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WASHINGTON, D.C. 20460

OFFICE OF PREVENTION,  
PESTICIDES AND  
TOXIC SUBSTANCES

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MEMORANDUM

**SUBJECT:** Residential Exposure Assessment and Recommendations for the Tolerance Reassessment Evaluation Decision (TRED) Document for Trifluralin

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Please find the review of Trifluralin.

DP Barcode: D296625

Pesticide Chemical Codes: 036101

EPA Reg Numbers:

**Residential Labels:**

228-208, 228-209, 228-254, 228-255, 228-257, 572-200, 961-280, 961-283, 961-335, 961-348, 1812-430, 5887-171, 7401-349, 8378-41, 8660-143, 8660-149, 8660-165, 8660-166, 9198-60, 9198-79, 9198-91, 9198-94, 9198-98, 9198-101, 9198-149, 9688-133, 32802-35, 32802-40, 32802-77, 49585-25, 54705-6, 59823-3, 62719-137, 62719-280, 62719-327, 62719-331, 62719-332, 72620-1

**Occupational Labels:**

228-207, 228-256, 961-370, 8378-37, 10404-57, 32802-35, 32802-40, 62719-97, 62719-150, 62719-151, 62719-152, 62719-175, 32719-192

PHED:

Yes, Version 1.1

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## RESIDENTIAL EXPOSURE/RISK ASSESSMENT AND CHARACTERIZATION

### Executive Summary

The Federal Food, Drug, and Cosmetic Act (FFDCA), as amended, requires the U.S. Environmental Protection Agency to reassess all the tolerances for the registered chemicals in effect on or before August 3, 1996, the date of the enactment of the Food Quality Protection Act (FQPA), against the new safety standard adopted in the FQPA. A reregistration eligibility decision (RED) for trifluralin was completed in April 1996, prior to the enactment of FQPA. Therefore, EPA is issuing a tolerance reassessment evaluation decision (TRED) to reassess the tolerances under the FQPA standard. Occupational exposure assessments are not included in TRED documents; however, potential occupational exposure to trifluralin was assessed in the April 1996 RED document.

At this time, products containing trifluralin are intended for both occupational and non-occupational uses. Trifluralin is a pre-emergent herbicide used to control annual grasses and broadleaf weeds on a variety of residential food and non-food uses. There are also several occupational uses which will not be addressed in this TRED. For residential uses, trifluralin is formulated as a granular (0.17 - 2.0 percent active ingredient) and an emulsifiable concentrate liquid (43 percent active ingredient).

In May 2003, the Hazard Identification Assessment and Review Committee (HIARC) reassessed toxicological endpoints for non-dietary exposures to trifluralin. The duration of exposure for residential populations is assumed to be short-term (1-30 days) only. No exposure or risk assessment is required for short-term dermal exposures, since there was no systemic toxicity at the limit dose in the dermal toxicity study and there are no developmental toxicity concerns. The short-term (1-30 days) inhalation toxicological endpoint was established at 81 mg/kg/day, based on the no-observed-adverse-effect level (NOAEL) from a 30-day inhalation rat study. Trifluralin is classified as a "Group C," possible human carcinogen with a Q\* of 0.00579 (mg/kg/day)<sup>-1</sup>. HED notes that the HIARC recommends that products containing trifluralin should be labeled as a dermal sensitizer and should state that skin contact should be avoided.

Short-term inhalation risks to residential handlers and dermal and inhalation cancer risks to residential handlers were calculated using surrogate data from the Pesticide Handler Exposure Database (PHED), the Outdoor Residential Exposure Task Force (ORETF), and a proprietary study using fipronil<sup>1</sup> with MRID 452507-01 .

HED has determined that there are potential exposures to residential handlers (i.e., mixer/loader/applicators) during the usual use-patterns associated with trifluralin. Based on the use patterns, seven major residential exposures were identified for trifluralin: (1) loading/applying granulars with a belly grinder; (2) loading/applying granulars with a push-type spreader; (3) loading/applying granulars with a spoon, measuring scoop, shaker can, or by hand; (4) mixing/loading/applying liquids with a hose-end sprayer; (5) mixing/loading/applying liquids with a low

pressure handwand; (6) mixing/loading/applying liquids with a backpack sprayer; and (7) applying trifluralin impregnated fabric squares to soil.

For short-term noncancer risks to residential handlers, a margin of exposure (MOE) of **less than 100** exceeds the Agency's level of concern. For residential handlers, the calculations of short-term inhalation noncancer risk indicate that the MOEs are **greater than 100** for all residential handler scenarios.

For residential handler scenarios, cancer risks **greater than  $1 \times 10^{-6}$**  are considered to be of concern. The calculations of residential handler cancer risk indicate that all scenarios have a cancer risk of less than  $1 \times 10^{-6}$ .

HED has determined that there are potential postapplication exposures to adults and children in residential settings during the usual use-patterns associated with trifluralin. Based on the use patterns, seven potential residential postapplication exposures were identified for trifluralin: (1) dermal exposure from residue on lawns (adult and toddler); (2) dermal exposure from residue on golf course turfgrass (adult and youth); (3) dermal exposure from residue on home gardens (adult and youth); (4) hand-to-mouth transfer of residue on lawns (toddler); (5) object-to-mouth transfer of residues on lawns (toddler); (6) incidental ingestion of soil from pesticide treated residential areas (toddler); and (7) incidental ingestion of granules from pesticide-treated residential areas.

For noncancer postapplication risks, since there is no short-term dermal toxicological endpoint of concern for trifluralin and no intermediate-term dermal exposure is anticipated, the only assessment is for incidental ingestion by toddlers.

For short-term noncancer residential postapplication risks, a margin of exposure (MOE) of **less than 100** exceeds the Agency's level of concern. For residential postapplication, the calculations of noncancer risk based on the incidental oral NOAEL endpoint indicate that the MOEs were **more than 100** for the following residential postapplication scenarios:

- hand-to-mouth transfer of residues on lawns (toddler),
- object-to-mouth transfer of residues on lawns (toddler), and
- incidental ingestion of residues of soil from pesticide treated residential areas (toddler).

In addition, HED determined that a combined risk assessment was necessary for the following noncancer residential postapplication scenarios listed above. The combined MOE for these scenarios is **greater than 100** and is not considered a risk concern.

The Agency also assesses the exposure and risk to toddlers from incidental ingestion of granules in pesticide-treated residential areas. Since this exposure is episodic and likely to occur, at most, only once following an application, an acute dietary NOAEL endpoint is used to assess the risks. Since

no acute dietary endpoint for trifluralin has been identified for the general population, including infants and children, acute dietary risks from ingestion of pesticide granules were not assessed.

HED has determined that there are potential postapplication cancer risks for adults in residential areas treated with trifluralin. The following scenarios were assessed: (1) dermal exposure to residue on lawns, (2) dermal exposure to golf course turfgrass, and (3) dermal exposure to residue on home gardens. For residential postapplication scenarios, cancer risks **greater than  $1 \times 10^{-6}$**  are considered to be of concern. The calculation of residential postapplication cancer risk indicate that all scenarios have a cancer risk of less than  $1 \times 10^{-6}$  and are not considered a risk concern.

For the residential turfgrass scenario, HED combined the cancer risks for residential handlers applying granular formulation to lawns with postapplication cancer risks to adults from exercising on just-treated lawns. This combined two screening-level calculations. The combined risks are less than  $1 \times 10^{-6}$  and are not considered a risk concern.

## **1.0 Residential Exposure/Risk Assessment**

### **1.1 Purpose**

The Federal Food, Drug, and Cosmetic Act (FFDCA), as amended, requires the U.S. Environmental Protection Agency to reassess all the tolerances for the registered chemicals in effect on or before August 3, 1996, the date of the enactment of the Food Quality Protection Act (FQPA), against the new safety standard adopted in the FQPA. A reregistration eligibility decision (RED) for trifluralin was completed in April 1996, prior to the enactment of FQPA. Therefore, EPA has issued a tolerance reassessment evaluation decision (TRED) to reassess the tolerances under the FQPA standard.

In this document, which is for use in EPA's development of the trifluralin TRED Document, EPA presents the results of its review of the potential human health effects of residential/non-occupational exposure to trifluralin. Occupational exposure assessments are not included in TRED documents; however, potential occupational exposure to trifluralin was briefly assessed in the April 1996 RED document.

### **1.2 Criteria for Conducting Exposure Assessments**

An occupational and/or residential exposure assessment is required for an active ingredient if (1) certain toxicological criteria are triggered and (2) there is a potential for exposure to handlers (mixers, loaders, applicators) during use or to persons entering treated sites after application is complete. Toxicological endpoints were identified for short-term inhalation exposures and for short-term incidental ingestion. In addition, trifluralin has been classified as a Category C possible human carcinogen with a  $Q_1^*$  of  $0.00579 \text{ (mg/kg/day)}^{-1.2}$ . Handler and postapplication exposure scenarios have been identified.

### 1.3 Summary of Hazard Concerns

The toxicological endpoints that were used to complete the residential risk assessments are summarized below and in Table 1 which has been extracted from the latest HIARC document dated May 2, 2003. Adverse effects were identified at different durations of exposure ranging from short-term (up to 30 days) to chronic durations (every working day). However, for residential exposure assessments, only short-term exposures and risks are evaluated because trifluralin is a pre-emergent herbicide where the use patterns in residential settings are limited to a few widely spaced applications each year. No short-term dermal endpoint was identified, since there was no systemic toxicity at the limit dose in the dermal toxicity study and there are no developmental toxicity concerns. The short-term inhalation risk assessment for trifluralin is based on an NOAEL of 81 mg/kg/day, which was defined in a 30-day inhalation study in rats. The short-term incidental oral risk assessments for trifluralin are based on an NOAEL of 10 mg/kg/day, which was defined in a two-generation reproductive study in rats. The acute dietary (toddler ingestion of granules) risks for trifluralin were not assessed, since no acute dietary endpoint of concern was identified for the general population, including infants and toddlers.

The Agency's level of concern for noncancer risks (i.e., target level for MOEs or Margins of Exposure) is defined by the uncertainty factors that are applied to the assessment. The Agency applies a factor of 100 to account for inter-species extrapolation to humans from the animal test species and to account for intra-species sensitivity. Based on the requirements of the 1996 Food Quality Protection Act, the Agency must also consider sensitive populations in its non-occupational risk assessments. The Agency has reduced the FQPA safety factor for trifluralin to 1x for all residential populations.<sup>2</sup> The total uncertainty factors that have been applied to noncancer risk assessments is 100 for the residential assessment.

In addition, trifluralin has been classified as a Category C – possible human carcinogen, based on increased incidences of combined malignant and benign tumors of the renal pelvis and benign tumors of the urinary bladder. Quantification of human risk using a low dose model extrapolation was recommended. Trifluralin has a  $Q_1^*$  of  $0.00579 \text{ (mg/kg/day)}^{-1}$ .<sup>2</sup> For residential handler and postapplication scenarios, cancer risks **greater than  $1 \times 10^{-6}$**  are considered by EPA to be of concern.

Trifluralin is also classified as a skin sensitizer, but EPA has no method of quantifying risk due to skin sensitization. Therefore, the HIARC recommends that all products containing trifluralin should be labeled as SENSITIZER and also recommend that human contact should be avoided.

<b>Table 1. Hazard Endpoints and Uncertainty Factors.</b>			
<b>Exposure Scenario</b>	<b>Dose Used in Risk Assessment, UF</b>	<b>Special FQPA SF* and Level of Concern for Risk Assessment</b>	<b>Study and Toxicological Effects</b>
Acute Dietary (General population including infants and children)	No appropriate single dose endpoint was found for this population sub group	<b>Residential NA</b>	No appropriate single dose endpoint was found for this population sub group
Short-Term Incidental Oral (1-30 days)	NOAEL= 10 mg/kg/day	<b>Residential LOC:</b> MOE = 100 <b>Occupational = NA</b>	<b>Two-generation Reproduction Study - Rat</b> LOAEL = 32.5 mg/kg/day based on decreased pup weights in both generations
Intermediate-Term Incidental Oral (1- 6 months)	NOAEL= 10 mg/kg/day	<b>Residential LOC:</b> MOE = 100 <b>Occupational =NA</b>	<b>Special Urinalysis Study - Rat</b> LOAEL = 40 mg/kg/day based on based on the presence of tubular cytoplasmic hyaline droplets; increased total protein, AST, and LDH in the urine; albumin $\alpha$ 1-globulin and $\alpha$ 2-globulin observed by urine electrophoresis; and increased urinary volume
Short-Term Dermal (1 to 30 days)	No quantification required since there was no systemic toxicity at the limit dose in the dermal toxicity study. There are no developmental toxicity concerns. Also, because risk cannot be quantified, the HIARC also recommends that the products containing trifluralin should be labeled as SENSITIZER and should avoid human contact.		
Intermediate-Term Dermal (1 to 6 months)	Oral study NOAEL = 10 mg/kg/day (dermal absorption rate = 3 %	<b>Residential LOC:</b> MOE = 100 <b>Occupational LOC:</b> MOE = 100	<b>Special Urinalysis Study - Rat</b> LOAEL = 40 mg/kg/day based on based on the presence of tubular cytoplasmic hyaline droplets; increased total protein, AST, and LDH in the urine; albumin $\alpha$ 1-globulin and $\alpha$ 2-globulin observed by urine electrophoresis; and increased urinary volume
Long-Term Dermal (>6 months)	Oral study NOAEL= 2.4 mg/kg/day (dermal absorption rate = 3 % when appropriate)	<b>Residential LOC:</b> MOE = 100 <b>Occupational LOC:</b> MOE = 100	<b>Chronic Toxicity (capsule) - Dog</b> LOAEL = mg/kg/day based on based on increased frequency of abnormal stool, decreased body weights and body weight gains, and on decreased erythrocytes and hemoglobin and increased thrombocytes in males
Short-Term Inhalation (1 to 30 days)	Inhalation study NOAEL= 81 mg/kg/day	<b>Residential LOC:</b> MOE = 100 <b>Occupational LOC:</b> MOE = 100	<b>30-Day Inhalation Study - Rat</b> LOAEL = 270 mg/kg/day based on increased methemoglobin and bilirubin in females and incidences of dyspnea and ruffled fur in males and females

<b>Table 1. Hazard Endpoints and Uncertainty Factors.</b>			
<b>Exposure Scenario</b>	<b>Dose Used in Risk Assessment, UF</b>	<b>Special FQPA SF* and Level of Concern for Risk Assessment</b>	<b>Study and Toxicological Effects</b>
Intermediate-Term Inhalation (1 to 6 months)	Oral study NOAEL = 10 mg/kg/day (inhalation absorption rate = 100%)	<b>Residential LOC:</b> MOE = 100 <b>Occupational LOC:</b> MOE = 100	<b>Special Urinalysis Study - Rat</b> LOAEL = <b>40</b> mg/kg/day based on based on the presence of tubular cytoplasmic hyaline droplets; increased total protein, AST, and LDH in the urine; albumin $\alpha$ 1-globulin and $\alpha$ 2-globulin observed by urine electrophoresis; and increased urinary volume
Long-Term Inhalation (>6 months)	Oral study NOAEL= 2.4 mg/kg/day (inhalation absorption rate = 100%)	<b>Residential LOC:</b> MOE = 100 <b>Occupational LOC:</b> MOE = 100	<b>Chronic Toxicity (capsule) - Dog</b> LOAEL = mg/kg/day based on based on increased frequency of abnormal stool, decreased body weights and body weight gains, and on decreased erythrocytes and hemoglobin and increased thrombocytes in males
Cancer (oral, dermal, inhalation)	$Q1^* = 5.79 \times 10^{-3} \text{ (mg/kg/day)}^{-1}$ “Group C” (limited evidence of carcinogenicity)		

UF = uncertainty factor, FQPA SF = Special FQPA safety factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, PAD = population adjusted dose (a = acute, c = chronic) RfD = reference dose, MOE = margin of exposure, LOC = level of concern, NA = Not Applicable

**NOTE:** The Special FQPA Safety Factor recommended by the HIARC **assumes** that the exposure databases (dietary food, drinking water, and residential) are complete and that the risk assessment for each potential exposure scenario includes all metabolites and/or degradates of concern and does not underestimate the potential risk for infants and children.

A series of acute toxicity tests were also conducted using trifluralin (see Table 2). The results indicate that trifluralin is a category IV toxicant via the oral route, and category III via the dermal route. It is also a category IV for acute inhalation toxicity and a category III/IV eye and skin irritant. Results were positive for dermal sensitization and the HIARC document recommends that dermal exposure to trifluralin should be minimized and the products labeled to provide instructions to avoid contact with skin.

<b>Table 2: Acute Toxicity of Trifluralin (technical)</b>				
<b>Guideline No.</b>	<b>Study Type</b>	<b>MRID No.</b>	<b>Results</b>	<b>Toxicity Category</b>
81.1 870.1100	Acute Oral (Rat)	00157486 (1985) TXR 006174  Acceptable/Guideline	LD50 > 5000 mg/kg	IV

<b>Table 2: Acute Toxicity of Trifluralin (technical)</b>				
<b>Guideline No.</b>	<b>Study Type</b>	<b>MRID No.</b>	<b>Results</b>	<b>Toxicity Category</b>
81.2 870.1200	Acute Dermal (Rat)	00157482 (1985) TXR 006174  Acceptable/Guideline	LD50 > 2000 mg/kg	III
81.3 870.1300	Acute Inhalation (Rat)	00155261 (1982) TXR 006174  Acceptable/guideline	LC50 > 4660 mg/m <sup>3</sup> , 4.66 mg/L	IV
81.4 870.2400	Primary Eye Irritation (Rabbit)	00157483 (1985) TXR 006174  Acceptable/Guideline	Conjunctival redness at 24 hr, cleared by day 4	III
81.5 870.2500	Primary Skin Irritation	00157485 (1985) TXR 006174  Acceptable/Guideline	Not an irritant	IV
81.6 870.2600	Dermal Sensitization	00157484 (1985) TXR 006174  Acceptable/Guideline	Sensitizing agent	N/A

#### **1.4 Summary of Use Patterns and Formulations**

At this time, products containing trifluralin are intended for both occupational and residential uses. However, in this TRED only residential (i.e., non-occupational) exposures will be assessed. Trifluralin is a pre-emergent herbicide registered for weed control on home lawns, vegetable gardens, ornamental gardens (including planting beds, flowers, shrubs, and trees), and at other residential sites, such as golf courses, recreational parks, bike/golf cart paths, and cemeteries. Trifluralin has several registrants including, Dow AgroSciences, Griffin LLC and Riverdale Chemical Company.

##### **1.4.1 End-Use Products**

Based on a review of the Office of Pesticide Programs – Pesticide Product Label System (PPLS), residential trifluralin formulations include liquid concentrates and granular formulations.

##### **1.4.2 Mode of Action and Targets Controlled**

Trifluralin is a pre-emergent herbicide used in commercial/residential settings for pre-emergent weed control of annual grasses and broadleaf weeds which include, but are not limited to, the following:

- **Grass Weeds:** annual bluegrass, barnyardgrass, brachiaria, bromegrass, cheat, crabgrass, foxtail, guineagrass, itchgrass, johnsongrass, junglerice, panicum, ryegrass, Texas panicum, red rice, sandbur, sprangletop, stinkgrass, shattercane, woolly cupgrass; and
- **Broadleaf Weeds:** carpetweed, chickweed, field bindweed, goosefoot, henbit, knotweed, kochi, lambsquater, pigweed, puncturevine, purslane, Russian thistle, stinging nettle.

Trifluralin is applied during the growing season to established plants and transplants. It is applied one to two weeks prior to the anticipated germination of annual grass weed seeds, since established weeds will not be controlled. Treated areas should be irrigated or soil incorporated soon after application.

### **1.4.3 Registered Use Categories and Sites**

An analysis of the current labeling and available use information was completed. Trifluralin is registered for use in a variety of occupational and homeowner/residential scenarios. This TRED deals only with homeowner/residential uses.

#### **Homeowner/Residential Use Sites**

Trifluralin can be purchased and used by homeowners in residential settings. The following is a list of use sites in the residential environment.

- vegetable gardens
- residential, golf course, and recreational turf
- ornamentals: flowers, trees, and shrubs, preplant ornamentals

## **2.0 Residential and Other Non-Occupational Exposures and Risks**

It has been determined there is a potential for exposure in residential settings during the application process for homeowners who use products containing trifluralin. There is also a potential for exposure from entering areas treated with trifluralin that could lead to exposures for adults and children. As a result, risk assessments have been completed for both residential handler and postapplication scenarios.

### **2.1 Residential Handler Exposures and Risks**

The Agency uses the term “handlers” to describe those individuals who are involved in the pesticide application process. Residential handlers are assumed to complete all elements of an application (i.e., mixing, loading, and application) without the use of personal protective equipment and are assumed to be attired in short-sleeve shirts, short pants, shoes, and socks.

### 2.1.1 Handler Exposure Scenarios

Scenarios are used to define risks based on the *U.S. EPA Guidelines For Exposure Assessment* (U.S. EPA; Federal Register Volume 57, Number 104; May 29, 1992). The purpose of this section is to describe how the exposure scenarios were defined.

- For residential scenarios, homeowner handlers are expected to complete all tasks associated with the use of a pesticide product, including mixing/loading as well as application;
- Residential handler exposure scenarios are only considered to be short-term in nature due to the episodic uses associated with homeowner products;
- Label use rates and use information specific to residential products serve as the basis for the risk calculations; and
- Area/volumes of spray or chemical used in the risk assessment are based on Agency guidance specific to residential use patterns.

It has been determined that exposure to pesticide handlers is likely during the residential use of trifluralin in a variety of environments including on turf, vegetable gardens, and ornamentals. The anticipated use patterns and current labeling indicate several major residential exposure scenarios based on the types of equipment and techniques that can potentially be used to make trifluralin applications. The quantitative exposure and risk assessment developed for residential handlers is based on these scenarios. [Note: The scenario numbers correspond to the tables of risk calculations included in the residential risk calculation aspects of the appendices.]

- (1) loading/applying granulars with a belly grinder;
- (2) loading/applying granulars with a push-type spreader;
- (3) loading/applying granulars using a spoon, measuring scoop, shaker can, or via hand;
- (4) mixing/loading/applying liquids with a hose-end sprayer;
- (5) mixing/loading/applying liquids with low pressure handwand sprayer;
- (6) mixing/loading/applying liquids with backpack sprayer; and
- (7) applying trifluralin impregnated fabric squares to soil.

### 2.1.2 Data and Assumptions For Handler Exposure Scenarios

A series of assumptions and exposure factors served as the basis for completing the residential handler risk assessments. Each assumption and factor is detailed below. In addition to these factors, unit exposure values were used to calculate risk estimates. These unit exposure values were taken from the Pesticide Handlers Exposure Database<sup>3</sup> (PHED), from Outdoor Residential Exposure Task Force<sup>4</sup> (ORETF) data, or from other surrogate data. Both PHED and the individual studies are presented below.

**Assumptions and Factors:** The assumptions and factors used in the risk calculations include:

- For noncancer assessments, the Agency always considers the maximum application rates allowed by labels in its risk assessments:
  - **Vegetable gardens:** The maximum label application rate using a granular formulation is 4.0 lbs a.i./A and using a liquid formulation is 4.1 lbs a.i./A or 0.047 lbs ai/gallon.
  - **Flowers, shrubs, trees:** The maximum label application rate using a granular formulation is 4.0 lbs a.i./A and using a liquid formulation is 4.1 lbs a.i./A or 0.047 lbs ai/gallon.
  - **Preplant Ornamentals:** The maximum label application rate is 20 lbs a.i./A (granular only).
  - **Turf (residential lawns, golf courses, recreation parks, etc):** The maximum label application rate is 3.0 lbs a.i./A (granular only).
  
- For cancer assessments, the Agency considers the typical application rate for a given use site, if known. The typical application rate is not known for most trifluralin applications in residential settings, therefore – with one exception – the maximum application rate was used in the cancer exposure and risk assessment. However, since the labeled rate for established ornamentals is 2 to 4 pounds active ingredient per acre, EPA used 3 pounds active ingredient per acre as a typical rate for ornamentals in the cancer assessment.
  
- Average body weight of an adult handler is 70 kilograms. Since the noncancer and cancer endpoints of concern are not sex-specific, the body weight of an average adult is used in the assessments.
  
- PHED values represent a handler wearing typical residential clothing attire of short-sleeved shirt, short pants, socks, shoes, and no gloves. Generally, the use of personal protective equipment (PPE) and engineering controls are not considered acceptable risk mitigation options for products sold for use by homeowners.
  
- Residential risk assessments are based on what would reasonably be treated by homeowners such as the size of a lawn, or the size of a garden. The factors used for the trifluralin assessment were those dictated in the Health Effects Division Science Advisory Committee *Standard Operating Procedure 12: Recommended Revisions To The Standard Operating Procedures For Residential Exposure Assessment*<sup>5</sup> which was completed on February 22, 2001. The following daily volumes handled and area treated, excerpted from the SOP and used in each residential scenario, include:
  - The amount of dilute pesticide used per day or area treated per day for liquid formulations:
    - > 5 gallons for a low-pressure wand and a backpack sprayers, and

- > 1,000 ft<sup>2</sup> for applications to gardens (vegetables and ornamentals) with a hose-end sprayer.
- The area treated with granules by a homeowner is assumed to be:
  - > 0.5 acres for broadcast applications with a belly grinder or push-type spreader to lawns,
  - > 1,000 ft<sup>2</sup> for spot treatments to lawns with a belly grinder, spoon, measuring scoop, shaker can, or by hand; and
  - > 1,000 ft<sup>2</sup> for flower or vegetable garden applications with a belly grinder, spoon, measuring scoop, shaker can, or by hand.

**Pesticide Handler Exposure Database (PHED) Version 1.1 (August 1998):**

Chemical-specific data for assessing human exposures during pesticide handling activities were not submitted to the Agency in support of the reregistration of trifluralin. It is the policy of the HED to use data from the Pesticide Handlers Exposure Database (PHED) Version 1.1 to assess handler exposures for regulatory actions when chemical-specific monitoring data are not available.<sup>6</sup>

PHED was designed by a task force of representatives from the U.S. EPA, Health Canada, the California Department of Pesticide Regulation, and member companies of the American Crop Protection Association. PHED 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)

Users select criteria to subset the PHED database to reflect the exposure scenario being evaluated. The subsetting algorithms in PHED are based on the central assumption that the magnitude of handler exposures to pesticides are primarily a function of activity (e.g., mixing/loading/applying), formulation type (e.g., liquid concentrates, granulars), application method (e.g., low-pressure handwand sprayer, push-type spreader), and clothing scenarios (e.g., short-sleeve shirt and short pants).

Once the data for a given exposure scenario have been selected, the data are normalized (i.e., divided by) by the amount of pesticide handled resulting in standard unit exposures (milligrams of exposure per pound of active ingredient handled). Following normalization, the data are statistically summarized. The distribution of exposure values for each body part (e.g., chest, upper arm) is categorized as normal, lognormal, or "other" (i.e., neither normal nor lognormal). A central tendency value is then selected from the distribution of the exposure values for each body part. These values are the arithmetic mean for normal distributions, the geometric mean for lognormal distributions, and the median for all "other" distributions. Once selected, the central tendency values for each body part are composited into a "best fit" exposure value representing the entire body.

The unit exposure values calculated by PHED generally range from the geometric mean to the median of the selected data set. To add consistency and quality control to the values produced from this system, the PHED Task Force has evaluated all data within the system and has developed a set of grading criteria to characterize the quality of the original study data. The assessment of data quality is based on the number of observations and the available quality control data. These evaluation criteria and the caveats specific to each exposure scenario are summarized in Table 6. While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases. HED has developed a series of tables of standard unit exposure values for many residential scenarios that can be utilized to ensure consistency in exposure assessments.<sup>5</sup>

**EPA MRID 449722-01 (ORETF Handler Studies):**

A report was submitted by the ORETF (Outdoor Residential Exposure Task Force<sup>4</sup>) that presented data in which the application of various products used on turf by homeowners and lawncare operators (LCOs) was monitored. All of the data submitted in this report were completed in a series of studies. The study that monitored homeowner exposure scenarios using a push-type spreader (ORETF Study OMA003) is summarized below.

**Homeowner Push-Type Spreader (OMA003):** A mixer/loader/applicator study was performed by the Outdoor Residential Exposure Task Force (ORETF) using Dacthal (active ingredient DCPA, dimethyl tetrachloroterephthalate) as a surrogate compound to determine “generic” exposures of individuals applying a granular pesticide formulation to residential lawns. A total of 30 volunteers were monitored using passive dosimetry (inner and outer whole body dosimeters, hand washes, face/neck wipes, and personal inhalation monitors). Each volunteer carried, loaded, and applied two 25-lb bags of fertilizer (0.89% active ingredient) with a rotary type spreader to a lawn covering 10,000 ft<sup>2</sup>. The target application rate was 2 lb ai/acre (actual rate achieved was about 1.9 lbs ai/acre). The average application time was 22 minutes, including loading the rotary push spreader and disposing of the empty bags. Each replicate handled approximately 0.45 lbs ai. Dermal exposure was measured using inner and outer whole body dosimeters, hand washes, face/neck washes, and personal air monitoring devices with OVS tubes. The study results are normalized to kg ai handled. The US EPA HED typically assumes that residential applicators wear short pants and short-sleeved shirts, as described in the Residential SOPs (1997). Therefore, the table reports the dermal exposures for the short pants and short-sleeve shirt clothing scenario only.

Scenario Monitored	Push-Type Spreader		
	Applied (lb ai)	Dermal (mg ai/lb handled)	Inhalation ( $\mu$ g ai/lb handled)
Geometric Mean	0.45	0.67	0.88

**EPA MRID 44518501 (ORETF Handler Studies):**

A report was submitted by the Outdoor Residential Exposure Task Force (ORETF) that presented data in which the application of various products used on ornamentals by homeowners was monitored. All of the data submitted in this report were completed in a series of studies. The study that monitored homeowner exposure scenarios using a hose-end sprayer and a low-pressure handwand are summarized below.

**Homeowner Hose-end and Hand-held Sprayer:** Applications of Sevin Liquid® Carbaryl insecticide [RP-2 liquid (21%)] were made by volunteers to two young citrus trees and two shrubs in each replicate that was monitored in the study. The test field was located only in Florida. Twenty (20) replicates were monitored using hose-end sprayer (Ortho® DIAL or Spray® hose end sprayer), and 20 replicates were monitored using hand held pump sprayers (low pressure handwands).

Each replicate opened the end-use product, added it to the hose-end sprayer or hand held pump and then applied it to the trees and shrubs. After application to two trees and two shrubs dosimeters were collected. Inhalation exposure was monitored with personal air sampling pumps with OVS tubes attached to the shirt collar in the breathing zone. Dermal exposure was assessed by extraction of carbaryl from inner and outer 100 percent cotton dosimeters. The inner and outer dosimeters were segmented into: lower and upper arms, lower and upper legs, front and back torso. No gloves were worn therefore hand exposure was assessed with 400 ml handwash with 0.01 percent Aerosol OT-75 sodium dioctyl sulfosuccinate (OTS). One hundred percent cotton handkerchiefs wetted with 25 ml OTS were used to wipe face and neck to determine exposure.

Field fortification recoveries for passive dosimeters averaged 88.3 percent for inner and 76.2 percent for outer dosimeters. Face and neck wipe fortifications average 82.5 percent. Handwash and inhalation OVS tube field fortification averaged >90 percent. Inner and outer dosimeter and face and neck wipe residues were adjusted for field fortification results. Handwash and inhalation residues were not adjusted.

Laboratory method validation for each matrix fell within the acceptable range of 70 to 120 percent. The limit of quantitation (LOQ) was 1.0  $\mu$ g/sample for all media except the inhalation monitors where the LOQ was 0.01  $\mu$ g/sample. The limit of detection (LOD) was 0.5  $\mu$ g/sample for all media except the inhalation monitors where the LOQ was 0.005  $\mu$ g/sample.

For use in reregistration documents, the dermal exposure was calculated by adding the values from the hand rinses, face/neck wipes to the outer dosimeter lower legs and lower arms plus the inner dosimeter front and rear torso, upper legs and upper arms. This accounts for the residential handler wearing short-sleeved shirt and short pants. The results for the low pressure handwand are summarized in Table 3 below.

The distribution of the unit exposure values is categorized as normal, lognormal, or “other” (i.e., neither normal nor lognormal). A central tendency value is selected from the distribution of the exposure values. These values are the arithmetic mean for normal distributions, the geometric mean for lognormal distributions, and the median for all “other” distributions. The dermal exposure had a lognormal distribution so the geometric mean value was used to determine dermal exposure to trifluralin. The inhalation exposure had neither a normal or lognormal distribution so the median was used to determine inhalation exposure to trifluralin.

<b>Table 4: Unit Exposure Values Obtained ORETF Study MRID 44518501)</b>						
Scenario Monitored	Hose End			Pump Sprayer		
	Applied (lb ai)	Dermal (mg ai/lb handled)	Inhalation ( $\mu$ g ai/lb handled)	Applied (lb ai)	Dermal (mg ai/lb handled)	Inhalation ( $\mu$ g ai/lb handled)
Geometric Mean	0.033	39.0	1.6	0.017	56.0	2.6

### Proprietary Studies

One proprietary study was used to obtain unit exposure values for handlers loading/applying with a bucket and spoon. This study is summarized below.

**Worker Exposure Study During Application of Regent 20GR In Banana Plantation<sup>1</sup>, EPA MRID 452507-02 (Fipronil Study):** Handler exposure data from a proprietary granular mixer/loader/applicator study (MRID 452507-02) in bananas using fipronil (Regent 20GR) were used in place of PHED data for the “loading/applying granulars using a spoon, measuring scoop, shaker can or by hand” scenario. This fipronil study is considered to be an appropriate source of surrogate handler exposure data for trifluralin because formulation types are similar (granular) and application methods are similar (applying granulars with a spoon). The study is considered to be of sufficient quality for use in risk assessment.<sup>1</sup> Data compensation for these data should be determined.

Several factors should be considered when using fipronil data in the trifluralin exposure assessment. Protection factors used to calculate trifluralin dermal unit exposure values, based on the fipronil unit exposure values, include a standard 50% protection factor for the torso, a 10% protection factor for legs, based on shorts, and a 10% protection factor for arms, based on a short-sleeved shirt. These protection factors represent the typical attire assumed to be worn by a homeowner during pesticide application (shorts and short-sleeved shirt). The 10% protection factor for shorts and the 10% protection factor for a short-sleeved shirt are not standard protection

factors used by the Agency; rather, these values are based on the best professional judgement of Agency scientists and are appropriate for calculating range-finding estimates only.

Some other issues and limitations to be considered when using the fipronil study include the following:

- Agency guidelines require that 15 replicates be completed in exposure studies in three different locations. In the fipronil study, only ten replicates were completed using spoons, and at only one location. However, the events that were monitored seemed to be reasonable representations of actual agricultural practices, so it is unlikely that additional replicates would significantly alter the final unit exposure results. Additionally, it is unlikely that cultural practices would significantly vary if the study was completed at different locations.
- The individual amounts of chemical applied were not recorded in this study. Instead, the investigators determined how much product was applied by the application teams used. Using this information, the investigators calculated the amount used for each individual by assuming that each was equally productive (i.e., dividing the total amount used per team by the number of team members).
- One applicator using the spoons had a spoon with no handle. The results for this individual were included with the other spoon applicators as it is a plausible variation of that application method.

Scenario Monitored	Spoon Applications		
	Handled (mg exposure/lb ai handled)	Dermal (mg ai/lb handled)	Inhalation ( $\mu$ g ai/lb handled)
Geometric Mean	0.045	3.5	45.0

### 2.1.3 Residential Handler Exposure and Non-Cancer Risk Estimates

The residential handler exposure and non-cancer risk calculations are presented in this section. Non-cancer risks were calculated using the Margin of Exposure (MOE) which is a ratio of the daily dose to the toxicological endpoint of concern. Daily dose values are calculated by first calculating exposures by considering application parameters (i.e., rate and area treated) along with unit exposure values. Exposures were then normalized by body weight and adjusted for absorption factors as appropriate to calculate dose levels. MOEs were then calculated.

**Daily Inhalation Exposure:** The daily inhalation exposure, daily inhalation dose and hence the inhalation risks, to handlers were calculated as described below. The first step was to calculate daily exposure (dermal or inhalation) using the following formula:

$$\text{Unit Exposure} \left( \frac{\mu\text{g ai}}{\text{lb ai}} \right) \times \text{Conversion Factor} \left( \frac{1\text{mg}}{1,000 \mu\text{g}} \right) \times \text{Use Rate} \left( \frac{\text{lb ai}}{\text{Sq ft, Gallons}} \right) \times \text{Amount Treated} \left( \frac{\text{Sq ft, Gallons}}{\text{day}} \right) = \text{Daily Inhalation Exposure} \left( \frac{\text{mg ai}}{\text{day}} \right)$$

Where:

<b>Daily Exposure</b>	=	Amount that is inhaled, also referred to as potential dose (mg ai/day);
<b>Unit Exposure</b>	=	Normalized exposure value derived from August 1998 PHED Surrogate Exposure Table and various referenced exposure studies noted above (mg ai/lb ai);
<b>Application Rate</b>	=	Normalized application rate based on a logical unit treatment such as square feet or gallons, maximum values are generally used (lb ai/sq ft, lb ai/gal) and
<b>Daily Area Treated</b>	=	Normalized application area based on a logical unit treatment such as square feet (sq ft/day), or gallons per day (gal/day).

**Daily Inhalation Dose:** Daily dose was calculated by normalizing the daily inhalation exposure value by body weight. For adult handlers using trifluralin, an average adult body weight of 70 kg was used for all exposure scenarios. Since there is no specific inhalation absorption factor that is available for trifluralin, a factor of 100 percent has been used for all calculations. Daily dose was calculated using the following formula:

$$\text{Average Daily Dose} \left( \frac{\text{mg ai}}{\text{kg/day}} \right) = \text{Daily Exposure} \left( \frac{\text{mg ai}}{\text{day}} \right) \times \left( \frac{\text{AbsorptionFactor}(\%/100)}{\text{Body Weight (kg)}} \right)$$

Where:

<b>Average Daily Dose</b>	=	The amount as absorbed dose received from exposure to a pesticide in a given scenario (mg pesticide active ingredient/kg body weight/day, also referred to as ADD);
<b>Daily Exposure</b>	=	Amount deposited on the surface of the skin that is available for dermal absorption or amount that is inhaled, also referred to as potential dose (mg ai/day);
<b>Absorption Factor</b>	=	A measure of the flux or amount of chemical that crosses a biological boundary such as the lungs (% of the total available absorbed); and
<b>Body Weight</b>	=	Body weight determined to represent the population of interest in a risk assessment (kg).

**Margins of Exposure:** Finally, the calculations of daily inhalation dose received by handlers were then compared to the appropriate endpoint (i.e., NOAEL) to assess the total risk to handlers for each exposure route within the scenarios. Inhalation MOEs for all durations were calculated using a NOAEL of 81 mg/kg/day (Table 1). All MOE values were calculated for inhalation exposure levels using the formula below:

$$MOE = \frac{NOAEL \left( \frac{mg \ ai}{kg/day} \right)}{Average \ Daily \ Dose \left( \frac{mg \ ai}{kg/day} \right)}$$

Where:

<b>MOE</b>	=	Margin of exposure, value used by the Agency to represent risk or how close a chemical exposure is to being a concern (unitless);
<b>ADD</b>	=	(Average Daily Dose) or the amount as absorbed dose received from exposure to a pesticide in a given scenario (mg pesticide active ingredient/kg body weight/day); and
<b>NOAEL</b>	=	Dose level in a toxicity study, where no observed adverse effects occurred (NOAEL) in the study or the lowest dose level where an adverse effect occurred.

A margin of exposure (MOE) uncertainty factor of 100 is considered an appropriate risk level for the residential risk assessments.<sup>2</sup>

**Noncancer Risk Summary:** All of the noncancer risk calculations for residential trifluralin handlers completed in this assessment are included in Appendix A. A summary of the results for each exposure scenario is also provided below.

- **Appendix A/Table A1: Sources of Exposure Data Used in the Short-Term Residential Trifluralin Handler Exposure and Risk Calculations** Describes the sources and quality of the exposure data used in all of the residential handler calculations.
- **Appendix A/Table A2: Margins of Exposure For Short-Term Trifluralin Residential Handler Risk Assessment** Unit exposure values, daily doses, and risks are presented for residential handlers for short-term exposures.

#### 2.1.4 Summary of Non-Cancer Risk Concerns for Residential Handlers

Short-term exposures and risks were not assessed for trifluralin, since no short-term dermal endpoint was identified. For the applications in residential settings, the inhalation risks are not a concern for all mixing/loading/applying scenarios. Note that there is assumed to be no inhalation risk data for applying ready-to-use trifluralin impregnated squares to soil. Due to the low vapor pressure of trifluralin ( $4 \times 10^{-5}$  mm Hg at 25°C), the inhalation risk from this exposure pattern is not expected to be a concern.

**Table 6. Residential Handler Short-Term Inhalation Exposure and Risks to Trifluralin**

Exposure Scenario (Scenario #)	Use Site	Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) <sup>a</sup>	Application Rate <sup>b</sup>	Amount Used or Area Treated per Day <sup>c</sup>	Daily Inhalation Dose (mg/day/day) <sup>d</sup>	Inhalation MOE <sup>e</sup>
MIXER/LOADER/APPLICATOR EXPOSURE						
Loading/applying granulars with a belly grinder (1)	ornamental (pre-plant)	62	20 lbs ai/acre	0.023 acres	4.10e-03	2.00e+05
	ornamental (post-plant)		4.0 lbs ai/acre	0.023 acres	8.20e-05	9.90e+05
	turf		3.0 lbs ai/acre	0.5 acres	1.30e-03	6.10e+04
	vegetable gardens		4.1 lbs ai/acre	0.023 acres	8.30e-05	9.70e+05
Loading/applying granulars with a push-type spreader (2)	ornamental (pre-plant)	0.88	20 lbs ai/acre	0.023 acres	5.80e-06	1.40e+07
	ornamental (post-plant)		4.0 lbs ai/acre	0.023 acres	1.20e-06	7.00e+07
	turf		3.0 lbs ai/acre	0.5 acres	1.90e-05	4.30e+06
	vegetable gardens		4.1 lbs ai/acre	0.023 acres	1.20e-06	6.90e+07
Loading/applying granulars using a spoon, measuring scoop, shaker can, or by hand(3)	ornamental (pre-plant)	45	20 lbs ai/acre	0.023 acres	3.00e-04	2.70e+05
	ornamental (post-plant)		4.0 lbs ai/acre	0.023 acres	5.90e-05	1.40e+07
	turf		3.0 lbs ai/acre	0.023 acres	4.40e-05	1.80e+06
	vegetable gardens		4.1 lbs ai/acre	0.023 acres	6.00e-05	1.30e+06
	rose bushes		0.00043 lbs ai/bush	50 bushes	1.40e-05	5.90e+06
Mixing/loading/applying liquids with a hose-end sprayer (4)	flowers, trees and shrubs	1.5	4.1 lbs ai/acre	0.023 acres	2.00e-06	4.00e+07
	vegetable gardens		4.1 lbs ai/acre	0.023 acres	2.00e-06	4.00e+07
Mixing/loading/applying liquids with low pressure hand wand (5)	flowers, trees, and shrubs	3.8	0.047 lbs ai/ gallon	5 gallons	1.30e-05	6.30e+06
	vegetable gardens		0.047 lbs ai/ gallon	5 gallons	1.30e-05	6.30e+06
Mixing/loading/applying liquids with back pack sprayer (6)	flowers, trees, and shrubs	30	0.047 lbs ai/ gallon	5 gallons	1.00e-04	8.00e+05
	vegetable gardens		0.047 lbs ai/ gallon	5 gallons	1.00e-04	8.00e+05
Applying trifluralin impregnated fabric squares to soil (7)	No data are available for this scenario.					

Footnotes:

<sup>a</sup> Inhalation unit exposure values from PHED represent no respirator.<sup>3</sup>

<sup>b</sup> Application Rates are based on the maximum application rates listed on the trifluralin labels.

- <sup>c</sup> Amount handled per day are from EPA estimates of acres treated, or square feet treated, in a single day based on the application method. For ready to use formulations, the whole container is assumed to be used in one day.
- <sup>d</sup> Daily Inhalation dose (mg/kg/day) = (Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) x (1mg/1000  $\mu\text{g}$ ) Conversion Factor x Application Rate (lb ai/A or lb ai/gal or lb ai/bush) x Area Treated per day (acres, gallons, or bushes))/ body weight (70 kg).
- <sup>e</sup> Short-term Inhalation MOE = Inhalation NOAEL (81 mg/kg/day)/Daily Inhalation Dose (mg/kg/day).

## 2.2 Residential Cancer Trifluralin Handler Exposure and Risk Assessment

This section presents the residential handler exposure and cancer risk assessment for trifluralin.

### 2.2.1 Data and Assumptions For Residential Cancer Handler Exposure Scenarios

A series of assumptions and exposure factors served as the basis for completing the residential handler risk assessments.

**Assumptions and Factors:** The assumptions and factors used in the risk calculations include:

- The Agency always considers the typical application rates allowed for its cancer risk assessments, however, no typical rates were available for residential trifluralin uses. As a result, the maximum rates were used, except for the post-plant applications to ornamentals. The label rates for this use pattern varied from 2 to 4 lb ai/acre and an average rate of 3 lb ai/acre was utilized for the cancer assessment.
- Residential applications per year (5 total) for the granular scenarios were as follows:
  - one pre-plant application to ornamentals (at 20 lb ai/acre, treat 1,000 sq ft);
  - one post-plant application to ornamentals (at 3 lb ai/acre, treat 1,000 sq ft - label rates range from 2 to 4 lb ai/acre);
  - one application to vegetable gardens (4.1 lb ai/acre, treat 1,000 sq ft); and
  - two applications to turf per year for all granular equipment (3 lb ai/acre, treat 0.5 acres).
- Residential applications per year for the liquid scenarios were set at 5 per year.

### 2.2.2 Residential Cancer Trifluralin Handler Exposure and Risk Calculations

Cancer risks resulting from exposures to trifluralin were calculated using a linear low-dose extrapolation approach in which a *Lifetime Average Daily Dose* (LADD) is first calculated and then compared with a  $Q_1^*$  that has been calculated for trifluralin based on dose response data ( $Q_1^* = 5.79 \times 10^{-3} \text{ (mg/kg/day)}^{-1}$ ). Absorbed average daily dose (ADD) levels were used as the basis for calculating the LADD values. Section 2.1.3 describes how the ADD values for inhalation exposures were calculated for the non-cancer MOEs. These values also serve as the basis for the cancer risk estimates. In the cancer assessment both dermal and inhalation ADD values are calculated and then added together to obtain combined dermal plus inhalation ADD values. Dermal ADD values are calculated as described in Section 2.1.3. To assess cancer risks, LADD values are calculated and then compared to the  $Q_1^*$  selected for trifluralin.

**Lifetime Average Daily Dose:** To calculate the carcinogenic risk from absorbed average daily dose, the values must be amortized over the lifetime of residential handlers. Current use

patterns indicate that application occurs only a few times per year. HED does not expect homeowner handler exposures to exceed five times per year for this cancer risk assessment:

Finally, a 50-year exposure and a 70-year lifespan were used to complete the calculations. LADD values were calculated using the following equation:

$$LADD \left( \frac{mg \ ai}{kg/day} \right) = Total \ Daily \ Dose \left( \frac{mg \ ai}{kg/day} \right) \times \left( \frac{days \ exposed}{365 \ days \ per \ year} \right) \times \left( \frac{50 \ years \ exposed}{70 \ year \ lifetime} \right)$$

Where:

<b>Lifetime Average Daily Dose</b>	=	The amount as absorbed dose received from exposure to a pesticide or degradate in a given scenario over a lifetime (mg/kg/day, also referred to as LADD);
<b>Average Daily Dose</b>	=	The amount as absorbed dose received from exposure to a pesticide or degradate in a given scenario on a daily basis (mg/kg/day, also referred to as ADD);
<b>Exposure Frequency</b>	=	The annual frequency of exposure to an individual (days/year);
<b>Exposure Duration</b>	=	The amount of a lifetime that an individual is exposed (50 years); and
<b>Lifetime</b>	=	The average life expectancy of an individual (70 years).

**Cancer Risks :** Finally, cancer risk calculations were completed by comparing the LADD values to the  $Q_1^*$  for trifluralin ( $Q_1^* = 5.97 \times 10^{-3} \text{ (mg/kg/day)}^{-1}$ ). Individual cancer risks were calculated using the following equation:

$$Cancer \ Risk = LADD \left( \frac{mg \ ai}{kg/day} \right) \times Q_1^*$$

Where:

<b>Cancer Risk</b>	=	Probability of excess cancer cases over a lifetime (unitless);
<b>Lifetime Average Daily Dose</b>	=	The amount as absorbed dose received from exposure to a pesticide or degradate in a given scenario over a lifetime (mg/kg/day); and
<b><math>Q_1^*</math></b>	=	Quantitative dose response factor used for linear, low-dose response cancer risk calculations $(\text{mg/kg/day})^{-1}$ .

After calculating all of the individual cancer risks, a total combined cancer risk was calculated by adding together all the individual cancer risks for a particular scenario.

HED has defined a range of acceptable cancer risks based on a policy memorandum issued in 1996 by then Office of Pesticide Programs director, Mr. Dan Barolo. This memo refers to a predetermined quantified "level of concern" for residential carcinogenic risk. In summary, this

policy memo indicates risks less than  $1 \times 10^{-6}$  are not considered to be of concern and require no risk management action.

**Cancer Risk Summary:** A summary of the results for each exposure scenario is provided below in Table 7. In addition, the cancer risk calculations for residential trifluralin handlers completed in this assessment are included in Appendix A: Table A3: Trifluralin Residential Handler Cancer Risk Assessment.

### **Summary of Risk Concerns for Cancer**

The target risk for cancer is  $1 \times 10^{-6}$ . Risks greater than  $1 \times 10^{-6}$  for the general population are considered to be of concern and risks less than  $1 \times 10^{-6}$  are not considered to be of concern. Homeowner exposure to trifluralin is not expected to occur more than five days per year. All scenarios have cancer risks of **less than  $1 \times 10^{-6}$** . Note that there is no inhalation risk data for applying ready-to-use trifluralin impregnated squares to soil, but inhalation exposure is expected to be negligible. HED expects the cancer risks for this scenario to be far less than applying granular formulations using a spoon, measuring scoop, shaker can, or by hand.

**Table 7. Baseline Residential Handler Dermal and Inhalation Cancer Exposure to Trifluralin**

Exposure Scenario (Scenario #)	Use Site	Application Rate <sup>a</sup>	Area Treated	Dermal Unit Exposure (mg/lb ai)	Inhalation Unit Exposure (ug/lb ai)	Residential Handler Treatments /Year <sup>b</sup>	Daily Total Dose (mg/kg/day) <sup>c</sup>	Residential Handler Total LADD (mg/kg/day) <sup>d</sup>	Residential Handler Cancer Risk <sup>e</sup>	Combined Residential Handler Cancer Risk <sup>f</sup>
MIXER/LOADER/APPLICATOR EXPOSURE										
Loading/applying granulars with a belly grinder (1)	ornamental (pre)	20 lb ai/acre	0.023 acres	110	62	1	0.022	4.4E-05	2.5E-07	8.85E-07
	ornamental (post)	3 lb ai/acre	0.023 acres	110	62	1	0.0033	6.5E-06	3.8E-08	
	turf	3 lb ai/acre	0.5 acres	110	62	2	0.024	9.4E-05	5.4E-07	
	vegetable gardens	4.1 lb ai/acre	0.023 acres	110	62	1	0.0045	8.8E-06	5.1E-08	
Loading/applying granulars with a push type spreader (2)	ornamental (pre)	20 lb ai/acre	0.023 acres	0.67	0.88	1	0.00014	2.7E-07	1.6E-09	5.52E-09
	ornamental (post)	3 lb ai/acre	0.023 acres	0.67	0.88	1	0.000021	4.0E-08	2.3E-10	
	turf	3 lb ai/acre	0.5 acres	0.67	0.88	2	0.00015	5.9E-07	3.4E-09	
	vegetable gardens	4.1 lb ai/acre	0.023 acres	0.67	0.88	1	0.000028	5.5E-08	3.2E-10	
Loading/applying granulars using a spoon, measuring scoop, shaker can, or by hand(3)	ornamental (pre)	20 lb ai/acre	0.023 acres	3.5	45	1	0.00099	1.9E-06	1.1E-08	1.68E-08
	ornamental (post)	3 lb ai/acre	0.023 acres	3.5	45	1	0.00015	2.9E-07	1.7E-09	
	turf	3 lb ai/acre	0.023 acres	3.5	45	2	0.000049	1.9E-07	1.1E-09	
	vegetable gardens	4.1 lb ai/acre	0.023 acres	3.5	45	1	0.0002	3.9E-07	2.3E-09	
Mixing/loading/applying liquids with a hose-end sprayer (4)	flowers, trees, shrubs, vegetable gardens	4.1 lb ai/acre	0.023 acres	39	1.5	5	0.0016	1.5E-05	8.9E-08	
Mixing/loading/applying liquids with low pressure hand wand (5)	flowers, trees, shrubs, vegetable gardens	0.047 lb ai/gal	5 gallons	56	3.8	5	0.0057	5.5E-05	3.2E-07	
Mixing/loading/applying liquids with back pack sprayer (6)	flowers, trees, shrubs, vegetable gardens	0.047 lb ai/gal	5 gallons	100	30	5	0.01	1.0E-04	5.8E-07	
Applying trifluralin impregnated fabric squares to soil (7)	No data are available for this scenario.									

**Footnotes:**

- a Maximum application rates were utilized for all use sites except for the granular, post-plant application. The label rates for this use ranged from 2 to 4 lb ai/acre so the average rate of 3 lb ai/acre was utilized for the cancer assessment.
- b The number of exposures per year are based on the label recommendations.
- c Total Daily Dose (mg/kg/day) = Daily Dermal Dose (mg/kg/day) \* Dermal Absorption (3%) + Daily Inhalation Dose (mg/kg/day).
- d LADD (mg/kg/day) = Total Daily Dose (mg/kg/day) \* (# days of exposure per year/365 days/year) \* (50 years exposed/70 years in a lifetime).
- e Cancer Risk = LADD (mg/kg/day) \* Q1\* (0.00579)
- f Combined Cancer Risk by Equipment Type = Cancer risks for each crop in the equipment scenario added to one another.

## 2.3 Residential Postapplication Exposures and Risks

### 2.3.1 Residential Postapplication Exposure Scenarios

Trifluralin residential uses (vegetable gardens, ornamentals, and turf) indicate that individuals of varying ages potentially can be exposed during activities in areas that have been previously treated. The Agency is concerned about these kinds of postapplication exposures. Postapplication exposure scenarios were developed for each residential setting where trifluralin can be used.

The Agency considered a number of residential postapplication exposure scenarios for different segments of the population including toddlers, youth-aged children, and adults. Noncancer risks were calculated for only a few scenarios, since no short-term dermal endpoint of concern has been identified. In general, postapplication inhalation risks following *outdoor* applications are considered negligible. Therefore, at this time, EPA is only assessing non-dietary ingestion exposures for toddlers (i.e., soil ingestion, hand-/object-to-mouth, and granule ingestion).

The Agency relies on a standardized approach for completing residential risk assessments that is based on current trifluralin labels and guidance contained in the following four documents:

- ***Series 875, Residential and Residential Exposure Test Guidelines: Group B - Postapplication Exposure Monitoring Test Guidelines (V 5.4, Feb. 1998)*** This document provides general risk assessment guidance and criteria for analysis of residue dissipation data.
- ***Standard Operating Procedures For Residential Exposure Assessment (Dec. 1997)*** This document provides the overarching guidance for developing residential risk assessments including scenario development, algorithms, and values for inputs.
- ***Science Advisory Council For Exposure Policy 12 (Feb. 2001): Recommended Revisions To The Standard Operating Procedures (SOPs) For Residential Exposure Assessment*** This document provides additional, revised guidance for completing residential exposure assessments.
- ***Overview of Issues Related To The Standard Operating Procedures For Residential Exposure Assessment (August 1999 Presentation To The FIFRA SAP)*** This document provides rationale for Agency changes in SOPs.

When the guidance in current labels and these documents is considered, it is clear that the Agency should consider children of differing ages as well as adults in its assessments. However, since no short-term dermal endpoint of concern has been identified, the only population that was considered in the assessment was:

- **Residential Children:** children are members of the general population that can also be exposed in their residences (e.g., on lawns or in gardens), as well as other areas treated with a pesticide (e.g., parks). These kinds of exposures are attributable to a variety of activities such as playing outside, or playing indoors on carpet or hard flooring. Toddlers have been selected as a sentinel (or representative) population for turf.

The *SOPs For Residential Exposure Assessment* define several scenarios that apply to uses specified in current labels. These scenarios served as the basis for the residential postapplication assessment along with the modifications to them and the additional data/approaches described above. The Agency used this guidance to define the postapplication exposure scenarios as only toddler nondietary ingestion exposure on treated lawns. The SOPs and the associated scenarios are presented below:

- ***Dose from incidental ingestion of granulars from treated turf calculated using SOP 1.3.1:*** Postapplication dose among toddlers from incidental nondietary ingestion of granulars in a treated turf area (i.e., those granular particles that end up in the mouth from a child touching treated turf then putting their hands in their mouth).
- ***Dose from hand-to-mouth activity from treated turf calculated using SOP 1.3.2:*** Postapplication dose among toddlers from incidental nondietary ingestion of pesticide residues on treated turf from hand-to-mouth transfer (i.e., those residues that end up in the mouth from a child touching turf and then putting their hands in their mouth);
- ***Dose from object-to-mouth activity from treated turf calculated using SOP 1.3.3:*** Postapplication dose among toddlers from incidental nondietary ingestion of pesticide residues on treated turf from object-to-mouth transfer (i.e., those residues that end up in the mouth from a child mouthing a handful of treated turf); and
- ***Dose from soil ingestion activity from treated turf calculated using SOP 1.3.4:*** Postapplication dose among toddlers from incidental nondietary ingestion of pesticide residues from ingesting soil in a treated turf area (i.e., those soil residues that end up in the mouth from a child touching treated soil and turf then putting their hands in their mouth).

The detailed residential postapplication calculations are presented in Appendix B of this document.

### **2.3.2 Data & Assumptions for Residential Noncancer Postapplication Exposure Scenarios**

A series of assumptions and exposure factors served as the basis for completing the residential noncancer postapplication risk assessments. Each assumption and factor are detailed below.

The assumptions and factors used in the risk calculations are consistent with current Agency Standard Operating Procedures for completing residential exposure assessments (i.e., *SOPs For Residential Exposure Assessment*<sup>5</sup>). [Note: More detail about the origin of each factor can be obtained in the SOP document and associated documents such as the Agency's 1999 Overview document presented to the FIFRA SAP.] The values used in this assessment include:

- The Agency combines risks resulting from exposures to individual chemicals when it is likely they can occur simultaneously based on the use pattern and the behavior associated with the exposed population. For this residential postapplication assessment, risks from individual exposure scenarios resulting from an application to turf are combined for the toddler hand-to-mouth, object-to-mouth, and soil ingestion scenarios, because they can co-occur.
- Exposures to children playing on treated turf have been addressed using the latest Agency approaches for this scenario including:
  - the TTR value at day zero from the trifluralin-specific turf transferable residue study<sup>7</sup> (MRID # 457456-01) was used in each scenario;
  - 3 year old toddlers are expected to weigh 15 kg;
  - short-term hand-to-mouth exposures are based on a frequency of 20 events/hour;
  - a surface area per event of 20 cm<sup>2</sup> representing the palmar surfaces of three fingers is used for short-term exposure durations;
  - saliva extraction efficiency<sup>7</sup> is 50 percent – meaning that every time the hand goes in the mouth approximately ½ of the residues on the hand are removed;
  - object-to-mouth exposures are based on a 25 cm<sup>2</sup> surface area;
  - exposure durations are expected to be 2 hours based on information in the *Agency's Exposure Factors Handbook*;
  - soil residues are contained in the top centimeter and soil density is 0.67 mL/gram;
  - The assumed ingestion rate of dry pesticide formulations (i.e., pellets and granules) is 0.3 grams/day for children (age 3 years);
  - hand- and object-to-mouth, and soil ingestion are added together to represent an overall risk from exposure to turf; and
  - Postapplication noncancer residential risks are based generally on maximum application rates or values specified in the *SOPs For Residential Exposure Assessment*.

**Dissipation of Transferable Residues of Benefin and Trifluralin on Turf Treated with a Formulation of the Pesticides<sup>8</sup> – EPA MRID 457456-01:** The registrant submitted a transferable residue study of benefin and trifluralin on turf. The study is designed to fulfill the

requirements of the EPA Series 875: Occupational and Residential Exposure Test Guidelines in accordance with EPA FIFRA Good Laboratory Practices Standards. The study was conducted from June to September, 1997 at three geographical locations (California, Indiana, and Mississippi) that are said to be representative of the climatic and turf growing conditions expected in the intended use-areas. Turf varieties used were common bermuda in California, tall fescue in Indiana, and a mixture of bermuda and barnyard grasses in Mississippi. The turf was mowed to its normal cutting height prior to pesticide application and no irrigation, mowing, or maintenance chemical applications were performed for the duration of the study. A granular product containing 1.33% benefin and 0.67% trifluralin was applied to the turf in a single application at the maximum label rate of two pounds benefin active ingredient per acre and one pound trifluralin active ingredient per acre using a drop granule spreader or an air-powered granular applicator. Sampling was performed using the California Roller technique and the sampling medium was a percale cloth sheet. Samples were collected at days 0, 1, 2, 4, and 7 following application. For trifluralin, the study limit of detection (LOD) was  $0.001 \mu\text{g}/\text{cm}^2$  and the limit of quantitation (LOQ) was  $0.003 \mu\text{g}/\text{cm}^2$ . Initial transferable residues of trifluralin were less than the LOQ and ranged from not detectable to  $0.002 \mu\text{g}/\text{cm}^2$ . The average transferable residues at day 0 were  $0.0011 \mu\text{g}/\text{cm}^2$ , just slightly higher than the limit of detection. After day 0, no residues were detectable.

### 2.3.3 Residential Postapplication Exposure and Noncancer Risk Estimates

The residential postapplication exposure and noncancer risk calculations are presented in this section. Noncancer risks were calculated using the Margin of Exposure (MOE), which is a ratio of the daily dose to the toxicological endpoint of concern. Exposures were calculated by considering the potential sources of exposure then calculating nondietary ingestion exposures to toddlers. The major difference with residential risk assessments is that the uncertainty factor which defines the level of risk concern also has to consider application of the additional FQPA safety factor specified by the legislation. The overall uncertainty factor applied to trifluralin for residential postapplication risk assessments is 100.

**Nondietary Ingestion Exposure From Treated Turf:** Nondietary ingestion exposure levels from turf are calculated using the following equations.

#### Hand-to-mouth Transfer of Pesticide Residues on Lawns (toddler)

$$\text{ADD} = (\text{TTR}_0 * \text{SA} * \text{FQ} * \text{ET} * \text{SE} * \text{CF1}) / \text{BW}$$

Where:

ADD	=	average daily dose (mg/kg/day)
TTR <sub>0</sub>	=	turf transferable residue on day "0" ( $0.0033 \mu\text{g}/\text{cm}^2$ )
SA	=	surface area of the hands ( $20 \text{ cm}^2/\text{event}$ )
FQ	=	frequency of hand-to-mouth activity ( $20 \text{ events}/\text{hr}$ )
ET	=	exposure time ( $2 \text{ hr}/\text{day}$ )
SE	=	extraction by saliva ( $50\%$ )

- CF1 = weight unit conversion factor to convert  $\mu\text{g}$  units in the DFR value to mg for the daily exposure (0.001 mg/ $\mu\text{g}$ )  
 BW = body weight (15 kg)

**Object-to-mouth Transfer of Pesticide Residues on Lawns (toddler)**

$$\text{ADD} = (\text{TTR}_0 * \text{IgR} * \text{CF1}) / \text{BW}$$

Where:

- ADD = average daily dose (mg/kg/day)  
 TTR<sub>t</sub> = turf transferable residue on day "0" (0.0033  $\mu\text{g}/\text{cm}^2$ )  
 IgR = ingestion rate of grass (25  $\text{cm}^2/\text{day}$ )  
 CF1 = weight unit conversion factor to convert the  $\mu\text{g}$  of residues on the grass to mg to provide units of mg/day (1E-3 mg/ $\mu\text{g}$ )  
 BW = body weight (15 kg)

**Incidental Ingestion of Soil from Pesticide-Treated Residential Areas (toddler)**

$$\text{ADD} = (\text{SR}_0 * \text{IgR} * \text{CF1}) / \text{BW}$$

Where:

- ADD = average daily dose (mg/kg/day)  
 SR<sub>0t</sub> = soil residue on day "0" (0.0022  $\mu\text{g}/\text{g}$ )  
 IgR = ingestion rate of soil (100 mg/day)  
 CF1 = weight unit conversion factor to convert the  $\mu\text{g}$  of residues on the soil to grams to provide units of mg/day (1E-6 g/ $\mu\text{g}$ )  
 BW = body weight (15 kg)

and

$$\text{SR}_t = \text{TTR}_t * \text{F} * \text{CF2}$$

Where:

- TTR<sub>t</sub> = turf transferable residue on day "0" (0.0033  $\mu\text{g}/\text{cm}^2$ )  
 F = fraction of ai available in uppermost cm of soil (1 fraction/cm)  
 CF2 = volume to weight unit conversion factor to convert the volume units ( $\text{cm}^3$ ) to weight units for the SR value (U.S. EPA, 1992) (0.67  $\text{cm}^3/\text{g}$  soil)

**Residential Postapplication Noncancer Short-Term Oral Risk Calculations:** For postapplication oral exposures to toddlers from contact with treated turfgrass and soil, the margin of exposure (MOE) is calculated as follows:

$$\text{Oral MOE} = \frac{\text{Short-Term Incidental Oral NOAEL}}{\text{Exposure Dose}}$$

**Episodic Exposure From Ingesting Granules or Pellets:** The Agency assesses risks to toddlers resulting from incidental ingestion of pesticide granules or pellets in pesticide-treated residential areas. Since this exposure is likely to occur, at most, only once following a residential application, the acute dietary NOAEL toxicological endpoint of concern is used to assess the risks. The following illustrates the approach used to calculate the nondietary ingestion exposures that are attributable to toddlers ingesting pesticide granules or pellets:

**Incidental ingestion of granules from pesticide-treated residential areas (toddler)**

$$ADD = IgR * F * CF1 / BW$$

Where:

- ADD = average daily dose (mg/kg/day)
- IgR = ingestion rate of dry pesticide formulation (0.3 g/day)
- F = fraction of ai in dry formulation (0.0175 unitless)
- CF1 = weight unit conversion factor to convert g units in the ingestion rate value to mg for the daily exposure (1,000 mg/g)
- BW = body weight (15 kg)

**Residential Postapplication Noncancer Acute Oral Risk Calculations:** For postapplication exposures to toddlers from a one-time incident involving ingestion of pesticide granules, the margin of exposure (MOE) is calculated as follows:

$$\text{Oral MOE} = \frac{\text{Acute Dietary NOAEL}}{\text{Exposure Dose}}$$

However, no acute dietary endpoint of concern for trifluralin was identified for the general population, including infants and toddlers, therefore no acute oral risks were assessed for toddlers ingesting pesticide granules.

**Noncancer Postapplication Risk Summary:** A summary of the results for each exposure scenario is also provided below in Table 8. In addition, the noncancer residential risk calculations for the trifluralin assessment are included in Appendix A: Table A4: NonCancer Postapplication Risk Assessment for Trifluralin.

The Agency has addressed residential postapplication exposures to trifluralin using the standard set of scenarios that are prescribed in current guidance. There are many issues associated with the development of these scenarios and, in general, residential exposure methods. The short-term incidental oral endpoint of 10 mg/kg/day was used for the hand-to-mouth, object-to-mouth, soil ingestion scenarios, granular ingestion since these are oral exposures. The FQPA safety factor was reduced to 1x for all residential populations<sup>2</sup>. The target MOE for the oral short-term exposures is 100.

The calculations of short-term oral risk indicate that oral MOEs are more than 100 for all of the assessed exposure scenarios.

<b>Table 8: Residential Risk Estimates for Postapplication Exposure to Trifluralin</b>				
Exposure Scenario	Route of Exposure	Population	Application Rate <sup>a</sup>	MOE <sup>b</sup>
<b>Short-term Postapplication Exposures</b>				
<b>Outdoors</b>				
Hand to Mouth Activity on Turf <sup>c</sup>	Oral	Toddler	3.0 lb ai/acre	110,000
Object to Mouth Activity on Turf <sup>d</sup>	Oral	Toddler	3.0 lb ai/acre	1,800,000
Incidental Soil Ingestion <sup>e</sup>	Oral	Toddler	3.0 lb ai/acre	680,000,000
Incidental Ingestion of Granules <sup>f</sup>	Oral	Toddler	1.75 % ai	NA

**Footnotes:**

- <sup>a</sup> Application rates represent maximum label rates from current EPA registered labels (Granular rate is 3.0 lb ai/acre), except for ingestion of granules where the highest percent active ingredient product is utilized.
- <sup>b</sup> MOEs calculated using residues which would be found on day of treatment. Short-term Oral MOE (S-T) = Short-term Incidental Oral NOAEL (10 mg/kg/day / short-term Oral Dose (mg/kg/day) with a target MOE of 100;
- <sup>c</sup> Hand-to-mouth Dose Calculation: oral dose to child (1-6 year old) on the day of treatment (mg/kg/day) = TTR at day 0 normalized to application rate (0.0033 ug/cm<sup>2</sup>) x median surface area for 1-3 fingers (20 cm<sup>2</sup>/event) x hand-to-mouth rate (20 events/hour) x exposure. time (2 hr/day) x 50% saliva extraction factor x 0.001 mg/μg] / bw (15 kg child).
- <sup>d</sup> Object to Mouth Activity on - Turf Dose Calculation: oral dose to child (1-6 year old) on the day of treatment = TTR at day 0 normalized to application rate (0.0033 ug/cm<sup>2</sup>) x median surface area for 1-3 fingers (25 cm<sup>2</sup>/event) x hand-to-mouth rate (20 events/hour) x 0.001 mg/μg]] / bw (15 kg child).
- <sup>e</sup> Incidental Soil ingestion - Dose Calculation: oral dose to child (1-6 year old) on the day of treatment (mg/kg/day) = [TTR at day 0 normalized to application rate (0.0033 ug/cm<sup>2</sup>) x fraction of residue retained on uppermost 1 cm of soil (100% or 1.0/cm) x 0.67 cm<sup>3</sup>/g soil conversion factor] x 100 mg/day ingestion rate x 1.0E-06 g/μg conversion factor] / bw (15 kg).

Note: Assumptions used in dose calculations (e.g., transfer coefficients) are from Residential SOPs (revised 2/01).

**Combined Risk Assessment for Residential Scenarios**

The Agency combines risk values resulting from separate postapplication exposure scenarios when it is likely they can occur simultaneously based on the use-pattern and the behavior associated with the exposed population. For trifluralin, HED combined risk values (i.e., MOEs) for postapplication exposures to toddlers associated with turf applications by combining risks from oral exposures via transfer of residues from turf to hands to mouth with risks from oral exposures via transfer from turf to directly to mouth, and risks from oral exposures via incidental soil ingestion.

The combined risk assessment was calculated as follows:

$$\text{Combined MOE} = \text{NOAEL} / (\text{ADD}_{\text{hand-to-mouth}} + \text{ADD}_{\text{object-to-mouth}} + \text{ADD}_{\text{incidental soil ingestion}})$$

The combined MOE for the above scenario is 180 (see Table 9) and is greater than the target MOE of 100 and thus is not a risk concern.

<b>Table 9: Trifluralin Residential Scenarios for Combined Risk Estimates</b>				
<b>Postapplication Exposure Scenario</b>			<b>Margins of Exposure (MOEs) (UF=100)</b>	
			<b>Short-Term Oral (Non-Dietary)</b>	<b>Total Non-Dietary Risk<sup>a</sup></b>
Toddler	Turf: granules on turf (3 lb ai/acre)	Hand to Mouth	110,000	110,000
		Object to Mouth	1,800,000	
		Incidental Soil Ingestion	680,000,000	

## 2.4 Residential Postapplication Cancer Exposures and Risks

### 2.4.1 Residential Postapplication Cancer Exposure Scenarios

HED has determined that there are potential postapplication exposures to residents entering the areas where trifluralin has been applied. Although postapplication exposures to youths and toddlers are expected, when assessing cancer risk, the only postapplication residential scenarios that are applicable, using the current methods, are the following:

- Dermal exposure to residues on lawns (adults);
- Dermal exposure to golf course turfgrass (adults); and
- Dermal exposure in home vegetable gardens.

### 2.4.2 Residential Postapplication Cancer Trifluralin Exposure and Risk Calculations

The Agency has trifluralin-specific turf transferrable residue data upon which to base the postapplication cancer assessment resulting from dermal exposures to adults in residential settings.

For cancer assessments, it is necessary to estimate the number of days per year an adult would be exposed to a treated surface. Trifluralin-specific turf transferable residue data indicate that residues are not detectable after the day of application and two applications are permitted each year. Therefore for postapplication exposures to residential turfgrass and golf course turfgrass, and for postapplication exposures to residential vegetable gardens, EPA estimated cancer risks to adults using the assumption that adults might be exposed on the day of application (day zero) following both the permitted applications each year.

For the exposure duration, standard default values<sup>5</sup> were used:

- Two hours of exposure while exercising on a treated lawn;

- Four hours of exposure while playing golf; and
- Forty minutes of exposure while working in a vegetable garden.

Exposure duration was assumed to be 50 years in a 70 year lifespan.

The exposure length (hours/day) and exposure frequency (days/year) assumptions are assumed to be worst-case, since it is unlikely that – for 50 years – an adult would spend:

- two hours exercising on a treated lawn on day 0 for two applications per year;
- 4 hours playing golf on a treated golf course on day 0 for two applications per year;  
or
- 2/3 hours working in the vegetable garden on day 0 for two applications per year.

In addition, the label recommends watering-in following application, which would further reduce the potential exposure in treated areas.

For the postapplication cancer risk assessment, EPA used the following transfer coefficients:

- 7300 for exposures to lawns while exercising; (This is the transfer coefficient in the revised Residential Standard Operating Procedures for intermediate-term – and presumably long-term – exposures by adults to turfgrass.<sup>5</sup>)
- 500 for exposures to treated turfgrass while golfing; (This is the transfer coefficient in the *draft* standard operating procedure for golfer exposure assessment for adults and children and has been used in other golfer exposure assessments.)
- 1000 for exposures to treated vegetables in a residential garden. (This is the transfer coefficient in the Agricultural Default Transfer Coefficient SOP<sup>10</sup> as high exposure to fruiting vegetables.)

Postapplication cancer risks resulting from exposures to trifluralin were calculated using a linear low-dose extrapolation approach in which a *Lifetime Average Daily Dermal Dose* (LADD) is first calculated and then compared with a  $Q_1^*$  that has been calculated for trifluralin based on dose response data ( $Q_1^* = 5.79 \times 10^{-3} \text{ (mg/kg/day)}^{-1}$ ). Absorbed average daily dermal dose (ADD) levels were used as the basis for calculating the LADD values. LADD values were then calculated and compared to the  $Q_1^*$  to obtain cancer risk estimates.

**Lifetime Average Daily Dose:** To calculate the carcinogenic risk from absorbed average daily dermal dose, the values must be amortized over the lifetime of residential handlers. Current use patterns indicate that application occurs only a few times per year.

LADD values were calculated using the following equation:

$$LADD \left( \frac{mg \ ai}{kg/day} \right) = Total \ Daily \ Dose \left( \frac{mg \ ai}{kg/day} \right) \times \left( \frac{days \ exposed}{365 \ days \ per \ year} \right) \times \left( \frac{50 \ years \ exposed}{70 \ year \ lifetime} \right)$$

Where:

<b>Lifetime Average Daily Dose</b>	=	The amount as absorbed dose received from exposure to a pesticide or degradate in a given scenario over a lifetime (mg/kg/day, also referred to as LADD);
<b>Average Daily Dermal Dose</b>	=	The amount as absorbed dose received from dermal and inhalation exposure to a pesticide or degradate in a given scenario on a daily basis (mg/kg/day, also referred to as ADD);
<b>Exposure Frequency</b>	=	The annual frequency of exposure to an individual (days/year);
<b>Exposure Duration</b>	=	The amount of a lifetime that an individual is exposed (50 years); and
<b>Lifetime</b>	=	The average life expectancy of an individual (70 years).

**Cancer Risks :** Cancer risk calculations were completed by comparing the LADD values to the  $Q_1^*$  for trifluralin ( $Q_1^* = 5.97 \times 10^{-3} \text{ (mg/kg/day)}^{-1}$ ). Individual cancer risks were calculated using the following equation:

$$Cancer \ Risk = LADD \left( \frac{mg \ ai}{kg/day} \right) \times Q_1^*$$

Where:

<b>Cancer Risk</b>	=	Probability of excess cancer cases over a lifetime (unitless);
<b>Lifetime Average Daily Dose</b>	=	The amount as absorbed dermal dose received from exposure to a pesticide or degradate in a given scenario over a lifetime (mg//kg/day); and
<b><math>Q_1^*</math></b>	=	Quantitative dose response factor used for linear, low-dose response cancer risk calculations ( $\text{mg/kg/day}^{-1}$ ).

Table 10 presents the residential lifetime average daily doses and cancer risks associated with postapplication exposures to trifluralin.

### Summary of Cancer Risk Concerns for Residential Postapplication

HED has defined a range of acceptable cancer risks based on a policy memorandum issued in 1996 by then Office of Pesticide Programs director, Mr. Dan Barolo. This memo refers to a predetermined quantified "level of concern" for residential carcinogenic risk. In summary, this policy memo indicates risks less than  $1 \times 10^{-6}$  are not considered to be of concern and require no risk management action. Risks greater than  $1 \times 10^{-6}$  for the general population are considered to be of concern.

Dermal contact with residential turf for adults when assessed at two days of exposure per year – each on the day of application – had risks of **less than**  $1 \times 10^{-6}$  and are not considered to be a risk concern. Dermal contact with golf course turfgrass for adults when assessed at two days of exposure per year – each on the day of application – had risks **less than**  $1 \times 10^{-6}$  and are not considered to be of concern. Dermal contact with vegetable gardens for adults when assessed at two days of exposure per year – each on the day of application after sprays have dried – had risks of **less than**  $1 \times 10^{-6}$  and are not considered to be a risk concern.

**Table 10. Residential Postapplication Scenarios and Cancer Risks from Trifluralin**

Exposure Scenario	Application Rate (lb ai/acre) <sup>a</sup>	TTR/DFR ( $\mu\text{g}/\text{cm}^2$ ) <sup>b</sup>	Transfer Coefficient (Tc) ( $\text{cm}^2/\text{hr}$ )	Exposure Time (ET) (hrs/day)	ADD (mg/kg/day) <sup>c</sup>	Days of Exposure	LADD (mg/kg/day) <sup>d</sup>	Cancer Risk <sup>e</sup>
Dermal contact with turf (adults)	3.0	0.0033 (at day 0)	7300	2	$2.06 \times 10^{-5}$	2	$8.08 \times 10^{-8}$	$4.7 \times 10^{-10}$
Dermal contact with golf course turfgrass (adults)		0.0033 (at day 0)	500	4	$2.83 \times 10^{-6}$	2	$1.11 \times 10^{-8}$	$6.4 \times 10^{-11}$
Dermal contact with vegetable gardens (adults)	4.0	0.0044 (at day 0)	1000	0.67	$1.26 \times 10^{-6}$	2	$7.42 \times 10^{-8}$	$4.3 \times 10^{-10}$

- a Application rate for turf is the maximum label rate for turfgrass use patterns; application rate for vegetable gardens is maximum label rate for use on vegetable gardens.
- b Turf transfer residue at day zero ( $\mu\text{g}/\text{cm}^2$ ) = [AR (3 lbs ai/A) \* TTR residue on day 0 from the trifluralin-specific study; Dislodgeable foliar residue for vegetable gardens at day zero ( $\mu\text{g}/\text{cm}^2$ ) = [AR (4 lbs ai/A) \* TTR residue on day 0 from the trifluralin-specific study;
- c Average daily dermal dose (ADD) (mg/kg/day) = [DFR/TTR ( $\mu\text{g}/\text{cm}^2$ ) \* TC ( $\text{cm}^2/\text{hr}$ ) \* mg/1,000  $\mu\text{g}$  \* ET ( hrs/day) \* Dermal Absorption (3%)] / [BW (70 kg)]
- d Lifetime average daily dose (LADD) = Average Daily Dermal Dose (mg/kg/day) \* (number of days of exposure per year / 365 days/year) \* (50 years exposed / 70 years in a lifetime).
- e Cancer Risk = LADD (mg/kg/day) x Q1\* (mg/kg/day) where Q1\* = 0.00579.

## 2.4 Combined Residential Handler and Postapplication Exposures and Risks

The Agency combines risk values resulting from separate exposure scenarios when it is likely they can occur simultaneously based on the use-pattern and the behavior associated with the exposed population. For trifluralin, HED combined cancer risk values for residential handler and residential postapplication exposures associated with turf applications. (Note that since both the residential handler and residential postapplication exposures were estimated using a worse-case rangefinder approach, combining these risk values may result in exaggerated cancer risks.) The combined handler plus postapplication cancer risk associated with applications to residential turfgrass is  $5.4 \times 10^{-7}$ . This below EPA's level of concern for cancer. Note that combining short-term risks was not done, since there are no short-term postapplication risks because there is no short-term dermal endpoint of concern.

## 3.0 Trifluralin Poisoning Incidents Information

HED tracks pesticide-related incidents involving humans through four main resources:

- OPP Incident Data System (IDS)
- Poison Control Centers
- California Department of Pesticide Regulation
- National Pesticide Information Center (NPIC)

**OPP Incident Data System (IDS):** The Office of Pesticide Programs (OPP) Incident Data System consists of reports of incidents from various sources, including registrants, other federal and state health and environmental agencies and individual consumers, submitted to OPP since 1992. Reports submitted to the Incident Data System represent anecdotal reports or allegations only, unless otherwise stated. Typically no conclusions can be drawn implicating the pesticide as a cause of any of the reported health effects.

Nevertheless, sometimes with enough cases and/or enough documentation risk mitigation measures may be suggested. For trifluralin, it appears that the majority of cases involved skin and eye illnesses.

**Poison Control Centers:** As the result of a data purchase by EPA, Office of Pesticide Programs received Poison Control Center data covering the years 1993 through 1998 for all pesticides. Most of the national Poison Control Centers (PCCs) participate in a national data collection system, the Toxic Exposure Surveillance System which obtains data from about 65-70 centers at hospitals and universities. PCCs provide telephone consultation for individuals and health care providers on suspected poisonings, involving drugs, household products, pesticides, etc. Poison Control Center data indicates that, in general, trifluralin is less likely to cause minor, moderate, or life-threatening symptoms than other pesticides, except among non-occupational cases where moderate effects are more likely. There were no major or life-threatening cases or cases requiring hospitalization or intensive care, except for one case involving a two year old child who ingested trifluralin and was hospitalized even though asymptomatic. It appears likely this case was kept in the hospital overnight for observation. Symptoms most commonly reported in ten or more reports were eye irritation/pain (25 reports), nausea (16 reports), vomiting (13 reports), and skin irritation/pain (10 reports). Of the symptomatic cases, one-quarter involved exposure to residue rather than direct spray or spill.

**California Department of Pesticide Regulation:** California has collected uniform data on suspected pesticide poisonings since 1982. Physicians are required, by statute, to report to their local health officer all occurrences of illness suspected of being related to exposure to pesticides. The majority of the incidents involve workers. Information on exposure (worker activity), type of illness (systemic, eye, skin, eye/skin and respiratory), likelihood of a causal relationship, and number of days off work and in the hospital are provided. Detailed descriptions of 77 trifluralin-related cases submitted to the California Pesticide Illness Surveillance Program (1982-2001) were reviewed. In 57 of these cases, trifluralin was used alone or was judged to be responsible for the health effects. Only cases with a definite, probable or possible relationship were reviewed. Trifluralin ranked 72<sup>nd</sup> as a cause of systemic poisoning in California based on data for 1982 through 2001. Pesticide handler (i.e., mixer/loader and applicator) were associated with 31 exposure incidents and field workers were associated with 12 incidents. The reported illnesses included symptoms of conjunctivitis, swollen arms, hand, and face and a rash, eye irritation, tearing and red eyes, headache, skin irritation, and abdominal pain.

**National Pesticide Information Center (NPIC):** NPIC is a toll-free information service supported by the Office of Pesticide Programs. A ranking has been prepared of the top 200 active ingredients for which telephone calls were received during the calendar years of 1984 through-1991. The total number of calls was tabulated for the categories human incidents, animal incidents, calls for information, and others. On the list, trifluralin was ranked 53<sup>rd</sup> with 75 incidents involving humans and 17 incidents involving animals (mostly pets).

**Incident Reported in the Scientific Literature:** Pentel et al. (1994) reported that a sixty-one year old male laboratory supervisor at a chemical pesticide company since 1951 was patch tested for trifluralin along with eight other pesticides. The man had a positive reaction to trifluralin. The authors concluded that exposure to this chemical caused him to have allergic contact dermatitis.

**Conclusions:** Based on California data and the Incident Data System, it appears that the majority of cases involved skin and eye illnesses. Poison Control Center data would tend to support these results, dermal and ocular effects were some of the most common effects reported.

## References

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- 3) U.S. EPA (1998) PHED Surrogate Exposure Guide. Version 1.1. Health Effects Division, Office of Pesticide Programs, August 1998.
- 4) Bangs, G. (2001) Summary of HED's Reviews of Outdoor Residential Exposure Task Force (ORETF) Chemical Handler Exposure Studies; MRID 449722-01. Memorandum from Gary Bangs (HED) to Demson Fuller (Special Review and Reregistration Division), April 30, 2001.
- 5) U.S. EPA (1997) *Draft Standard Operating Procedures (SOPs) for Residential Exposure Assessments*. December 1997 with revisions stated in the HED Science Advisory Council for Exposure, SOP 12. *Recommended Revisions to the Standard Operating Procedures (SOPs) for Residential Exposure Assessments*. February 22, 2001.
- 6) U.S. EPA (1998) HED Exposure Science Advisory Council SOP Memo No. 7. *Use of Values from the PHED Surrogate Table and Chemical Specific Data*. Health Effects Division, Office of Pesticide Programs, December 1998.
- 7) Clothier, J.M. (2000) Dermal Transfer Efficiency of Pesticides from Turf Grass to Dry and Wetted Palms. U.S. Environmental Protection Agency, National Exposure Research Laboratory, Research Triangle Park, NC.
- 8) Trifluralin. Dissipation of transferable residues of benefin and trifluralin on turf treated with a formulation of the pesticides (MRID 457456-01). Washington, D.C.: U.S. Environmental Protection Agency, Office of Pesticide Programs. Study completed July 26, 2002.
- 9) U.S. EPA (2000) HED Science Advisory Council for Exposure, SOP 003.1. *Agricultural Default Transfer Coefficients*. Health Effects Division, Office of Pesticide Programs, August 7, 2000.
- 10) U.S. EPA (2000) HED Science Advisory Council for Exposure, SOP 003.1. *Agricultural Default Transfer Coefficients*. Health Effects Division, Office of Pesticide Programs, August 7, 2000.

# Appendices

**Table A1: Sources of Exposure Data Used in the Short-Term Residential Trifluralin Handler Exposure and Risk Calculations**

Exposure Scenario (Scenario #)	Data Source	Standard Assumption <sup>a</sup>	Comments <sup>b</sup>
<b>Mixer/Loader/Applicator Descriptors</b>			
Loading/applying granules with a belly grinder (1)	PHED V1.1	0.5 acres/day for use on turf, 1000 ft <sup>2</sup> /day for use on ornamentals (both pre-plant and post-plant ) and vegetable gardens.	<b>Baseline:</b> Dermal data = A, B, C grades; 20-45 replicates (medium confidence). Hands data = A, B, C grades; 23 replicates (medium confidence). Inhalation data = A, B grades; 40 replicates (high confidence). <b>PPE and Engineering Controls:</b> Not required for assessment.
Loading/applying granules with a push-type spreader (2)	PHED V1.1	0.5 acres/day for use on turf, 1000 ft <sup>2</sup> /day for use on ornamentals (both pre-plant and post-plant ) and vegetable gardens.	<b>Baseline:</b> Dermal data = C grade; 0-15 replicates (low confidence). Hands data = C grades; 15 replicates (low confidence); Inhalation data = B grades; 15 replicates (high confidence). <b>PPE and Engineering Controls:</b> Not required for assessment.
Loading/applying granules using a spoon, measuring scoop, shaker can, or by hand (3)	Review of fipronil granular mixer/loader/applicator study as a source of surrogate data, MRID 452507-01. J. Dawson memo, D270065, 1/5/01.	1000 ft <sup>2</sup> /day for use on ornamentals (both pre-plant and post-plant ), turf and vegetable gardens. 50 bushes/day for use on roses.	<b>Baseline:</b> A 90% protection factor was applied to gloved hands data to back calculate “no glove” hand exposure. A standard 50% protection factor was used for the torso. A 10% protection factor was used to represent the protection afforded by shorts and a short-sleeved shirt. <b>PPE and Engineering Controls:</b> Not required for assessment.
Mixing/loading/applying liquids using a hose end sprayer (4)	ORETF Chemical Handler Exposure Studies	1000 ft <sup>2</sup> /day	<b>Baseline:</b> Dermal, inhalation, and hands = A grade. Dermal, inhalation, and hands = 20 replicates each. High confidence in all data. <b>PPE and Engineering Controls:</b> Not required for assessment.
Mixing/loading/applying liquids with a low pressure handwand (5)	ORETF Chemical Handler Exposure Studies	5 gallons spray/day	<b>Baseline:</b> Dermal, inhalation, and hands = A grade. Dermal, inhalation, and hands = 20 replicates each. High confidence in all data. <b>PPE and Engineering Controls:</b> Not required for assessment.
Mixing/loading/applying liquids with a backpack sprayer (6)	PHED V1.1	5 gallons spray/day	<b>Baseline:</b> Dermal data = A, B grades; 9-11 replicates (low confidence). Hands data = C grade, 11 replicates (low confidence). Inhalation data = A grade; 11 replicates (low confidence). <b>PPE and Engineering Controls:</b> Not required for assessment.
Applying trifluralin impregnated fabric squares to soil (7)	No data is available for this scenario.		

**Footnotes:**

<sup>a</sup> Standard Assumptions from Residential SOPs.

<sup>b</sup> "Best Available" grades are defined by HED SOP for meeting Subdivision U Guidelines. Best available grades are assigned as follows: matrices with grades A and B data and a minimum of 15 replicates; if not available, then grades A, B and C data and a minimum of 15 replicates; if not available, then all data regardless of the quality and number of replicates. Data confidence are assigned as follows:

High = grades A and B and 15 or more replicates per body part

Medium = grades A, B, and C and 15 or more replicates per body part

Low = grades A, B, C, D and E or any combination of grades with less than 15 replicates

**Table A2: Margins of Exposure For Short-Term Trifluralin Residential Handler Risk Assessment**

Exposure Scenario (Scenario #)	Crop or Target	Application Rate <sup>a</sup>	Area Treated Daily <sup>b</sup>	Baseline Inhalation Unit Exposure (ug/lb ai) <sup>c</sup>	Baseline Inhalation Exposure <sup>d</sup>	Baseline Inhalation Dose <sup>e</sup>	Baseline Inhalation MOE <sup>f</sup>
Loading/applying granules with a belly grinder (1)	ornamental (pre)	20 lbs ai/acre	0.023 acres	62	0.029	0.00041	200,000
	ornamental (post)	4.0 lbs ai/acre	0.023 acres	62	0.0057	0.000082	990,000
	turf	1.0 lbs ai/acre	0.5 acres	62	0.031	0.00044	180,000
	vegetable gardens	4.1 lbs ai/acre	0.023 acres	62	0.0058	0.000083	970,000
Loading/applying granules with a push-type spreader (2)	ornamental (pre)	20 lbs ai/acre	0.023 acres	0.88	0.00041	0.0000058	14,000,000
	ornamental (post)	4.0 lbs ai/acre	0.023 acres	0.88	0.000081	0.0000012	70,000,000
	turf	1.0 lbs ai/acre	0.5 acres	0.88	0.00044	0.0000063	13,000,000
	vegetable gardens	4.1 lbs ai/acre	0.023 acres	0.88	0.000083	0.0000012	69,000,000
Loading/applying granules using a spoon, measuring scoop, shaker can, or by hand (3)	ornamental (pre)	20 lbs ai/acre	0.023 acres	45	0.021	0.0003	270,000
	ornamental (post)	4.0 lbs ai/acre	0.023 acres	45	0.0041	0.000059	1,400,000
	turf	1.0 lbs ai/acre	0.023 acres	45	0.001	0.000015	5,500,000
	vegetable gardens	4.1 lbs ai/acre	0.023 acres	45	0.0042	0.00006	1,300,000
	rose bushes	0.000425 lbs ai/bush	50 bushes	45	0.00096	0.000014	5,900,000
Mixing/loading/applying liquids using a hose end sprayer (4)	flowers, trees, shrubs	4.1 lbs ai/acre	0.023 acres	1.5	0.00014	0.000002	40,000,000
	vegetable gardens	4.1 lbs ai/acre	0.023 acres	1.5	0.00014	0.000002	40,000,000
Mixing/loading/applying liquids with a low pressure handwand (5)	flowers, trees, shrubs	0.047 lb ai/gallon	5 gallons	3.8	0.00089	0.000013	6,300,000
	vegetable gardens	0.047 lb ai/gallon	5 gallons	3.8	0.00089	0.000013	6,300,000
Mixing/loading/applying liquids with a backpack sprayer (6)	flowers, trees, shrubs	0.047 lb ai/gallon	5 gallons	30	0.0071	0.0001	800,000
	vegetable gardens	0.047 lb ai/gallon	5 gallons	30	0.0071	0.0001	800,000

**Footnotes:**

- a Application Rates are based on the maximum application rates listed on the trifluralin labels.
- b Amount handled per day are from EPA estimates of acres treated, or square feet treated, in a single day based on the application method. For ready to use formulations, the whole container is assumed to be used in one day.
- c Baseline inhalation unit exposure represents no respirator.
- d Daily Inhalation Exposure ( $\mu\text{g}/\text{day}$ ) = (Inhalation Unit Exposure ( $\mu\text{g}/\text{lb ai}$ ) x (1mg/1000  $\mu\text{g}$ ) Conversion Factor x Application Rate (lb ai/A) x Area Treated per day (acres and square feet)).

- e Daily Inhalation Exposure ( $\mu\text{g}/\text{day}$ ) = (Daily Inhalation Exposure ( $\mu\text{g}/\text{day}$ ) x Inhalation Absorption Factor (%)) / Body Weight (70 kg).
- f Short-term Inhalation MOE = Inhalation NOAEL (81 mg/kg/day) / Daily Inhalation Dose (mg/kg/day).

**Table A3: Cancer Risks For Trifluralin Residential Handler Risk Assessment**

Exposure Scenario	Crop Type	Application Rate <sup>a</sup>	Area Treated Daily <sup>b</sup>	Baseline Dermal Unit Exposure (mg/lb ai)	Baseline Inhalation Unit Exposure (ug/lb ai)	Days / Yr	Baseline Daily Total Dose (mg/kg/day)	Residential Applicator Total Baseline LADD (mg/kg/day)	Residential Applicator Baseline Cancer Risk
Loading/applying granules with a belly grinder (1)	ornamental (pre)	20 lbs ai/acre	0.023 acres	110	62	1	0.022	4.4E-05	2.5E-07
	ornamental (post)	4.0 lbs ai/acre	0.023 acres	110	62	1	0.0033	6.5E-06	3.8E-08
	turf	1.0 lbs ai/acre	0.5 acres	110	62	2	0.024	9.4E-05	5.4E-07
	vegetable gardens	4.1 lbs ai/acre	0.023 acres	110	62	1	0.0045	8.8E-06	5.1E-08
Loading/applying granules with a push-type spreader (2)	ornamental (pre)	20 lbs ai/acre	0.023 acres	0.67	0.88	1	0.00014	2.7E-07	1.6E-09
	ornamental (post)	4.0 lbs ai/acre	0.023 acres	0.67	0.88	1	0.000021	4.0E-08	2.3E-10
	turf	1.0 lbs ai/acre	0.5 acres	0.67	0.88	2	0.00015	5.9E-07	3.4E-09
	vegetable gardens	4.1 lbs ai/acre	0.023 acres	0.67	0.88	1	0.000028	5.5E-08	3.2E-10
Loading/applying granules using a spoon, measuring scoop, shaker can, or by hand (3)	ornamental (pre)	20 lbs ai/acre	0.023 acres	3.5	45	1	0.00099	1.9E-06	1.1E-08
	ornamental (post)	4.0 lbs ai/acre	0.023 acres	3.5	45	1	0.00015	2.9E-07	1.7E-09
	turf	1.0 lbs ai/acre	0.023 acres	3.5	45	2	0.000049	1.9E-07	1.1E-09
	vegetable gardens	4.1 lbs ai/acre	0.023 acres	3.5	45	1	0.0002	3.9E-07	2.3E-09
	rose bushes	0.000425 lb ai/bush	50 bushes	3.5	45	1	0.000046	8.9E-08	5.2E-10
Mixing/loading/applying liquids using a hose end sprayer (4)	flowers, trees, shrubs, vegetable gardens	4.1 lb ai/acre	0.023 acres	39	1.5	5	0.0016	1.5E-05	8.9E-08
Mixing/loading/applying liquids with a low pressure handwand (5)	flowers, trees, shrubs	0.047 lb ai/gal	5 gallons	56	3.8	5	0.0057	5.5E-05	3.2E-07
Mixing/loading/applying liquids with a backpack sprayer (6)	flowers, trees, shrubs	0.047 lb ai/gal	5 gallons	100	30	5	0.01	1.0E-04	5.8E-07

**Footnotes:**

- a Application Rates are based on the typical application rates listed on the trifluralin labels when available. If no typical rate was provided, maximum applications rates were used.
- b Amount handled per day are from EPA estimates of acres treated, or square feet treated, in a single day based on the application method. For ready to use formulations, the whole container is assumed to be used in one day.
- c Baseline inhalation unit exposure represents no respirator.

**Table A4 - Short-Term Oral Exposure from Hand-to-Mouth Activity on Trifluralin Treated Turf**

Exposure Scenario	Maximum Application Rate	TTR at day 0 (normalized to max appl. rate)	Surface Area (cm <sup>2</sup> )	Hand to Mouth (events/hr)	Extraction by Saliva	Exposure Time (hours)	Body Weight (kg)	Average Daily Dose (mg/kg/day)	MOE
Hand to Mouth (turf)	3.0lb ai/acre	0.0033 $\mu\text{g}/\text{cm}^2$	20	20	50%	2	15	0.000088	110,000

$$\text{Oral Dose (mg/kg/day)} = \frac{\text{TTR}(\mu\text{g}/\text{cm}^2) \times \text{CF} (0.001\text{mg}/\mu\text{g}) \times \text{SA} (\text{cm}^2) \times \text{EXT} \times \text{FQ} (\text{events}/\text{hr}) \times \text{ET} (\text{hrs}/\text{day})}{\text{BW} (\text{kg})}$$

Where:

- Dose = oral dose on day of application (mg/kg/day)
- TTR = turf transferable residue normalized to maximum application rate ( $\mu\text{g}/\text{cm}^2$ )
- CF = conversion factor from  $\mu\text{g}$  to mg (0.001)
- F = fraction of residue dislodgeable from wet hands (unitless)
- SA = surface area of 1 to 3 fingers (cm<sup>2</sup>)
- EXT = extraction rate by saliva (unitless)
- FQ = frequency of hand-to-mouth events (events/hour)
- ET = exposure duration (hours/day)
- BW = body weight (kg)

Assumptions:

- SA - The surface area of 1 to 3 finger is 20 cm<sup>2</sup>
- FQ - The frequency of hand-to-mouth events is 20 events per hour for short-term
- EXT - The extraction rate by saliva is 50%.
- ET - The time spent outdoors is 2 hours/day

Endpoint of Concern = Short-Term Incidental Oral NOAEL (10 mg/kg/day)

**Table A5 - Short-Term Oral Exposure from Mouthing Trifluralin Treated Turf**

Exposure Scenario	Application Rate	TTR at day 0 (normalized to max appl. rate)	Surface Area (cm <sup>2</sup> )	Body Weight (kg)	Average Daily Dose (mg/kg/day)	MOE
Object (turf) to Mouth	3.0 lb ai/acre	0.0033 μg/cm <sup>2</sup>	25	15	0.0000055	1,800,000

$$\text{Short-Term Oral Dose (mg/kg/day)} = (\text{TTR}_t * \text{IgR} * \text{CF1}) / \text{BW}$$

Where:

- ADD = average daily dose (mg/kg/day)
- TTR<sub>t</sub> = turf transferable residue on day "0" (μg/cm<sup>2</sup>) normalized to maximum application rate
- IgR = ingestion rate of grass (25 cm<sup>2</sup>/day)
- CF1 = weight unit conversion factor to convert the μg of residues on the grass to mg to provide units of mg/day (1E-3 mg/μg)
- BW = body weight (15 kg)

$$\text{Endpoint of Concern} = \text{Short-Term Incidental Oral NOAEL (10 mg/kg/day)}$$

Table A6 - Short-Term Oral Exposure from Incidental Soil Ingestion						
Exposure Scenario	Application Rate Application Rate Units	% of Application Rate in Uppermost 1 cm of Soil (fraction/cm)	Ingestion Rate (IgR) mg/day	Body Weight (kg)	Average Daily Dose (mg/kg/day)	MOE
Incidental Soil Ingestion	3.0lb ai/acre	100%	100	15	$1.47 \times 10^{-8}$	680,000,000

$$\text{Oral Dose} = \frac{\text{TTR (ug/cm}^2) \times \text{F(1.0/cm)} \times \text{IgR(mg/day)} \times (0.67 \text{ cm}^3/\text{g}) \times (1\text{E-6 g/}\mu\text{g})}{\text{BW (kg)}}$$

Where:

- Dose = oral dose on day of application (mg/kg/day)
- AR = application rate (lb ai/A)
- F = fraction or residue retained on uppermost 1 cm of soil
- IgR = ingestion rate of soil (mg/day)
- CF2 = volume to weight unit conversion factor to convert the volume units (cm<sup>3</sup>) to weight units for the soil residue value (0.67 cm<sup>3</sup>/g soil)
- CF3 = weight unit conversion factor to convert the μg of residues on the soil to grams to provide units of mg/day (1E-6 g/μg)
- BW = body weight (kg)

Assumptions:

- F - The fraction or residue retained on uppermost 1 cm of soil is 100 percent based on soil incorporation into top 1 cm of soil after application (1.0/cm)
- IgR - The ingestion rate of soil is 100 mg/day

Endpoint of Concern = Short-Term Incidental Oral NOAEL (10 mg/kg/day)

**Table A8: Cancer Risks For Trifluralin Residential Postapplication Risk Assessment**

Scenario	TC cm <sup>2</sup> /hr	Hours of Exposure	Days of Exposure	TTR/DFR ug/cm <sup>2</sup>	Absorbed Dose (mg/kg/day)	LADD	Cancer
Residential Turf <sup>a</sup> - adults (2 days of exposure using TTR at day 0)	7,300	2	2	0.0033	2.06E-05	8.08E-08	4.7E-10
Golf Course Turf <sup>b</sup> - adults (2 days of exposure using TTR at day 0)	500	4	2	0.0033	2.83E-06	1.11E-08	6.4E-11
Vegetable gardens <sup>a</sup> - adults (2 days of exposure using DFR at day 0)	1,000	0.67	2	0.0044	1.26E-06	7.42E-08	4.3E-10

- a Application rate for turf is the maximum label rate for turfgrass use patterns; application rate for vegetable gardens is maximum label rate for use on vegetable gardens.
- b Turf transfer residue at day zero ( $\mu\text{g}/\text{cm}^2$ ) = data from the trifluralin-specific TTR study normalized to maximum application rate; Dislodgeable foliar residue for vegetable gardens at day zero ( $\mu\text{g}/\text{cm}^2$ ) = data from the trifluralin-specific TTR study normalized to maximum application rate;
- c Average daily dermal dose (ADD) (mg/kg/day) = [DFR/TTR ( $\mu\text{g}/\text{cm}^2$ ) \* TC (cm<sup>2</sup>/hr) \* mg/1,000  $\mu\text{g}$  \* ET (hrs/day) \* Dermal Absorption (3%)] / [BW (70 kg)]
- d Lifetime average daily dose (LADD) = Average Daily Dermal Dose (mg/kg/day) \* (number of days of exposure per year / 365 days/year) \* (50 years exposed / 70 years in a lifetime).
- e Cancer Risk = LADD (mg/kg/day) x Q1\* (mg/kg/day) where Q1\* = 0.00579.