required.
Tolerances established under 40 CFR § 180.371(b)			

Commodity	Current Tolerance (ppm)	Tolerance Reassessment[a] (ppm)	Comment/*Correct Commodity Definition*
Blueberry	1.5	1.5	The available data are adequate to support a temporary Section 18 Emergency Exemption tolerance in CT, IN, MI, NJ, NY, OH, and PA of 1.5 ppm with a 7-day PHI.
Citrus	0.5	0.5	The available data are adequate to support a temporary Section 18 Emergency Exemption tolerance in FL and LA of 0.5 ppm.
Mushroom	0.01	0.01	The available data are adequate to support a temporary Section 18 Emergency Exemption tolerance in DE, MD, and PA of 0.01 ppm.
Tolerances to be established under 40 CFR § 180.371(c)			
Canola, seed	-	0.2	The available data are adequate to support a tolerance on canola, seed with a regional registration in MN, MT (East of Interstate 15), and ND.

a Reassessed tolerances are tentative pending submission of supporting storage stability data.
b TBD = To be determined. Tolerance cannot be determined at this time because additional data are required.

(1) Codex Harmonization

The Codex Alimentarius Commission has established maximum residue limits (MRLs) for thiophanate-methyl residues in/on various plant and animal commodities. Codex MRLs for thiophanate-methyl are currently expressed as carbendazim (MBC). The Codex MRL residue definition and the U.S. tolerance definition are currently incompatible and will remain incompatible even after the U.S. tolerance definition is revised, as the revised tolerance definition will include both thiophanate-methyl and MBC, while the Codex MRL definition only includes MBC.

A comparison of the Codex MRLs and the corresponding U.S. tolerances is presented in Table 37.

Table 37. Codes MRLs for thiophanate-methyl and applicable U.S. tolerances.

Codex		Reassessed U.S. Tolerance (ppm)	Recommendation and Comments
Commodity (As Defined)	MRL (mg/kg)		
Apple	5 (Po) [a]	2.0	U.S. data reflect only a pre-harvest use.
Banana	1	TBD	Residue data are required for reassess U.S. tolerance
Broad bean (green pods/immature seeds)	2	2.0	
Carrot	5	None	Not registered for this use in the U.S.
Celery	20 (Po)	None	The use on celery was voluntarily cancelled and the Agency has proposed revoking the tolerance.
Cereal grains	0.1 (*) [b]	0.1 (wheat)	Residue data reflecting the U.S. use pattern support a 0.1 ppm tolerance
Cherries	10	20.0	Residue data reflecting the U.S. use pattern support a 20 ppm tolerance
Chicken fat	0.1 (*)	–	40 CFR §180.6 (a)(3)
Chicken meat	0.1 (*)	–	40 CFR §180.6 (a)(3)
Citrus fruits	10 (Po)	None	Not currently registered for this use in the U.S.
Common bean (pods and /immature seeds)	2.0	2.0	
Cucumber	0.5	1.0	Crop group tolerance will be established.
Currant, Black	5	None	Not registered for this use in the U.S.
Gherkin	2	1.0	Crop group tolerance will be established.
Gooseberry	5	None	Not registered for this use in the U.S.
Grapes	10	5.0	Residue data reflecting the proposed U.S. use pattern support a 5.0 ppm tolerance.
Lettuce, Head	5	None	Not registered for this use in the U.S.
Mushrooms	1	None	Not registered for this use in the U.S.
Onion, Bulb	0.1 (*)	0.5	Residue data (dry bulb) reflecting the U.S. use pattern support a 0.5 ppm tolerance
Peach	10 (Po)	3.0	U.S. data reflect only a pre-harvest use.
Pear	5 (Po)	3.0	U.S. data, under current review, reflect only a pre-harvest use.
Plums (including prunes)	2	0.5	Residue data reflecting the U.S. use pattern support a 0.5 ppm tolerance
Raspberries, Red, Black	5	None	Not registered for this use in the U.S.
Strawberry	5	7.0	Residue data reflecting the U.S. use pattern support a 7.0 ppm tolerance
Sugar beet	0.1 (*)	TBD	Residue data are required for reassess U.S. tolerance

Codex		Reassessed U.S. Tolerance (ppm)	Recommendation and Comments
Commodity (As Defined)	MRL (mg/kg)		
Sugar beet leaves or tops	5	TBD	Residue data are required for reassess U.S. tolerance
Tomato	5	None	Not registered for this use in the U.S.

a The (Po) following the MRL indicates that the MRL reflects a postharvest use.
b An asterisk (*) signifies that the MRL was established at or about the limit of detection.

Residue Analytical Methods

Adequate analytical methodology is available for collecting residue data on TM and its metabolites (MBC, 2-AB and the hydroxylated metabolites of MBC) in plant and animal commodities; however, new enforcement analytical methods for plant and animal RACs are required.

A single enforcement method for determining parent and MBC in plant commodities is listed in the Pesticide Analytical Manual (PAM), Vol. II, as Method I. As this method is a spectrophotometric method, it is no longer considered acceptable for enforcing tolerances. The two additional methods listed in PAM Vol. II, Methods A and B, are also spectrophotometric methods for plant commodities. In addition, Method A is for determining the metabolite allophanate, which is no longer a residue of concern.

The registrant, Cerexagri, has proposed a HPLC/UV enforcement method for TM residues in/on plant commodities and a successful independent laboratory validation (ILV) trial using potatoes and peanut hay. The Agency has concluded that this method, BR-93-28, is adequate for determining residues of TM and MBC in/on plant commodities and has a validated limit of quantitation (LOQ) of 0.5 ppm and 0.5 ppm for potatoes and peanut hay, respectively for both TM and MBC. However, the HPLC/UV Method BR-93-28 must still be radio validated using samples from a plant metabolism study prior to Agency validation.

The registrant has proposed a HPLC/UV enforcement analytical method for determining residues of TM and MBC in animal commodities, which recently underwent a successful ILV trial. The validated method LOQ is 0.05 ppm for TM and MBC in muscle, liver and eggs, and MBC in milk. Prior to Agency validation, the method should be radio validated using samples from an animal study.

The FDA PESTDATA database indicates that TM and MBC are completely recovered using FDA Multiresidue Protocol A (PAM I Section 242.2). Additional multiresidue method (MRM) recovery data are required for TM and MBC through FDA MRM protocols A through G.

D. Regulatory Rationale

The following is a summary of the rationale for managing risks associated with the use of thiophanate-methyl. Where labeling revisions are warranted, specific language is set forth in the summary tables of Section V of this document.

1. Human Health Risk Management

a. Dietary (Food) Risk Mitigation

The Agency conducted highly refined probabilistic acute, chronic and cancer dietary risk assessments for all current uses of thiophanate-methyl. The acute, chronic and cancer dietary exposure assessments were conducted using the Dietary Exposure and evaluation Model (DEEM™) system. The DEEM™ analysis evaluated the individual food consumption as reported by respondents in the USDA 1989-91 Continuing Surveys for Food Intake by Individuals (SCFII) and accumulated exposure to the chemical for each commodity. For all analyses, anticipated residues and percent of crop treated data were used.

(1) Acute Dietary (Food)

The acute dietary risk for TM is below the Agency's level of concern for all population subgroups for both TM and MBC. The acute dietary risk estimates range from 5% to 25% for TM and 4% to 89% for MBC of the acute PAD at 99.9th percentile exposure, with infants (<1 year) being the highest exposed population subgroup. Therefore, the acute dietary (food) risk estimate is not of concern, and no risk reduction measures are necessary.

(2) Chronic Dietary (Food)

The chronic non-cancer dietary analysis indicates all risk estimates are below the Agency's level of concern for all population subgroups for either TM or MBC. The highest chronic dietary risk estimates are 2% and 26% of the chronic PAD, for TM and MBC, respectively, with the highest exposed population subgroup being children (1-6 years). Therefore, the chronic dietary (food) risk estimate is not of concern, and no risk reduction measures are necessary.

(3) Cancer Dietary (Food)

In accordance with the EPA Draft Guidelines for Carcinogen Risk Assessment, the Cancer Assessment Review Committee has classified TM as "likely to be carcinogenic to humans." MBC was classified as a group C (possible human carcinogen). The lifetime dietary cancer risk estimates range from 6.4×10^{-7} to 1.1×10^{-6} for TM, and 7.7×10^{-9} to 9.3×10^{-8} for MBC, depending on the uses, and whether field trial or PDP data were used. Generally, the Agency is concerned when cancer risk estimates exceed the range of 1×10^{-6} or one in one million. Therefore, no risk reduction measures are necessary.

b. Drinking Water Risk Mitigation

Risk mitigation for drinking water concerns were implemented prior to publication of this RED. In the preliminary risk assessment for TM, surface and groundwater concentrations were modeled based on application to turf and onions; the crops with the highest application rates. An application rate of 11 - 19.3 lbs ai/acre could be applied unlimited times to turf and up to 15 lbs ai/acre, once per season could be used on onions as per the labels. Based on the results of the preliminary drinking water assessment, the TM registrants submitted label amendments to lower the use rates. In addition, the use of TM on commercial sod turf was voluntarily cancelled. Turf rates were reduced as follows:

- Turf in residential/public areas (e.g., parks, athletic fields, lawns):
  2.74 lbs ai/acre, maximum annual application of 10.88 lbs ai/acre, 14 day retreatment interval.

- Golf course turf:
  1) Tees/greens (approximately 4% of a golf course):
  8.16 lbs ai/acre/application, 21.8 lbs ai/acre/year, 14 day retreatment interval.

  2) Fairways (approximately 23% of a golf course):
  5.45 lbs ai/acre/year, except in Florida, which has a maximum annual rate of 2.72 lbs ai/acre on fairways.

Agricultural use rates were also reduced due to drinking water concerns. The application rate on onions was reduced from 15 lbs ai/acre/season to 1.4 lbs ai/acre/season. The highest seasonal maximum rate for agricultural commodities is now 2.8 lbs ai/acre for the pomefruits, stonefruits, grapes, and potato foliar use. All other crops have a maximum rate lower than 2.8 lbs ai/acre/season.

Acute Dietary Risk (Food + Drinking Water) - post mitigation

The EECs are lower than the DWLOCs for all subpopulations except infants < 1 year old. Although the highest EEC of 28.3 ppb is higher than the DWLOC of 18, EPA believes that this risk is not of concern. The 1-year citrus Section 18 use significantly contributes to the food exposure estimate for infants, adding 45% to the %aPAD. If "citrus only" is removed from food exposure, the DWLOC becomes 94 ppb, which is well above the highest EEC. The DWLOC is significantly lowered by the addition of citrus because field trial data were used which results in an overly conservative estimation. Therefore, no further mitigation is necessary.

Chronic (Non-Cancer) Dietary Risk (Food + Drinking Water) - post mitigation

Chronic dietary food risk estimates are below the Agency's level of concern. The total dietary exposure to TM and MBC for the highest exposed population subgroup, children 1-6 years, is 28% of the cPAD for liver/thyroid effects, leaving 72% of the cPAD available for exposure through drinking water. The lowest DWLOC is 18 ppb for children 1-6. The highest long-term

surface water EEC is 12.2 ppb. Therefore, the non-cancer DWLOCs are greater than the surface water EECs for infants and children (1-6 years), indicating that chronic dietary (food + water) risks are below EPA's level of concern. Therefore, no further mitigation is necessary.

Cancer Dietary Risk (Food + Drinking Water) - post mitigation

The highest long-term surface water EEC is 12.2 ppb, adjusted to reflect TM + MBC as an MBC equivalent. This EEC is greater than the DWLOC (2.1 ppb), indicating that chronic (cancer) dietary (food and water) risks may be of concern. However, EPA believes that it is likely that the model overestimates exposure to thiophanate-methyl and MBC in surface water for the following reasons:

(1) The surface water assessment based on PRZM-EXAMS, a screening-level model that assumes maximum application rates are used every year for seventy years. This is a worst-case assumption because disease pressure fluctuates each year.

(2) The highest surface water EEC of 12.2 ppb translates into a cancer risk of $8.3x10^{-7}$ for surface water alone. This risk combined with the cancer risk from food of $8.5x10^{-7}$ results in a combined cancer risk of $1.7x10^{-6}$, which is still within a range considered acceptable by the Agency.

In light of these factors, EPA believes that mitigation measures already implemented adequately reduce potential cancer dietary risks and no further mitigation is necessary.

c. TM: Residential Risk Mitigation

Residential risk mitigation has already been implemented at the time of publication of this RED. Upon release of the risk assessments, a series of meetings were held with the registrants of TM products for use in the residential environment to discuss ways to reduce residential risks to levels below the Agency's level of concern. All registrants have submitted revised labels to the Agency and these label changes were in place for new production for the 2003 sales season (October - December 2002). The risk mitigation measures implemented are as follows:

- The maximum application rate on residential/public turf was reduced from 11 - 19.3 lb ai/acre to 2.74 lb ai/acre with a 14 day retreatment interval and a limit of 10.88 lbs ai/acre per year.

- The maximum single application rate for ornamentals is 1.8 lb ai/acre for homeowners using spray products.

- Only granular formulations are now available to residents for broadcast lawn treatment. Use of liquid formulations for broadcast turf/lawn use is restricted to commercial pest control operators (PCOs).

- Product labels were revised to specifically prohibit belly grinder and hand application methods.

- PCO treatment of backyard fruit trees will be allowed only up to fruit set.

(1) Residential Handler Mitigation

Residential application of TM formulated products to lawns and ornamentals at the new maximum label rate and with the other measures identified above resulted in risk estimates that are below the Agency's level of concern (i.e., total MOE >300). Total dermal and inhalation MOEs range from 5,800 to 35,000 for both broadcast (granular) and ornamental treatment scenarios for all equipment types. Lifetime cancer risk estimates for applying TM formulated products once per year for 50 years range from $4.7x10^{-9}$ to $2.8x10^{-8}$ for ornamental treatment using a backpack sprayer and a ready-to-use hose-end sprayer, respectively. Cancer risk estimates for the other application methods are between these ranges. Therefore, no further risk mitigation is necessary.

(2) Residential Postapplication Mitigation

Two short-term MOEs for children playing on treated turf were less than 300 and therefore, exceed EPA's level of concern (MOEs range from 31 to 250) for hand to mouth activities and incidental granular ingestion based on a screening level assessment. Dermal MOEs are acceptable; however, the aggregate MOE for children based on combined dermal and oral exposures is also below 300 (total MOE = 170 for treated turf). All other short-term MOEs were greater than 300 for adults and children during high dermal contact activities (such as hand weeding, playing, etc.), and adults involved in mowing and golf activities, and therefore, do not exceed EPA's level of concern.

The registrants of residential use products have committed to undertake a study to determine the dermal transfer efficiency of granular thiophanate-methyl residues from turf to dry and wetted palms. This hand press study is intended to confirm that the transfer coefficient used in the toddler oral ingestion exposure assessment is conservative and overestimates risk from mouthing behaviors. The Agency believes that the chemical-specific data in this study will verify that the residue dislodgeable from wet hands is, to some degree, less than the 5% default used in the assessment. This study will be submitted within the 8-month time period allotted to submit revised labels for thiophanate-methyl. In the event that registrants are unable to demonstrate an acceptable MOE for the hand to mouth scenario, registrants have committed to cancel all broadcast uses of thiophanate-methyl on lawns and turf in public areas.

The lifetime cancer risk estimates ranged from $1.3x10^{-9}$ to $1.3x10^{-7}$ for the scenarios evaluated (mowing and dermal contact, respectively). These cancer risks are below the Agency's level of concern; therefore, no further risk mitigation is necessary based on cancer concerns.

d. MBC: Residential Risk Mitigation

(1) Residential Handler Mitigation

For handlers of paints and other products containing MBC, all of the dermal short-term exposures failed to meet the target MOE of 1000 for non-occupational handlers. The dermal MOE was 750 for applying paints and coatings with a paint brush. For painting with an airless sprayer, the dermal MOE was 620. Loading and applying 5 gallons of paint or stain with a low-pressure hand wand resulted in a dermal MOE of 690.

Because of the uncertainty surrounding the use of the 90-day rat inhalation study with benomyl to evaluate short-term inhalation risks from MBC in paint, Troy Corporation, the sole registrant of MBC for use in paints and sealants, submitted a 5-day inhalation study with MBC, which was reviewed by the Agency as an acceptable non-guideline study after March 28, 2004 (post signature of the existing RED). Using the toxicity data from this study the Agency developed a NOAEL of 0.178 mg/L/day. Using this NOAEL, the Agency recalculated the MOEs for applying using an airless sprayer. The recalculated MOEs were now judged to be acceptable (e.g. MOEs>1000) without mitigation. However, there are still dermal exposure concerns, therefore:

- Label amendments were submitted to reduce the concentration of MBC in paint from 0.5% to 0.35%. Product containing 0.5% MBC may not be distributed or sold after December 31, 2002.

(2) Residential Postapplication Risk Mitigation

Post-application exposure to MBC-treated paints, coatings, and sealants is anticipated to be only by the inhalation route, as the treated materials will have dried and be relatively inert. The inhalation treated paint scenario post-application MOEs for toddlers and adults are 1,100,000 and 4,600,000 respectively. The cancer risk estimates for the same scenario are $3.6x10^{-10}$. Therefore, these exposures are not of concern and no mitigation is necessary.

e. Aggregate Risk Mitigation

(1) **Acute Aggregate Risk** (from TM use)

Since MBC has no food uses and exposure through drinking water is not likely based on current use patterns, acute aggregate risk reflects risks resulting from TM uses only. The total TM and MBC acute dietary risk estimate ranges from 44-51% of the aPAD for developmental effects for females of child bearing age (13-50 years). For infants (<1 year), the surface water EECs (but not groundwater) for MBC (23.5 - 28.3) are greater than the DWLOC of 18 ppb, indicating that aggregate food and drinking water exposure could exceed the Agency's level of concern. Although the EEC is exceeded, the DWLOC is greatly inflated as 50% of the aPAD percentage is consumed by citrus which is a 1-year registration only. When citrus is removed from the DWLOC estimation, the DWLOC becomes 94 ppb which is well above the EEC of 28.3 ppb.

The DWLOC is significantly lowered by the addition of citrus because field trial data were used which results in an overly conservative estimation.

This risk was mitigated by the cancellation of the use of thiophanate-methyl on commercial sod. Other turf rates have been reduced as follows:

- Turf in residential/public areas (e.g. parks, athletic fields, lawns):
  2.74 lbs ai/acre, maximum of 10.88 lbs ai/acre per year, 14 day retreatment interval.

- Golf course turf:
  1) Tees/greens (approximately 4% of a golf course): 8.16 lbs ai/acre/application. 21.8 lbs ai/acre/year. 14 day retreatment interval.

  2) Fairways (approximately 23% of a golf course): 5.45 lbs ai/acre/year, except in Florida, which has a maximum annual rate of 2.72 lbs ai/acre on fairways.

(2) Short-term Aggregate Risk (from all uses)

Aggregate potential short-term exposure to MBC and TM resulting from food, water and residential use due to TM, and MBC uses exceeds the Agency's level of concern for children (infants, and 1-6 years of age) and females 13 50 years, due primarily to TM post-application exposures on turf and MBC's use as a paint additive. These risks were mitigated by the rate reductions discussed above, for both turf products (TM) and paints and stains containing MBC. No further risk reduction is necessary.

(3) Chronic (Non-cancer) Aggregate Risk (from TM use)

The lowest DWLOC is 18 ppb for children 1-6. Using screening-level models, the highest long-term surface water EEC is 12.2 ppb. Therefore, the chronic non-cancer DWLOCs are greater than the surface water EECs indicating that chronic dietary (food + water) risks are below EPA's level of concern. Therefore, chronic aggregate risk is also below EPA's level of concern. No further risk mitigation is necessary.

(4) Chronic (Cancer) Aggregate Risk (from TM use)

The cancer aggregate 1 risk assessment includes chronic dietary exposures from TM and MBC residues estimated in food and water, and residential uses of TM. Cancer risk estimates using benomyl/MBC PDP monitoring data to estimate TM residues are below $1x10^{-6}$ for TM existing uses, new uses, and considering the amortized Section 18 use for citrus. The total TM and MBC dietary cancer risk estimate from food alone is $8.5x10^{-7}$. The cancer DWLOC is 2.1 ppb. Using screening-level models, the highest long-term surface water EEC (mean 36 year annual

concentration) is 11.5 ppb, adjusted to reflect TM + MBC as an MBC equivalent. This EEC is greater than the DWLOC, indicating that chronic dietary (food and water) risk may be of concern. Because the surface water assessment is based on a screening-level model that assumes maximum application rates are used every year for seventy years, this is a worst-case estimate. Finally, when combining conservative cancer risk estimates from food and from water (assuming the surface water estimated concentration is equivalent to the concentration that could be found in finished drinking water), the resultant risk is still within the range considered acceptable by the Agency. The highest surface water EEC of 12.2 ppb translates into a cancer risk of $8.3x10^{-7}$. When combined with the cancer risk from food of $8.5x10^{-7}$, this results in a cancer risk of $1.7x10^{-6}$. Including cancer risks from residential exposures does not significantly increase these risks. Adding cancer risk from treating ornamentals (the worst-case residential handler scenario with a cancer risk of $2.8x10^{-8}$) and dermal postapplication lawn exposure (the worst-case cancer risk of $1.3x10^{-7}$) results in a total food, drinking water, and residential cancer risk of $1.9x10^{-6}$. Considering the conservative nature of the aggregate scenarios, this is still within the range considered acceptable to the Agency.

(5) Chronic (Cancer) Aggregate Risk (from all uses)

Cancer risk to residential handlers during painting and to vapors following painting is $2.2x10^{-7}$. Added to the TM + MBC cancer risk of $1.9x10^{-6}$ from food, drinking water, and TM residential exposures, the total cancer risk is $2.1 x10^{-6}$. EPA considers this cancer risk within the range considered negligible. Also, this cancer risk is considered worst-case because the drinking water cancer risk is based on the highest modeled surface water EEC, which assumes the maximum application rate is used every year for seventy years in an area vulnerable to surface water contamination. Also, it is unlikely that a person would use TM to treat their ornamentals each year, perform high-exposure activities on the lawn immediately following application of TM, and also apply paint containing MBC every year. Finally, the cancer estimates for MBC use as a paint additive are conservative, because they are based on high end assumptions for occupancy, air exchange rates used in the air model, and assume no degradation or matrix effects of the paint.

f. Occupational Risk Mitigation

The Agency met with various stakeholders to discuss occupational risk mitigation on September 12, 2002 and January 23, 2003. Stakeholders submitted information regarding use rates, acreage, and use practices to the Agency in order to further refine the cancer risk assessment and possibly eliminate the necessity for some of the risk mitigation measures proposed by the Agency. This information was confirmed and used by the Agency to significantly refine the risk estimates.

(1) Handler Risk Mitigation

Handler exposure assessments are completed by EPA using a baseline exposure scenario and, if required, increasing levels of mitigation (PPE and engineering controls) to achieve an adequate

margin of exposure (MOE). For thiophanate-methyl the target MOE for workers is 100. Analyses for handler/applicator exposures were performed using PHED. These calculations indicate that the MOEs for many handler scenarios are below 100 at the baseline level and exceed EPA's level of concern. Most of these scenarios are acceptable with the addition of single layer PPE (which includes chemical resistant gloves). However, mixing/loading wettable powder formulations for aerial/chemigation application requires the use of engineering controls (i.e., water soluble bags) to reach an acceptable risk level.

Occupational cancer risks greater than $1x10^{-4}$ are of concern. For risks between $1x10^{-6}$ and $1x10^{-4}$, EPA carefully evaluates exposure scenarios to seek cost effective ways to reduce cancer risks to the greatest extent feasible, preferably to a risk of $1x10^{-6}$ or less.

Based on the revised cancer risk estimates, all handler risk estimates were below $1x10^{-4}$ and most were below $3x10^{-6}$ (with either protective equipment or engineering controls).

There are currently insufficient data to evaluate scenarios of applying dip treatments, mixing/loading/applying dry flowables using a low pressure handwand, and loading/applying wettable powder/DF solution as a seedling or bulb dip treatment. Although there are no data to assess mixing/loading/applying dry flowables using a low pressure handwand, EPA believes exposure resulting from this registered use scenario would be less than mixing/loading/applying a wettable powder using a low pressure handwand. Additional data are requested for the registered uses of dip treatment.

To address cancer risks to occupational handlers, EPA has determined that the following mitigation measures are necessary, reasonable, and cost-effective:

- Wettable powder formulations labeled for aerial/chemigation application on food crops must be packaged in **water soluble bags**. Wettable powder formulations not packaged in water soluble bags must be labeled to specifically prohibit aerial/chemigation use.

- An **enclosed cab** is required for planters/operators during the following activity:

  Planting Potato Seed that has been treated with dust

- Because of a lack of data, **double-layer PPE, chemical-resistant gloves, and a chemical-resistant apron** must be worn when performing the following task:

  Applying Dip Treatment
  Mixing/Loading/Applying Dip Treatment

- **Single-layer PPE (Baseline) and chemical-resistant gloves** must be worn when handlers are performing the following tasks:

  Mixing/Loading Wettable Powders

Mixing/Loading Liquid Flowable Concentrates
Loading Dusts for Seed Treatment
Mixing/Loading/Applying Liquids using High Pressure Handwand
Mixing/Loading/Applying Dry Flowables using Low Pressure Handwand
Mixing/Loading/Applying Wettable Powder using Low Pressure Handwand
Mixing/Loading/Applying Liquids using Low Pressure Handwand
Mixing/Loading/Applying with a Backpack Sprayer
Loading/Applying Granules to Turf using Belly Grinder
Loading/Applying Dust as a Seed Treatment (dry) in planter box
Cutting & Sorting potatoes that were treated with dust as a seed treatment

- Single-layer PPE (Baseline) must be worn by handlers during the following activities

Mixing/Loading Dry Flowables/Water Dispersible Granules
Loading Granulars for Mechanical Ground Application
Applying Sprays Aerially
Applying with Groundboom Sprayer
Applying with Airblast Sprayer
Applying with a Handgun Sprayer
Applying Granulars with a Tractor-Drawn Spreader
Loading/Applying Granules to Turf using Push-Type Spreader
Flagging Aerial Spray Applications

(2) Post-application Risk Mitigation

The Restricted Entry Interval (REI) represents the amount of time required for residues to dissipate in treated areas prior to beginning a job or task in that area such that the resulting exposures do not exceed the Agency's level of risk concern. 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 risk level. For a specific crop/pesticide combination, the duration required to achieve the target risk estimate can vary depending on the activity assessed.

To address potential risks to postapplication workers, the Agency is modifying the REIs for thiophanate-methyl as described in Table 38 below. Based upon revised risk estimates, most postapplication practices result in cancer risk estimates below $3x10^{-6}$ and all are below $1x10^{-4}$. EPA's goal is to reduce risks to workers to the greatest extent feasible, preferably to $1x10^{-6}$ or less. At current labeled thiophanate-methyl application rates, cut flower harvesters would have both short-term and cancer risks of concern when contacting plants after application. The Agency has determined that significant risk reduction would occur by **reducing the maximum allowable rate on cut flowers to 0.5 lb ai/acre**, which is currently the typical rate at which TM is applied to cut flowers.

Table 38. Restricted Entry Intervals (REIs) for Thiophanate-methyl

Crop	REI (days)
Apples, apricots, cherries, grapes, nectarines, peaches, pears, plums/prunes, and potato	2
Almonds, dry beans, onions, pecans, pistachio	3
Blueberries, cucurbits, green beans, strawberries, peanuts, sugar beets, soybeans, wheat	1
Cut flowers and woody ornamentals	12 hours

EPA is aware that certain activities, including scouting, irrigation and beehive maintenance may need to take place during REIs. Scouting is a handler activity under the WPS, so anyone performing this activity may enter the treated field during the REI provided they use the handler 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 irrigation and beehive maintenance, EPA believes that these activities will usually be allowed under one or more of the WPS reentry exceptions, such as for no contact short-term and limited contact activities.

2. Environmental Risk Mitigation

The implementation of the mitigation measures described above (i.e, rate reductions), has resulted in decreases in exposure values, leading to much lower RQ's for both terrestrial and aquatic organisms. There are a few scenarios which still show LOC exceedances as outlined in Chapter 3. All of these exceedances are slight and therefore, EPA has determined that no further risk mitigation is necessary for environmental concerns.

3. Other Labeling Requirements

In order to be eligible for reregistration, various use and safety information must also be placed on the labeling of all end-use products containing thiophanate-methyl. For the specific labeling statements, refer to Section V of this document.

a. Endangered Species Statement

The Agency is not currently requiring Thiophanate Methyl products to carry an endangered species specific label statement. However, should pesticide use limitations be identified as necessary to ensure protection of endangered and threatened species, the Agency may require changes to the label at that time. 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 pesticides 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 that time. A determination that there is a likelihood of potential impact to a listed species may result in limitations on use of the pesticide, other measures to mitigate any potential impact, or consultations with the Fish and Wildlife Service and/or the National Marine Fisheries Service as necessary.

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. These Pamphlets are available for voluntary use by pesticide applicators, on EPA's web site at www.epa.gov/espp. A final Endangered Species Protection Program, which may be altered from the interim program, was proposed for public comment in the Federal Register on December 2, 2002.When the program is implemented, epa will undertake an effort to validate measures and alternatives contained in county specific pamphlets. Valid measures and alternatives, or new pesticide use limitations may be required to fully mitigate potential risk to listed species.

b. Spray Drift Management

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 is 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, 66 FR 44141 (http://www.epa.gov/fedrgstr) announcing the availability of this draft guidance for a 90-day public comment period. After receipt, and review of the comments, the Agency will publish final guidance in a PR notice for registrants to use when labeling their products.

V. What Registrants Need to Do

The Agency has determined that thiophanate-methyl is eligible for reregistration provide that: (i) additional data that the Agency intends to require confirm this interim decision; 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 V.D. below. The additional data requirements that the Agency intends to obtain will include, among other things, submission of the following:

A. For thiophanate-methyl 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 Nathan Mottl at (703) 305-0208 with questions regarding generic reregistration and/or the DCI. All materials submitted in response to the generic DCI should be addressed as follows:

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

By express or courier service:
Document Processing Desk (DCI/SRRD)
Nathan Mottl
Office of Pesticide Programs (7508C)
Room 266A, Crystal Mall 2
1801 South Bell Street
Arlington, VA 22202

B. For products containing the active ingredient thiophanate-methyl, 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:

(1) two copies of the confidential statement of formula (EPA Form 8570-4);

(2) a completed original application for reregistration (EPA Form 8570-1). Indicate on the form that it is an "application for reregistration";
(3) five copies of the draft label incorporating all label amendments outlined in Table 39 of this document;
(4) a completed for certifying compliance with data compensation requirements (EPA Form 8570-34);
(5) if applicable, a completed for certifying compliance with cost share offer requirements (EPA Form 8570-32); and
(6) the product-specific data responding to the PDCI.

Please contact Jane Mitchell at (703) 308-8061 with questions regarding product reregistration and/or the PDCI. All materials submitted in response to the PDCI should be addressed as follows:

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

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

A. Manufacturing Use Products

1. Additional Generic Data Requirements

The generic data base supporting the reregistration of thiophanate-methyl for the above eligible uses has been reviewed and determined to be substantially complete. However, the following data requirements are necessary to confirm the reregistration eligibility decision documented in this RED.

Toxicology Data
TM:
OPPTS GLN 870.6200 - Rat Acute and Subchronic Neurotoxicity Screening Studies
OPPTS GLN 870.6300 - Developmental Neurotoxicity Study 'Reserved' pending the results of the above studies.
OPPTS GLN 870.3465 - 90-day Subchronic Inhalation Toxicity Test, Rat

MBC:
OPPTS GLN 870.3200 - Repeated Dose Dermal Toxicity Test (21 Day - rat)
OPPTS GLN 870.6300 - Developmental Neurotoxicity Study in rats
OPPTS GLN 870.3800 - 2-Generation Reproduction and Fertility Effects, Rat

Product Chemistry Data
OPPTS GLN 830.1620 - Starting Materials and Manufacturing Process
OPPTS GLN 830.1670 - Discussion of Formation of Impurities
OPPTS GLN 830.6313 - Stability
OPPTS GLN 830.7050 - UV/Visible Absorption

Residue Chemistry Data
OPPTS GLN 860.1200 - Directions for Use
OPPTS GLN 860.1340 - Residue Analytical Methods
OPPTS GLN 860.1360 - Multiresidue Method Testing
OPPTS GLN 860.1380 - Storage Stability Data
OPPTS GLN 860.1500 - Magnitude of the Residue in Plants
OPPTS GLN 860.1520 - Magnitude of the Residue in Processed Food/Feed

Occupational Exposure Data
Handlers:
OPPTS GLN 875.1100 - Dermal Exposure: Outdoor (Mixing/loading/applying WP/DF solution as a seedling or bulb treatment)
OPPTS GLN 875.1200 - Dermal Exposure: Indoor (Mixing/loading/applying wettable powder; greenhouse use)
OPPTS GLN 875.1300 - Inhalation Exposure: Outdoor (Mixing/loading/applying WP/DF solution as a seedling or bulb treatment)

OPPTS GLN 875.1400 - Inhalation Exposure: Indoor (Mixing/loading/applying wettable powder; greenhouse use)

Post-application Workers:
OPPTS GLN 875.2400 - Dermal Exposure - Handling treated seed & seedlings; sorting, packing crops; cultivating, transplanting in treated soil.
OPPTS GLN 875.2800 - Descriptions of human activity - Handling treated seed & seedlings; sorting, packing crops; cultivating, transplanting in treated soil.

2. Labeling for Manufacturing-Use Products

To ensure compliance with FIFRA, manufacturing use product (MUP) labeling should be revised to comply with all current EPA regulations, PR Notices and applicable policies. The MUP labeling should bear the labeling contained in Table 39 at the end of this section.

B. 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 measures outlined in Section IV above. Specific language to incorporate these changes is specified in Table 39.

C. Existing Stocks

Registrants may generally distribute and sell products bearing old labels/labeling for 12 months from the date of the issuance of this Reregistration Eligibility Decision document. Persons other than the registrant may generally distribute or sell such products for 24 months from the date of the issuance of this RED. However, existing stocks time frames will be established case-by-case, depending on the number of products involved, the number of label changes, and other factors. Refer to "Existing Stocks of Pesticide Products; Statement of Policy"; *Federal Register*, Volume 56, No. 123, June 26, 1991.

D. Labeling Requirements Summary Table

Table 39. Summary of Required Labeling Changes for Thiophanate-methyl

Description	Amended Labeling Language	Placement on Label
Manufacturing Use Products		
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	"Only for formulation into a fungicide for the following uses: almonds, apples, apricots, canola, dry beans, grapes, green beans, cantaloupes, cherries, cucumbers, melons, nectarines, onions, peaches, peanuts, pears, pecans, pistachios, plums, potatoes, pumpkins, soybeans, squash, strawberries, sugar beets, watermelons, wheat, ornamentals, and turf.	Directions for Use
	"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	"Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the EPA."	Precautionary Statements immediately following the User Safety Recommendations

Description	Amended Labeling Language	Placement on Label
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 thiophanate-methyl, 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 thiophanate-methyl, 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
Storage and Disposal	"Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be used according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance."	Pesticide Disposal
End Use Products Intended for Occupational Use (WPS and Non-WPS Uses)		

Description	Amended Labeling Language	Placement on Label
PPE Requirements Established by the RED[1] for Liquid Products	"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. Handlers mixing, loading and applying the product as a dip must wear: Coveralls over long sleeved shirt and long pants, Chemical-resistant gloves, Chemical resistant footwear plus socks, A chemical resistant apron. All other mixers and loaders and applicators must wear: Long-sleeved shirt and long pants, Shoes plus socks, Chemical-resistant gloves for all mixers and loaders and for applicators using hand held equipment, and Chemical-resistant apron for mixers, loaders and other handlers exposed to the concentrate."	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals

Description	Amended Labeling Language	Placement on Label
PPE Requirements Established by the RED[1] for wettable powder products Wettable powder products labeled for aerial and chemigation use on food crops must be in water soluble bags.	"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. Mixers, loaders, applicators and other handlers supporting dip treatment must wear: Coveralls over long sleeved shirt and long pants, Chemical-resistant gloves, Chemical resistant footwear plus socks, Chemical-resistant apron. All other mixers, loaders, applicators and handlers must wear: Long-sleeved shirt and long pants, Shoes plus socks, Chemical-resistant gloves for all mixers and loaders and for applicators using hand held equipment. See engineering controls for additional requirements" *(Only required for products for aerial and chemigation use on food crops)*	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals

Description	Amended Labeling Language	Placement on Label
PPE Requirements Established by the RED for Granular Products	"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. Loaders, applicators and other handlers must wear: Long-sleeved shirt and long pants, Shoes plus socks, Chemical-resistant gloves are required for applicators using hand held equipment."	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals
PPE Requirements Established by the RED for Dry Flowable/Water Dispersible Granule Products	"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. Handlers mixing, loading and applying the product as a dip must wear: Coveralls over long sleeved shirt and long pants, Chemical-resistant gloves, Chemical resistant footwear plus socks, A chemical resistant apron. All other mixers, loaders, applicators and other handlers must wear: Long-sleeved shirt and long pants, Shoes plus socks, Chemical resistant gloves for all mixers and loaders and for applicators using hand held equipment."	

Description	Amended Labeling Language	Placement on Label
PPE Requirements Established by the RED[1] for Formulations Applied as a Dust	"Personal Protective Equipment (PPE) Loaders, applicators, and other handlers must wear: Long-sleeved shirt and long pants Shoes plus socks Chemical-resistant gloves. See engineering controls for additional requirements."	Immediately following/below Precautionary Statements: 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." *If coveralls are on label, use the following in addition to the above statement:* "Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them."	Precautionary Statements: Hazards to Humans and Domestic Animals immediately following the PPE requirements
Engineering Controls for liquid formulations	"Engineering Controls" "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."	Precautionary Statements: Hazards to Humans and Domestic Animals (Immediately following PPE and User Safety Requirements.)

Description	Amended Labeling Language	Placement on Label
Engineering Controls for wettable powders products packaged in water soluble packaging. (Products having chemigation and aerial application use on food crops will only be eligible for reregistration if packaged in water soluble packaging).	When water soluble packaging is required: "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 the personal protective equipment required above for mixers/loaders, and -be provided and must have immediately available for use in an emergency, such as a broken package, spill, or equipment breakdown coveralls, and chemical resistant footwear." Wettable powder products not packaged in water soluble bags must bear the following label statement: "Do not apply aerially or through chemigation equipment to any food crops." Required for all wettable powder products: "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."	Precautionary Statements: Hazards to Humans and Domestic Animals (Immediately following PPE and User Safety Requirements.)
Engineering Controls for Dusts	"Planters/operators planting potato seed that has been treated with dust must be in an enclosed cab." "When handlers use closed systems or 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: Hazards to Humans and Domestic Animals (Immediately following PPE and User Safety Requirements.)

Description	Amended Labeling Language	Placement on Label
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 under: Hazards to Humans and Domestic Animals immediately following Engineering Controls (Must be placed in a box.)
Environmental Hazards	""Do not apply directly to water, or areas where surface water is present or to intertidal areas below the mean high water mark. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment wash water."	Precautionary Statements immediately following the User Safety Recommendations
Restricted-Entry Interval	"Do not enter or allow worker entry into treated areas during the restricted entry interval (REI)." In the Directions for Use under Application Instructions for each crop, specify the following REIs: -Almonds and pecans: The REI is 3 days. -Apples, cherries, peaches, nectarines, apricots, and plums/prunes: The REI is 2 days. -Strawberries, blueberries, wheat, celery, cucurbits, soybeans, and green beans: The REI is 24 hours. -Woody ornamentals and cut flowers: The REI is 12 hours.	Directions for Use, Agricultural Use Requirements Box and Application Instructions for Appropriate Crop
Early Entry Personal Protective Equipment established by the RED.	"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 over long sleeved shirt and long pants, Chemical-resistant gloves made of any waterproof material, Chemical- resistant footwear plus socks, Chemical-resistant headgear for over head exposures."	

Description	Amended Labeling Language	Placement on Label
Notification Requirements	"Notify workers of the application by warning them orally and by posting warning signs at entrances to treated areas."	Directions for Use, Agricultural Use Requirements Box
General 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." Wettable powder formulations not packaged in water soluble bags must bear the following label statement: "Do not apply aerially or through chemigation equipment to any food crops."	Directions for Use

Description	Amended Labeling Language	Placement on Label
Other Application Restrictions	The following risk mitigation measures must be reflected in the directions for use: New Maximum Application Rate Restrictions: -Cut flowers: 0.5 lbs ai/acre/application -Professional use products for residential/public turf areas: 2.74 lbs ai/acre/application 10.88 lbs ai/acre/year Minimum retreatment interval = 14 days -Golf course turf (tees/greens/aprons): 8.16 lbs ai/acre/application 21.8 lbs ai/acre/year Minimum retreatment interval = 14 days -Golf course turf (fairways): 5.45 lbs ai/acre/year (except Florida) 2.72 lbs ai/acre/year in Florida -Almonds: 1.05 lbs ai/acre/application 2.1 lbs ai/acre/year -Apples: 0.7 lbs ai/acre/application (except California) 1.0 lbs ai/acre/application in California 2.8 lbs ai/acre/year PHI = 1 day -Cucurbits: 2.1 lbs ai/acre/year PHI = 1 day Continue on next page.	Directions for Use

Description	Amended Labeling Language	Placement on Label
Other Application Restrictions (Risk Mitigation) continued	-Onions: 1.4 lbs ai/acre/application 1.4 lbs ai/acre/year -Peanuts: 1.4 lbs ai/acre/year -Pecans: 2.1 lbs ai/acre/year -Soybeans: PHI = 21 days -Stone Fruits: 2.8 lbs ai/acre/year -Sugar Beets: 0.7 lbs ai/acre/application (except California) 0.35 lbs ai/acre/application (in California) 2.1 lbs ai/acre/year	

Description	Amended Labeling Language	Placement on Label
Other Application Restrictions/Risk Mitigation	The following label statements are required to appear on products intended for professional use on residential/public turf, and golf course turf: For **liquid spray** products: "Not for homeowner use. For use only by certified applicators or those under their immediate supervision. Do not apply with fixed wing or rotary aircraft. Not for use on turf being grown for sale or other commercial use as sod. Do not apply to home orchards/backyard fruit trees after fruit set." For **granular** products: " For use only by certified applicators or those under their immediate supervision. Not for use on turf being grown for sale or other commercial use as sod."	Directions for Use
Storage and Disposal	"Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be used according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance."	Pesticide Disposal
End Use Products Intended of Occupational Use (Non-WPS Only)		

Description	Amended Labeling Language	Placement on Label
PPE Requirements Established by the RED[1] for Liquid Products	"Personal Protective Equipment (PPE) Handlers mixing, loading and applying the product as a dip must wear: Coveralls over long sleeved shirt and long pants, Chemical-resistant gloves, Chemical resistant footwear plus socks, A chemical resistant apron. All other mixers and loaders and applicators must wear: Long-sleeved shirt and long pants, Shoes plus socks, Chemical-resistant gloves for all mixers and loaders and for applicators using hand held equipment, and Chemical-resistant apron for mixers, loaders and other handlers exposed to the concentrate."	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals

Description	Amended Labeling Language	Placement on Label
PPE Requirements Established by the RED[1] for wettable powder products	"Personal Protective Equipment (PPE)" Mixers, loaders, applicators and other handlers supporting dip treatment must wear: Coveralls over long sleeved shirt and long pants, Chemical-resistant gloves, Chemical resistant footwear plus socks, Chemical-resistant apron. All other mixers, loaders, applicators and handlers must wear: Long-sleeved shirt and long pants, Shoes plus socks, Chemical-resistant gloves for all mixers and loaders and for applicators using hand held equipment, and Chemical-resistant apron for mixers and loaders."	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals
PPE Requirements Established by the RED for Granular Products	"Personal Protective Equipment (PPE)" Loaders, applicators and other handlers must wear: Long-sleeved shirt and long pants, Shoes plus socks, Chemical-resistant gloves are required for applicators using hand held equipment."	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals

Description	Amended Labeling Language	Placement on Label
PPE Requirements Established by the RED for Dry Flowable/Water Dispersible Granule	"Personal Protective Equipment (PPE) Handlers mixing, loading and applying the product as a dip must wear: Coveralls over long sleeved shirt and long pants, Chemical-resistant gloves, Chemical resistant footwear plus socks, A chemical resistant apron. All other mixers, loaders, applicators and other handlers must wear: Long-sleeved shirt and long pants, Shoes plus socks, Chemical resistant gloves for all mixers and loaders and for applicators using hand held equipment."	Immediately following/below Precautionary Statements: 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." *If coveralls are on label, use the following in addition to the above statement:* "Discard clothing and other absorbent materials that have been drenched or heavily contaminated with this product's concentrate. Do not reuse them."	Precautionary Statements: Hazards to Humans and Domestic Animals (Immediately following the PPE requirements)

Description	Amended Labeling Language	Placement on Label
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."	Placed in a box in the Precautionary Statements under Hazards to Humans and Domestic Animals
Environmental Hazards	"Do not apply directly to water, or areas where surface water is present or to intertidal areas below the mean high water mark. Runoff from treated areas may be hazardous to aquatic organisms in neighboring areas. Do not contaminate water when disposing of equipment wash water."	Precautionary Statements following the User Safety Recommendations under the heading "Environmental Hazards"
Entry Restrictions	***Entry Restriction for non-WPS uses applied as a spray****:* "Do not enter or allow others to enter until sprays have dried." ***Entry Restriction for non-WPS uses applied dry****:* "Do not enter or allow others to enter until dusts have settled."	Directions For Use under General Precautions and Restrictions
General 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."	Directions For Use

Description	Amended Labeling Language	Placement on Label
Application Restrictions	The following must be reflected in the directions for use: New Maximum Application Rate Restrictions: -Cut flowers: 0.5 lbs ai/acre/application -Professional use products for residential/public turf areas: 2.74 lbs ai/acre/application 10.88 lbs ai/acre/year Minimum retreatment interval = 14 days -Golf course turf (tees/greens/aprons): 8.16 lbs ai/acre/application 21.8 lbs ai/acre/year Minimum retreatment interval = 14 days -Golf course turf (fairways): 5.45 lbs ai/acre/year (except Florida) 2.72 lbs ai/acre/year in Florida The following label statements are required to appear on products intended for professional use on residential/public turf, and golf course turf: For **liquid spray** products: "Not for homeowner use. For use only by certified applicators or those under their immediate supervision. Do not apply with fixed wing or rotary aircraft. Not for use on turf being grown for sale or other commercial use as sod. Do not apply to home orchards/backyard fruit trees after fruit set." For **granular** products: "For use only by certified applicators or those under their immediate supervision. Not for use on turf being grown for sale or other commercial use as sod."	Directions For Use under General Precautions and Restrictions

Description	Amended Labeling Language	Placement on Label
Storage and Disposal	"Pesticide wastes are toxic. Improper disposal of excess pesticide, spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be used according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance."	Pesticide Disposal
End Use Products Intended Primarily for Use by Homeowners		
Environmental Hazards	"**Environmental Hazards**" "Do not apply directly to water. Do not contaminate water when disposing of equipment washwaters or rinsate."	Precautionary Statements
Application Restrictions	"Do not apply this product in a way that will contact ay person, pet, either directly or through drift. Keep people and pets out of the area during application."	Directions for Use under General Precautions and Restrictions
Entry Restriction	**Products Applied as a Liquid**: "Do not allow people or pets to enter the treated area until sprays have dried." **Products Applied Dry:** "Do not enter or allow others to enter the treated areas until dusts have settled.	Directions for Use under General Precautions and Restrictions Statement must be in the color red and in all caps.

Description	Amended Labeling Language	Placement on Label
Application Equipment and Rate Restrictions	The following label statements are required to appear on homeowner products: -For **liquid spray** products: "For use on ornamentals only. Do not apply to home orchards/fruit trees." -For **granular** products: "Do not apply by hand or with hand-held rotary spreader (e.g., belly grinder)." <u>Rate Restrictions for Liquids</u> 1.8 lbs ai/acre/application <u>Rate/interval restrictions for Granulars</u> 2.72 lbs ai/acre/application 10.88 lbs ai/acre/year Minimum retreatment interval = 14 days	Directions for Use under General Precautions and Restrictions
Storage and Disposal	This addition is not necessary for homeowner use products.	

[1]PPE that is established on the basis of Acute Toxicity of the end-use product must be compared to the active ingredient PPE in this document. 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.

Instructions in the Labeling Required section appearing in quotations represent the exact language that must appear on the label.
Instructions in the Labeling Required section not in quotes represent actions that the registrant must take to amend their labels or product registrations.

VI. Appendices

This Reregistration Eligibility Document is supported by documents that are presently maintained in the OPP docket. The OPP docket is located in Room 119, Crystal Mall #2, 1921 Jefferson Davis Highway, Arlington, VA. It is open Monday through Friday, excluding legal holidays from 8:30 am to 4 pm.

All documents, in hard copy form, may be viewed in the OPP docket room or downloaded or viewed via the Internet at the following site: www.epa.gov/pesticides/reregistration/thiophanate-methyl.

Appendix A. Use Patterns Eligible for Reregistration

Site Application Type ApplicationTiming Application Equipment[a]	**Maximum Single Application Rate (lb ai/acre)**	**Maximum Seasonal Rate (lb ai/acre)**	**Preharvest Interval (Days)**	**Minimum Retreatment Interval (Days)**	**Use Limitations**
Almond					
Broadcast applications at flowering Ground[b] and aerial equipment	1.05	2.1	1	NS	
Nonbearing applications Ground equipment					
Apple					
Broadcast foliar applications Ground[b] and aerial equipment	0.7 (1.0 in CA)	2.8	1	7 (5 days during flowering)	
Nonbearing applications Ground[b] and aerial equipment					
Apricot					
Broadcast foliar applications Ground[b] and aerial equipment	1.05	2.8	1	7	
Nonbearing applications Ground equipment					

Site Application Type ApplicationTiming Application Equipment[a]	**Maximum Single Application Rate (lb ai/acre)**	**Maximum Seasonal Rate (lb ai/acre)**	**Preharvest Interval (Days)**	**Minimum Retreatment Interval (Days)**	**Use Limitations**
Beans (dry and succulent)					
Broadcast foliar applications Ground[b] and aerial equipment	1.4	2.8	14 (snap/lima) 28 (dry)	4-7	
In-furrow application at planting Ground[b] equipment			NA		
Canola					
Broadcast foliar applications at 20-50% flowering Ground[b] and aerial equipment	1.4	1.4	40	NS	Use is restricted to MN, ND, and MT (East of I-15)
	0.7 split application				For the split application, apply initially at 20-30% flowering and reapply at 40-50% flowering.
Cherry					
Broadcast foliar applications Ground[b] and aerial equipment	1.05	2.8	1	10	
Nonbearing applications Ground[b] and aerial equipment					
Cucurbit vegetables (cucumbers, melons, pumpkins, summer and winter squash)					
Broadcast foliar applications Ground[b] and aerial equipment	0.35	2.1	1	7	

Site Application Type ApplicationTiming Application Equipment[a]	**Maximum Single Application Rate (lb ai/acre)**	**Maximum Seasonal Rate (lb ai/acre)**	**Preharvest Interval (Days)**	**Minimum Retreatment Interval (Days)**	**Use Limitations**
Grapes					
Broadcast foliar applications Ground[b] or aerial equipment	1.05	4.2	7	14	
Nectarine					
Broadcast foliar applications Ground[b] or aerial equipment	1.05	2.8	1	10	
Nonbearing applications Ground equipment					
Onion					
Broadcast application at planting Ground[b] equipment	1.4	1.4	NA	NA	Do not apply through any type of irrigation system.
Peach					
Broadcast foliar applications Ground[b] and aerial equipment	1.05	2.8	1	10	
Nonbearing applications Ground[b] and aerial equipment					
Peanuts					
Broadcast foliar applications Ground[b] and aerial equipment	0.35	1.4	14	14	

Site Application Type ApplicationTiming Application Equipment[a]	**Maximum Single Application Rate (lb ai/acre)**	**Maximum Seasonal Rate (lb ai/acre)**	**Preharvest Interval (Days)**	**Minimum Retreatment Interval (Days)**	**Use Limitations**
Pears					
Broadcast foliar applications beginning at petal fall Ground[b] and aerial equipment	0.7	2.8	1	7	Apply in a minimum spray volume of 10 gallons/A for aerial applications and do not apply through irrigation equipment.
Pecan					
Broadcast foliar applications Ground[b] and aerial equipment	0.7	2.1	1	21	Do not apply after shuck split.
Nonbearing applications Ground[b] and aerial equipment					
Pistachios					
Broadcast foliar application at flowering Ground[b] and aerial equipment	1.4	1.4	NA	NA	
Plums/Prunes					
Broadcast foliar applications Ground[b] and aerial equipment	1.05	2.8	1	10-14	Do not apply after shuck split.
Nonbearing applications Ground[b] and aerial equipment					

Site Application Type ApplicationTiming Application Equipment[a]	**Maximum Single Application Rate (lb ai/acre)**	**Maximum Seasonal Rate (lb ai/acre)**	**Preharvest Interval (Days)**	**Minimum Retreatment Interval (Days)**	**Use Limitations**
Potatoes					
Treatment of seed-pieces prior to planting	0.05 lb/100 lb of cut pieces	0.05	NA	NA	Do not use seed pieces for food, feed, or fodder.
Broadcast foliar applications Ground[b] and aerial equipment	1.05	2.8	21	7	
Soybeans					
Broadcast foliar applications beginning at full bloom Ground[b] and aerial equipment	0.7	1.4	21	14 7 (70% WP)	Applications later than 14 days after pods average ¼ inch in length are prohibited. Do not graze or feed treated vines or hay to livestock.
Strawberry					
Broadcast foliar applications Ground[b] and aerial equipment	0.7	2.8	1	7	
Sugar Beet					
Broadcast foliar applications Ground[b] and aerial equipment	0.7 (0.35 in CA)	2.1	21	14	

Site Application Type ApplicationTiming Application Equipment[a]	**Maximum Single Application Rate (lb ai/acre)**	**Maximum Seasonal Rate (lb ai/acre)**	**Preharvest Interval (Days)**	**Minimum Retreatment Interval (Days)**	**Use Limitations**
Wheat (Fall-seeded only in ID, OR, and WA)					
Broadcast application at tillering prior to stem elongation Ground[b] and aerial equipment	0.7	0.7	90	NA	Do not cut for hay within 90 days of application or allow livestock to graze in treated area prior to harvest.
Citrus (nonbearing only)					
Containerized, Nonbearing, postplant, pretransplant, seedling stage Soil drench treatment/Soil incorporated treatment by irrigation Drencher	0.4 lb/1000 sq ft	NS	730	28	
Coffee (nonbearing only)					
Nonbearing, postplant, preplant, seedling stage Soil incorporated treatment by irrigation/Soil treatment Sprayer	0.00125 lb/sq ft	NS	730	28	

Site Application Type ApplicationTiming Application Equipment[a]	**Maximum Single Application Rate (lb ai/acre)**	**Maximum Seasonal Rate (lb ai/acre)**	**Preharvest Interval (Days)**	**Minimum Retreatment Interval (Days)**	**Use Limitations**
Golf Course Turf					
Spray applications Ground[b] equipment/Hand held equipment	Tees/greens/ aprons 8.16	Tees/greens/ aprons 21.8	NA	14	Do not graze animals on treated turf. Do not feed clippings to livestock or poultry. Do not apply with fixed wing or rotary aircraft.
	Fairways 5.45 (except FL) 2.72 (in FL only during overseeding)	Fairways 5.45 (except FL) 2.72 (in FL only during overseeding)			
Ornamental Lawns and Turf - Professional Use only (commercial and residential lawns, parks, athletic fields, cemeteries)					
Spray applications Ground[b] equipment/Hand held equipment	2.74	10.88	NA	14	<u>Liquid and granular products:</u> Not for homeowner use. For use only by certified applicators or those under their immediate supervision. Not for use on turf being grown for sale or other commercial use as sod. Do not graze animals on treated turf. Do not feed clippings to livestock or poultry. <u>Liquid products only:</u> Do not apply with fixed wing or rotary aircraft.

Site Application Type ApplicationTiming Application Equipment[a]	**Maximum Single Application Rate (lb ai/acre)**	**Maximum Seasonal Rate (lb ai/acre)**	**Preharvest Interval (Days)**	**Minimum Retreatment Interval (Days)**	**Use Limitations**
Ornamental Lawns (homeowner products)					
Granular applications Push type spreader	2.72	10.88	NA	14	Do not apply by hand or with hand-held rotary spreader (e.g., belly grinder)
Ornamentals (professional products)					
Containerized/Foliar/Interiorscapes/ Nurserystock/Plantbed/Posttransplant/ Transplant bed Aerial, Ground[b], and hand held equipment	3.0 (0.5 maximum for cut flowers)	up to 300 lb/crop cycle	NA	4-28	Do not apply to home orchards/backyard fruit trees after fruit set.
Dip treatment (Bulb, Cutting, Preplant, Post-thinning) Dip tank	0.7	NS	NA	NS	
Drench applications	NA	up to 300 lb/crop cycle	NA	NA	
Ornamentals (homeowner products)					
Spray applications Hose-end sprayer/Low pressure hand wand/Backpack sprayer	1.8		NA	NA	For use on ornamentals only. Do not apply to home orchards/fruit trees.

[a] Unless specifically prohibited, ground applications can include chemigation using center pivot, lateral move end tow, side (wheel) roll, traveler, big gun, solid set, or hand move sprinkler systems.

[b] Chemigation prohibited in California.

Appendix B. Data Supporting Guideline Requirements for the Reregistration of Thiophanate-Methyl

REQUIREMENT			USE PATTERN	CITATION(S)
PRODUCT CHEMISTRY				
New Guideline Number	Old Guideline Number			
830.1600 830.1620 830.1650	61-2A	Start. Mat. & Mnfg. Process	All	DATA GAP, 40053202
830.1670	61-2B	Formation of Impurities	All	DATA GAP, 40053203
830.1700	62-1	Preliminary Analysis	All	41608901
830.1800	62-3	Analytical Method	All	41608903
830.6302	63-2	Color	All	41608904
830.6303	63-3	Physical State	All	41608905
830.6304	63-4	Odor	All	41608906
830.7050	None	UV/Visible Absorption	All	DATA GAP
830.7200	63-5	Melting Point	All	41608907
830.7220	63-6	Boiling Point	All	NA[a]
830.7300	63-7	Density	All	40053207
830.7840 830.7860	63-8	Solubility	All	40053205, 41482801
830.7950	63-9	Vapor Pressure	All	41482802
830.7370	63-10	Dissociation Constant	All	41482803
830.7550	63-11	Octanol/Water Partition Coefficient	All	41482803
830.7000	63-12	pH	All	41608908
830.6313	63-13	Stability	All	DATA GAP, 41608909

REQUIREMENT			USE PATTERN	CITATION(S)
	ECOLOGICAL EFFECTS			
850.2100	71-1A	Avian Acute Oral Toxicity - Quail	ABCIKM	00083012
850.2200	71-2A	Avian Dietary Toxicity - Quail	ABCIKM	00069600
850.2200	71-2B	Avian Dietary Toxicity - Duck	ABCK	00083014
850.2400	71-3	Wild Mammal Toxicity	ABCK	41644301, 42607701
850.2300	71-4A	Avian Reproduction - Quail	ABCK	42930701
850.2300	71-4B	Avian Reproduction - Duck	ABCK	42474801
850.1075	72-1A	Fish Acute Toxicity Bluegill	ABCK	42123501
850.1075	72-1C	Fish Acute Toxicity Rainbow Trout	ABCIKM	00050516
850.1010	72-2	Invertebrate Toxicity	ABCIKM	42298101, 42529401
None	72-3A	Estuarine/Marine Toxicity - Fish	ABCK	42123503
None	72-3B	Estuarine/Marine Toxicity - Mollusk	ABCK	42094602
None	72-3C	Estuarine/Marine Toxicity - Shrimp	ABCK	42123502
None	72-4A	Fish- Early Life Stage - Daphnid	ABCK	42529401
None	72-4B	Estuarine/Marine Invertebrate Life Cycle	ABCK	42723701
850.4400	123-2B	Aquatic Plant Growth, Tier 2	ABCK	42123505, 42229801, 42229802, 42298102, 42229803
850.3020	141-1	Honey Bee Acute Contact	ABCK	40053209
	TOXICOLOGY			
870.1100	81-1	Acute Oral Toxicity-Rat	ABCIKM	41644301, 00256025 [b]
870.1200	81-2	Acute Dermal Toxicity-Rabbit	ABCIKM	41644302, 00256025 [b]
870.1300	81-3	Acute Inhalation Toxicity-Rat	ABCIKM	41482804, 00256025 [b]
870.2400	81-4	Primary Eye Irritation-Rabbit	ABCIKM	40095501, 00256025 [b]
870.2500	81-5	Primary Skin Irritation	ABCIKM	40095502, 00256025[b]
870.2600	81-6	Dermal Sensitization	ABCIKM	41482805, 00256025[b]
870.6200	81-8	Neurotoxicity Screening Battery	ABCIKM	DATA GAP
870.3100	82-1A	90-Day Feeding - Rodent	ABCIKM	42001701, 42533802

REQUIREMENT			USE PATTERN	CITATION(S)
870.3150	82-1B	90-Day Feeding - Non-rodent	ABCHIK	41982203
870.3200	82-2	21-Day Dermal - Rabbit/Rat	ABCHIK	42110801, DATA GAP[b]
870.3465	82-4	90-Day Inhalation-Rat	ABCIKM	DATA GAP
870.4100	83-1A	Chronic Feeding Toxicity - Rodent	ABCIKM	00088333[b], 00068982[b], 00232870[b], 0232871[b]
870.4100	83-1B	Chronic Feeding Toxicity - Non-Rodent	ABCIKM	42311801, 00164304[b], 00088333[b]
870.4200	83-2A	Oncogenicity - Rat	ABCIKM	00088333[b], 00068982
870.4200	83-2B	Oncogenicity - Mouse	ABCIKM	42607701, 00154676 [b], 00096513[b]
870.3700	83-3A	Developmental Toxicity - Rat	ABCIKM	00106090, 00146643, 40438001[b]
870.3700	83-3B	Developmental Toxicity - Rabbit	ABCIKM	45051001, 00260571[b]
870.3800	83-4	2-Generation Reproduction - Rat	ABCIKM	42799101, 42799102, 42799103, 42799104, 42799105, 43624401, 00117870, 00088333 [b], DATA GAP[b]
870.4300	83-5	Combined Chronic Toxicity/ Carcinogenicity	ABCIKM	42896601
870.6300	83-6	Developmental Neurotoxicity - Rat	ABCIKM	Reserved, DATA GAP[b]
870.5140	84-2A	Gene Mutation (Ames Test)	ABCIKM	41608910, 00154668 [b], 00154669 [b], 00005531[b], 43205504[b], 00154670[b], 00154671[b], 0015673 [b], 00159370 [b]
870.5375	84-2B	Structural Chromosomal Aberration	ABCIKM	40980101, 43205505[b]
870.5550	84-2	Bacterial DNA Damage or Repair	ABCIKM	41051510[b], 42911602[b], 00154754[b], 43205506[b], 00154672[b]
None	84-4	Other Genotoxic Effects	ABCIKM	40095503[b]
870.7485	85-1	General Metabolism	ABCIKM	42474802, 42601601

OCCUPATIONAL/RESIDENTIAL EXPOSURE

REQUIREMENT			USE PATTERN	CITATION(S)
875.1100	231	Dermal Exposure: Outdoor	ABCIKM	DATA GAP[k]
875.1200	233	Dermal Exposure: Indoor	ABCIKM	DATA GAP[l]
875.1300	232	Inhalation Exposure: Outdoor	ABCIKM	DATA GAP[k]
875.1400	234	Inhalation Exposure: Indoor	ABCIKM	DATA GAP[l]
875.2100	132-1A	Foliar Residue Dissipation	ABCIK	44876301, 44866201, 45000701, 45027501
875.2400	133-3	Dermal Passive Dosimetry Exposure	ABCIK	DATA GAP[m]
875.2800	133-1	Descriptions of Human Activity	ABCIKM	DATA GAP[m]
ENVIRONMENTAL FATE				
835.2120	161-1	Hydrolysis	ABCIK	40095507
835.2240	161-2	Photodegradation - Water	ABCK	41482806, 00151418 [b], 00151419 [b], 41291501[b]
835.2410	161-3	Photodegradation - Soil	ABC	42094601, 00151420 [b]
835.4100	162-1	Aerobic Soil Metabolism	ABCIK	00106085, 41255801[b]
835.4400	162-3	Anaerobic Aquatic Metabolism	ABC	40061501, 41137701
835.4300	162-4	Aerobic Aquatic Metabolism	ABC	41291501
835.1240	163-1	Leaching/Adsorption/Desorption	ABCIK	00151421, 00151422, 42351001
835.1410	163-2	Laboratory Volatilization	ABCHIK	waived
835.6100	164-1	Terrestrial Field Dissipation	ABCK	43433701, 41930101, 43941301, 41930102
RESIDUE CHEMISTRY				
860.1300	171-4A	Nature of Residue - Plants	ABK	42298103, 42513701, 43337801, 44103202, 42492501, 42533801, 44103201
860.1300	171-4B	Nature of Residue - Livestock	AB	42472101, 42658301, 42995001, 43095701, 43137802, 42472102, 42874101, 43019201, 43137801
860.1340	171-4C	Residue Analytical Method - Plants/Animals	ABK	42683601, 43521901,43624801,43986601, 44526101, 44703602, DATA GAP[c]

REQUIREMENT			USE PATTERN	CITATION(S)
860.1360	171-4M	Multiresidue Method		DATA GAP [d]
860.1380	171-4E	Storage Stability	ABK	43948201, 44401801, 44401803, 44471401, 44533302, 44533304, 44643502, 45081801, 45081803, 45081805, 44400001, 44401802, 44401804, 44533301, 44533303, 44592301, 45160401, 45081802, 45081804, 45081806, DATA GAP [e]
860.1480	171-4J	Magnitude of Residues - Meat/Milk/Poultry /Egg	ABK	445626101, 44287501, 44643502
860.1500	171-4K	Crop Field Trials (Potatoes)	ABK	44468202, 45061901
860.1500	171-4K	Crop Field Trials (Sugar beets)	ABK	44478601, 44643501, DATA GAP[f]
860.1500	171-4K	Crop Field Trials (Sugar beet, tops)	ABK	44478601, 44643501, DATA GAP[f]
860.1500	171-4K	Crop Field Trials (Onions, dry)	ABK	44148201
860.1500	171-4K	Crop Field Trials (Onions, green)	ABK	DATA GAP[g]
860.1500	171-4K	Crop Field Trials (Beans, dry)	ABK	44161001
860.1500	171-4K	Crop Field Trials (Beans, snap)	ABK	44184301
860.1500	171-4K	Crop Field Trials (Beans, Lima)	ABK	44083802
860.1500	171-4K	Crop Field Trials (Peas, dry)	ABK	44286701[h]
860.1500	171-4K	Crop Field Trials (Soybeans)	ABK	44572701
860.1500	171-4K	Crop Field Trials (Cucumbers)	ABK	44471401[i]
860.1500	171-4K	Crop Field Trials (Melons)	ABK	44468201[i]
860.1500	171-4K	Crop Field Trials (Pumpkins)	ABK	N/A[i]
860.1500	171-4K	Crop Field Trials (Squash)	ABK	44467901[i]
860.1500	171-4K	Crop Field Trials (Oranges)	ABK	45520603
860.1500	171-4K	Crop Field Trials (Grapefruits)	ABK	45520603
860.1500	171-4K	Crop Field Trials (Apples)	ABK	43516301
860.1500	171-4K	Crop Field Trials (Apricots)	ABK	DATA GAP
860.1500	171-4K	Crop Field Trials (Banana)	ABK	N/A

REQUIREMENT			USE PATTERN	CITATION(S)
860.1500	171-4K	Crop Field Trials (Strawberry)	ABK	44228801
860.1500	171-4K	Crop Field Trials (Pears)	ABK	43750902, 44375701
860.1500	171-4K	Crop Field Trials (Cherries)	ABK	44182401
860.1500	171-4K	Crop Field Trials (Peaches/Nectarines)	ABK	44083801
860.1500	171-4K	Crop Field Trials (Plums)	ABK	44036301
860.1500	171-4K	Crop Field Trials (Blueberries)	ABK	45520602
860.1500	171-4K	Crop Field Trials (Almonds)	ABK	44487001
860.1500	171-4K	Crop Field Trials (Almond hulls, pistachios)	ABK	44487001
860.1500	171-4K	Crop Field Trials (Pecans)	ABK	44498501
860.1500	171-4K	Crop Field Trials (Wheat, grain)	ABK	40324701, 44162001, 44106901
860.1500	171-4K	Crop Field Trials (Wheat hay and straw)	ABK	44162001, DATA GAP[j]
860.1500	171-4K	Crop Field Trials (Canola)	ABK	45534302
860.1500	171-4K	Crop Field Trials (Grapes)	ABK	43750901, 45218901
860.1500	171-4K	Crop Field Trials (Peanuts, hay)	ABK	44515701
860.1500	171-4K	Crop Field Trials (Strawberries)	ABK	44228801
860.1500	171-4K	Crop Field Trials (Mushroom)	ABK	N/A
OTHER				
860.1520	171-4L	Processed Food (Canola)	ABK	45534301
860.1520	171-4L	Processed Food (Grape)	ABK	43701701
860.1520	171-4L	Processed Food (Peanut)	ABK	DATA GAP, 44850901
860.1520	171-4L	Processed Food (Prunes)	ABK	43887101
860.1520	171-4L	Processed Food (Potato)	ABK	44498502
860.1520	171-4L	Processed Food (Soybeans)	ABK	44572702
860.1520	171-4L	Processed Food (Sugar beet)	ABK	44585601
860.1520	171-4L	Processed Food (Wheat)	ABK	44106901
860.1850	165-1	Confined Accumulation in Rotational	ABC	42670501, 44216201

REQUIREMENT			USE PATTERN	CITATION(S)
860.1900	**165-2**	**Field Accumulation in Rotational**	**ABC**	**45258301**

a- TGAI is a solid at room temperature.

b- Data used to support carbendazim.

c- Additional data is needed. The registrant has proposed two HPLC/UV methods for enforcing tolerances of thiophenate-methyl in plant (Method BR-93-28) and animal (Method KP-100-04) commodities. Prior to validation by the Agency, the method should be radiovalidated using samples from animal and plant metabolism studies.

d- Multiresidue method (MRM) recovery data are required for thiophenate-methyl and MBC through FDA protocols A through G.

e- Data are required depicting the frozen storage stability of thiophenate-methyl and MBC in representative raw and processed plant commodities held in frozen storage for up to five years.

f- Additional field trial in CA is required (see residue chemistry chapter).

g- Data are required depicting residues of thiophenate-methyl and MBC in/on green onions harvested at the minimum interval following a broadcast application at planting of thiophenate-methyl (WP/WDG/FIC) at 1.4 lb ai/A. A minimum of three field trials should be conducted; two in Region 10 and one in Region 6.

h- If the registrant intends to support a use on dry peas and lentils, additional residue data for dried peas need to be submitted.

i- To support this group crop tolerance, the registrant has submitted representative field trials for the following representative crops: cucumbers, melon, pumpkin and squash.

j- The available residue data are inadequate because of deficiencies in analytical method.

k-Data gap for mixing/loading/applying WP/DF solution as a seedling or bulb treatment.

l- Data gap for mixing/loading/applying wettable powder; greenhouse use.

m-Data gap for handling treated seed and seedlings; sorting, packing crops; cultivating, transplanting in treated soil.

N/A not applicable.

Appendix C. Citations Considered to be Part of the Database Supporting the Reregistration Eligibility Decision (Bibliography)

GUIDE TO APPENDIX C

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.

BIBLIOGRAPHY

MRID CITATION

32673 Noguchi, T.; Hashimoto, Y.; Makita, T.; et al. (1971) Chronic Oral Toxicity Studies of Thiophanate, Diethyl 4,4'-0-phenylene bis 3-thioallophanate in Sprague-Dawley Strain Rats. (Unpublished study received Jun 27, 1980 under 4581-336; prepared by Nippon Soda Co., Ltd. in cooperation with Nara Medical Univ., Second Dept. of Pathology, submitted by Pennwalt Corp., Agchem Div., King of Prussia, Pa.; CDL:242740-B)

50516 Kikuchi, M. (1971) Letter sent to Obren Keckemet dated Jan 20, 1971 Fish toxicity test. (Unpublished study received Mar 4, 1971 under unknown admin. no.; prepared by Nippon Soda Co., Ltd., Japan, submitted by W.A. Cleary Corp., Somerset, N.J.; CDL:104612-A)

57651 Noguchi, T.; Hashimoto, Y.; Makita, T.; et al. (1971) The Results of Intermediate Data about the Chronic Oral Toxicity Studies of Thiophanate-methyl in Rats: III. Intermediate Report after 12 Months. (Unpublished study received Sep 5, 1972 under 2G1249; prepared by Nippon Soda Co., Ltd., Japan in cooperation with Kanazawa Univ., Dept. of Pathology, Japan, submitted by Pennwalt Corp., Philadelphia, Pa.; CDL:091777-F)

68982 Lee, K.P. (1978) 2-Benzimidazolecarbamic acid, Methyl Ester (INE-965) Two-Year Feeding Study--ChR-CD Rats: H-5793--MR-1149: Supplemental Pathology Report No. 82-77. (Unpublished study received Feb 9, 1978 under 352-354; submitted by E.I. du Pont de Nemours & Co., Wilmington, Del.; CDL:232866-A)

69600 Fink, R.; Beavers, J.B.; Brown, R. (1977) Final Report: Eight-day Dietary LC50--Bobwhite Quail: Project No. 110-116. (Unpublished study received Nov 8, 1977 under 4581-322; prepared by Wildlife International, Ltd. and Washington College, submitted by Pennwalt Corp., Philadelphia, Pa.; CDL:232169-D)

81603 Roberts, S. (1978) Acute Delayed Neurotoxicity of Topsin^(R)IM Technical 94% (N/B No. 77-126-3) in Chickens: Laboratory No. 7E-8045. (Unpublished study received Sep 27, 1979 under 4581-340; prepared by Cannon Laboratories, Inc., submitted by Pennwalt Corp., Philadelphia, Pa.; CDL:099005-H)

81605 Thomas, J.A.; Schein, L. (1974) Effects of thiophanate and thiopha- nate-methyl on the male reproductive system of the mouse. Toxi- cology and Applied Pharmacology 30:129-133. (Also~In~unpub- lished submission

received Sep 27, 1979 under 4581-340; submit- ted by Pennwalt Corp., Philadelphia, Pa.; CDL:099005-J)

83012 Fink, R.; Beavers, J.B.; Brown, R. (1977) Final Report: Acute Oral LD50--Bobwhite Quail: Project No. 110-118. (Unpublished study received Nov 8, 1977 under 4581-322; prepared by Wildlife International, Ltd. and Washington College, submitted by Pennwalt Corp., Philadelphia, Pa.; CDL:232169-B)

83014 Fink, R. (1975) Final Report: Eight-day Dietary LCµ50¼--Mallard Ducks: Project No. 110-108. (Unpublished study received Nov 8, 1977 under 4581-322; prepared by Truslow Farms, Inc., submitted by Pennwalt Corp., Philadelphia, Pa.; CDL:232169-E)

88333 Sherman, H.; Fretz, S.B.; Wasileski, L.S.; et al. (1972) Long-term Feeding Studies in Rats and Dogs with 2-Benzimidazolecarbamic Acid, Methyl Ester ?INE-965|: Haskell Laboratory Report No. 195- 72. (Unpublished study received Feb 9, 1977 under 352-354; submitted by E.I. du Pont de Nemours & Co., Inc., Wilmington, Del.; CDL:232870-A; 232871)

96513 Schneider, P.W., Jr.; Wood, C.K.; Hall, C.L.; et al. (1982) Long- term Feeding Study with 2-Benzimidazolecarbamic Acid, Methyl Ester (MBC, I NE-965) in Mice: Haskell Laboratory Report No. 70- 82. Final rept. (Unpublished study received Mar 8, 1982 under 352-417; submitted by E.I. du Pont de Nemours & Co., Inc., Wilmington, Del.; CDL:246946-A; 246947)

96514 Schneider, P.W., Jr.; Wiechman, B.E.; Dilworth, T.; et al. (1980) Long-term Feeding Study with Methyl 1-(Butylcarbamoyl)-2-benzi-midazolecarbamate, (INT-1991, Benomyl, Benlate(R)) in Mice:Haskell Laboratory Report No. 20-82. Final rept. (Unpublished study received Mar 30, 1982 under 352-417; submitted by E.I. du Pont de Nemours & Co.,Inc., Wilmington, Del.; CDL:246948-A; 246949; 246950)

106090 Spicer, E.; Rodwell, D.; Graffenius, C.; et al. (1981) Teratology Study in Rats: 449-006. (Unpublished study received Jul 21, 1982 under 4581-322; prepared by International Research and Development Corp., submitted by Agchem Div., Pennwalt Corp., Philadelphia, PA; CDL:070993-B)

117868 Taniguchi, T.; Hashimoto, Y.; Tsubura, Y.; et al. (1972) Final Report on the Chronic Oral Toxicity Studies of ... Topsin Min Rats of Sprague Dawley Strain for 24 Months. (Unpublished study received Sep 7, 1972 under 2G1249; prepared by Nippon Soda Co., Ltd., Japan and others, submitted by Pennwalt Corp.,Takoma, WA; CDL:091779-C)

117870 Palmer, A.; Lovell, M.; Newman, A. (1972) Effect of Thiophanate Methyl on Reproductive Function of Multiple Generations in the Rat: 4800/72/235. Final rept. (Unpublished study received Sep 7, 1972 under 2G1249; prepared by Huntingdon Research Centre, Eng., submitted by Pennwalt Corp., Takoma, WA; CDL: 091779-E)

119017 Burdock, G.; Coble, B.; Hardy, R. (1981) Acute Inhalation Toxicity Study: CGA 15281-4E (Formulated): Project 2173-109. Final rept. (Unpublished study received Nov 23, 1982 under 769-EX-7; pre- pared by Hazleton Laboratories America, Inc., submitted by Wool- folk Chemical Works, Inc., Fort Valley, GA; CDL:248943-C)

146643 Keets, S.; Leist, P.; Mercieca, M. (1985) A Dietary Teratology Study of Topsin M Fungicide in Albino Rats: Final Report: Pro- ject No. WIL-75002. Unpublished study prepared by Wil Research Laboratories, Inc. 284 p.

148393 E.I. du Pont de Nemours & Co., Inc. (1985) Supplement to the Beno- myl Gavage Teratogenicity Study in the Rat (HLR No. 649-80). Unpublished compilation. 106 p.

151418 Wheeler, J. (1985) Hydrolysis of (Phenyl-[Carbon 14]) Benomyl: Document No. AMR 419-85. Unpublished study prepared by E. I. du Pont de Nemours and Co., Inc. 30 p.

151419 Powley, C. (1985) Aqueous Photolysis of (Phenyl-[Carbon 14]) Benomyl: Document No. AMR 420-85. Unpublished study prepared by E. I. du Pont de Nemours and Co., Inc. 17 p.

153420 Beems, R.; Til, H.; Van der Heijden, C. (1976) Carcinogenicity Study with Carbendazim in Mice: Report No. R 4936: [Includes Review of Liver Sections from Mice and Rats Fed with Carben- dazim by U. Mohr and Interpretation of the Results of the TNO Study by R. Everett]. Unpublished study prepared by Central Institute for Nutrition and Food Research. 67 p.

154668 Arce, G. (1983) Mutagenicity Evaluation in Salmonella typhimurium: Report No. 290-83: MR No. 4581-123. Unpublished study prepared by E. I. du Pont de Nemours & Co., Inc. 8 p.

154669 Arce, G. (1983) Mutagenicity Evaluation in Salmonella typhimurium: Report No. 291-83: MR No. 4581-123. Unpublished study prepared by E. I. du Pont de Nemours & Co., Inc. 8 p.

154670 Shirasu, Y.; Moriya, M.; Watanabe, K. (1977) Mutagenicity Testing on Fungicide 1991 Metabolite (MBC) in Microbial Systems. Un- published study prepared by The Institute of Environmental Toxi- cology. 10 p.

154671 Waterer, J. (1980) Chinese Hamster Ovary Cell Assay for Mutageni- city: Report No. 660-80: MR No. 0581-873. Unpublished study prepared by E. I. du Pont de Nemours & Co., Inc. 16 p.

154672 Tong, C. (1981) The Hepatocyte Primary Culture/DNA Repair Assay on Compound 11,201-01 Using Rat Hepatocytes in Cultures: HLO-744- 81: MR 4065-001. Unpublished study prepared by Naylor Dana In- stitute. 17 p.

154673 Jotz, M.; Rundle, D.; Mitchell, A. (1980) An Evaluation of Muta- genic Potential of Benomyl (MBC) Employing the L5178Y+/-Mouse Lymphoma Assay: Contract No. 68-02-2947: Project No. LSU/7558. Unpublished study prepared by SRI International. 17 p.

154676 Wood, C. (1982) Long-term Feeding Study with 2-Benzimidazolecarba- mic Acid, Methyl Ester (MBC, INE-965) in Mice: Project No. 3207- 001: Report No. 70-82. Unpublished study prepared by E. I. du Pont de Nemours & Co., Inc. 890 p.

154679 Donaubauer (1982) Repeated-dose (24-month) Feeding Study for Deter- mination of the Cancerogenic Effect of HOE 17411 O F AT204 (Car- bendazim) in Mice: Report No. 643/82: Study No. 606. Unpub- lished study prepared by Hoechst Aktiengesellschaft. 3848 p.

154754 Tong, C. (1981) The Hepatocyte Primary Culture/DNA Repair Assay on Compound 11,201-01 Using Mouse Hepatocytes in Culture: HLO/743/ 81: MR-4065-001. Unpublished study prepared by Naylor Dana In- stitute. 17 p.

159370 McCooey, K. (1983) L5178Y Mouse Lymphoma Cell Assay for Mutageni- city: Carbamic Acid, 1H-Benzimidazol-2yl-, Methyl Ester: Report No. 87-83. Unpublished study prepared by Dupont Haskell Labora- tory for Toxicology and Industrial Medicine. 16 p.

164304 Stadler, J. (1986) One-year Feeding Study in Dogs with INE-965: Haskell Laboratory No. 291-86: MR No. 7473-001. Unpublished study prepared by Haskell Laboratory for Toxicity and Industrial Medicine. 459 p.

241931 Goldenthal, E. (1978) Neurotoxicity Study in Hens [with] H# 11201, 2-Benzimidazolcarbamic Acid, Methyl Ester: 125-028 [and] 125- 029. Unpublished study prepared by International Research and Development Corporation. 20 p.

256025 Fritz, S.; Sherman, H. (1969) Acute Oral Test [with 2-Aminobenzi- midazole on Male ChR-CD Rats]: Haskell Laboratory Report No: 51-69. Unpublished study prepared by E.I. du Pont de Nemours and Co. 2 p.

256025 Dashiell, O.L. (1974) Ten-day Subacute Exposure of Rabbit Skin to 2-Benzimidazolecarbamic Acid, Methyl Ester (MBC): Haskell Lab- oratory Report No. 826-74. (Unpublished study, including path- ology report no. 122-74, received Feb 9, 1977 under 352-354; submitted by E.I. du Pont de Nemours & Co., Inc., Wilmington, Del.; CDL:232869-A)

256025 Sarver, J. (1975) Acute Inhalation Toxicity (One Hour Head Only) [on ChR-CD male rats with Methyl 2-Benzimidazole Carbamate]: Haskell Laboratory Report No: 58-75. Unpublished study prepared by E.I. du Pont de Nemours and Co., Inc. 1 p.

256025 Henry, J. (1982) Eye Irritation Test in Rabbits [with Carbamic Acid, 1H-Benzimidazol-2-yl-, Methyl Ester]: Haskell Laboratory Report No: 66-82. Unpublished study prepared by E.I. du Pont de Nemours and Co., Inc. 4 p.

256025 Ford, L. (1981) Skin Irritation Test on Rabbits [with Carbamic Acid, 1H-Benzimidazol-2-yl, Methyl Ester]: Haskell Laboratory Report No: 728-81. Unpublished study prepared by E.I. du Pont de Nemours and Co., Inc. 3 p.

256028 Wood, C. (1982) Long-term Feeding Study with 2-Benzimidazolecarbamic Acid, Methyl Ester (MBC, INE-965) in Mice: Project No. 3207- 001: Report No. 70-82. Unpublished study prepared by E. I. du Pont de Nemours & Co., Inc. 890 p.

256029 Everett, R (1981) Proposed Mechanism of Hepatic Neoplasia Induction in Mice Fed Benomyl or MBC. (Unpublished study received Mar 20, 1981 under 352-354; submitted by E.I. du Pont de Nemours & Co., Inc., Wilmington, DE; CDL:250889-C)

256032 Donaubauer (1982) Repeated-dose (24-month) Feeding Study for Determination of the Cancerogenic Effect of HOE 17411 O F AT204 (Carbendazim) in Mice: Report No. 643/82: Study No. 606. Unpub- lished study prepared by Hoechst Aktiengesellschaft. 3848 p.

260571 Feussner, E. (1985) Developmental Toxicity Study of H-15647 Administered via Gavage to New Zealand White Rabbits: Final Report: Project No. 104-008. Unpublished study prepared by Argus Re- search Laboratories, Inc. 174 p.

40022801 Tesh, J.; Ross, F.; Wightman, T.; et al. (1986) Thiophanate Methyl: Teratology Study in the Rabbit: LSR Report No. 86NIS010/111. Unpublished study prepared by Life Science Research. 125 p.

40028801 Brown, R.; Heinrichs, T. (1986) Product Chemistry Data: (Inert ingredient). Lab Project Number: PC86-028. Unpublished study prepared by Ciba-Geigy Corp. 86 p.

40053201 Watanabe, I. (1986) Thiophanate-methyl - Product Identity and Disclosure of Ingredients: Study No. TL-6181. Unpublished study prepared by Nippon Soda Co., Ltd., Takaoka Laboratory. 6 p.

40053202 Watanabe, I. (1986) Thiophanate-methyl - Description of Beginning Materials and Manufacturing Process: Study No. TL-6182. Unpub- lished study prepared by Nippon Soda Co., Ltd., Takaoka Labora- tory. 13 p.

40053203 Watanabe, I. (1986) Thiophanate-methyl - Discussion of Formation of Impurities: Study No. TL-6183. Unpublished study prepared by Nippon Soda Co., Ltd., Takaoka Laboratory. 12 p.

40053204 Watanabe, I. (1986) Thiophanate-methyl - Density, Bulk Density or Specific Gravity: Study No. TL-6194. Unpublished study prepared by Nippon Soda Co., Ltd., Takaoka Laboratory. 5 p.

40053205 Seoda, Y.; Shiotani, H. (1986) Thiophanate-methyl - Solubility in Water: Study No. NISSO EC-62. Unpublished study prepared by Nippon Soda Co., Ltd., Environmental Toxicology Laboratory. 10p.

40053206 Soeda, Y.; Nomura, O. (1986) Thiophanate-methyl - Vapor Pressure: Study No. NISSO EC-60. Unpublished study prepared by Nippon Soda Co., Ltd., Environmental Toxicology Laboratory. 13 p.

40053207 Soeda, Y.; Shiotani, H. (1986) Thiophanate-methyl - Octanol/Water Partition Coefficient: Study No. NISSO EC-63. Unpublished study prepared by Nippon Soda Co., Ltd., Environmental Toxicology Laboratory. 13 p.

40053209 Yamada, T.; Matsuda, M. (1986) Thiophanate-methyl - Honey Bee Acute Contact LD50: Study No. NISSO IE-6703M. Unpublished study prepared by Nippon Soda Co., Ltd., Biological Laboratory. 11 p.

40061501 Dykeman, R. (1986) Thiophanate-methyl - Anaerobic Aquatic Metabolism: Amended Final Report: Laboratory Project Identification WT-1-82. Unpublished study prepared by Pennwalt Corp., Agchem Div. 127 p.

40095501 Nishibe, T. (1986) Thiophanate-methyl: Primary Eye Irritation Study in Rabbits: Laboratory Project ID. NISSO TXR 0217. Unpublished study prepared by Nippon Soda Co., Ltd. 16 p.

40095502 Nishibe, T. (1986) Thiophanate-methyl: Primary Dermal Irritation Study in Rabbits: Laboratory Project ID. NISSO TXR 0218. Unpublished study prepared by Nippon Soda Co., Ltd. 16 p.

40095503 Myhr, B. (1981) Evaluation of Pure Thiophanate-methyl in the Primary Rat Hepatocyte Unscheduled DNA Synthesis Assay: Laboratory Project ID. 21191. Unpublished study prepared by Litton Bionetics, Inc. 15 p.

40095507 Nomura, O. (1986) Thiophanate-methyl: Hydrolysis Study: Laboratory Project ID. EC-67. Unpublished study prepared by Nippon Soda Co., Ltd. 44 p.

40324701 Landskov, A. (1986) Topsin M Fungicide--Magnitude of Residues in Wheat: Laboratory Project Identification WT-87-C-5. Unpublished study prepared by Pennwalt Corp., Agchem Div. 76 p.

40438001 Alvarez L. 1987. Teratogenicity study of INE-965 in rats. Haskell Laboratory for Toxicology and Industrial Medicine. Newark, DE. Lab Proj No. 281-87. Med Res No. 7976-001. November 5, 1987. Unpublished. MRID

40438001 Alvarez, L. (1987) Teratogenicity Study of INE-965 in Rats: Lab. Proj. ID 281-87. Unpublished study prepared by Dupont Haskell Laboratory. 195 p.

40801201 Vlachos, D. (1988) Mutagenicity Evaluation of Carbendazim (IN E965) in an in vitro Sister Chromatid Exchange Assay in Chinese Ham- ster Ovary (CHO) Cells: Medical Research No. 4581-152: LBI Genetics Assay No. 7216. Unpublished study prepared by Litton Bionetics, Inc. 24 p.

40980101 Murli, H. (1988) Mutagenicity Test on Topsin M Technical in an in vitro Cytogenetic Assay Measuring Chromosomal Aberration Frequencies in Chinese Hamster Ovary (CHO) Cells: HLA Study No.: 10345-0-437. Unpublished study prepared by Hazleton Laboratories America, Inc. 40 p.

41051510 Seiler, J. (1976) The mutagenicity of benzimidazole and benzimidaz- ole derivatives...chinese hamster. Mutation Res. 40:339-348.

41051523 Gardner, R. (1982) Analysis of Benomyl Mutagenicity. Unpublished study prepared by the U. S. EPA. 37 p.

41056701 Tesh, J.; Ross, F.; Wrightman, T. (1989) Thiophanate-methyl Teratology Study in the Rabbit: Proj. ID 88/782. Unpublished study prepared by Life Science Research. 16 p.

41137701 Arthur, M.; Marsh, B.; Fadel, L. et al. (1989) Anaerobic Aquatic Metabolism of ?Phenyl(U)-Carbon 14| Benomyl in West Jefferson, Ohio, Pond Water and Sediment: Battelle Project No. NO799-8800: Du Pont Report No. AMR-770-87. Unpublished study prepared by Battelle Columbus Division. 41 p.

41184601 Sasaki, Y. (1988) Benomyl: In vitro Cytogenetic Test: Project ID: IET 88-0043. Unpublished study prepared by Institute of Environmental Toxicology Kodaira Laboratories. 39 p.

41291501 Arthur, M.; Schweitzer, K.; Fadel, L.; et al. (1989) Aerobic Aquatic Metabolism of ?Phenyl(U)-{Carbon 14}|Benomyl in Greenville, Mississippi, Water and Sediment: Lab Project Number AMR/1452/89: N/0996/7301. Unpublished study prepared by Battelle. 52 p.

41419201 Monson, K. (1990) Metabolism of ?Phenyl(U)-Carbon 14|Carbendazim in Rats: Lab Project Nos. AMR-1141-88: NO962-1800. Unpublished study prepared by E. I. du Pont de Nemours and Co., Inc. 246 p.

41482801 Ishihara, K. (1990) Thiophanate-methyl Solubility in Organic Solvents: Lab Project I.D.: EC-223. Unpublished study prepared by Nipppon Soda Co., Ltd., Odawara Research Center. 11 p.

41482802 Ishihara, K. (1990) Thiophanate-methyl Vapor Pressure: Lab Project Number: EC/224. Unpublished study prepared by Nippon Soda Co., Ltd., Odawara Research Center. 13 p.

41482803 Ishihara, K. (1990) Thiophanate-methyl Dissociation Constant: Lab Project I.D.: EC-225. Unpublished study prepared by Nippon Soda Co., Ltd. 12 p.

41482804 Nishibe, T. (1987) Thiophanate-methyl: Acute Inhalation Toxicity Study in Rats: Toxicology Report No.: 0219. Unpublished study prepared by Nippon Soda Co., Ltd., Environmental Toxicology Laboratory. 58 p.

41482805 Nishibe, T. (1989) Thiophanate-methyl: Delayed Contact Hypersensitivity Study in Guinea Pigs: Toxicology Report No.: 0271. Unpublished study prepared by Nippon Soda Co., Ltd., Environmental Toxicology Laboratory. 19 p.

41482806 Soeda, Y.; Shiotani, H. (1987) Thiophanate-methyl Photodegradation in Water: Lab Study No.: NISSO EC-74. Unpublished study prepared by Nippon Soda Co., Ltd., Environmental Toxicology Laboratory. 35 p.

41608901 Iguchi, K. (1990) Thiophanate-methyl - Preliminary Analysis of Product Samples: Lab Project Number: TR-896201. Unpublished study prepared by Nippon Soda Co., Ltd. 9 p.

41608902 Iguchi, K. (1990) Thiophanate-methyl - Certification of Ingredient Limits: Lab Project Number: TR-896202. Unpublished study pre- pared by Nippon Soda Co., Ltd. 9 p.

41608903 Iguchi, K. (1990) Thiophanate-methyl-Analytical Methods to Verify Certified Limits: Lab Project Number: TR-896203. Unpublished study prepared by Nippon Soda Co., Ltd. 31 p. Page 89

41608904 Nakayama, K. (1990) Thiophanate-methyl - Color: Lab Project Number: TR-896302. Unpublished study prepared by Nippon Soda Co., Ltd. 8 p.

41608905 Nakayama, K. (1990) Thiophanate-methyl - Physical State: Lab Project Number: TR-896303. Unpublished study prepared by Nippon Soda, Ltd. 8 p.

41608906 Nakayama, K. (1990) Thiophanate-methyl-Odor: Lab Project Number: TR-896304. Unpublished study prepared by Nippon Soda Co., Ltd. 8 p.

41608907 Nakayama, K. (1990) Thiophanate-methyl - Melting Point: Lab Project Number: TR-896305. Unpublished study prepared by Nippon Soda Co., Ltd. 8 p.

41608908 Nakayama, K. (1990) Thiophanate-methyl-pH: Lab Project Number: TR - 896312. Unpublished study prepared by Nippon Soda Co., Ltd. 8 p.

41608909 Nakayama, K. (1990) Thiophanate-methyl-Stability: Lab Project Number: TR-896313. Unpublished study prepared by Nippon Soda Co., Ltd. 11 p.

41608910 Nishibe, T. (1990) Thiophanate-methyl: Reverse Mutation Study on Bacteria: Lab Project Number: 0301. Unpublished study prepared by Nippon Soda Co., Ltd., Environ. Toxicology Lab. 25 p.

41644301 Nishibe, T. (1990) Thiophanate-methyl: Acute Oral Toxicity Study in Rats: Lab Project Number: 0330. Unpublished study prepared by Nippon Soda Co., Ltd., Environmental Toxicology Lab. 14 p.

41644302 Nishibe, T. (1990) Thiophanate-methyl: Acute Dermal Toxicity in Rabbits: Lab Project Number: 0331. Unpublished study prepared by Nippon Soda Co., Ltd., Environmental Toxicology Lab. 20 p.

41930101 Dykeman, R. (1991) Field Dissipation Study for Thiophanate-Methyl Applied to an Apple Orchard: Final Report: Lab Project Number: WT-86-C-25:6012-188: 87-001. Unpublished study prepared by Hazleton Labs America in coop. with ACDS Corp. 469 p.

41930102 Dykeman, R. (1991) Field Dissipation Study for Thiophanate-Methyl pplied to a Dry Bean Crop: Final Report: Lab Project Number: WT 86-C-27: 6012-186: 87029. Unpublished study prepared by Hazleton Labs America in coop. with Hulst Research Farm Services.439 p.

41982203 Auletta, C. (1991) A Subchronic (3-Month) Oral Toxicity Study in the Dog via Capsule Administration with Thiophanate-methyl: Final Report: Lab Project Number: 89-3525. Unpublished study prepared by Bio/Dynamics, Inc. 347 p.

42001701 Nishibe, T.; Takaori, H. (1990) Thiophanate-methyl--Subchronic Oral Toxicity in Rats: Lab Project Number: 0565. Unpublished study prepared by Toxicology Institute, Environmental Toxicology Laboratory. 410 p.

42094601 Shiotani, H. (1991) Thiophanate-methyl: Photodegradation on Soil: Comments to EPA Phase 4 Response to MRID 41482807: Lab Project Number: EC-336. Unpublished study prepared by Nippon Soda Co.,Ltd. 13 p.

42094602 Dionne, E. (1991) Thiophanate-methyl: Acute Toxicity to Eastern Oyster (Crassostrea virginica) Under Flow-Through Conditions: Lab Project Number: 91-7-3816: 12442.0191.6107.504. Unpublished study prepared by Springborn Labs, Inc. 66 p.

42110801 Naas, D. (1991) 21-Day Dermal Study in Rabbits with Thiophanate-methyl Technical: Lab Project Number: WIL 75030. Unpublished study prepared by WIL Research Laboratories, Inc. 231 p.

42123502 Bettencourt, M. (1991) Thiophanate-methyl--Acute Toxicity to Mysid Shrimp (Mysidopsis bahia) Under Flow-through Conditions: Final Report: Lab Project Number: 91-7-3845: 12442.0191.6110.515. Unpublished study prepared by Springborn Labs., Inc. 67 p.

42123503 Bettencourt, M. (1991) Thiophanate-methyl--Acute Toxicity to Sheepshead Minnow (Cyprindon variegatus) Under Flow-through Conditions: Final Report: Lab Project Number: 91-8-3872:12442.0191.6111.505. Unpublished study prepared by Springborn Labs., Inc. 68 p.

42123505 Hoberg, J. (1991) Thiophanate-methyl--Toxicity to the Duckweed Lemna gibba G3: Final Report: Lab Project Number: 91-8-3878:12442.1190.6101.410. Unpublished study prepared by Springborn Labs., Inc. 57 p.

42229801 Hoberg, J. (1992) Thiophanate-Methyl--Toxicity to the Freshwater Green Alga, Selenastrum capricornutum: Final Report: Lab Project Number: 91-9-3915: 12442.1190.6102.430. Unpublished study prepared by Springborn Laboratories, Inc. 68 p.

42229802 Hoberg, J. (1992) Thiophanate-Methyl--Toxicity to the Freshwater Diatom Navicula Pelliculosa: Final Report: Lab Project Number: 91-10-3965: 12442. 1190. 6102. 440. Unpublished study prepared by Springborn Laboratories, Inc.71 p.

42229803 Hoberg, J. (1992) Thiophanate-methyl--Toxicity to the Marine Diatom, Skeletonema costatum: Lab Project Number: 91-10-3939: 12442.1190.6102.450. Unpublished study prepared by Springborn Labs, Inc. 72 p.

42298101 Putt, A. (1992) Thiophanate-methyl--Acute Toxicity to Daphnids (Daphnia magna) Under Flow-through Conditions: Final Report: Lab Project Number: 92-4-4217: 12681.1191.6100.115. Unpublished study prepared by Springborn Labs., Inc. 68 p.

42298102 Hoberg, J. (1992) Thiophanate-methyl--Toxicity to the Freshwater Blue-Green Alga Anabaena Flos-Aquae: Final Report:Lab Project Number: 91-10-3963: 12442.1190.6102.420. Unpublished study prepared by Springborn Labs., Inc. 67 p.

42298103 Davis, M.; Malik, N.; Lofthouse, T. (1992) Metabolism of the Fungicide Thiophanate-methyl in Spray-Treated Spring Wheat: Final Report: Lab Project Number: SC900053: BR-90-17.Unpublished study prepared by Battelle Columbus Operations.104 p.

42311801 Auletta, C. (1992) A Chronic (1-Year) Oral Toxicity Study in the Dog via Capsule Administration with Thiophanate-methyl: Lab Project Number: 89-3526. Unpublished study prepared by Bio/dynamics, Inc. 485 p.

42351001 Shiotani, H. (1992) Thiophanate-methyl--Batch Equilibrum(Adsorption/Desorption on Soild): Lab Project Number: NISSOEC-362. Unpublished study prepared by Nippon Soda Co., Ltd.,Envir. Tox. Lab. 106 p.

42472101 Hanlon, C.; Norris, K. (1992) Metabolism of the Fungicide (Carbon 14)-Thiophanate Methyl in Lactating Goats: Final Report. Lab Project Number: 1210: BR-90-16. Unpublished study prepared by Analytical Developmentt Corp. and Colorado State Univ. 104 p.

42472102 Wright, M. (1992) (Carbon 14)-Thiophanate Methyl Nature of theResidue in Laying Hens: Executive Summary Final Report: Lab Project Number: 38948: XBL 91021. Unpublished study prepared by ABC Laboratories, Inc. and XenoBiotic Laboratories, Inc. 424 p.

42474801 Pedersen, C.; Lesar, C. (1992) Thiophanate-methyl: Toxicity and Repoduction Study in Mallard Ducks: Lab Project Number: 89 DR 36. Unpublished study prepared by Bio-Life Associates, Ltd. 399 p.

42474802 Tanoue, T. (1992) Thiophanate-methyl: Metabolism in Rats: Lab Project Number: EC-338. Unpublished study prepared by Nippon Soda Co., Ltd. 295 p.

42492501 Malik, N.; Wright, M. (1992) óCarbon 14|-Thiophanate-Methyl Nature of the Residue in Spray Treated Sugar Beets: Lab Project Number: EF-90-322: XBL 90094. Unpublished study prepared by Elf Atochem North America, Inc. 262 p.

42513701 Malik, N.; Wright, M. (1992) óCarbon 14|-Thiophanate-MethylNature of the Residue in Spray Treated Lima Beans: Lab Project Number: BR-90-19: EF-90-323: XBL 90093. Unpublished study prepared by Pan-Agricultural Labs, Inc. and XenoBiotic Labs, Inc. 299 p.

42527601 Holbert, M. (1992) Subacute Inhalation Toxicity Study in Rats: Tops 5: Lab Project Number: 8900-92. Unpublished study prepared by Stillmeadow, Inc. 154 p.

42533801 Davis, M. ; Lofthouse, T. ; Malik, N. (1992) Metabolism of the Fungicide Thiophanate-Methyl in Spray-treated Spring Wheat: A Supplement: Lab Project Number: SC900053: BR-90-17. Unpublished study prepared by Battelle Columbus Operations. 70 p.

42533802 Nishibe, T.; Takaori, H. (1992) Thiophanate-Methyl--Subchronic Oral Toxicity in Rats: A Supplement: Lab Project Number: 0565. Unpublished study prepared by Environmental Toxicology Laboratory. 26 p

42601601 Tanoue, T. (1992) Thiophanate-methyl: Metabolism in Rats--Supplemental Report to NISSO EC-338: Lab Project Number:

NISSO EC-395. Unpublished study prepared by Nippon Soda Co.,Ltd. 57 p.

42607701 Tompkins, E. (1992) 18-month Dietary Oncogenicity Study in Mice with Topsin M: Final Report: Lab Project Number: WIL-75024. Unpublished study prepared by WIL Research Labs, Inc. 2009 p.

42658301 Hanlon, C.; Norris, K. (1992) Metabolism of the Fungicide (carbon 14)-Thiophanate Methyl in Lactating Goats: Addendum No. 2 to Final Report: Lab Project Number: 1210: BR-90-16. Unpublished study prepared by Analytical Development Corp. and Colorado State University. 1470 p.

42670501 Malik, N.; Wright, M. (1993) Nature of the Residues in Rotational Crops (carbon 14)-Thiophanate Methyl: Executive Summary Final Report: Lab Project Number: BR-90-14: R099010: 92175. Unpublished study prepared by Research for Hire, Pan-AG Labs., Inc. and Battelle Columbus Operations. 598 p.

42683601 Evans, R.; Wright, M. (1993) Proposed Tolerance Enforcement HPLC Analytical Method for Simultaneous Determination of Thiophanate Methyl, Allophanate, DX-105 and MBC in/on Crops: Final Report: Lab Project Number: BR-93-28. Unpublished study prepared by Elf Atochem N.A., Inc. 31 p.

42817003 Foss, J. (1993) Acute Neurotoxicity Study of DPX-T1991-529 (Benomyl) Administered Orally Via Gavage toCr1:CD BR VAF/Plus Rats: Final Report: Lab Project Number: HLO 825-92: 104-016: 9579-001. Unpublished study prepared by Argus Research Labs., Inc. and Haskell Lab. for Toxicology and Industrial Medicine. 875 p.

42874101 Eldeib, M.; Hurshman, B.; Patterson, C.; et al. (1993) Isolation, Characterization, and Identification of Unknown Metabolite(s) from Goat's Liver Treated with (carbon14)-Thiophanate Methyl: Lab Project Number: 40875. Unpublished study prepared by ABC Laboratories, Inc. 94 p.

42896601 Takaori, H. (1993) Thiophanate-methyl--Combined Chronic Toxicity/Oncogenicity Study in Rats: Lab Project Number: 0566:0023. Unpublished study prepared by Nippon Soda Co., Ltd.,Environ. Tox. Laboratory. 1993 p.

42899101 Muller, Wolfgang (1993) Two Generation Oral (Dietary Administra- tion) Reproduction Toxicity Study in the Rat (With One Litter in the P and Two Litters in the F1 Generation): Topsin-M: Final Report-Volume 1: Lab Project Number: 996-683-004. Unpublished study prepared by Hazleton Labs. Deutschland GMBH. 1401 p.

42911601 Bentley, K. (1992) Classification of DPX-T1991-529 (Benomyl)-Induced Micronuclei in Mouse Bone Marrow Erythrocytes Using Immunofluorescent Antikinetochore Antibodies: Lab Project Number: 9425-001: 568-92. Unpublished study prepared by Haskell Laboratory for Toxicology and Industrial Medicine. 26 p.

42911602 Bentley, K. (1992) Classification of DPX-E965-299 (Carbendazim, MBC)-Induced Micronuclei in Mouse Bone Marrow Erythrocytes Using Immunofluorescent Antikinetochore Antibodies: Lab Project Number: 9426-001: 569-92. Unpublished study prepared by Haskell Laboratory for Toxicology and Industrial Medicine. 27 p.

42930701 Pedersen, C.; Solatycki, A. (1993) Thiophanate-methyl: Toxicity and Reproduction Study in Bobwhite Quail: Lab Project Number: 106-014-07. Unpublished study prepared by Bio-life Associates, Ltd. 443 p.

42995001 Eldeib, M.; Patterson, C.; Harris, D.; et al. (1993) Isolation, Characterization, and Identification of Unknown Metabolite(s) from Goat's Liver Treated with (carbon 14)-Thiophanate Methyl: Draft of Second Interim Report: Lab Project Number: 40875: 6120-175: HWI 6120-175. Unpublished study prepared by ABC Labs, Inc. 133 p.

43019201 Eldeib, M.; Harris, D.; Patterson, C. et al. (1993) Isolation, Characterization, and Identification of Unknown Metabolite(s) from Goat's Liver Treated with (carbon-14)-Thiophanate Methyl: Final Report: Lab Project Number: 40875. Unpublished study prepared by ABC Labs., Inc. 203 p.

43095701 Eldeib, M.; Harris, D.; Patterson, C. (1994) Isolation,Characterization, and Identification of Unknown Metabolite(s) from Goat's Liver Treated with (carbon 14)--Thiophanate Methyl: Supplement 1 to Final Report: Lab Project Number: 40875: 40875A. Unpublished study prepared by ABC Labs, Inc

43137801 Eldeib, M.; Harris, D.; Patterson, C. (1994) Isolation, Characterization, and Identification of Unknown Metabolite(s) from Goat's Liver Treated with (carbon 14)-Thiophanate Methyl: Amendment to Supplement #1, 40875A to Final Report 40875: Lab Project Number: 40875A: 40875. Unpublished study prepared by ABC Labs., Inc. 7 p.

43137802 Eldeib, M.; Harris, D.; Patterson, C. (1994) Isolation,Characterization, and Identification of Unknown Metabolite(s) from Goat's Liver Treated with (carbon 14)-Thiophanate Methyl:Supplement #2, 40875B to Final Report 40875: Lab Project Number: 40875B: 40875. Unpublished study prepared by ABC Labs., Inc. 42 p.

43205504 Stammberger, I. (1992) Study of the Mutagenic Potential in Strains of Salmonella typhimurium (Ames Test) and Escherichia coli with BCM Technical: Lab Project Number: 92.0153: A47583. Unpublished study prepared by Hoechst Aktiengesellschaft. 33 p.

43205505 Putman, D.; Morris, M. (1990) Chromosome Aberrations in Chinese Hamster Ovary (CHO) Cells with BCM Technical: Lab Project Number: T8791.337: BD-049-89: 89023. Unpublished study prepared by Microbiological Associates, Inc. 49 p.

43205506 Stammberger, I. (1992) Evaluation of HOE 017411 Substance Technical in the Unscheduled DNA Synthesis Test in Mammalian Cells In vitro: Lab Project Number: 92.0208: A48040. Unpublished study prepared by Hoechst Aktiengesellschaft. 27 p

42911602 Bentley, K. (1992) Classification of DPX-E965-299 (Carbendazim, MBC)-Induced Micronuclei in Mouse Bone Marrow Erythrocytes Using Immunofluorescent Antikinetochore Antibodies: Lab Project Number: 9426-001: 569-92. Unpublished study prepared by Haskell Laboratory for Toxicology and Industrial Medicine. 27 p.

43205506 Stammberger, I. (1992) Evaluation of HOE 017411 Substance Technical in the Unscheduled DNA Synthesis Test in Mammalian Cells In vitro: Lab Project Number: 92.0208: A48040. Unpublished study prepared by Hoechst Aktiengesellschaft. 27 p

43277901 Foss, J. (1994) Subchronic Neurotoxicity Study of DPX-T1991-529 (Benomyl) Administered Orally via the Diet to Crl:CD-BR VAF/Plus Rats: Final Report: Lab Project Number: 9619: 104/019: HLO/551/93. Unpublished study prepared by Argus Research Laboratories, Inc. 1065 p.

43337801 Alam, F.; Dedmore, M.; Jalal, M. (1994) Nature of the Residues of (carbon 14)-Thiophanate-Methyl in Spray Treated Apples: Lab Project Number: 93292: BR/93/29. Unpublished study prepared by Pan-Agricultural Labs, Inc. 255 p.

43337801 Alam, F.; Dedmore, M.; Jalal, M. (1994) Nature of the Residues of (carbon 14)-Thiophanate-Methyl in Spray Treated Apples: Lab Project Number: 93292: BR/93/29. Unpublished study prepared by Pan-Agricultural Labs, Inc. 255 p.

43433701 Wright, J. (1994) Terrestrial Dissipation of Topsin-M Applied to a Lettuce Crop: Lab Project Number: BR-92-30: ML92-0299-ATO:92.135. Unpublished study prepared by Plant Sciences, Inc. and Morse Labs, Inc. 827 p.

43516301 Pitt, J. (1994) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Apples: Lab Project Numbers: BR-92-16: 40690: 27A-92. Unpublished study prepared by ABC Labs, Inc. 827 p.

43521901 Churchill, G.; Wright, M. (1995) Proposed Tolerance Enforcement HPLC Analytical Method for Simultaneous Determination of Thiophanate Methyl, Allophanate, DX-105 and MBC in/on Crops: Revised Final Report: Lab Project Number: BR/93/28. Unpublished study prepared by Elf Atochem North America, Inc. 55 p.

43591901 Pitt, J. (1995) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Processed Apple Fractions: Lab Project Number: BR-90-05: 40730. Unpublished study prepared by ABC Labs, Inc. 401 p.

43624401 Muller, W.; Singer, A. (1995) Final Addendum Histopathology Report and Peer Review Pathology Report to MRID 42899101: Topsin-M: Two Generation Oral (Dietary Administration)

43624801 Churchill, G.; Wright, M. (1995) Proposed Tolerance EnforcementHPLC Analytical Method for Simultaneous Determination of Thiophanate Methyl, Allophanate, DX-105 and MBC In/On Crops: Revised Final Report; Amendment 1 to MRID 43521901: Lab Project Number: BR-93-28. Unpublished study prepared by ElfAtochem North America, Inc. 8 p.

43701701 Pitt, J. (1995) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Processed Grape Fractions: Lab Project Number: A036.030: BR-93-24: BR-011-02. Unpublished study prepared by Huntingdon Analytical Services, Inc. 442 p.

43750901 Pitt, J. (1995) Thiophanate-Methyl and Its Metabolites: Magnitude of the Residue in Grapes: Lab Project Number: A036. 029: BR-93-10: 10A-93. Unpublished study prepared by Huntingdon Analytical Services. 506 p.

43750902 Pitt, J. (1995) Thiophanate-Methyl and Its Metabolites: Magnitude of the Residue in Pears: Lab Project Number: 40823: BR-92-17: 28A-92. Unpublished study prepared by ABC Labs, Inc. 548 p.

43788301 Munley, S. (1995) Developmental Toxicity Study of DPX-T1991-529 (Benomyl) in Rabbits: Lab Project Number: HLR 164-95: 10126-001. Unpublished study prepared by DuPont's Haskell Lab for Toxicology and Industrial Medicine. 147 p.

43887101 Leppert, B. (1995) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Plum Processed Fractions: Final Report: Lab Project Number: 41044: BR-91-22: 08-91. Unpublished study prepared by Stewart Agricultural Research Services, Inc.; ABC Labs, Inc. and Elf Atochem North America, Inc. 498 p.

43948201 Hundley, S.; Churchill, G. (1996) Residue Stability Study ofMBC (Methyl-2-Benzimidazole Carbamate) in Snap Beans, Apples, Wheat Grain, Spinach, Sugar Beets, and Tomatoes: Lab Project Number: BR-87-6: 80502: 88023. Unpublished study prepared by Tegeris Labs, Inc.; ChemAlysis, Inc.; and Elf Atochem North America. 168 p.

43986601 Churchill, G.; Castro, L.; Li, F.; et al. (1996) Proposed Tolerance Enforcement HPLC Analytical Method for Simultaneous Determination of Thiophanate Methyl, Allophanate, DX-105 and MBC in/on Crops: Final

Report-Revision No. 2: Lab Project Number: BR-93-28: BR-011-05. Unpublished study prepared by Elf Atochem North America, Inc. 49 p

44036301 Pitt, J.; Leppart, B. (1996) Thiophenate-Methyl and its Metabolites: Magnitude of the Residue in Plum: Final Report: Lab Project Number: BR-91-17:07-91:07A-91. Unpublished study prepared by Elf Atochem North America, Inc. and ABC Laboratories, Inc. 97 p.

44073301 Williams, B. (1996) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Processed Apple Fractions: Amendment to MRID 43591901: Lab Project Number: 407301: BR-011-00: BR-011-04. Unpublished study prepared by ABC Labs., Inc. 97 p.

44083801 Leppert, B.; Castro, L. (1996) Thiophanate-Methyl and Its Metabolites: Magnitude of the Residue in Peach and Nectarine: Lab Project Number: BR-90-40: 07-90: 07A-90. Unpublished study prepared by Elf Atochem North America, Inc. 320 p.

44083802 Rice, F.; Williams, B. (1996) Magnitude of the Residue of Thiophanate-Methyl and Its Metabolites in/on the Raw Agricultural Commodity of Lima Beans: Amended Final Report: Lab Project Number: 42486: BR-95-08: 08-95. Unpublished study prepared by ABC Labs., Inc. 419 p.

44103201 Wright, M. (1996) Nature of the Residue of (carbon 14)-Thiophanate-Methyl in Spray Treated Sugar Beets: Supplement To Final Report: Lab Project Number: XBL90094: BR-90-18. Unpublished study prepared by Elf Atochem North America, Inc. and XenoBiotic Laboratories, Inc. 22 p.

44103202 Wright, M. (1996) (Carbon 14)-Thiophanate-Methyl Nature of the Residue in Spray Treated Lima Beans: Supplement No. 1 To FinalReport: Lab Project Number: BR-90-19: 90093. Unpublished study prepared by Elf Atochem North America, Inc. and XenoBiotic Laboratories, Inc. 20 p.

44106901 Castro, L. (1996) Analysis of Thiophanate Methyl Residues in Processed Fractions of Winter Wheat: Lab Project Number: BR-90-08: 95-0054: 06-90. Unpublished study prepared by Elf Atochem North America, Inc. 187 p.

44115901 Prince, D. (1996) AOAC Use-Dilution Test on D-125 Disinfectant: Lab Project Number: G-88858.1: GR 1247: 1521. Unpublished study prepared by Gibraltar Labs., Inc. 13 p.

44115901 Prince, D. (1996) AOAC Use-Dilution Test on D-125 Disinfectant: Lab Project Number: G-88858.1: GR 1247: 1521. Unpublished study prepared by Gibraltar Labs., Inc. 13 p.

44148201 Pitt, J. (1996) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Onion: Final Report: Lab Project Number: 42646: 13-91: BR-91-11. Unpublished study prepared by ABC Labs., Inc. 235 p.

44161001 Leppert, B.; Churchill, G. (1996) Thiophanate-Methyl and its Metabolites: Magnitude of the Residue in Dry Bean: Lab Project Number: 42250: BR-90-39: 10-90. Unpublished study prepared by ABC Labs., Inc. 264 p.

44162001 Castro, L. (1996) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Winter Wheat: Lab Project Number: BR-90-43: 94-0027: BR-011-04. Unpublished study prepared by Elf Atochem North America, Inc. 468 p.

44182401 Leppert, B.; Castro, L. (1996) Thiophanate-methyl and Its Metabolites: Magnitude of the Residue in Cherry: Lab Project Number: BR-91-27: BR-011-00: 23-91. Unpublished study prepared by Elf Atochem North America, Inc. and Stewart Agricultural Research Service, Inc. 221 p.

44184301 Leppert, B.; Churchill, G. (1996) Thiophanate-Methyl and its Metabolites: Magnitude of the Residue in Snap Bean: Lab Project Number: 42251: BR-90-41: 08-90. Unpublished study prepared by ABC Labs., Inc.; Stewart Agricultural Research Services, Inc.; and Elf Atochem North America, Inc. 300 p.

44216201 Wright, M. (1997) (Carbon-14)-Thiophanate Methyl: Nature of the Residue in Rotational Crops: Final Report Addendum #1 to MRID 42670501: Frozen Storage Stability of the Radioactive Residue: Lab Project Number: BR-90-14: WT-87-C-11: BR-87-6. Unpublished study prepared by Research For Hire; Battelle Memorial Institute; and Pan-Ag Labs, Inc. 35 p.

44228801 Churchill, G.; Carey, D. (1997) Thiophanate-methyl and Its Metabolites: Magnitude of Residue in Strawberry: (Final report): Lab Project Number: BR-91-19: 03A-91: 03B-91. Unpublished study prepared by Elf Atochem North America, Inc. 330 p. (Relates to L0000118).

44232401 Castro, L. (1997) Magnitude of the Residue of Thiophanate-methyl in Milk and Tissue of Lactating Dairy Cattle: Final Report: Lab Project Number: KP-96-04: 43285: 04-96. Unpublished study prepared by Elf Atochem North America, Inc. and ABC Labs. 242 p.

44286701 Pitt, J. (1997) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Field Peas: Final Report: Lab Project Number: 42647: BR-91-12: 14-91. Unpublished study prepared by ABC Laboratories, Inc. 256 p.

44287501 Castro, L. (1997) Residues of Thiophanate Methyl and its Major Metabolites in the Eggs and Tissues of Laying Hens Following Daily Oral Dosing with Thiophanate Methyl: (Final Report): Lab Project Number:

KP-96-05: 106-018-09. Unpublished study prepared by Bio-Life Associates, Ltd. 165 p. {OPPTS 860.1480}.

44308600 Elf Atochem North America, Inc. (1997) Submission of FQPA Supplemental Data in Support of the Petition for Thiophanate- methyl on Grapes and Pears. Transmittal of 1 Study.

44336001 Castro, L. (1997) Independent Laboratory Validation of a Proposed Analytical Method for the Appropriate Metabolites of Thiophanate-methyl in Meat, Milk and Eggs: Interim Report: Lab Project Number: 100S17: KP-96-03: KP-100-01. Unpublished study prepared by EPL Bio-Analytical Services, Inc. 189 p. {OPPTS 860.1340}

44375701 Wright, M. (1997) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Pears: Addendum #1: Lab ProjectNumber: 40823: BR-92-17. Unpublished study prepared by ABC Laboratories, Inc. 7 p.

44375702 Wright, M. (1997) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Processed Grape Fractions: Revised Report: Lab Project Number: A036.030: BR-93-24. Unpublished study prepared by Huntingdon Analytical Services, Inc. 8 p.

44375703 Wright, M. (1997) Field Trial Data for 1980 & 1981: Thiophanate Methyl and Metabolites: Magnitude of the Residue on Grapes California, Pennsylvania and New York Trial Sites: Supplement: Lab Project Number: GRAPESUP: GP27: GP38. Unpublished study prepared by Elf Atochem North America, Inc. 45 p.

44400001 Lucas, L. (1997) Thiophanate-methyl Frozen Storage Stability of Residues in/on Whole Apples: Interim Report: Lab Project Number: 42455: BR-95-09: ELF ATOCHEM BR-95-09. Unpublished study prepared by ABC Labs., Inc. 64 p.

44401801 Barker, W.; Tomkinson, R. (1997) Stability of ThiophanateMethyl in Wheat Grain During Frozen Storage Pending Analysis: 6-Month Interim Report: Lab Project Number: 96-0089: KP-96-13. Unpublished study prepared by EN-CAS Analytical Labs. 9 p.{OPPTS 860.1380}

44401802 Lucas, L. (1997) Stability of Thiophanate Methyl in Cucumbers During Frozen Storage Pending Analysis: 6-Month Interim Report: Lab Project Number: 43512: KP-96-10. Unpublished study prepared by ABC Labs, Inc. 27 p. {OPPTS 860.1380}

44401803 Burton, J. (1997) Stability of Thiophanate Methyl in Snap Beans During Frozen Storage Pending Analysis: (6-Month) Interim Report: Lab Project Number: 009-04: KP-96-11: 11-96. Unpublished study prepared by Centre Analytical Labs, Inc. 19p. {OPPTS 860.1380}

44401804 Burton, J. (1997) Stability of Thiophanate Methyl in SugarBeets During Frozen Storage Pending Analysis: (6-Month) Interim Report: Lab Project

Number: 009-03: KP-96-12: 12-96. Unpublished study prepared by Centre Analytical Labs, Inc. 19p. {OPPTS 860.1380}

44467901 Carr, B. (1997) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Summer Squash: Lab Project Number: BR-91-31: CAR 136-91: 27-91. Unpublished study prepared by Elf Atochem North America, Inc. 101 p. {OPPTS 860.1500}

44468201 Bennett, R.; Castro, L. (1998) Thiophanate-Methyl and Its Metabolites: Magnitude of the Residue in Watermelon: Final Report: Lab Project Number: BR-91-29: 25-91: 96-0083. Unpublished study prepared by EN-CAS Analytical Labs., 336 p. {OPPTS 860.1500}

44468202 Castro, L. (1998) Thiophanate-Methyl and Its Metabolites: Magnitude of the Residue in Potato: Lab Project Number: BR-91-18: 44138: 04B-91. Unpublished study prepared by Elf Atochem N.A., Inc. 242 p.

44471401 Bennett, R.; Castro, L. (1998) Thiophanate-Methyl and its Metabolites: Magnitude of the Residue in Cucumber: Final Report: Lab Project Number: 43510: BR-91-30: BR-011-05. Unpublished study prepared by ABC Labs. 313 p. {OPPTS860.1500}

44478601 Bradway, D.; Carr, B. (1998) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Sugarbeet: Lab Project Number: BR-91-20: 009-05: BR-011-05. Unpublished study prepared by Centre Analytical Labs., Inc. 233 p. {OPPTS 860.1500}

44487001 Bennett, R.; Castro, L. (1997) Thiophanate-Methyl and its Metabolites: Magnitude of the Residue in Almond: Final Report: Lab Project Number: 42783: ABC 42783: BR-90-37. Unpublished study prepared by ABC Labs. 201 p. {OPPTS 860.1500}

44498501 Carr, B. (1998) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Pecans: Lab Project Number: BR-91-16: 06C-91: 06B-91. Unpublished study prepared by Elf Atochem North America, Inc. 128 p. {OPPTS 860.1500}

44498502 Castro, L. (1998) Thiophanate Methyl and Its Metabolites: Magnitude of the Residue in Potato Processed Commodities: Lab Project Number: BR-91-23: 44175: 05B-91. Unpublished study prepared by Elf Atochem North America, Inc. 315 p.

44515701 Bradway, D.; Carr, B. (1998) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Peanut: Lab Project Number: BR-91-14: 01-91: 009-02. Unpublished study prepared by Centre Analytical Labs., Inc. 207 p. {OPPTS 860.1500}

44526101 Mayer, J. (1998) Independent Laboratory Validation of a Proposed Analytical Method for the Appropriate Metabolites of Thiophanate-Methyl in Meat, Milk, and Eggs: Lab Project Number: 100S17: KP-96-03: KP-100-04. Unpublished study prepared by EPL Bio-Analytical Services, Inc. 411 p. {OPPTS 860.1340}

44533301 Burton, J. (1998) Stability of Thiophanate Methyl in Snap Beans During Frozen Storage Pending Analysis: Lab Project Number: 009-04: KP-96-11: 11-96. Unpublished study prepared by Centre Analytical Laboratories, Inc. 19 p. {OPPTS 860.1380}

44533302 Barker, W.; Tomkinson, R. (1998) Stability of Thiophanate Methyl in Wheat Grain During Frozen Storage Pending Analysis: Analytical Report: 1 Year Interim: Lab Project Number: 96-0089: KP-96-13. Unpublished study prepared by EN-CAS Analytical Laboratories. 9 p. {OPPTS 860.1300}

44533303 Lucas, L. (1998) Stability of Thiophanate-Methyl in Cucumbers During Frozen Storage Pending Analysis: Lab Project Number: 43512: KP-96-10. Unpublished study prepared by ABC Laboratories, Inc. 27 p. {OPPTS 860.1380}

44533304 Barker, W.; Tomkinson, R. (1998) Stability of Thiophanate Methyl in Wheat Grain During Frozen Storage Pending Analysis: Analytical Report: 1 Year Interim: Lab Project Number: 96-0089: KP-96-13. Unpublished study prepared by EN-CAS Analytical Laboratories. 9 p. {OPPTS 860.1300}

44554601 Lucas, L. (1998) Stability of Thiophanate-Methyl in Soybean Seed During Frozen Storage Pending Analysis: Lab Project Number: 44137: KP-97-10. Unpublished study prepared by ABC Laboratories, Inc. 27 p. {860.1380}

44572701 Castro, L. (1998) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Soybean: Lab Project Number: 43782. Unpublished study prepared by ABC Laboratories. 241 p.

44572702 Castro, L. (1998) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Soybean Processed Commodites: Lab Project Number: 43783: BR-90-07. Unpublished study prepared by ABC Laboratories, Inc. 174 p.

44585601 Carr, B. (1998) Thiophanate Methyl and its Metabolites: Magnitude of the Residue Sugar Beet Processed Fractions: Lab Project Number: BR-91-24: 009-06: 91-22A-02. Unpublished study prepared by Elf Atochem North America, Inc. 361 p.

44592301 Castro, L. (1998) Magnitude of the Residue of Thiophanate-methyl in Milk and Tissue of Lactating Dairy Cattle: Addendum No. 1 to EPA MRID 44232401: Lab Project Number: KP-96-04. Unpublished study prepared by Elf Atochem.66 p. {OPPTS 860.1480}

44643501 Carr, B. (1998) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Sugar Beet from the Application of Topsin M: Lab Project Number: KP-97-05: TD-2115-02: QC0032R2. PAM. Unpublished study prepared by Gustafson, Inc. and Elf Atochem North America, Inc. 261 p. {OPPTS 860.1500}

44643502 Castro, L. (1998) Residues of Thiophanate Methyl and its Major Metabolites in Eggs and Tissue of Laying hens Following Daily Oral Dosing with Thiophanate Methyl: Addendum No.1: Lab Project Number: KP-96-05. Unpublished study prepared by Elf Atochem North America, Inc. 57 p. {OPPTS 860.1480}

44676901 Barker, W.; Tomkinson, R. (1998) Stability of Thiophenate Methyl in Wheat Grain During Frozen Storage Pending Analysis: Lab Project Number: 96-0089: KP-96-13. Unpublished study prepared by EN-CAS Analytical Laboratories. 9 p.

44676902 Lucas, L. (1998) Stability of Thiophanate Methyl in Cucumbers During Frozen Storage Pending Analysis: Lab Project Number: 43512: KP-96-10. Unpublished study prepared by ABC Laboratories, Inc. 27 p. {OPPTS 860.1380}

44676903 Wickremesinhe, E. (1998) Stability of Thiophenate Methyl in Snap Beans During Frozen Storage Pending Analysis: Lab Project Number: 009-04: KP-96-11. Unpublished study prepared by Centre Analytical Laboratories, Inc. 19 p.

44676904 Wickremesinhe, E. (1998) Stability of Thiophenate Methyl in Snap Beans During Frozen Storage Pending Analysis: Lab Project Number: 009-03: KP-96-11. Unpublished study prepared by Centre Analytical Laboratories, Inc. 19 p.

44703601 Lucas, L. (1998) Stability of Thiophenate-Methyl in Soybean Seed During Frozen Storage Pending Analysis: Lab Project number: 44137:KP-97-10. Unpublished study prepared by ABC Laboratories, Inc. 27 p.

44703602 Shaffer, S. (1998) Independent Laboratory Confirmation of an Analytical Method for the Determination of Thiophanate Methyl and MBC in Plant Tissues: Lab Project Number: 10217: KP-98-33. Unpublished study prepared by Horizon Laboratories, Inc.148 p. {OPPTS 860.1340}.

44788001 Lucas, L. (1999) Stability of Thiophanate-Methyl in Cucumbers During Frozen Storage Pending Analysis: Lab Project Number: 43512: KP-96-10. Unpublished study prepared by ABC Laboratories, Inc. 27 p. {OPPTS 860.1380}

44850901 Carr, B. (1999) Thiophanate Methyl and its Metabolites: Magnitude of the Residue in Peanut Processed Fractions: Lab Project Number: BR-91-21:

44587: BR-011-05. Unpublished study prepared by Elf Atochem North America, Inc. and ABC Labs. 177 p. {OPPTS 860.1520}

44850902 Lucas, L. (1999) Stability of Thiophanate Methyl in Soybean Seed During Frozen Storage Pending Analysis: Lab Project Number: KP-97-10: 44137. Unpublished study prepared by Elf Atochem North America, Inc. and ABC Labs. 27 p. {OPPTS 860.1380}

44866201 Castro, L. (1999) Dissipation of Dislodgeable Residues of Topsin M from Strawberry Leaves: Lab Project Number: KP-98-08.Unpublished study prepared by Elf Atochem North America, Inc.166 p. {OPPTS 875.2100}

44876301 Castro, L. (1999) Dissipation of Dislodgeable Residues of Topsin M From Apple Leaves: Lab Project Number: KP-98-07:.Unpublished study prepared by Elf Atochem North America, Inc.178 p.

44921301 Wickremesinhe, E. (1999) Stability of Thiophanate Methyl in Snap Beans During Frozen Storage Pending Analysis (Up to and Including 24 Months): Lab Project Number: 009-04: KP-96-11: BR-011-05. Unpublished study prepared by Centre Analytical Laboratories, Inc. 19 p. {OPPTS 860.1380}

44921302 Wickremesinhe, E. (1999) Stability of Thiophanate Methyl in Sugar Beets During Frozen Storage Pending Analysis (Up to and Including 24 Months): Lab Project Number: 009-03: KP-96-12: 12-96. Unpublished study prepared by Centre Analytical Laboratories, Inc. 19 p. {OPPTS 860.1380}

45000701 Pitt, J. (1999) Determination of Transferable Turf Residues on Turf Treated with Thiophanate Methyl: Lab Project Number: KP-99-04. Unpublished study prepared by Grayson Research, LLC.171 p.

45027501 Ampofo, S. (2000) Dissipation of Dislodgeable Residues of 3336 WP from Cut Flowers: Lab Project Number: KP-98-47. Unpublished prepared by Elf Atochem. 160 p.

45051001 York, R. (1997) Oral (Stomach Tube) Development Toxicity Study of Thiophanate-Methyl in Rabbits: Final Report: Lab Project Number: 914-002. Unpublished study prepared by Argus Research Labs., Inc. 233 p.

45061901 Bradway, D.; Castro, L. (1999) 1998 Thiophanate-Methyl and MBC:Magnitude of the Residue in Potato: Lab Project Number: KP-98-28. Unpublished study prepared by Elf Atochem North America, Inc. 164 p. {OPPTS 860.1500}

45081801 Barker, W. (2000) Stability of Thiophanate Methyl in Wheat Grain During Frozen Storage Pending Analysis: Lab Project Number: 96-0089: KP-96-13. Unpublished study prepared by EN-CAS Analytical Labs. 11 p. {OPPTS 830.1380}

45081802 Barker, W. (2000) Stability of Thiophanate Methyl in Wheat Grain During Frozen Storage Pending Analysis: Lab Project Number: 96-0089: KP-96-13. Unpublished study prepared by EN-CAS Analytical Labs. 12 p. {OPPTS 860.1380}

45081803 Wickremesinhe, E. (2000) Stability of Thiophanate Methyl in Snap Beans During Frozen Storage Pending Analysis (Up to and Including 36 Months): Lab Project Number: 009-94: KP-96-11:11-96. Unpublished study prepared by Centre Analytical Labs. 22 p. {OPPTS 860.1380}

45081804 Wickremesinhe, E. (2000) Stability of Thiophanate Methyl in Sugar Beets During Frozen Storage Pending Analysis (Up to and Including 36 Months): Lab Project Number: 009-03: KP-96-12: 12-96. Unpublished study prepared by Centre Analytical Labs. 22 p. {OPPTS 860.1380}

45081805 Lucas, L. (1999) Stability of Thiophanate Methyl in Cucumbers During Frozen Storage Pending Analysis (Up to and Including 36 Months): Lab Project Number: 43512: KP-96-10. Unpublished study prepared by ABC Labs., Inc. 27 p. {OPPTS 860.1380}

45081806 Lucas, L. (2000) Stability of Thiophanate Methyl in Soybean Seed During Frozen Storage Pending Analysis (Up to and Including 36 Months): Lab Project Number: 44137: KP-97-10. Unpublished study prepared by ABC Labs., Inc. 29 p. {OPPTS 860.1380}

45160401 Lucas, L. (2000) Thiophanate Methyl Frozen Storage Stability of Residues in/on Whole Apples: Final Report: Lab Project Number: 42455: BR-95-09: 42455-SS. Unpublished study prepared by ABC Laboratories, Inc. 129 p.

45208901 Ampofo, S. (2000) Determination of Percent of Thiophanate-Methyl Residue Reduction in Apples Effected by Typical Consumer Home Practices: Lab Project Number: KP-2000-14. Unpublished study prepared by Elf Atochem North America, Inc. 119 p.

45218901 Carr, B. (1999) 1998 Thiophanate Methyl and MBC: Magnitude of the Residue in Grapes: Lab Project Number: KP-98-19: 19-98A: 19-98B. Unpublished study prepared by Elf Atochem North America, Inc. 139 p. {OPPTS 860.1500}

45258301 Ampofo, S. (2000) Field Accumulation of Topsin M in Rotated Crops: Lab Project Number: KP-98-01. Unpublished study prepared by Elf Atochem North America, Inc. 192 p. {OPPTS 860.1900}

45520602 Artz, S. (2001) Magnitude of the Residue of Thiophanate-methyl and MBC in Blueberries Raw Agricultural Commodities Following Applications of TOPSIN M 70W: Lab Project Number: KP-2001-12.

Unpublished study prepared by Cerexagri, Inc. 204 p. {OPPTS 860.1000 and 860.1500}

45520603 Robinson, P. (2001) TOPSIN M 70W Field Residue Study in Citrus: Lab Project Number: KP-2001-13. Unpublished study prepared by Cerexagri, Inc. 238 p.

45534301 Robinson, P. (2001) Topsin M 70W Field Processing Study in Canola: Lab Project Number: KP-2001-15: KP-024-01: 01ND104. Unpublished study prepared by Cerexagri, Inc. and Agro-Tech. 208 p. {OPPTS 860.1520}

45534302 Robinson, P. (2001) Topsin M 70W Field Residue Study in Canola: Lab Project Number: KP-2001-16: 01ND101: 01ND102. Unpublished study prepared by Cerexagri, Inc. and Agro-Tech. 190 p. {OPPTS 860.1500}

Barale, R., Scapoli, C., Meli, C., Casini, D., Minunni, M., Marrazzini, A., Loprieno, N., and Barrai, I. (1993) Cytogenic effects of benzamidazoles in mouse bone marrow. Mutat. Res. 300:15-28.

Nakai, M., Hess, R.A., Moore, B.J., Guttroff, R.F., Strader, L.F., and, Linder, R.E. 1992. "Acute and Long-term Effects of a Single Dose of the Fungicide Carbendazim (Methyl 2-Benzimidazole Carbamate) on the Male Reproductive System in the Rat." Journal of Andrology. 13(6):507-517.

Perocco, P., Del Ciello, C., Mazzullo, M., Rocchi, P., Ferreri, A.M., Paolini, M., Pozzetti, L. and Cantelli-Forti, G. (1997) Cytotoxicity and cell transforming activities of the fungicide methyl thiophanate on BALB/c 3T3 cells *in vitro. Mutat. Res.* 394:29-35.

Selling, H.A., Vonk, J.W. and Kaars Sijpesteijn, A. (1970) Transformation of the systemic fungicide methyl thiophanate into 2-benzimidazole carbamic acid methyl ester, in: *Chemistry and Industry*, Madley, London, pp. 1625-1626.

United States Environmental Protection Agency (U.S. EPA) 1997. Draft Standard Operating Procedures (SOPs) for Residential Exposure Assessments. Office of Pesticide Programs, Health Effects Division (HED). Prepared by the
Residential Exposure Work Group. December 18, 1997.

United States Environmental Protection Agency (U.S. EPA) 1998. Assessment of thyroid follicular cell tumors. Publication EPA/630/R-97/002, March, 1998.
United States Environmental Protection Agency (U.S. EPA) 1998. Route-to-Route Extrapolations. Office of Pesticide Programs. Health Effects Division (HED). Memo From John E. Whalen (HED) to Margaret Stasikowski, Director. October
9, 1998.

Zeiger, E., Anderson, B., Haworth, S. Lawlor, T. and Mortelmans, K. (1992) *Salmonella* mutagenicity tests: IV Results of testing 311 chemicals. *Environ. And Molec. Mutagen* 19[Suppl. 21]:2-141.

Appendix D. Generic Data Call-In

See the following table for a list of generic data requirements. Note that a complete Data Call-In (DCI), with all pertinent instructions, is being sent to registrants under separate cover.

Appendix E. Product Specific Data Call-In

See attached table for a list of product-specific data requirements. Note that a complete Data Call-In (DCI), with all pertinent instructions, is being sent to registrants under separate cover.

Appendix F. List of Registrants Sent This Data Call-In

Cleary Chemical Corporation
Gowan Company
Nufarm Americas Inc.
Cerexagri, Inc.
Regal Chemical Company
Micro-Flo Company LLC
The Scotts Company
Scotts-Sierra Crop Protection Company
Gowan Pacific Group, LLC
Nations Ag II, LLC
Gustafson, LLC
The Andersons Lawn Fertilizer Division, Inc.

Appendix G. EPA'S Batching of Thiophanate-methyl 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 **Thiophanate-methyl** 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. Notwithstanding 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 five products were found which contain **Thiophanate-methyl** as the active ingredient. These products have been placed into six batches and a "No Batch" category in accordance with the active and inert ingredients and type of formulation. Furthermore, the following bridging strategies are deemed acceptable for this chemical:

- In Batch 2 the three 85% products may not cite the data generated by EPA Reg.No. 10163-249 (80% product).
- In Batch 5 the five 46.2% products may not cite the data generated by EPA Reg. No. 1001-69 (41.25% product).
- No Batch: Each product in this Batch should generate their own data.

NOTE: The technical acute toxicity values included in this document are for informational purposes only. The data supporting these values may or may not meet the current acceptance criteria.

Batch 1	EPA Reg. No.	% Active Ingredient
	4581-401	95.0
	51036-310	97.0
	66996-3	95.1
	72167-5	99.0

Batch 2	EPA Reg. No.	% Active Ingredient
	4581-407	85.0
	10163-249	80.0
	48234-13	85.0
	72167-10	85.0

Batch 3	EPA Reg. No.	% Active Ingredient
	4581-402	70.0
	4581-403	70.0
	4581-408	70.0
	10163-262	70.0
	51036-328	70.0
	51036-344	70.0

Batch 4	EPA Reg. No.	% Active Ingredient
	1001-63	50.0
	9198-211	50.0
	51036-330	50.0
	58185-30	50.0

Batch 5	EPA Reg. No.	% Active Ingredient
	1001-69	41.25
	4581-405	46.2
	48234-12	46.2
	51036-329	46.2
	58185-33	46.2
	72167-9	46.2

Batch 6	EPA Reg. No.	% Active Ingredient
	58185-31	Thiophanate methyl: 15.6 Mancozeb: 64.0
	58185-32	Thiophanate methyl: 15.6 Mancozeb: 64.0

No Batch	EPA Reg. No.	% Active Ingredient
	538-88	2.30
	538-133	1.75
	538-183	Thiophanate methyl: 19.65 Iprodione: 19.65
	538-194	Thiophanate methyl: 2.05 Iprodione: 1.02
	538-253	3.89
	1001-70	2.08
	1001-72	Thiophanate methyl: 18.00 Chlorothalonil: 72.00

No Batch	EPA Reg. No.	% Active Ingredient
	4581-404	5.00
	4581-406	5.00
	7501-157	Thiophanate methyl: 2.50 Mancozeb: 6.00
	7501-178	Thiophanate methyl: 2.50 Cymoxanil: 1.00 Mancozeb: 6.00
	7501-183	Thiophanate methyl: 2.50 Imidacloprid: 1.25 Mancozeb: 6.00
	7501-32	2.50
	7501-149	5.00
	9198-204	Thiophanate methyl: 1.63 Chloroneb: 3.26
	48234-7	Thiophanate methyl: 16.66 Chlorothalonil: 50.00
	48234-18	Thiophanate methyl: 28.58 Flutolanil: 51.42
	58185-10	Thiophanate methyl: 25.00 Terrazole: 15.00
	58185-23	Thiophanate methyl: 5.00 Terrazole: 3.00

Appendix H. Technical Support Documents

Additional documentation in support of this RED is maintained in the OPP docket, located in Room 119, Cyrstal Mall #2, 1921 Jefferson Davis Highway, Arlington, VA. It is open Monday through Friday, excluding legal holidays, from 8:30 am to 4 pm.

The docket initially contained preliminary risk assessments and related documents as of August 8, 2001. Sixty days later the first public comment period closed. The EPA then considered comments, revised the risk assessment, and added the formal "Response to Comments" document and the revised risk assessment to the docket on November 29, 2001.

All documents, in hard copy form, may be viewed in the OPP docket room or downloaded or viewed via the Internet at the following site:

www.epa.gov/pesticides/

These documents include:

HED Documents:

1. Thiophanate-methyl: Updated HED Occupational Handler and Postapplication Worker Cancer Risk Estimates, December 3, 2002, Gary Bangs, OPP/HED.

2. Toxicology Chapter for Thiophanate Methyl and Carbendazim, March 14, 2002, Debbie Smegal, OPP/HED.

3. Carbendazim (Mergal BCM: Degradate of Thiophanate-Methyl). Review of 5-day Inhalation Toxicity Study, July 8, 2003, Pamela Hurley, OPP/HED.

AD Documents

1. Carbendazim: Reevaluation of Inhalation Risks for Indoor Paint Use to Support a Labeling Amendment for Polyphase 678. Debbie Smegal, OPP/AD.

EFED Documents:

1. Addendum to EFED RED chapter (revised) for thiophanate-methyl fungicide (TM) and its major degradate, MBC (methyl 2-benzimidazolycarbamate), June 24, 2002, Allen Vaughan and Faruque Khan, OPP/EFED.

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@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 (PR Notice 98-5)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-5.pdf
8570-35	Data Matrix (PR Notice 98-5)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-5.pdf
8570-36	Summary of the Physical/Chemical Properties (PR Notice 98-1)	http://www.epa.gov/opppmsd1/PR_Notices/pr98-1.pdf
8570-37	Self-Certification Statement for the Physical/Chemical Properties (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' website.

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.

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 website.

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 website: 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:

   a. Date of receipt;
   b. EPA identifying number; and
   c. 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 chemical abstract system (CAS) number if one has been assigned.