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WASHINGTON, DC 20460

OFFICE OF CHEMICAL SAFETY  
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**MEMORANDUM**

**Subject:** Registration Review: Problem Formulation for the Environmental Fate, Ecological Risk, Endangered Species, and Drinking Water Exposure Assessments for Trifluralin

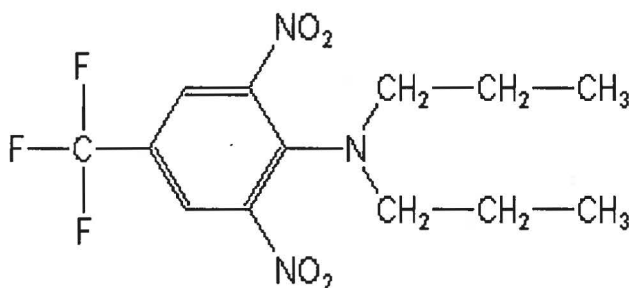
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The Environmental Fate and Effects Division (EFED) has completed the problem formulation (attached) for the environmental fate, ecological risk, endangered species, and drinking water exposure assessments to be conducted as part of the Registration Review of the herbicide trifluralin (PC Code 036101). Functioning as the first stage of the risk assessment process for registration review, this problem formulation provides an overview of what is currently known about the environmental fate and ecological effects associated with trifluralin and its degradates. It also describes the preliminary ecological risk hypothesis and analysis plan for evaluating and characterizing drinking water exposure and risk to non-target species and the environment in support of the registration review of trifluralin. This document also recommends studies that should be included in a data call-in (DCI) to address uncertainties surrounding the environmental fate and potential ecological effects of trifluralin.

# Problem Formulation for the Environmental Fate, Ecological Risk, Endangered Species, and Drinking Water Exposure Assessments in Support of the Registration Review of Trifluralin



2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine

CAS Registry Number: 1582-09-8

PC Code: 036101

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Date: June 6, 2012

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## **1. Purpose**

The purpose of this problem formulation is to provide the status of the environmental fate and ecological effects of trifluralin, considering its currently registered conventional uses. Trifluralin is a pre-emergent fluorinated dinitroaniline herbicide used to control annual grasses and broadleaf weeds on a variety of food crops and non-food uses. This document will provide a plan for analyzing data relevant to trifluralin and for conducting ecological risk, endangered species, and drinking water exposure assessments for its registered uses. Additionally, this problem formulation is intended to identify data gaps, uncertainties, and potential assumptions used to address those uncertainties relative to characterizing the ecological risk associated with the registered uses of trifluralin.

## **2. Problem Formulation**

### **2.1. Nature of Regulatory Action**

Under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), all pesticides distributed or sold in the United States generally must be registered by the Environmental Protection Agency (EPA or the Agency). In determining whether a pesticide can be registered in the United States, EPA evaluates its safety to non-target species based on a wide range of environmental and health effects studies. In 1996, FIFRA was amended by the Food Quality Protection Act, and the Agency was mandated to implement a new program for the periodic review of pesticides, *i.e.*, registration review ([http://www.epa.gov/oppsrrd1/registration\\_review/](http://www.epa.gov/oppsrrd1/registration_review/)). The registration review program is intended to ensure that, as the ability to assess risk evolves and as policies and practices change, all registered pesticides continue to meet the statutory standard of no unreasonable adverse effects to human health and the environment. Changes in science, public policy, and pesticide use practices will occur over time. Through the new registration review program, the Agency periodically reevaluates pesticides to make sure that as change occurs, products in the marketplace can be used safely.

As part of the implementation of the new registration review program pursuant to Section 3(g) of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Agency is beginning its evaluation of trifluralin to determine whether it continues to meet the FIFRA standard for registration. This problem formulation for the ecological risk, endangered species, and drinking water assessment chapter in support of the registration review will be posted in the initial docket, which will open the public phase of the review process.

### **2.2. Previous Assessments**

#### **2.2.1. Ecological Risk Assessments**

Trifluralin has a long regulatory history and has been the subject of numerous assessments. It was first registered in the United States in 1963 for use as a selective pre-emergent herbicide. In April 1996, EPA completed its Reregistration Eligibility Decision on the active ingredient trifluralin (U.S. EPA, 1996). The Agency determined all labeled uses of trifluralin at the time of the assessment were eligible for reregistration with the exception of non-grass forage/fodder/straw/hay and dill. Residue data were not generated to support these uses and they

were to be deleted from all labels. Relevant ecological conclusions from the RED include the following:

- For aquatic animals (fish and invertebrates), trifluralin was ranked as having moderate to high toxicity according to the hazard classification scheme. Due to trifluralin's toxicity to fish, aquatic invertebrates and estuarine/marine organisms, the Agency required aquatic impact labeling on all trifluralin end-use products. Also, the LOC determination is based on trifluralin dissolved in the water column and does not take into account trifluralin adsorbed to sediment. Trifluralin adsorbed to sediment may pose a risk for fish species that forage by feeding from sediment, particularly since trifluralin has a moderate tendency to bioaccumulate. The Agency planned to explore further monitoring efforts or additional analyses with the registrants of technical trifluralin in order to obtain more refined characterization of the risk to fish.
- Trifluralin was ranked as practically non-toxic to birds and mammals on an acute basis. Two of four laboratory bird studies indicated chronic risk, as evidenced by egg shell cracking. Chronic risks to mammals were not evaluated.
- For terrestrial and semi-aquatic plants, the Agency did find a concern for the semi-aquatic category. The Agency did not find concerns for aquatic plants resulting from use of trifluralin.
- For control of effects caused by spray drift, the RED indicated that the Agency will require precautionary labeling, which is standard for pesticides with aerial applications.

The Agency also completed an Effects Determination for 26 threatened and endangered Pacific anadromous salmon and steelhead in April 2004 based on trifluralin uses in a variety of field, fruit, and vegetable crops, ornamentals, and non-crop sites in the Pacific Northwest consistent with a court order in *WTC v. EPA* (Case No. 1:04-Cv-00126-Ckk, 2004a). The results of that endangered species risk assessment showed that the use of trifluralin may affect and was likely to adversely affect 11 Evolutionary Significant Units (ESUs), may affect but was not likely to adversely affect 4 ESUs, and had no effect on 11 ESUs of Pacific salmon and steelhead when used according to labeled application directions (<http://www.epa.gov/oppfead1/endanger/litstatus/effects/#trifluralin>). The National Marine Fisheries Service indicated it would review EPA's determination regarding effects of trifluralin to the Pacific salmon and steelhead and complete consultation with issuance of a final Biological Opinion on May 31, 2012 (the document could not be reviewed before this problem formulation was finalized).

In 2009, Agency completed an assessment to evaluate potential direct and indirect effects on the following species arising from FIFRA regulatory actions regarding use of trifluralin:

California red-legged frog (CRLF), *Rana aurora draytonii*  
Delta smelt (DS), *Hypomesus transpacificus*,  
San Francisco Garter Snake (SFGS), *Thamnophis sirtalis tetrataenia*,  
San Joaquin Kit Fox (SJKF), *Vulpes macrotis mutica*

This assessment also addressed whether these actions could be expected to result in modification of the species' designated critical habitat. This assessment was completed in accordance with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS)

*Endangered Species Consultation Handbook* (USFWS/NMFS, 1998) and procedures outlined in the Agency's Overview Document (U.S. EPA, 2004b). Based on the best available information, the Agency made a Likely to Adversely Affect (LAA) determination for the CRLF, DS, SJKF and SFGS from the use of trifluralin. Additionally, the Agency determined that there was potential for modification of the designated critical habitat for the CRLF and the DS from the use of the chemical. Risk conclusions and effects determinations for each listed species and their designated critical habitat assessed can be obtained from Effects Determination for Trifluralin and the California Red-legged Frog, Delta Smelt, San Francisco Garter Snake and San Joaquin Kit Fox (U.S. EPA, 2009; <http://www.epa.gov/espp/litstatus/effects/redleg-frog/>).

### **2.2.2. Drinking Water Exposure Assessments**

In support of the human health risk assessment for the Tolerance Reassessment Eligibility Decision (TRED), a drinking water exposure assessment was completed (U.S. EPA, 2004c). Tier I and Tier II surface water and Tier I groundwater modeling were performed for parent trifluralin and its several major degradation products. The drinking water exposure assessment also relied on an extensive review of available surface water and groundwater monitoring data.

## **3. Stressor Source and Distribution**

Trifluralin is a pre-emergent dinitroaniline herbicide used to control annual grasses and broadleaf weeds on a variety of food crops and non-food uses (see **Table 3.2** for a list of labeled uses). The herbicide is formulated as an emulsifiable concentrate and granular products. Trifluralin is typically applied dormant, semi-dormant, pre-plant, pre-transplant, post-plant, pre-emergence, post-emergence, lay-by, or postharvest. Trifluralin can be applied by aerial spray, ground spray or by granular spreaders. Some labels require soil incorporation, while others do not.

There are three major degradates (TR-4, TR-6 and TR-15) identified in the submitted environmental fate studies for trifluralin. However, there is insufficient data on the major degradates of trifluralin to adequately assess their persistence and mobility. Available aquatic toxicity data for TR-6 and TR-15 suggest that degradates are not more toxic than the parent (**Section 4.3**). No degradate toxicity data were available for birds or mammals, and EFED defers to the Health Effects Division's Metabolite Assessment Review Committee's conclusion that there are no degradates of concern for mammals. EFED extrapolates this conclusion for mammals to birds in the absence of an avian quantitative structure activity relationship model. Therefore, only the parent trifluralin will be considered in the risk assessment process.

### **3.1. Mode of Action**

Trifluralin is a synthetic fluorinated dinitroaniline herbicide that enters plants through developing roots preventing the alignment and separation of chromosomes during mitosis (mitosis disruptor). Trifluralin binds to the major microtubule protein tubulin leading to microtubule loss and the absence of the spindle apparatus preventing alignment and separation of chromosomes during mitosis. Dinitroaniline-induced microtubule loss typically results in the swelling of root tips as cells in this region fail to divide or elongate.

### 3.2. Overview of Pesticide Use and Usage

As of February 29, 2012, there were no pending, in-process actions for trifluralin and no recent regulatory actions.

**Table 3.1** summarizes the trifluralin products that are currently registered in the United States. Several of the products listed include one or more additional active ingredients. **Table 3.2** presents the uses and corresponding application rates (includes maximum single rates only) and application interval that will be considered in the registration review risk assessment. **Table 3.2** is a summary of the report provided by the Biological and Economic Analysis Division (BEAD); this report will be referred to in the event that more information is needed for exposure modeling. The table also illustrates that use information is not always specified on the label (number of applications per year, maximum application rate per year, and minimum retreatment interval). In the event that a parameter is not specified on the label, the Agency must make conservative assumptions to estimate environmental exposure. Where possible, the technical registrant should provide information on all the parameters for all registered uses.

Registration #	Name	Company Name	Percent Active Ingredient
241-307	TRI-SCEPT HERBICIDE	BASF CORPORATION	28.6
241-343	TRI-4 HF HERBICIDE	BASF CORPORATION	42.8
279-3104	COMMENCE EC	FMC CORP. AGRICULTURAL PRODUCTS GROUP	32
961-280	PREEN THE WEED PREVENTER	LEBANON SEABOARD CORPORATION	1.47
961-283	GREENVIEW PREEN 'N GREEN	LEBANON SEABOARD CORPORATION	0.74
961-335	LEBANON GREEN GOLD GARDEN WEED PREVENTER	LEBANON SEABOARD CORPORATION	1.75
961-346	LEBANON LAWN CRABGRASS PREVENTER WITH FERTILIZER	LEBANON SEABOARD CORPORATION	0.385
961-348	LEBANON LAWN FERTILIZER WITH TEAM CRABGRASS CONTROL	LEBANON SEABOARD CORPORATION	0.515
961-370	LEBANON PREEN PRO 1.875G	LEBANON SEABOARD CORPORATION	1.5
961-390	LEBANON LAWN FERTILIZER CONTAINS CONFRONT AND TEAM	LEBANON SEABOARD CORPORATION	0.43
961-391	LEBANON TURF FERTILIZER WITH CONFRONT AND TEAM	LEBANON SEABOARD CORPORATION	0.43
961-405	LEBANON TRIFLURALIN G-5	LEBANON SEABOARD CORPORATION	5
961-407	PREEN GARDEN WEED PREVENTER PLUS FERTILIZER	LEBANON SEABOARD CORPORATION	1.47
961-408	PREEN LANDSCAPE MULCH	LEBANON SEABOARD CORPORATION	0.0032
961-409	PREEN TRIFLURALIN MULCH	LEBANON SEABOARD CORPORATION	0.0032
1381-146	AGRISOLUTIONS TRUST HERBICIDE	WINFIELD SOLUTIONS, LLC	43

**Table 3.1. Summary of Trifluralin Products Registered in the United States**

Registration #	Name	Company Name	Percent Active Ingredient
1386-609	TRIFLURALIN 4EC HERBICIDE	UNIVERSAL COOPERATIVES INC	43
2217-480	GORDON'S WEEDER GRANULES	PBI/GORDON CORP	1.47
2724-687	SECURITY E Z E GARDEN WEED KILLER	WELLMARK INTERNATIONAL	1.75
2749-542	TRIFLURALIN 4 E.C. HERBICIDE	ACETO AGRICULTURAL CHEMICALS CORP	43
2749-561	ACETO TRIFLURALIN 4 EC HERBICIDE	ACETO AGRICULTURAL CHEMICALS CORP	43
5905-519	TRIFLURALIN 4 E.C.	HELENA CHEMICAL CO	43
5905-521	TRIFLURALIN 60D	HELENA CHEMICAL CO	60
5905-532	TRIFLURALIN HFP	HELENA CHEMICAL CO	43
5905-554	BAYONET 2	HELENA CHEMICAL CO	10
7401-349	HI-YIELD TREFLAN WEED & GRASS PREVENTER	VOLUNTARY PURCHASING GROUPS, INC.	1.47
8378-17	25-5-10 TURF FOOD WITH CRABGRASS CONTROL	KNOX FERTILIZER CO INC	0.38
8378-18	SHAW'S PREMIUM TURF FOOD WITH CRABGRASS CONTROL	KNOX FERTILIZER CO INC	0.43
8378-19	PREMIUM LAWN FOOD WITH CRABGRASS CONTROL	KNOX FERTILIZER CO INC	0.5
8378-20	SHAW'S 18-5-9 TURF FOOD WITH XL CRABGRASS CONTROL	KNOX FERTILIZER CO INC	0.3
8378-37	SHAW'S TURF FOOD & CRABGRASS CONTROL W/TEAM 142	KNOX FERTILIZER CO INC	0.49
8378-41	SHAW'S ANNUAL GRASS CONTROL 147	KNOX FERTILIZER CO INC	1.47
8378-65	SHAW'S GARDEN WEED PREVENTER WITH FERTILIZER	KNOX FERTILIZER CO INC	0.74
8660-165	STA-GREEN FLOWER & GARDEN WEED PREVENTER	UNITED INDUSTRIES CORP.	1.47
8660-166	FLOWER & GARDEN WEED PREVENTER PLUS FERTILIZER	UNITED INDUSTRIES CORP.	0.74
9198-60	EASY WEEDER FLOWER AND GARDEN WEED PREVENTER	THE ANDERSONS LAWN FERTILIZER DIVISION, INC.	1.47
9198-79	THE ANDERSONS TEE TIME FERTILIZER WITH 1.15% TEAM	THE ANDERSONS LAWN FERTILIZER DIVISION, INC.	0.38
9198-94	THE ANDERSONS TEE TIME WITH 0.92% TEAM	THE ANDERSONS LAWN FERTILIZER DIVISION, INC.	0.3
9198-129	TEE TIME TREFLAN 5G	THE ANDERSONS LAWN FERTILIZER DIVISION, INC.	5
9198-149	THE ANDERSONS EASY WEED 'N GREEN	THE ANDERSONS LAWN FERTILIZER DIVISION, INC.	0.74
9198-237	THE ANDERSONS WEED & GRASS PREVENTER WITH 5% TRAMMEL HERBICI	THE ANDERSONS LAWN FERTILIZER DIVISION, INC.	5
9198-252	THE ANDERSONS 2.0% TREFLAN & 0.5% GALLERY HERBICIDES	THE ANDERSONS LAWN FERTILIZER DIVISION, INC.	2
9688-133	CHEMSICO GREEN 'N WEED 15-15-15	CHEMSICO	0.74

**Table 3.1. Summary of Trifluralin Products Registered in the United States**

Registration #	Name	Company Name	Percent Active Ingredient
9779-303	TRUST 4EC	WINFIELD SOLUTIONS, LLC	46
9779-326	TRIFIC 10G	WINFIELD SOLUTIONS, LLC	10
9779-341	TRIFIC 2L	WINFIELD SOLUTIONS, LLC	22.08
10163-99	GOWAN TRIFLURALIN 5	GOWAN COMPANY	50.8
10163-120	GOWAN TRIFLURALIN 10G	GOWAN COMPANY	10
10163-289	BUCKLE 10G HERBICIDE	GOWAN COMPANY	3
11603-13	TRIFLUREX (TRIFLURALIN) TECHNICAL	AGAN CHEM MFG, LTD	96
11773-17	CORNBELT TRIFLURALIN	VAN DIEST SUPPLY COMPANY	43
17545-9	TREFLAN E.C. WEED AND GRASS PREVENTER	MONTEREY AGRESOURCES	43
19713-254	DREXEL TRIFLURALIN 4EC HERBICIDE	DREXEL CHEMICAL COMPANY	44.5
19713-384	DREXEL TRIFLURALIN 96% TECHNICAL	DREXEL CHEMICAL COMPANY	96
19713-403	DREXEL TRIFLURALIN TECHNICAL II	DREXEL CHEMICAL COMPANY	96.3
19713-404	DREXEL TRIFLURO TECHNICAL	DREXEL CHEMICAL COMPANY	96
19713-543	DREXEL TRIFLURALIN	DREXEL CHEMICAL COMPANY	5
32802-77	PREVENTS GARDEN WEED PREVENTER	GRO TEC, INC.	0.74
33270-17	SENTRY TRIFLURALIN 4EC	UNITED SUPPLIERS INC.	43
34704-790	TRIFLURALIN 10G	LOVELAND PRODUCTS, INC.	10
34704-792	TRIFLURALIN HF	LOVELAND PRODUCTS, INC.	43
34704-853	TREFLAN 4L HERBICIDE	LOVELAND PRODUCTS, INC.	43
35935-1	TRIFLURALIN 50W	NUFARM LIMITED	50
42750-32	ALBAUGH TRIFLURALIN 4EC	ALBAUGH INC	43
42750-34	ALBAUGH TRIFLURALIN 10G	ALBAUGH INC	10
46146-2	TRIFLURALIN TECHNICAL	ATANOR S.A.	98.6
49585-25	GARDEN WEEDER	ALLJACK	1.75
52287-11	FERTILIZER WITH STARTEEM(R) #2	HARRELL'S, LLC	0.25
52287-12	FERTILIZER WITH STARTEEM(R) #3	HARRELL'S, LLC	0.25
52287-15	HARRELL'S GRANULAR HERBICIDE 75	HARRELL'S, LLC	3
53883-234	WEED PREVENTER	CONTROL SOLUTIONS, INC.	1.47
53883-240	TRIFLURALIN 5G	CONTROL SOLUTIONS, INC.	5
54705-6	VEGETABLE AND ORNAMENTAL WEEDER	LAWN AND GARDEN PRODUCTS, INC.	43
59823-1	BIOBARRIER ROOT CONTROL SYSTEM	FIBERWEB, INC.	17.5
59823-3	BIOBARRIER II, PREEMERGENCE WEED CONTROL SYSTEM	FIBERWEB, INC.	17.5
62355-5	MIRACLE-GRO GARDEN WEED PREVENTER	MIRACLE GRO LAWN PRODUCTS, INC	1.47

**Table 3.1. Summary of Trifluralin Products Registered in the United States**

Registration #	Name	Company Name	Percent Active Ingredient
62355-7	MIRACLE GRO SHAKE 'N FEED ALL PURPOSE PLANT FOOD PLUS WEED P	MIRACLE GRO LAWNS PRODUCTS, INC	0.153
62719-97	TREFLAN E.C. WEED AND GRASS PREVENTER	DOW AGROSCIENCES LLC	43
62719-98	TREFLAN 5G	DOW AGROSCIENCES LLC	5
62719-99	TRIFLURALIN TECHNICAL	DOW AGROSCIENCES LLC	96.3
62719-131	TREFLAN TR-10	DOW AGROSCIENCES LLC	10
62719-137	TEAM 2G	DOW AGROSCIENCES LLC	0.67
62719-150	TURF FERTILIZER CONTAINS TEAM 1.15%	DOW AGROSCIENCES LLC	0.39
62719-151	TURF FERTILIZER - CONTAINS TEAM 0.92%	DOW AGROSCIENCES LLC	0.31
62719-152	TURF FERTILIZER CONTAINS TEAM 1.25%	DOW AGROSCIENCES LLC	0.43
62719-175	SNAPSHOT 2.5 TG	DOW AGROSCIENCES LLC	2
62719-192	TURF FERTILIZER CONTAINS GALLERY PLUS TEAM	DOW AGROSCIENCES LLC	0.27
62719-250	TREFLAN H.F.P.	DOW AGROSCIENCES LLC	43
62719-280	T&O FERTILIZER-CONTAINS GALLERY PLUS TEAM	DOW AGROSCIENCES LLC	0.39
62719-289	TURF FERTILIZER - CONTAINS TEAM* PRO {X.XX}%	DOW AGROSCIENCES LLC	0.5
62719-290	TURF FERTILIZER-CONTAINS TEAM (XXX) %	DOW AGROSCIENCES LLC	0.29
62719-317	TEAM MU	DOW AGROSCIENCES LLC	32.2
62719-318	TEAM PRO MU	DOW AGROSCIENCES LLC	48.2
62719-327	SUPER TEAM* 1.25%	DOW AGROSCIENCES LLC	0.43
62719-331	SUPER TEAM* 1.15%	DOW AGROSCIENCES LLC	0.39
62719-332	SUPER TEAM* 0.92%	DOW AGROSCIENCES LLC	0.31
62719-516	SHOWCASE	DOW AGROSCIENCES LLC	2
62719-565	TURF FERTILIZER - CONTAINS GALLERY PLUS TEAM PRO	DOW AGROSCIENCES LLC	0.5
66222-46	TRIFLUREX HFP	MAKHTESHIM AGAN OF NORTH AMERICA, INC.	42.78
66222-97	TRIFLUREX 10G GRANULAR HERBICIDE	MAKHTESHIM AGAN OF NORTH AMERICA, INC.	10
66222-224	QUALI-PRO T/I 2.5 G	MAKHTESHIM AGAN OF NORTH AMERICA, INC.	2
66222-235	TRIFLURALIN HFP	MAKHTESHIM AGAN OF NORTH AMERICA, INC.	43
67959-2	TRILIN 10G	TRI CORP	10
67959-4	TRILIN HERBICIDE	TRI CORP	42.8
68156-3	TECHNICAL TRIFLURALIN	DINTEC AGRICHEMICALS	96.3
68156-4	DINTEC HFP TRIFLURALIN	DINTEC AGRICHEMICALS	43

**Table 3.1. Summary of Trifluralin Products Registered in the United States**

Registration #	Name	Company Name	Percent Active Ingredient
71058-1	TRIAP 4HF	INDEPENDENT AGRIBUSINESS PROFESSIONALS	43
72620-1	BIOGUARD ROOT CONTROL SYSTEM	PLANTER TECHNOLOGY	18.9
83189-1	TECHFILTER	NETAFIM USA	13.44
AZ110004	TREFLAN TR-10	DOW AGROSCIENCES LLC	10
AZ910004	GOWAN TRIFLURALIN 10G	GOWAN COMPANY	10
CA010021	TREFLAN H.F.P.	DOW AGROSCIENCES LLC	43
CA110012	TREFLAN TR-10	DOW AGROSCIENCES LLC	10
CA870029	TREFLAN TR-10	DOW AGROSCIENCES LLC	10
CA940002	GOWAN TRIFLURALIN 10G	GOWAN COMPANY	10
CA940003	GOWAN TRIFLURALIN 10G	GOWAN COMPANY	10
ID910001	TREFLAN TR-10	DOW AGROSCIENCES LLC	10
KS990005	TREFLAN H.F.P.	DOW AGROSCIENCES LLC	43
KS990006	TREFLAN TR-10	DOW AGROSCIENCES LLC	10
MN010003	TREFLAN H.F.P.	DOW AGROSCIENCES LLC	43
MN100004	TREFLAN HFP	DOW AGROSCIENCES LLC	43
ND020001	TREFLAN H.F.P.	DOW AGROSCIENCES LLC	43
NM910001	TREFLAN TR-10 GRANULES	DOW AGROSCIENCES LLC	10
NM970002	TREFLAN H.F.P.	DOW AGROSCIENCES LLC	43
NV900001	TREFLAN TR-10 GRANULES	DOW AGROSCIENCES LLC	10
OR900019	TREFLAN TR-10 GRANULES	DOW AGROSCIENCES LLC	10
TN050006	TRIFLURALIN HF	LOVELAND PRODUCTS, INC.	43
TX070005	TRIFLURALIN 4EC	ALBAUGH INC	43
TX930003	TREFLAN TR-10	DOW AGROSCIENCES LLC	10
TX960012	TREFLAN H.F.P.	DOW AGROSCIENCES LLC	43
UT870002	TREFLAN TR-10 GRANULES	DOW AGROSCIENCES LLC	10
UT900001	TREFLAN TR-10 GRANULES	DOW AGROSCIENCES LLC	10
WA900016	TREFLAN TR-10	DOW AGROSCIENCES LLC	10
44390-EUP-1		STATE OF ALASKA	100
62719-EUP-17		DOW AGROSCIENCES LLC	36.35
62719-EUP-20		DOW AGROSCIENCES LLC	36.35

**Table 3.2. Maximum Labeled Application Rates for Trifluralin**

Use Site	Maximum Single Application Rate (lb a.i./acre)	Maximum Applications per Year	Maximum Application Rate per Year (lb a.i./acre)	Minimum Retreatment Interval (days)
<b>Row Crops</b>				
asparagus, beans, celery, collards, turnip (greens), kale, lentils, peas	2	NS	NS	NS
castor bean	1	NS	NS	NS
leafy greens	.9	NS	NS	NS
chicory, endive (escarole)	1.3	NS	NS	NS
guar	.75	NS	NS	NS
<b>Brassica (Cole) Leafy Vegetables</b>				
kohlrabi, broccoli raab	.75	NS	NS	NS
broccoli, cauliflower, Brussels sprouts, cabbage	2	NS	NS	NS
cole crops, crambe	1	NS	NS	NS
<b>Tree Nuts</b>				
almond, walnut, pistachio, filbert, macadamia nut, pecan	4	3	12	60
tree nuts	4	NS	12	60    70
<b>Pome Fruits</b>				
apple, pear, pomegranate	4	3	12	60
<b>Stone Fruits</b>				
apricot, cherry, fig, nectarine, prune, peach, plum, avocado	4	3	12	60
<b>Small Fruits/Berries</b>				
gooseberry, elderberry, blackberry, blueberry, boysenberry, loganberry, grapes, dewberry, raspberry, currant	4	3	12	60
fruits (unspecified)	4	NS	12	60    70
<b>Citrus</b>				
grapefruit, lemon, orange, kiwi fruit	4	3	12	60
tangelo, tangerines	2	NS	NS	NS
<b>Cereal and Oil Grains</b>				
barley, small grains (unspecified)	.75	NS	NS	NS
canola/rape, flax, sorghum, lupine, wheat, sunflower, crops grown for oil, kenaf	1	NS	NS	NS
safflower	1.3	NS	NS	NS
mustard	2	NS	NS	NS
<b>Cucurbit Vegetables</b>				
cucumber, melons, cucurbit vegetables	2	NS	NS	NS
<b>Fruiting Vegetables</b>				
tomato, okra, pepper	2	NS	NS	NS

**Table 3.2. Maximum Labeled Application Rates for Trifluralin**

Use Site	Maximum Single Application Rate (lb a.i./acre)	Maximum Applications per Year	Maximum Application Rate per Year (lb a.i./acre)	Minimum Retreatment Interval (days)
eggplant	1	NS	NS	NS
Root and Tuber Vegetables				
sugar beet	.75	NS	NS	NS
potato, radish, carrot	2	NS	NS	NS
Other				
peanuts	.75	NS	NS	NS
soybeans	2	NS	NS	NS
banana	4	3	12	60
field corn	1	NS	NS	NS
cotton	2	NS	2	NS
olive	4	3	12	60
onion	1	NS	NS	NS
sugarcane	4	2	NS	NS
hops	.9	NS	NS	NS
mint, peppermint, spearmint	.75	NS	NS	NS
alfalfa	4	NS	NS	60
clover	2	NS	NS	NS
Non-agricultural				
Christmas tree plantations	4	1	12	60
cottonwood, poplar (forest/shelterbelt)	2	NS	NS	NS
greenhouses-in use	4	3	12	60
industrial/construction areas (outdoor)	4	1	12	60
irrigation systems	NS	NS	NS	NS
non-agricultural outdoor buildings and structures	4	NS	12	60
non-agricultural rights-of-way/fencerows/hedgerows	4	1	12	60
non-agricultural uncultivated areas/soils	4	3	12	60
nongrass forage/fodder/straw/hay	.9679	NS	NS	NS
nursery stock	4	NS	NS	NS
ornamental and/or shade trees	4	NS	NS	NS
ornamental ground cover	4	NS	NS	NS
ornamental herbaceous plants	4	NS	NS	60
ornamental nonflowering plants	4	3	12	60
ornamental woody shrubs and vines	4	3	12	60    70
paved areas (private roads/sidewalks)	16.4	NS	NS	NS
rose	2	NS	NS	60

**Table 3.2. Maximum Labeled Application Rates for Trifluralin**

Use Site	Maximum Single Application Rate (lb a.i./acre)	Maximum Applications per Year	Maximum Application Rate per Year (lb a.i./acre)	Minimum Retreatment Interval (days)
golf course turf, recreation area lawns, residential lawns, ornamental lawns and turf	1.7	2	NS	56    70
ornamental sod farm (turf)	.5	1	NS	NS
ornamental grasses	4	NS	NS	NS
bermudagrass	2	NS	NS	NS
commercial/industrial lawns	1	2	2	56    70

NS – Not specified. Conservative assumptions will be made for risk assessment if information is not provided.

**Table 3.3** contains estimates for the annual average pounds of trifluralin applied on a given crop based on data obtained from the USDA's National Agricultural Statistics Service (2001-2009), private market research data (2001-2010), and California Department of Pesticide Regulation data (2000-2009). Additional registered uses may exist but are not included because the available surveys do not report usage (*e.g.*, small acreage crops). Lack of reported usage data for the pesticide on a crop does not imply zero usage. In instances where usage on a site was noted but not quantified, the site would not be reported. **Table 3.3** does not include non-agricultural use sites (*e.g.*, turf, post-harvest). Some sites show some use, even though they are not on the label. This usage could be due to various factors, including, but not limited to Section 18 requests, existing stocks of the chemical, data collection errors, and experimental use permits (EUPs). The top five crops on which trifluralin was used on a yearly average basis include cotton (3,500,000 lb), soybeans (2,700,000 lb), alfalfa (500,000 lb), dry beans/peas (300,000 lb), and sunflowers (300,000 lb).

**Table 3.3. Screening Level Estimates of Agricultural Uses of Trifluralin, Sorted Alphabetically**

Crop	Amount Active Ingredient (lb)	Percent Crop Treated	
		Average	Maximum
1 Alfalfa	500,000	<2.5	<2.5
2 Almonds	10,000	<2.5	5
3 Apples	1,000	<1	<2.5
4 Asparagus	15,000	20	30
5 Barley	20,000	<2.5	5
6 Beans, Green	60,000	30	45
7 Broccoli	8,000	10	25
8 Brussels Sprouts *	<500	N/C	N/C
9 Cabbage	20,000	45	60
10 Canola/Rapeseed	40,000	5	10
11 Cantaloupes	15,000	25	45
12 Carrots	40,000	55	75

**Table 3.3. Screening Level Estimates of Agricultural Uses of Trifluralin, Sorted Alphabetically**

	Crop	Amount Active Ingredient (lb)	Percent Crop Treated	
			Average	Maximum
13	Cauliflower	3,000	10	20
14	Celery	<500	<2.5	5
15	Chicory *	<500	N/C	N/C
16	Corn	70,000	<1	<2.5
17	Cotton	3,500,000	30	40
18	Cucumbers	2,000	<2.5	5
19	Dry Beans/Peas	300,000	15	25
20	Fallow, Summer	50,000	<1	<2.5
21	Garlic	1,000	5	10
22	Grapefruit	1,000	<1	<2.5
23	Grapes	20,000	<2.5	5
24	Honeydew	3,000	20	35
25	Lemons	1,000	<2.5	5
26	Lettuce	2,000	<1	<2.5
27	Nectarines *	<500	N/C	N/C
28	Olives *	<500	N/C	N/C
29	Onions	2,000	<2.5	5
30	Oranges	10,000	<1	<2.5
31	Peaches	1,000	<1	<2.5
32	Peanuts	40,000	5	10
33	Peas, Green	10,000	15	35
34	Pecans	3,000	<1	<2.5
35	Peppers	15,000	20	40
36	Pistachios	1,000	<2.5	<2.5
37	Potatoes	20,000	5	10
38	Prunes	2,000	<2.5	<2.5
39	Pumpkins	2,000	5	10
40	Sorghum	30,000	<1	<2.5
41	Soybeans	2,700,000	5	10
42	Spinach	<500	<1	<2.5
43	Squash	1,000	5	10
44	Strawberries	<500	<1	<2.5
45	Sugar Beets	20,000	<2.5	5
46	Sugarcane	100,000	10	15
47	Sunflowers	300,000	15	30

**Table 3.3. Screening Level Estimates of Agricultural Uses of Trifluralin, Sorted Alphabetically**

Crop		Amount Active Ingredient (lb)	Percent Crop Treated	
			Average	Maximum
48	Sweet Corn +	1,000	<1	<2.5
49	Tomatoes	150,000	60	70
50	Walnuts	2,000	<1	<2.5
51	Watermelons	20,000	15	20
52	Wheat	100,000	5	15

All numbers rounded.

<500 Less than 500 pounds of active ingredient

<2.5 Less than 2.5 percent of crop treated

<1 Less than 1 percent of crop treated

N/C Only Lbs. A.I. available

\* Based on CA DPR data only (valid because 95% or more of U.S. acres grown are in California)

+ Crops not known to be listed on active end use product registrations or as Section 18 emergency exemptions when this report was run

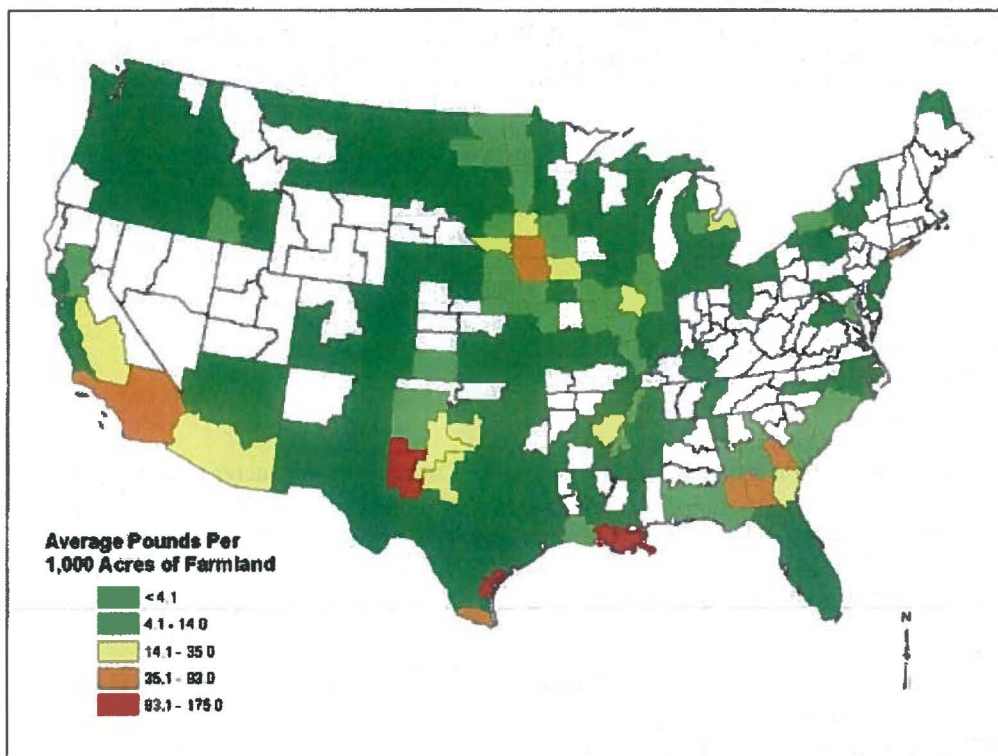
SLUA data sources include:

USDA-NASS (United States Department of Agriculture's National Agricultural Statistics Service)

Private Pesticide Market Research

California DPR (Department of Pesticide Regulation)

### Trifluralin Usage by Crop Reporting District (2006 – 2010)



This is a map of agricultural pesticide usage at the Crop Reporting District (CRD) level. CRDs are boundaries created by USDA NASS which are aggregates of counties (USDA, 2010). Pesticide usage is displayed as average pounds (for the years 2006-2010) per 1,000 acres of farmland in a CRD to normalize for the variation in farmland between CRDs. Farmland acreage was obtained from USDA (2007).

Usage is based on private market surveys of pesticide use in agriculture (Proprietary Data, 2006-2010). The survey data are limited to the states that represent the top 80-90% of acreage for the individual crops, therefore, use may be occurring in regions outside the scope of the survey. CRDs showing no usage of pesticides may be due to either the lack of pesticide use in the region or non-participation in the agricultural surveys. In addition, across the years, there may be variations in the specific crops included in the CRD survey. This may result in a lower annual average for the CRD.

**Sources:**

Proprietary Data. 2006-2010

USDA, 2006-2010. NASS Crop Reporting Districts. Online:

<http://www.ers.usda.gov/briefing/anms/resourceregions/resourceregions.htm#nass>.

USDA, 2007. Census of Agriculture. Online: <http://www.agcensus.usda.gov/Publications/2007/index.asp>.

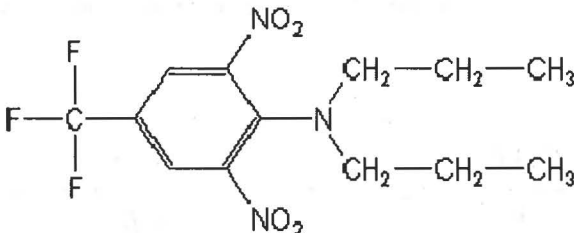
Figure 3.1. Estimated Annual National Agricultural Trifluralin Usage

### 3.3. Environmental Fate and Transport

The physicochemical properties (Table 3.4) suggest that trifluralin is hardly soluble in water, with a solubility of less than 1.0 mg/L. The vapor pressure ( $1.10 \times 10^{-4}$  to  $4.58 \times 10^{-5}$  mm Hg) and Henry's Law Constant ( $1.03 \times 10^{-4}$  atm-m<sup>3</sup>/mol) indicate that trifluralin has potential to volatilize

from soil and water surfaces. The log  $K_{ow}$  of 4.85 to 5.34 suggests that trifluralin has a potential to bioaccumulate.

**Table 3.4. Summary of Trifluralin Physical and Chemical Properties**

Physical/Chemical Property	Value (unit)	Source
Chemical Structure		MRID 44428601
IUPAC Name	<i>α,α,α</i> -trifluoro-2,6-dinitro- <i>N,N</i> -dipropyl- <i>p</i> -toluidine	MRID 44428601
CAS Name	2,6-dinitro- <i>N,N</i> -dipropyl-4-(trifluoromethyl)benzenamine	MRID 44428601
CAS No.	1582-09-9	MRID 44428601
Molecular Formula	$C_{13}H_{16}F_3N_3O_4$	MRID 44428601
Molecular Weight	335.28 g/mole	MRID 44428601
Smile Code	CCCN(CCC)c1c(cc(cc1N(=O)=O)(=O))C(F)(F)F	EPISUITE 4.1
Physical State	orange crystalline solid	MRID 44428601
Melting Point	42-49° C	US EPA, 2004c
Density or Specific gravity (22°C)	1.36 g/mL	US EPA, 2004c
Dissociation constant ( $pK_a$ )	Does not dissociate	US EPA, 2004c
Vapor Pressure (25°C)	$6.1 \times 10^{-3}$ Pa ( $4.58 \times 10^{-5}$ mm Hg) $1.10 \times 10^{-4}$ mm Hg	US EPA, 2004c Weed Science Society of America,
Water Solubility (25°C)	<1 mg/L 0.2 to 0.4 mg/L	US EPA, 2004c U.S. National Research Council, 1977
Solvent Solubility (25°C)	>100 g/100mL in acetone, acetonitrile, chloroform, toluene 5-6.7 g/100ml in hexane 3.3-4.0 g/100mL in methanol	US EPA, 2004c
Octanol-Water Coefficient (Log $K_{ow}$ at 20°C)	4.83 5.27 5.34	US EPA, 2004c Connell and Schueuermann 1988 Meylan et al., 1999
Henry's Law Constant at 20°C	$1.03 \times 10^{-4}$ atm-m <sup>3</sup> /mol $6.7 \times 10^{-3}$ (Dimensionless)	TOXNET <sup>1</sup> Suarez, 12005
Photodegradation in air	DT <sub>50</sub> = 0.22 days DT <sub>50</sub> = 21 to 63 minutes (Under California field condition) DT <sub>50</sub> = 25 to 60 minutes (Under Nevada field condition) DT <sub>50</sub> = 47 to 117 minutes (Under Laboratory condition)	OSPAR, 2005 Woodrow et al, 1978 Monger and Miller 1988 Woodrow et al, 1983

<sup>1</sup> <http://toxnet.nlm.nih.gov/cgi-bin/sis/search/f?./temp/~oM3pqx:l>

Environmental fate properties of trifluralin are summarized in **Table 3.5**. Except for the laboratory volatility study that was classified as acceptable, all submitted environmental fate studies were classified as supplemental, *i.e.*, scientifically sound but not entirely consistent with current guideline recommendations. Based on supplemental information, the major dissipation routes of trifluralin are volatilization and photodegradation and to a lesser extent by biotic degradation. Trifluralin is stable to hydrolysis at various pHs, but is very prone to phototransformation in air and water with DT<sub>50</sub> of < 1.0 day) and to a lesser extent in soil (DT<sub>50</sub> of 41 days).

Laboratory aerobic biotransformation studies indicate that trifluralin is moderately persistent to persistent in soil and with degradation half-lives of 189, 202, and 116 days in sandy loam, clay loam, and loam soils, respectively. Anaerobic soil biotransformation of trifluralin is faster than aerobic biotransformation with half-lives of 22-59 days. Field dissipation half-life has been reported as low as 29 days and as high as 149 days for trifluralin. Published field dissipation half-lives range from 60 to 132 days (Wauchope *et al.*, 1992). Several major and minor degradates were detected in fate studies. **Table 3.5** lists environmental fate properties of trifluralin and the percent for degradates formed in various environmental fate studies.

Trifluralin has a very low propensity to leach from majority of soils because of its affinity to bind with soil colloids and organic matter. Adsorption/desorption and leaching studies indicate that trifluralin is strongly adsorbed (Average K<sub>foc</sub> = 8,757.9 L/kg) to most soils and classified as immobile according to FAO Classification System (FAO, 2000). Trifluralin is described by the EPA as persistent, bioaccumulative, and toxic (PBT) (US EPA, 1999) and is also being discussed within the United Nations Economic Commission for Europe (UNECE) Long-Range Transboundary Air Pollution Protocol on Persistent Organic Pollutants (UNECE, 2009).

<b>Table 3.5. Summary of Physical, Chemical and Environmental Fate Properties of Trifluralin</b>				
<b>Study</b>	<b>Value (units)</b>	<b>Major Degradates<sup>1,2</sup> Minor Degradates<sup>1,2</sup></b>	<b>MRID #</b>	<b>Comments and Study Status</b>
<b>Hydrolysis</b> (DT <sub>50</sub> )	Stable at pH 5, pH 7, pH 9	None	00131135	Supplemental
Aqueous Photolysis (DT <sub>50</sub> )	0.371 days	<b>TR-15, ≤47.4%</b> <b>TR-6, ≤29.8%</b>  <i>TR-2, ≤9.6%</i>	40560101	Supplemental  Volatility of trifluralin may have contributed for short half-life. Approximately 50 to 70% volatile residue was detected in trap under control and light exposed samples.
	41 days	<i>TR-2 ≤ 6.0%</i>	40597801	Supplemental

**Table 3.5. Summary of Physical, Chemical and Environmental Fate Properties of Trifluralin**

Study	Value (units)	Major Degradates <sup>1,2</sup> Minor Degradates <sup>1,2</sup>	MRID #	Comments and Study Status
Photodegradation on Soil (DT <sub>50</sub> )		TR-12, ≤ 7.1%	40751301	
<b>Aerobic Soil Metabolism</b> (DT <sub>50</sub> )	189 days (sandy loam) 201 days (clay loam) 116 days (loam soils) 22°C	TR-2, ≤ 4.6% TR-5, ≤ 2.1% TR-11, ≤ 0.3% TR-13, ≤ 1.0% TR-15, ≤ 2.6% TR-20, ≤ 2.7% TR-28, ≤ 3.0%	41240501	Supplemental  Volatile and unextractable residues increased to 22% and 45% by 364 days and could have contributed to trifluralin dissipation in aerobic soil metabolism study.
Anaerobic Soil Metabolism (DT <sub>50</sub> )	59 days (sandy loam) 25 days loam 35 clay loam soils 22° C	TR-4, ≤ 13.2% TR-14, ≤ 8.3% TR-7, ≤ 4.1% <i>Other degradates identified at ≤ 2.1% :</i> TR-2 TR-5 TR-13 TR-28	41240502	Supplemental  An increase of unextractable trifluralin residues (9.4 to 60%) indicated that binding of residues to soil could be the major route of anaerobic dissipation for this chemical.
Anaerobic Aquatic Metabolism (DT <sub>50</sub> )	N/A <sup>3</sup>	N/A	N/A	Data Gap
Aerobic Aquatic Metabolism (DT <sub>50</sub> )	N/A	N/A	N/A	Data Gap
<b>Adsorption/ Desorption and Leaching</b>	<b>Adsorption</b> sand: K <sub>f</sub> = 18.6, L/kg (K <sub>oc</sub> =6,413 L/kg) sandy loam: K <sub>d</sub> = 54.8, L/kg (K <sub>oc</sub> =6,748 L/kg) loam: K <sub>f</sub> = 88.3, L/kg (K <sub>oc</sub> = 8,457 L/kg) clay loam: K <sub>f</sub> = 155.6, L/kg (K <sub>oc</sub> =13,413 L/kg) Average K <sub>foc</sub> = 8,757.9 L/kg <b>Desorption</b>		40673501	Supplemental

<b>Table 3.5. Summary of Physical, Chemical and Environmental Fate Properties of Trifluralin</b>				
<b>Study</b>	<b>Value (units)</b>	<b>Major Degradates<sup>1,2</sup> Minor Degradates<sup>1,2</sup></b>	<b>MRID #</b>	<b>Comments and Study Status</b>
	No significant desorption <b>Leaching</b> No significant leaching of parent and degradates			
Terrestrial Field Dissipation (DT <sub>50</sub> )	Granular DT <sub>1/2</sub> = 49 days; EC formulations DT <sub>50</sub> = 149 days from California loam soil; DT <sub>50</sub> = 93 days from Alabama clay soil; DT <sub>50</sub> = 29 days, coarse sandy loam soil, Shellman, GA; DT <sub>50</sub> = 35 days when applied to fine (silty clay loam soil, Mansfield, IL); trifluralin did not appear in depths greater than 6 inches		41781901 41661101 42309101	Supplemental Supplemental Supplemental
Laboratory volatility	<b>Maximum volatility and Concentration in air</b> <b>Emulsifiable formulation - Incorporated into soil</b> 0.0027 µg/cm <sup>2</sup> /hour and 25.7 µg/cm <sup>3</sup> -clay loam (day1) 0.0015 µg/cm <sup>2</sup> /hour and 12.4 µg/cm <sup>3</sup> -loam (day 2) 0.0036 µg/cm <sup>2</sup> /hour 31.0 µg/cm <sup>3</sup> -sandy loam (day 1) <b>Non-incorporated into soil</b> 0.026 µg/cm <sup>2</sup> /hour and 248 µg/cm <sup>3</sup> -clay loam (day1)  <b>Granular formulation - Incorporated into soil</b> 0.0010 µg/cm <sup>2</sup> /hour and 9.2 µg/cm <sup>3</sup> -clay loam (day7) <b>Non-incorporated into soil</b> 0.011 µg/cm <sup>2</sup> /hour and 90.7 µg/cm <sup>3</sup> -clay loam (day4)  Approximately 0.34 to 60 percent volatilized		43915701              40673601 A-C	Acceptable              Supplemental
Field Volatility	<b>Maximum concentrations of trifluralin detected in air</b> 0.16 to 165 µg/m <sup>3</sup>		40673601 D-F	Supplemental
Bioconcentration Factor (BCF)	Edible - 2041x, Non-edible - 9586x, Whole fish - 5674x		40673801	Supplemental
<p><sup>1</sup> Following are the chemical names of degradates of trifluralin detected in the environmental fate studies. Bolded degradates are major degradates forming &gt;10% in environmental fate studies</p> <p>TR-2 <i>α,α,α-trifluoro-2,6-dinitro-N-propyl-p-toluidine</i></p> <p><b>TR-4 <i>α,α,α-trifluoro-5-nitro-N4,N4-dipropyl-toluene-3,4-diamine</i></b></p> <p>TR-5 <i>α,α,α-trifluoro-5-nitro-4-propyl-toluene-3,4-diamine</i></p> <p><b>TR-6 <i>5-trifluoromethyl-3-nitro-1,2-benzenediamine</i></b></p> <p>TR-7 <i>α,α,α-trifluoro-N4,N4-dipropyltoluene-3,4,5-triamine</i></p> <p>TR-11 <i>2-ethyl-7-nitro-1-propyl-5-(trifluoromethyl)benzimidazole-3-oxide</i></p> <p>TR-12 <i>2-ethyl-7nitro-5- trifluoromethylbenzimidazole- 3-oxide</i></p> <p>TR-13 <i>2-ethyl-7-nitro-1-propyl-5-(trifluoromethyl) benzimidazole</i></p> <p>TR-14 <i>7-amino-2-ethyl-1-propyl-5-(trifluoromethyl) benzimidazole</i></p> <p><b>TR-15 <i>2-ethyl-7-nitro-5-(trifluoromethyl)benzimidazole</i></b></p> <p>TR-20 <i>α,α,α-trifluoro-2,6-dinitro-p-cresol</i></p> <p>TR-28 <i>2,2'azoxybis(α α α-trifluoro-6-nitro-N-propyl-p- toluidine</i></p> <p><sup>2</sup> Structures of major and minor degradates are presented in Appendix D.</p> <p><sup>3</sup> Not available</p>				

### 3.3.1. Degradation

Trifluralin is hydrolytically stable under most environmental conditions. The vapor-phase of trifluralin is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals, and the estimated half-life for this reaction in air is estimated to be 5.3 hours or 0.22 days (Convention for the Protection of the Marine Environment of the North-East Atlantic Convention (OSPAR, 2005). Several studies also reported shorter photolytic half-lives of trifluralin ranging from 21 to 193 minutes for North America (Woodrow et al., 1978, Woodrow et al., 1983 and Monger and Miller, 1988). Trifluralin is also susceptible to direct aqueous photolysis (DT<sub>50</sub> of 8.9 hours), which should limit its persistence in the top segment of the water column. Photolytic degradation of trifluralin in soil is much slower (DT<sub>50</sub> of 41 days) as compared to air and water.

Trifluralin is persistent in aerobic soil with half-lives of 189, 201, and 116 days in sandy loam, clay loam, and loam soils, respectively. No major metabolites were formed. In an anaerobic soil metabolism study trifluralin's half-lives ranged from 25-59 days in sandy loam, loam, and clay loam soils, respectively. Aerobic and anaerobic aquatic guideline studies have not been submitted.

The major degradates reported in the aqueous photolysis study include: TR-6, 29.8% (5-trifluoromethyl-3-nitro-1,2-benzenediamine) and TR-15, 47.4% (2-ethyl-7-nitro-5-trifluoromethylbenzimidazole). One more major metabolite, TR-4 ( $\alpha,\alpha,\alpha$ -trifluoro-5-nitro-N4,N4-dipropyl-toluene-3,4-diamine), up to 13.2% was formed in two out of the three tested soils under anaerobic condition but this metabolite was shown to degrade in one of the soils by the end of the study. There is no information of metabolites formed by photolytic reaction of trifluralin in air and no environmental fate data for the major degradates of trifluralin available at this time to adequately assess their persistence and mobility. **Appendix D** provides nomenclature and chemical structures of trifluralin degradates.

### 3.3.2. Mobility

Potential transport mechanisms for trifluralin include surface water runoff/ erosion, spray drift, and secondary drift of volatilized or soil-bound residues leading to deposition onto nearby or more distant ecosystems. The vapor pressure range from 1.10E-4 mm Hg to 4.58 x 10<sup>-5</sup> mm Hg and Henry's law constant of 1.03 x 10<sup>-4</sup> atm-m<sup>3</sup>/mol indicate that trifluralin has potential to volatilize from soil and water surfaces. Laboratory volatility of trifluralin was evaluated over a period of 30 days following application of two formulated products: emulsifiable and granular formulations. In the pesticide-incorporated soils, the maximum air concentration and the maximum volatility of the parent were 31.0  $\mu\text{g}/\text{m}^3$  and 0.0036  $\mu\text{g}/\text{cm}^2/\text{hour}$  from emulsifiable formulation on day 1. In the clay loam soil in which emulsifiable formulation of trifluralin was not incorporated, the maximum volatility (0.026  $\mu\text{g}/\text{cm}^2/\text{hour}$ ) and the air concentration (248.0  $\mu\text{g}/\text{m}^3$ ) of the parent and these values are an order of magnitude higher than the values for incorporated soils for day 1 (**Table 3.5**).

The relatively high soil/water partitioning coefficient of trifluralin (Average K<sub>foc</sub> of 8,757.9 g/mL) indicates that trifluralin is strongly adsorbed to most soils and classified as immobile

according to FAO Classification System (FAO, 2000). Mean Freundlich adsorption coefficient ( $K_f$ ) ranged from 18.6 for sand soil with 0.5 organic matter to 155.6 for clay loam soil with 2.0 percent organic matter. The mean slopes of the initial absorption isotherms were linear with  $1/n$  values were relatively constant ranging from 0.96 to 0.97. However, the desorption isotherms were nonlinear, with means of slopes ranging from 0.3 to 0.6, depending on soil types and suggest desorption of trifluralin from soil matrix would be minimal. Even though trifluralin appears to be immobile in various soils, trifluralin residues appear to be non-mobile in a column leaching study. Following 30 day of incubation, the material balance in the aged soils accounted for the following constituents: parent 80.3%, TR-2, TR-13 and TR-28 metabolites (4.24%) and non-extractable residues (6.79%). About 90% of the applied radioactivity remained in the upper 6 cm; 0.65-2.57% leached from the column. However, trifluralin and its degradates were not detected in leachate. In terrestrial field dissipation studies, trifluralin also did not appear to leach below the 6 inch depth of soils.

Trifluralin can be transported from application sites to adjacent water bodies via surface water runoff as a dissolved phase and as an adsorbed molecule with eroded sediment. Trifluralin's relatively high soil/water partitioning indicates that the concentration of trifluralin adsorbed to suspended and bottom sediment will be substantially greater than its dissolved concentration in the water column. Water monitoring data from the United States have shown detections of trifluralin in surface water and in groundwater.

Even though phototransformation of trifluralin in air and water is rapid, residues of trifluralin have been detected in air, precipitation (rain and snow) and fog in remote areas such as the Canadian Arctic, Greenland, and the Bering Sea (Hoferkamp et al., 2010). These detections in remote regions indicate that trifluralin sorbed to airborne particulate is more resistant to phototransformation; thus, transport of particulates might be the primary transport mode for deposition in remote areas.

### **3.3.3. Terrestrial Field Dissipation Study**

In field dissipation studies, trifluralin (Treflan, 44.1 or 50.7% EC) applied at 2.78 lb/acre dissipated with a half-life of 149 days from loam soil planted with cotton in California and 93 days from clay soil planted with soybeans in Alabama. Trifluralin did not appear to leach below the 0- to 6-inch soil depth. Trifluralin granular formulation dissipated with a reported half-life of 49 days in the top six inches of soil when applied to loamy sand soil in California. Emulsifiable concentrate trifluralin formulations were reported to dissipate with half-lives ranging from 29 to 35 days when applied to coarse sandy loam soil (Shellman, GA site) and fine silty clay loam soil (Mansfield, IL site).

### **3.3.4. Accumulation**

Trifluralin residues accumulated in bluegill sunfish exposed to 0.0059 ppm of trifluralin for 28 days under flow through conditions. The maximum mean bioconcentration factors (BCF) were 2041x, 9586x, and 5674x for edible, non-edible, and whole fish tissues, respectively. Depuration occurred with 86.34-88.01% of the [ $^{14}\text{C}$ ] residues eliminated from the fish tissues after 14 days of exposure to pesticide free water. Based on the Log  $K_{ow}$  of 5.27 and available BCF data,

trifluralin poses a high potential for bioaccumulation and may biomagnify at higher trophic levels. Additional exposure pathways resulting from bioaccumulation will be considered for trifluralin.

### 3.4. Clean Water Act

Trifluralin is not identified as a cause of impairment for any water bodies listed as impaired under section 303(d) of the Clean Water Act<sup>1</sup>. In addition, no Total Maximum Daily Loads (TMDLs) have been developed for trifluralin<sup>2</sup>. The Impaired Waters and Total Maximum Daily Loads website can be consulted for more information<sup>3</sup>. The Agency invites submission of water quality data for this pesticide. To the extent possible, data should conform to the quality standards in Appendix A of the *OPP Standard Operating Procedure: Inclusion of Impaired Water Body and Other Water Quality Data in OPP's Registration Review Risk Assessment and Management Process*<sup>4</sup>, in order to ensure they can be used quantitatively or qualitatively in pesticide risk assessments.

### 4. Receptors

Consistent with the process described in the Overview Document (U.S. EPA, 2004b), the risk assessment for trifluralin will rely on a surrogate species approach. Toxicological data generated from surrogate test species, which are intended to be representative of broad taxonomic groups, are used to extrapolate the potential effects on a variety of species (receptors) included under these taxonomic groupings. The most sensitive endpoints from the available toxicity data for trifluralin will be used to quantify risk.

Acute and chronic toxicity data from studies submitted by pesticide registrants along with the available open literature are used to evaluate the potential direct and indirect effects of trifluralin to aquatic and terrestrial receptors. This includes toxicity on the technical grade active ingredient, degradates, and when available, formulated products (*e.g.*, "Six-Pack" studies). The open literature studies are identified through EPA's ECOTOXicology (ECOTOX) database, which employs a literature search engine for locating chemical toxicity data for aquatic life, terrestrial plants, and wildlife. The evaluation of both sources of data may also provide insight into the direct and indirect effects of trifluralin on biotic communities from loss of species that are sensitive to the chemical and from changes in structure and functional characteristics of the affected communities. A complete review of studies obtained from ECOTOX for trifluralin will be conducted prior to initiation of the risk assessment phase for possible quantitative and/or qualitative inclusion in this risk assessment. The Agency seeks comments from the public on more sensitive endpoints that may be used in risk assessment.

A summary of the most sensitive data representing non-target organisms exposed to trifluralin in aquatic and terrestrial habitats is provided in **Sections 4.1** and **4.2**, respectively. The bibliography

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<sup>1</sup> [http://iaspub.epa.gov/tmdl\\_waters10/attains\\_nation\\_cy.cause\\_detail\\_303d?p\\_cause\\_group\\_id=885](http://iaspub.epa.gov/tmdl_waters10/attains_nation_cy.cause_detail_303d?p_cause_group_id=885)

<sup>2</sup> [http://iaspub.epa.gov/tmdl\\_waters10/attains\\_nation.tmdl\\_pollutant\\_detail?p\\_pollutant\\_group\\_id=885&p\\_pollutant\\_group\\_name=PESTICIDES](http://iaspub.epa.gov/tmdl_waters10/attains_nation.tmdl_pollutant_detail?p_pollutant_group_id=885&p_pollutant_group_name=PESTICIDES)

<sup>3</sup> <http://www.epa.gov/owow/tmdl/>

<sup>4</sup> <http://www.epa.gov/oppfead1/cb/ppdc/2006/november06/session1-sop.pdf>

of all submitted ecotoxicity data for trifluralin is provided in **Appendix B**. Degradate toxicity data are discussed in **Section 4.3**. A summary of ecological incidents associated with trifluralin and a description of ecosystems potentially at risk are provided in **Sections 4.4 and 4.5**, respectively.

#### 4.1. Effects to Aquatic Organisms

A summary of the available aquatic toxicity data for trifluralin is provided in **Table 4.1**.

<b>Table 4.1. Aquatic Toxicity Profile (Most Sensitive Endpoints) for Trifluralin</b>				
<b>Assessment Endpoint</b>	<b>Species</b>	<b>Toxicity Value to Be Used in Risk Assessment</b>	<b>MRID</b>	<b>Status/Comment</b>
<i><b>Freshwater Organisms</b></i>				
Acute fish	Bluegill sunfish	LC <sub>50</sub> = 18.5 µg/L probit slope = 23.94	400980-01	Supplemental  Study should not be used quantitatively; new studies recommended for request
Chronic fish (full life cycle study)	Fathead minnow	NOAEC = 1.9 µg/L LOAEC = 5.1 µg/L	05008271	Acceptable
Acute invertebrates	Daphnid	EC <sub>50</sub> = 251 µg/L (moving average)	478070-07	Acceptable
Chronic invertebrates	Daphnid	NOAEC = 2.4 µg/L LOAEC = 7.2 µg/L	05008271	Acceptable
<i><b>Estuarine/Marine Organisms</b></i>				
Chronic fish	Sheepshead minnow	NOAEC = <1.3 µg/L LOAEC = 1.3 µg/L	424499-01	Supplemental
Acute invertebrates	Grass shrimp	LC <sub>50</sub> = 638.5 µg/L Probit slope = 3.48	406748-01	Acceptable; however, the study should be conducted on a mysid. The available mysid study did not yield a definitive LC <sub>50</sub> , as test concentrations were not high enough.
<i><b>Plants</b></i>				
Vascular Aquatic Plants	<i>Lemna gibba</i>	IC <sub>50</sub> = 49.7 µg/L IC <sub>05</sub> = 14.7 µg/L NOAEC < 2.53 µg/L, LOAEC = 2.53 µg/L	428341-04	Supplemental (Classification revised under DP 367203; 2010)
Non-vascular Aquatic Plants	<i>Skeletonema costatum</i>	IC <sub>50</sub> = 21.9 µg/L  NOAEC = 14 µg/L, LOAEC = 18.3 µg/L	428341-01	Acceptable

##### *Acute Toxicity – Freshwater Fish*

Acute toxicity to freshwater fish can be summarized as very highly toxic for trifluralin. The most sensitive LC<sub>50</sub> values for trifluralin were 18.5 and 43.6 µg/L (bluegill sunfish (*Lepomis macrochirus*) and rainbow trout (*Oncorhynchus mykiss*), respectively (MRID 400980-01,

Supplemental). Nominal concentrations were reported for these two studies; these values may overestimate the actual exposure concentration due to trifluralin's tendency to volatilize and sorb to surfaces. Therefore, these studies were classified as supplemental, and new studies have been recommended for request.

#### *Chronic Toxicity – Freshwater Fish*

Two acceptable chronic studies were available to the Agency to evaluate the effects of chronic exposure to trifluralin (technical) on freshwater fish which were conducted on rainbow trout and fathead minnow (*Pimephales promelas*). The early life-stage study conducted on rainbow trout (MRID 413862-02) demonstrated that chronic exposure to a mean-measured concentration as low as 4.32 µg/L has the potential to cause a reduction in larval fish length (3.5% relative to negative control) and reduction in body weight (8.8% relative to negative control). The NOAEC and LOAEC for this study are 2.18 and 4.32 µg/L, respectively. This study was re-evaluated and the data statistically re-analyzed (updated values, justifications and details are provided in DP barcode 417055).

The full life-cycle study, conducted on fathead minnow (MRID 05008271), demonstrated that chronic exposure to a mean-measured concentration at 5.1 µg/L caused a 64% reduction in survival at 61 weeks. The NOAEC and LOAEC for this study are 1.9 and 5.1 µg/L, respectively.

#### *Acute Toxicity – Freshwater Invertebrates*

One acceptable acute toxicity test to freshwater invertebrate was available to the Agency to evaluate acute exposure of trifluralin (technical) which was conducted on daphnids (MRID 478070-07). The resulting EC<sub>50</sub> was 251 µg/L (calculated using moving average).

#### *Chronic Toxicity – Freshwater Invertebrates*

Two acceptable chronic (life-cycle) exposure studies with trifluralin (technical) involving the freshwater invertebrate, *Daphnia magna*, were submitted to the Agency. The first life-cycle study (MRID 05008271), demonstrated that chronic exposure to a mean-measured concentration at 7.2 µg/L resulted in 100% mortality in the third generation (day 64 of study). The NOAEC and LOAEC for this study are 2.4 and 7.2 µg/L. The second life-cycle study (MRID 413862-01) demonstrated that chronic exposure to a mean-measured concentration as high as 50.7 µg/L (highest level tested) resulted in no effects on survival, reproduction or growth. The NOAEC for this study is 50.7 µg/L and the LOAEC is > 50.7 µg/L.

#### *Acute Toxicity – Estuarine/Marine Fish*

No acceptable or supplemental studies evaluating the acute toxicity of trifluralin to estuarine/marine fish were submitted to the Agency.

#### *Chronic Toxicity – Estuarine/Marine Fish*

A 56-day early life cycle study was submitted for sheepshead minnow (*Cyprinodon variegates*, MRID 424499-01). The NOAEC was undefined (< 1.3 µg/L) as reproduction (number of eggs spawned/day/female) in the lowest test concentration was significantly less than in the control group (a 27% reduction). This study was classified as supplemental because insufficient data were submitted for completing a full review; in addition, a definitive NOAEC was not established.

#### Acute Toxicity – Estuarine/Marine Invertebrates

The acute toxicity studies available to the Agency demonstrate that trifluralin can be classified as highly toxic to estuarine/marine invertebrates. The EC<sub>50</sub> values were 638.5 µg/L for grass shrimp (*Palaemonetes pugio*) and >136 µg/L for the mysid (MRIDs 406748-01 and 436620-01, respectively). Although the mysid study is in review, the study did not utilize test concentrations higher than 136 µg/L; therefore, there is uncertainty as to the toxic effects of trifluralin on the mysid.

#### Chronic Toxicity – Estuarine/Marine Invertebrates

No studies evaluating the chronic toxicity of trifluralin to estuarine/marine invertebrates have been submitted to the Agency.

#### Acute Toxicity – Aquatic Plants

Five aquatic plant studies with trifluralin (technical) conducted on *Skeletonema costatum*, *Pseudokirchneriella subcapitata* (formerly known as *Selenastrum capricornutum*), *Navicula pelliculosa*, *Anabaena flos-aquae*, and *Lemna gibba* were submitted by the registrant (MRIDs 428341-01, 419345-02, 428341-02, 428341-03, and 428341-04, respectively). For vascular plants (*Lemna gibba*), the IC<sub>50</sub> and IC<sub>05</sub> are 49.7 and 14.7 µg/L (NOAEC not definitive; study reclassified as supplemental under DP 367203 in 2010). For non-vascular plants (*Skeletonema costatum*), the IC<sub>50</sub> and NOAEC are 21.9 and 14.0 µg/L. However, for *Navicula pelliculosa* and *Pseudokirchneriella subcapitata*, NOAECs were not definitive due to effects occurring at the lowest test concentrations (studies reclassified as supplemental under DP 367203 in 2010). Therefore, studies with *Navicula pelliculosa* and *Pseudokirchneriella subcapitata*, as well as *Lemna gibba*, are recommended for request to establish definitive NOAECs.

## 4.2. Effects to Terrestrial Organisms

Table 4.2 summarizes the terrestrial toxicity data for trifluralin based on an evaluation of submitted studies.

Taxa	Acute/ Chronic	Species	Toxicity Value to Be Used in Risk Assessment	MRID	Status/Comment
Birds	Acute (oral gavage)	Bobwhite quail	LD <sub>50</sub> > 2000 mg/kg- bwt	00137573	Practically non-toxic Both studies classified Acceptable, no mortalities or sublethal effects
		Mallard duck	LD <sub>50</sub> > 2000 mg/kg- bwt	00160000	
	Acute (dietary)	Bobwhite quail	LC <sub>50</sub> > 5000 mg/kg- diet	00138857	Practically non-toxic Both studies classified Acceptable, no mortalities or sublethal effects
		Mallard duck	LC <sub>50</sub> > 5000 mg/kg- diet	00138858	
	Chronic	Mallard Duck	NOAEC = 500 mg/kg- diet LOAEC = 1000	403347-04	Acceptable Effects were reductions in egg shell thickness,

**Table 4.2. Terrestrial Toxicity Profile (Most Sensitive Endpoints) for Trifluralin**

Taxa	Acute/ Chronic	Species	Toxicity Value to Be Used in Risk Assessment mg/kg-diet	MRID	Status/Comment
					14-day hatchling weights.
Mammals	Acute (oral gavage)	Laboratory rat	LD <sub>50</sub> > 5000 mg/kg-bwt	00157486	Practically non-toxic Acceptable, no mortalities or sublethal effects
	Acute (inhalation)	Laboratory rat	LC <sub>50</sub> > 4.66 mg/L	00155261	Acceptable
	Chronic	Laboratory rat	NOAEL = 10 mg/kg-bwt/day (converted to 200 mg/kg-diet) LOAEL = 32.5 mg/kg-bwt/day (converted to 650 mg/kg-diet)	00151901 00151902 00151903	Acceptable Effects were kidney toxicity (renal lesions and increased relative liver weight), reduced weanling body weights and reduced litter sizes
Terrestrial invertebrates	Acute	Honey bee, contact	LD <sub>50</sub> > 24.17 µg/bee	00028772	Supplemental (13% mortality at only test level = 24.17 µg/bee)
Terrestrial plants	N/A	<u>Seedling Emergence</u> Monocots (sorghum)	EC <sub>25</sub> = 0.09 lb a.i./acre NOAEC = 0.06 lb a.i./acre (based on fresh shoot weight)	439844-01	Supplemental (reclassified under DP 402487; June 5, 2012)  conducted using TEP*
	N/A	<u>Seedling Emergence</u> Dicots (cucumber)	EC <sub>25</sub> = 0.19 lb a.i./acre NOAEC = 0.13 lb a.i./acre (based on fresh shoot weight)		
	N/A	<u>Vegetative Vigor</u> Monocots (corn)	EC <sub>25</sub> = 1.09 lb a.i./acre NOAEC = 0.5 lb a.i./acre (based on fresh shoot weight)	419345-03	Supplemental (reclassified under DP 402487; June 5, 2012)  conducted using technical
	N/A	<u>Vegetative Vigor</u> Dicots (cucumber)	EC <sub>25</sub> = 0.796 lb a.i./acre NOAEC = 0.25 lb a.i./acre (based on fresh shoot weight)		
N/A: not applicable * TEP = typical end-use product, in this case product was Treflan HFP containing 43.8% trifluralin					

### *Acute Toxicity - Birds*

The acute toxicity of the technical grade trifluralin (~96.7% purity) to birds was established with the following guideline tests: two avian single-dose oral (LD<sub>50</sub>) studies on the bobwhite quail and mallard duck; two sub-acute dietary studies (LC<sub>50</sub>) on the mallard duck and the bobwhite quail.

The non-definitive LD<sub>50</sub>s for bobwhite quail and mallard duck were > 2000 mg/kg-bwt (MRIDs 00137573 and 00160000). The LC<sub>50</sub>s for both bobwhite quail and mallard duck were > 5000 mg/kg-diet (MRIDs 00138858 and 00138857). No mortalities or sublethal effects occurred at any treatment level for all the above acute avian studies. Based on these studies, acute exposure of trifluralin to birds was classified as “practically non-toxic”.

### *Chronic Toxicity - Birds*

Two recent studies were classified as acceptable for the bobwhite quail and mallard duck using 96% technical trifluralin. In the bobwhite quail study (MRID 403347-06 and DP barcode 417055 for revisions), the NOAEC was established at 1000 mg/kg-diet with no significant adverse effects observed. In the mallard duck study (MRID 403347-04), the NOAEC was established at 500 mg/kg-diet with the most sensitive endpoints being reduction in eggshell thickness, 14-day survival body weight of chicks and male body weight for the duck at the highest test concentration of 1000 mg/kg-diet.

### *Acute Toxicity - Mammals*

There is one registrant submitted acceptable rat acute oral toxicity study. No mortality or signs of systemic toxicity were reported; based on a laboratory rat LD<sub>50</sub> value greater than 5000 mg/kg-bwt, trifluralin is practically non-toxic to small mammals on an acute oral basis (MRID 00157486). Based on this study, acute oral toxicity of trifluralin to mammals was classified as “practically non-toxic”. In addition, an acute inhalation study for the laboratory rat was submitted (MRID 00155261). The LC<sub>50</sub> value was determined to be greater than 4.66 mg/L.

### *Chronic Toxicity - Mammals*

In 2-generation rat reproduction study (MRIDs 00151901, 00151902 and 00151903, technical grade), toxic effects in Wistar-Kyoto-Han rats included kidney toxicity (renal lesions and increased relative liver weight), reduced weanling body weights and reduced litter sizes. The NOAEC for reproductive and developmental toxicity was 200 mg/kg-diet and the LOAEC was 650 mg/kg-diet based on reduced weanling body weights at 650 and 2000 mg/kg-diet and reduced litter sizes at the highest concentration (2000 mg/kg-diet). Using standard laboratory rat weights, the NOAEC = 200 mg/kg-diet can be converted to a NOAEL = 10 mg/kg-bwt. This study is used for risk estimation in this assessment.

### *Acute Toxicity – Terrestrial Invertebrates*

Based on an acute contact LD<sub>50</sub> of >24.17 µg/bee, trifluralin appears to be “practically non-toxic” to honeybees (MRID 00028772). At the only tested dose, 24.17 µg/bee, 12.85% mortality occurred.

One additional honeybee study was submitted with an acute contact of LD<sub>50</sub> of > 100 µg/bee and acute oral of LD<sub>50</sub> of > 50 µg/bee, trifluralin appears to be “practically non-toxic” to honeybees (MRID 05001991). Mortality at each test dose was not reported.

### Acute Toxicity – Terrestrial Plants

One terrestrial plant seedling emergence Tier II study was classified as supplemental (classification revised under DP 402487; June 5, 2012) using the formulation product Treflan HFP (43.8% purity) (MRID 439844-01). In general, the emerged monocots were more sensitive than emerged dicots based on EC<sub>25</sub> comparisons (see **Table 4.3**). Shoot fresh weight was the most sensitive parameter for both monocots and dicots. Sorghum was the most sensitive monocot (EC<sub>25</sub> = 0.09 lb/acre), and cucumber was the most sensitive dicot (EC<sub>25</sub> = 0.19 lb/acre). However, the study was reclassified as supplemental because fresh weights were measured instead of dry weights and an endpoint could not be determined for cotton.

A Tier II study was submitted that evaluated the effects of technical trifluralin (95.7% purity) on non-target terrestrial plant vegetative vigor (MRID 419345-03) and was classified as supplemental (classification revised under DP 402487; June 5, 2012). Shoot fresh weight was the most sensitive parameter for both monocots and dicots (see **Table 4.4**). The most sensitive monocot was corn (EC<sub>25</sub> = 1.09 lb/acre), and the most sensitive dicot was cucumber (EC<sub>25</sub> = 0.796 lb/acre). However, the study was reclassified as supplemental because NOAECs could not be determined for several species and the study was conducted with the TGAI rather than a TEP.

**Table 4.3. Non-target Terrestrial Plant Seedling Emergence Toxicity (Tier II) Data for Trifluralin TEP (Treflan HFP) 43.8% purity (MRID 439844-01)\***

Crop	Species	NOAEC (lb a.i./acre)	IC <sub>25</sub> (lb a.i./acre)	Most Sensitive Endpoint
Monocot	Corn	0.13	0.17	Shoot fresh weight
	Sorghum	0.06	0.09	Shoot fresh weight
	Onion	0.50	0.74	Shoot fresh weight
	Wheat	0.13	0.21	Shoot fresh weight
Dicot	Cotton	NA	NA	Results invalid (soil medium detrimental to plant growth)
	Cabbage	0.50	0.78	Shoot fresh weight
	Radish	1.0	2.4	Shoot fresh weight
	Cucumber	0.13	0.19	Shoot fresh weight
	Soybean	1.0	1.3	Shoot fresh weight
	Sunflower	2.0	4.0	Shoot fresh weight

\* For this study, an incorporated application was simulated by spraying the material into a rotating cement mixer filled with soil. This soil was used to provide the top two 2 inches of soil in each treatment pot.

**Table 4.4. Non-target Terrestrial Plant Vegetative Vigor Toxicity (Tier II) Data for Trifluralin (Treflan 95.7% purity, MRID 419345-03)**

Crop	Species	NOAEC (lb a.i./acre)	IC <sub>25</sub> (lb a.i./acre)	Most Sensitive Endpoint
Monocot	Corn	0.50	1.09	Fresh Shoot weight
	Sorghum	ND	2.648 <sup>a</sup>	Height
	Onion	0.25	1.45	Height
	Wheat	ND	>2 <sup>c</sup>	Height and

**Table 4.4. Non-target Terrestrial Plant Vegetative Vigor Toxicity (Tier II) Data for Trifluralin (Treflan 95.7% purity, MRID 419345-03)**

Crop	Species	NOAEC (lb a.i./acre)	IC <sub>25</sub> (lb a.i./acre)	Most Sensitive Endpoint
				fresh shoot weight
Dicot	Cabbage	ND	2.644 <sup>a</sup>	Height
	Cotton	ND	2.267 <sup>a</sup>	Height
	Cucumber	0.25 <sup>b</sup>	0.796	Fresh Shoot weight
	Sunflower	ND	2.476 <sup>a</sup>	Height
	Soybean	ND	>2 <sup>c</sup>	Height and fresh shoot weight
	Radish	0.25	0.939	Height

<sup>a</sup> values reported by the study author, not verified by EFED reviewer  
<sup>b</sup> NOAEC=0.125 lbs/acre was used in the RED, correct value is 0.25 lbs/acre  
<sup>c</sup> Endpoints determined visually by study author, no statistical analysis conducted.  
 ND - Not determined; NOAEC values not reported by the study author or the EFED reviewer.

### 4.3. Degradate Toxicity

TR-4, TR-6 and TR-15 are the primary degradates of exposure concern for trifluralin. Data recently submitted to the Agency suggests that TR-6 and TR-15 are less toxic than the parent for representative aquatic taxonomic groups (Table 4.5). Although data suggest that TR-4 is more toxic to earthworms than the parent, the reported toxicity value (LC<sub>50</sub> = 186 mg/kg-dry soil) is much greater than expected concentrations in the soil after labeled trifluralin usage. No degradate toxicity data for mammals and birds are available. The Agency does not have concerns for any degradates of trifluralin relative to human health issues as the tolerance is expressed in terms of the trifluralin parent only, based on the determination of the Metabolite Assessment Review Committee (MARC) Health Effects Division (HED) of OPP. As such, EFED concludes that the degradates are not of concern to birds in the absence of an avian quantitative structure activity relationship model.

**Table 4.5. Comparison of the Toxicity of Trifluralin to the Toxicity of its Degradates.**

Study Type	Trifluralin	TR-6	TR-15	TR-4
Rainbow trout (96-hr LC <sub>50</sub> , mg/L)	0.041 (MRID 400980-01)	0.991 (MRID 478070-01)	6.04 (MRID 478070-02)	NA
Daphnid (48-hr EC <sub>50</sub> , mg/L)	0.251 (MRID 478070-07)	3.52 (MRID 478070-04)	8.91 (MRID 478070-03)	NA
Selenastrum (96-hr IC <sub>50</sub> , mg/L)	0.089 (MRID 419345-02)	4.6 (MRID 478070-06)	6.7 (MRID 478070-05)	NA
Earthworm (14-day LC <sub>50</sub> , mg/kg-dry soil)	>1000 (MRID 478070-09)	NA	NA	186 (MRID 478070-10)

#### 4.4. Incident Databases Review

Preliminary reviews of the Ecological Incident Information System (EIIS, version 2.1) and the Avian Incident Monitoring System (AIMS)<sup>5</sup> were conducted on January 30, 2012. There were no avian incidents reported in the AIMS database. There were 83 incidents involving trifluralin in the EIIS database, 78 of which involved terrestrial ecosystems involving effects to terrestrial plants. Five incident reports involved aquatic ecosystems. North Dakota was most represented among all 50 states (20 reports) followed by Iowa (16), Minnesota (7), California (6) and Texas (5). Of the 83 incidents reported, 1 was categorized as 'highly probable' and 58 were categorized as 'probable.' Regarding the legal status, the 'registered use' represents the largest legality category with 81.9% of the incidents reported. Approximately 9.6% of the reports consist of 'misuse accidental' and 8.4 % undetermined uses. The incidents are summarized below (see **Appendix G** for a complete list).

In addition to the incidents recorded in EIIS and AIMS, additional incidents have been reported to the Agency in an aggregated format. Pesticide registrants report certain types of incidents to the Agency as aggregate counts of incidents occurring per product per quarter. Ecological incidents reported in aggregate reports include those categorized as 'minor fish and wildlife' (W-B), 'minor plant' (P-B), and 'other non-target' (ONT) incidents. 'Other non-target' incidents include reports of adverse effects to insects and other terrestrial invertebrates. There were eight minor aggregate incident reports for fish and wildlife (W-B), and 169 minor aggregate incident reports for plants (P-B).

Due to limitations with data in the EIIS, a low number or lack of reported incidents for a particular taxon in the database cannot be used as evidence that additional incidents have not occurred. Incident reports for non-target plants and animals typically provide information on mortality events only. Reports for other adverse effects, such as reduced growth or impaired reproduction, are rarely received. EPA's changes in the registrant reporting requirements of incidents may also account for the reduced number of reported incidents. Registrants are now only required to submit detailed information on 'major' incidents. Minor incidents are generally reported aggregately and are not included in EIIS. In addition, there have been changes in state monitoring efforts due to lack of resources.

##### ***Terrestrial Incidents***

No terrestrial animal incidents were reported.

For trifluralin, 78 incidents were reported for plant damage to a wide variety of terrestrial plants particularly from direct treatment or spray drift (*e.g.*, alfalfa, barley, bean, birch, blue spruce, corn, cotton, dry bean, ornamentals, peanut, percfia shrubs, pinto bean, potato, raspberry, rose, soybean, soybean seed, spreading yew, sudan grass, sugarcane, sunflower, tomato and wheat (spring and other varieties). For trifluralin, 66 of the 78 incidents reported were registered uses, five were accidental misuses and seven were of unknown legality. Of the 78 incidents involving terrestrial plants, 55 (70.5%) are classified as 'probable' in the context of trifluralin use. Other

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<sup>5</sup> <http://www.abcbirds.org/abcprograms/policy/toxins/aims/aims/index.cfm>

reported incident exposures included spills, stunted growth, discoloration, reduced yield, incapacitation, mortality, runoff, and carryover.

### ***Aquatic Incidents***

All five of the aquatic incident reports involved mortality to aquatic organisms. One of the five incidents reportedly involved an eel, but the likelihood of observing impacts to eels are low compared to fish based on a reported trifluralin spill. Of the five aquatic incidents involving fish, four (80%) are classified as either 'highly probable' or 'probable' in the context of trifluralin use. A wide variety of fresh and estuarine fish species were reportedly affected due to runoff and accidental spills (*e.g.*, catfish, minnow, bass, shad, bluegill sunfish, gar and crappie). All of the probable incidents were accidental misuses except incident # I002215-001 which occurred in Texas. This report failed to give the name of the county where the incident occurred. The incident date, which was not reported in the memo of 06/12/95, was estimated to be 06/01/95. According to the report, an area was treated with pesticide prior to asphalt paving. Light rain followed and there was a heavy thunderstorm a day later which allegedly resulted in a runoff into a three acre pond causing a fish kill of an unspecified number of bass, bluegill and crappie. Catfish and carp were not affected. It was believed that trifluralin, as Treflan, was responsible for the observed mortality.

#### **4.5. Ecosystems Potentially at Risk**

The ecosystems at risk are often extensive in scope; therefore, it may not be possible to identify specific ecosystems during the development of a nation-wide ecological risk assessment. However, in general terms, terrestrial ecosystems potentially at risk could include the treated field and immediately adjacent areas that may receive drift or runoff. Areas adjacent to the treated field could include cultivated fields, fencerows and hedgerows, meadows, fallow fields or grasslands, woodlands, riparian habitats, and other uncultivated areas.

Aquatic ecosystems potentially at risk include water bodies adjacent to or downstream from the treated field and could include impounded bodies such as ponds, lakes and reservoirs, or flowing waterways such as streams or rivers. For uses in coastal areas, aquatic habitat also includes marine ecosystems, including estuaries.

### **5. Assessment Endpoints**

Assessment endpoints represent the actual environmental value that is to be protected, as defined by an ecological entity (species, community, or other entity) and its attribute or characteristics (U.S. EPA, 1998). For trifluralin, the ecological entities may include the following: birds, mammals, terrestrial-phase amphibians, reptiles, freshwater fish and invertebrates, aquatic-phase amphibians, estuarine/marine fish and invertebrates, terrestrial plants, terrestrial invertebrates, and aquatic plants. The attributes for each of these entities include survival, growth, and reproduction.

## 6. Conceptual Model

The conceptual model for trifluralin provides a written description and visual representation of the predicted relationships between trifluralin, potential routes of exposure, and the predicted effects for the assessment endpoint. A conceptual model consists of two major components: risk hypothesis and a conceptual diagram (U.S. EPA, 1998).

For a pesticide to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. An exposure pathway is the means by which a pesticide moves in the environment from a source to an ecological receptor. For an ecological pathway to be complete, it must have a source, a release mechanism, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure.

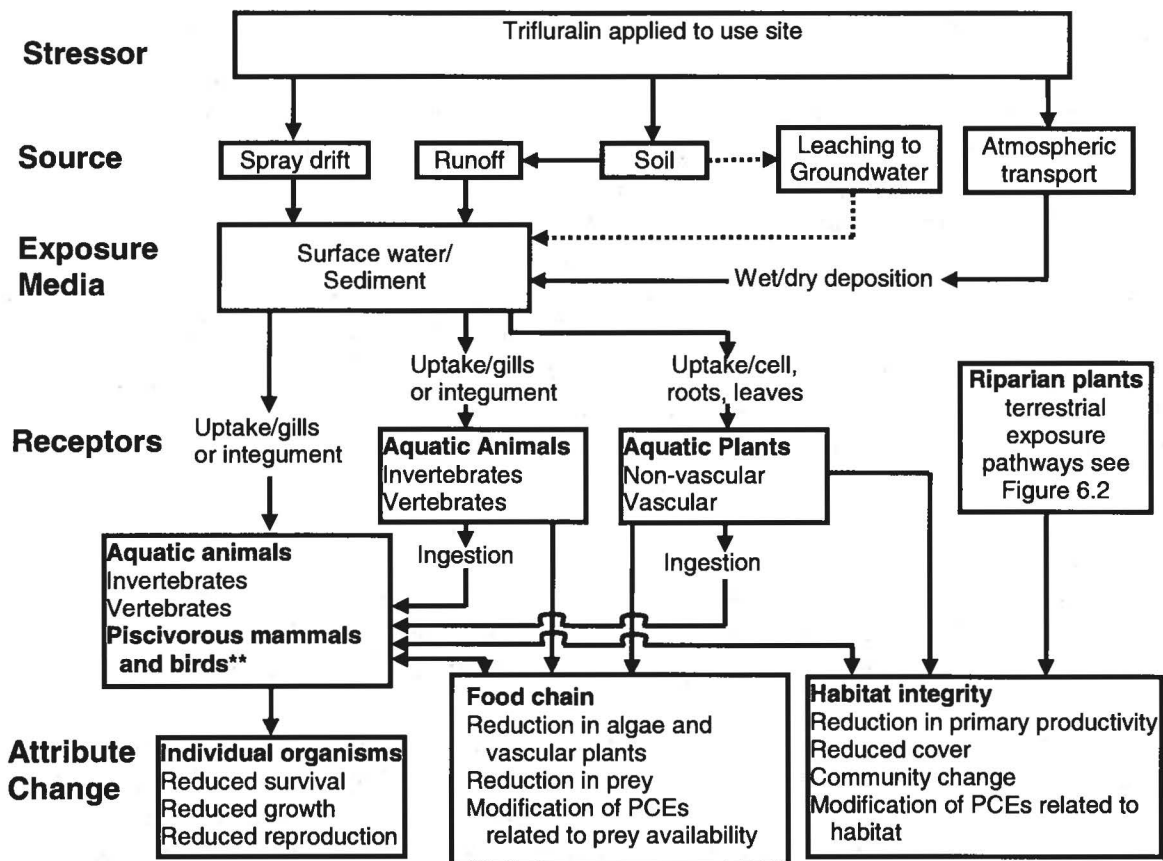
### 6.1. Risk Hypothesis

A risk hypothesis describes the predicted relationship among the stressor, exposure, and assessment endpoint response along with the rationale for their selection. For trifluralin, the following ecological risk hypothesis is being employed for this ecological risk assessment:

*Trifluralin, when used in accordance with current labels, can result in off-site movement of the compound and its transformation product via runoff (both dissolved phase and with eroded sediment), spray-drift, and atmospheric transport and expose non-target organisms. Application to foliar surfaces and soil may also result in exposure to non-target organisms. These potential exposure pathways may result in adverse effects on the survival, growth, and/or reproduction of non-target terrestrial and aquatic organisms, including Federally-listed threatened and endangered species.*

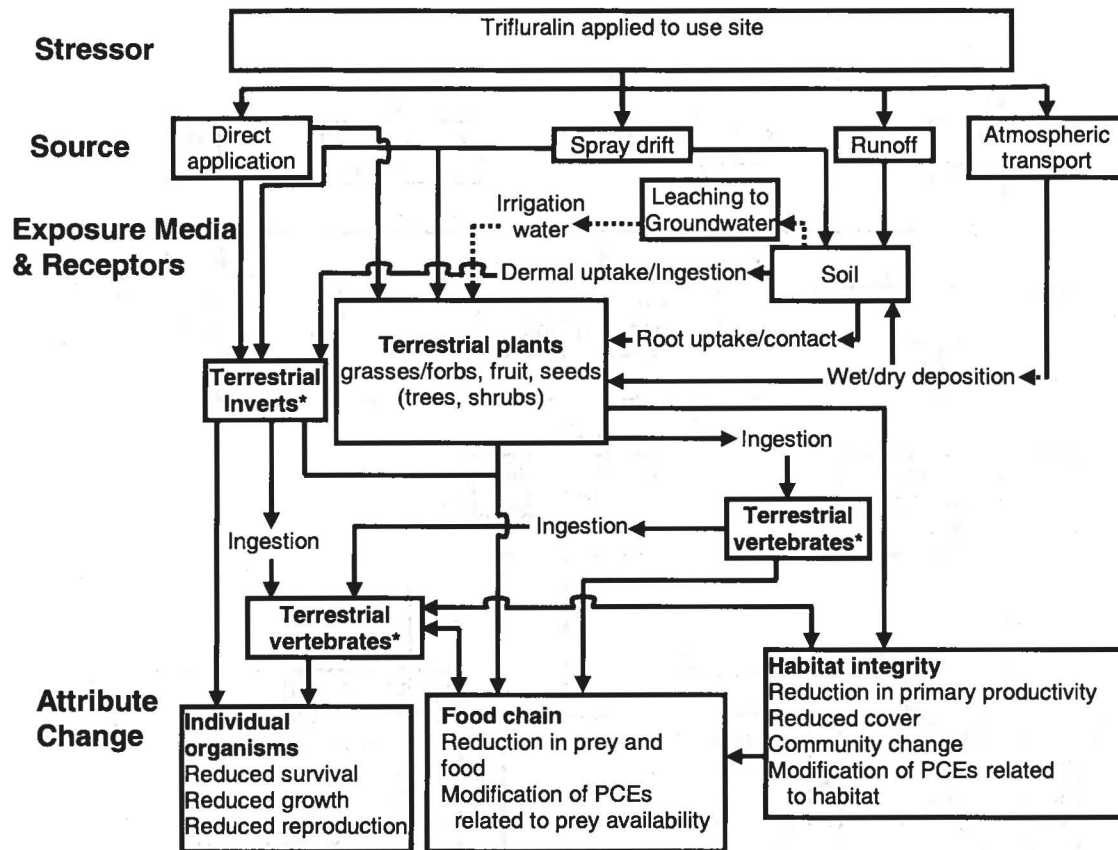
### 6.2. Conceptual Diagram

The environmental fate properties of trifluralin indicate that runoff, spray drift, direct spray, and atmospheric transport represent potential transport mechanisms of trifluralin to aquatic and terrestrial habitats where non-target organisms may be exposed. These transport mechanisms (*i.e.*, sources) are depicted in the conceptual models below (**Figures 6.1, 6.2, and 6.3**) along with the receptors of concern and the potential attribute changes in the receptors due to exposure to trifluralin.



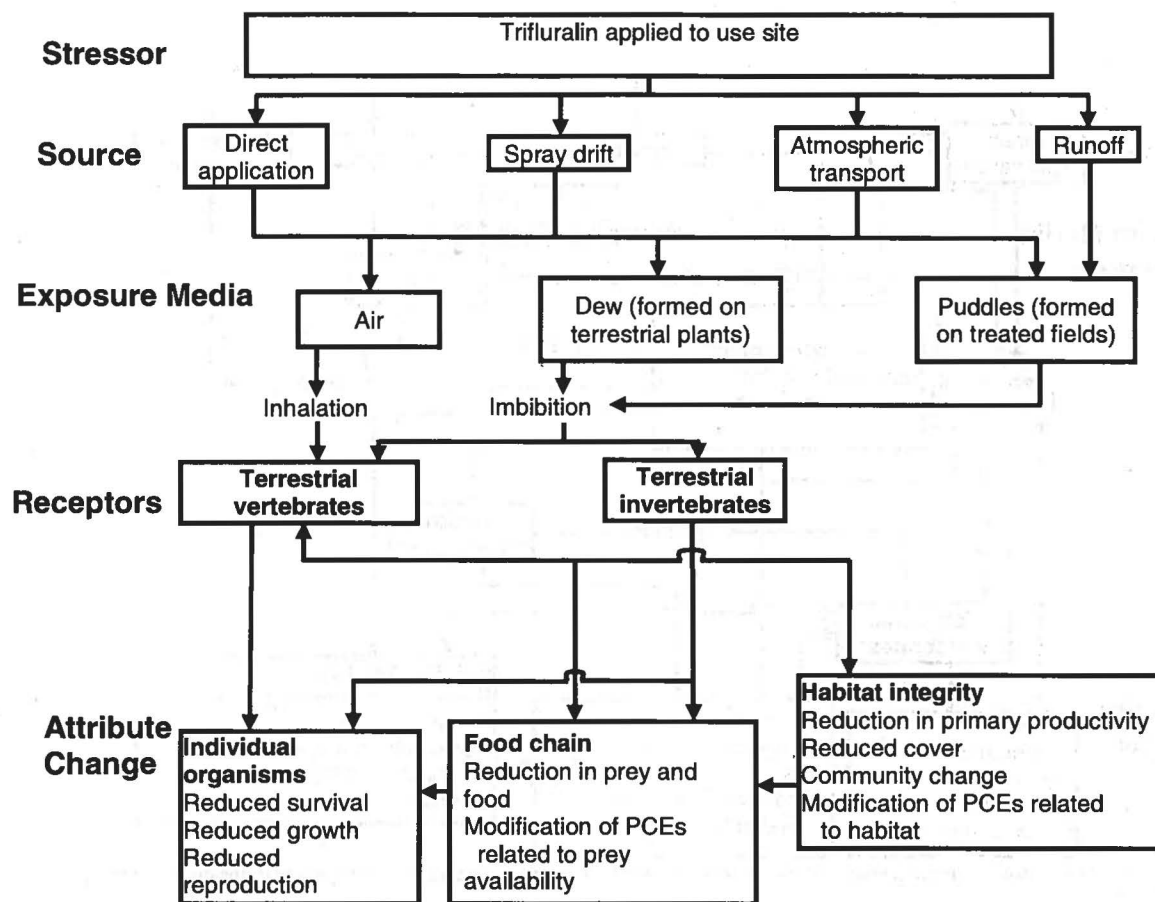
\*\*Route of exposure includes only ingestion of fish and aquatic invertebrates

**Figure 6.1. Conceptual Model for Exposure and Effects of Trifluralin to Aquatic Organisms. Dotted Lines Indicate Exposure Pathways that Have a Low Likelihood of Contributing to Ecological Risk.**



\* See Figure 6.3 for drinking water and inhalation exposure pathways for terrestrial vertebrates and ingestion of residues in dew by terrestrial invertebrates.

**Figure 6.2. Conceptual Model for Exposure and Effects of Trifluralin to Terrestrial Organisms. Dotted Lines Indicate Exposure Pathways that Have a Low Likelihood of Contributing to Ecological Risk.**



**Figure 6.3. Conceptual Model for Drinking Water and Inhalation Exposure Pathways for Terrestrial Vertebrates and Ingestion of Residues in Dew by Terrestrial Invertebrates. Dotted Lines Indicate Exposure Pathways that Have a Low Likelihood of Contributing to Ecological Risk.**

## 7. Analysis Plan

In order to address the risk hypothesis, the potential for adverse effects on the environment will be estimated. The use, environmental fate, and ecological effects of trifluralin will be characterized and integrated to assess the risks. Risk quotients (RQs) will be derived for trifluralin by dividing estimated environmental concentrations (EEC) by the most sensitive endpoint from the relevant, available toxicity data for trifluralin.

This analysis plan will be revisited and may be revised depending upon a full review of the data available in the open literature and the information submitted by the public in response to the opening of the registration review docket.

## 7.1. Stressors of Concern

Three major degradates (TR-4, TR-6 and TR-15) were identified in the submitted environmental fate studies for trifluralin. However, the assessment will pertain to the parent trifluralin only (see **Section 3** and **4.3**).

The Agency does not routinely include, in its risk assessments, an evaluation of mixtures of active ingredients, either those mixtures of multiple active ingredients in product formulations or those in the applicator's tank. In the case of the product formulations of multiple active ingredients (that is, a registered product containing more than one active ingredient), each active ingredient is subject to an individual risk assessment for regulatory decision regarding the active ingredient on a particular use site. If effects data are available for a formulated product containing more than one active ingredient, they may be used qualitatively or quantitatively in accordance with the Agency's Overview Document and the Services' Evaluation Memorandum (U.S. EPA, 2004b; USFWS/NMFS, 2004).

## 7.2. Measures of Exposure

In order to estimate risks of trifluralin exposures in aquatic and terrestrial environments, all exposure modeling and resulting risk conclusions will be based on registered labels including maximum application rates and methods cited in **Table 3.2** for each use of trifluralin. Measures of exposure are based on aquatic and terrestrial models that predict estimated environmental concentrations (EECs) of trifluralin. The models used to predict aquatic EECs are the Pesticide Root Zone Model coupled with the Exposure Analysis Model System (PRZM/EXAMS). The model used to predict terrestrial EECs on food items is T-REX. The model used to derive EECs relevant to terrestrial and wetland plants is TerrPlant. These models are parameterized using relevant reviewed environmental fate data from registrant submissions and the literature; model input values will be consistent with the most recent version of the input parameter guidance (Version 2.1, 2009).

PRZM (v3.12.2, May 2005) and EXAMS (v2.98.4.6, April 2005) are simulation models coupled with the input shell pe5.pl (November 2006). The models generate daily exposures and calculate 1-in-10 year EECs of trifluralin that may occur in surface water bodies adjacent to application sites receiving trifluralin through runoff and spray drift. PRZM simulates pesticide application, movement, and transformation on an agricultural field and the resultant pesticide loadings to a receiving water body via runoff, erosion and spray drift. EXAMS simulates the fate of the pesticide in the water body and estimates resulting concentrations. The standard scenarios used for ecological pesticide assessments assume application to a 10-hectare agricultural field that drains into an adjacent 1-hectare water body that is 2 meters deep (20,000 m<sup>3</sup> volume) with no outlet. PRZM/EXAMS is used to estimate screening-level exposure of aquatic organisms to trifluralin. The measure of exposure for aquatic species is the 1-in-10 year return peak or rolling mean concentration. The 1-in-10 year peak is used for estimating acute exposures of direct effects to aquatic organisms. The 1-in-10-year 60-day mean is used for assessing chronic exposure to fish and aquatic-phase amphibians. The 1-in-10-year 21-day mean is used for assessing chronic exposure to aquatic invertebrates.

In addition to modeling estimates, available monitoring data will be evaluated. Monitoring data will include those collected/reported by states as well as other federal departments/agencies (e.g., USGS National Water Quality Assessment; <http://water.usgs.gov/nawqa>). A critical step in the process of characterizing predicted EECs is comparing the modeled estimates with available surface water monitoring data. An evaluation of the surface water monitoring data will be conducted to assess the occurrence of trifluralin in surface and ground waters. Most of this data, however, is non-targeted (i.e., study was not specifically designed to capture trifluralin concentrations in high-use areas). Typically, sampling frequencies employed in these monitoring studies are insufficient to document peak exposure values. This, coupled with the fact that these data are not temporally or spatially correlated with pesticide applications, limits the utility of these data for estimating exposure concentrations for risk assessment purposes. These monitoring data will be characterized in terms of general statistics including number of samples, frequency of detection, maximum concentration, and mean value of all detections, where that level of detail is available.

A downstream dilution model (under development) may be used to identify areas downstream from a use area that may have EECs high enough to result in a risk concern. This analysis will be used to define the potential area of effects for endangered species.

Exposure estimates for terrestrial animals assumed to be in the target area or in an area exposed to spray drift are derived using the T-REX model (version 1.4.1, October 2008). This model incorporates the Kenaga nomograph, as modified by Fletcher *et al.* (1994), which is based on a large set of field residue data. The upper limit values from the nomograph represent the 95<sup>th</sup> percentile of residue values from actual field measurements (Hoerger and Kenaga, 1972). The Fletcher *et al.* (1994) modifications to the Kenaga nomograph are based on measured field residues from 249 published research papers, including information on 118 species of plants, 121 pesticides, and 17 chemical classes. A default 35-day foliar dissipation rate will be used because no foliar dissipation data have been submitted.

EECs for terrestrial plants inhabiting dry and wetland areas are derived using TerrPlant (version 1.2.2, December 2006). This model uses estimates of pesticides in runoff and in spray drift to calculate EECs. EECs are based upon solubility, application rate and minimum incorporation depth in addition to type of formulation and method of application.

Two spray drift models, AgDisp and AgDRIFT, are used to assess exposures of aquatic and terrestrial organisms to trifluralin deposited in terrestrial and aquatic habitats by spray drift. AgDrift (version 2.1.1) is the model most commonly used to simulate spray drift into terrestrial and aquatic environments from aerial and ground applications. AgDisp (version 8.26) (Teske and Curbishley, 2011) is used when a parameter needs to be modeled that is not available in AgDRIFT. Spray drift analysis will be an important part of the analysis in defining the potential area of effects for endangered species.

The Screening Imbibition Program (SIP v.1.0) was used on March 26, 2012 to provide an upper-bound estimate of exposure of birds and mammals to pesticides through drinking water alone. SIP is intended for use during the problem formulation phase and does not aggregate the drinking water exposure route with other exposure routes (i.e., dietary, inhalation, dermal). Based on SIP analysis, acute and chronic exposure through drinking water alone is not a

potential concern for both birds and mammals (see **Appendix E** for SIP inputs and outputs). It should be noted that the SIP outputs are very conservative since the avian and mammalian LD<sub>50</sub>s were non-definitive (*i.e.*, greater than the highest concentration tested).

The Screening Tool for Inhalation Risk (STIR v.1.0) is used to assess the potential for risk to birds and mammals through inhalation exposure. The exposure pathways that are assessed by this tool include both droplet inhalation and vapor phase inhalation. STIR, used in the problem formulation phase, is intended to determine if exposure is likely and not whether or not the potential for risk exists. If STIR predicts that exposure is likely, additional inhalation data may be necessary to adequately assess risk due to the inhalation exposure pathway. Although trifluralin has the potential to volatilize from soil and water surfaces, the mammalian inhalation study (classified as acceptable) did not establish a median lethal concentration at the highest concentration tested, *i.e.*, the LC<sub>50</sub> was > 4.66 mg/L (MRID 00155261). Therefore, trifluralin is considered a Category IV toxicant, and STIR was not used to determine whether inhalation is a significant route of exposure in the absence of toxic effects.

KABAM (Kow (based) Aquatic BioAccumulation Model) is used to estimate potential bioaccumulation of hydrophobic organic pesticides in freshwater aquatic food webs and subsequent risks to mammals and birds via consumption of contaminated aquatic prey. This model can also be used to estimate pesticide concentrations in fish tissues consumed by humans. The model was designed for use by the U. S. Environmental Protection Agency Office of Pesticide Programs' Environmental Fate and Effects Division (EFED) scientists. KABAM is composed of two parts: 1) a bioaccumulation model estimating pesticide concentrations in aquatic organisms and 2) a risk component translating exposure and toxicological effects of a pesticide into risk estimates for mammals and birds consuming contaminated aquatic prey. Because trifluralin is a non-ionic, organic chemical with a log Kow between 4 and 8 and has the potential to enter aquatic habitats, KABAM will be used in the risk assessment phase.

Potential transport mechanisms or routes of pesticide exposure for trifluralin also include secondary drift of volatilized or soil-bound residues leading to deposition onto nearby or more distant ecosystems. A number of studies have documented atmospheric transport and re-deposition of pesticides in remote regions such as the Canadian Arctic, Greenland and the Bering Sea (Hoferkamp *et al.*, 2010). At this time, OPP has not settled on a specific model for estimating atmospheric transport of pesticides and resulting exposure to organisms in areas receiving pesticide deposition from the atmosphere. However, a number of transport models are currently under evaluation for both human health and ecological risk assessment with the key model input being pesticide flux. The submission of data allowing estimation of flux rates for trifluralin under incorporated and non-incorporated scenarios from the field are expected to enhance the Agency's ability to predict exposures in aquatic and terrestrial habitats far from the treated site. It is anticipated that methods to describe the contributions of atmospheric transport and deposition of trifluralin to exposures to non-target organisms will be fully explored and capable of being incorporated into this risk assessment as part of registration review of trifluralin. As part of this assessment, available monitoring from the open literature will be also evaluated to assess the potential impacts of atmospheric transport on non-target organisms.

### 7.3. Measures of Effect

Ecological effects data are used as measures of direct and indirect effects to biological receptors. Data are obtained from registrant-submitted studies or from literature studies identified by ECOTOX. The ECOTOX database provides more ecological effects data in an attempt to bridge existing data gaps. ECOTOX is a source for locating single chemical toxicity data and potential chemical mixture toxicity data for aquatic life, terrestrial plants, and wildlife. ECOTOX was created and is maintained by EPA, Office of Research and Development, and the National Health and Environmental Effects Research Laboratory's Mid-Continent Ecology Division (U.S. EPA, 2009a).

Information on the potential effects of trifluralin on non-target plants and animals is also collected from the Ecological Incident Information System (EIIS; U.S. EPA, 2007c). The EIIS is a database containing adverse effect (typically mortality) reports on non-target organisms where such effects have been associated with the use of pesticides. Incidents reported in the aggregate incident reports and the Avian Incident Monitoring System (AIMS) will also be searched<sup>6</sup>. AIMS is a database administered by the American Bird Conservancy (partially funded by EPA). It contains publicly available data on reported avian incidents involving pesticides.

Where available, sub-lethal effects observed in both registrant-submitted and open literature studies will be evaluated qualitatively. Such effects may include behavioral changes (*e.g.*, lethargy and changes in coloration). Quantitative assessments of risks, though, are limited to those endpoints that can be directly linked to the Agency's assessment endpoints of impaired survival, growth, and reproduction.

The assessment of risk for direct effects to non-target organisms makes the assumption that toxicity of trifluralin to birds is similar to terrestrial-phase amphibians and reptiles. The same assumption is made for fish and aquatic-phase amphibians.

The acute measures of effect used for animals in this assessment are the LD<sub>50</sub>, LC<sub>50</sub> and EC<sub>50</sub>. LD stands for "Lethal Dose", and LD<sub>50</sub> is the amount of a material, given all at once, that is estimated to cause the death of 50% of the test organisms. LC stands for "Lethal Concentration" and LC<sub>50</sub> is the concentration of a chemical that is estimated to kill 50% of the test organisms. EC stands for "Effective Concentration" and the EC<sub>50</sub> is the concentration of a chemical that is estimated to produce a specific effect in 50% of the test organisms. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL/NOAEC and NOEC. NOAEL stands for "No Observed-Adverse-Effect-Level" and refers to the highest tested dose of a substance that has been reported to have no harmful (adverse) effects on test organisms. The NOAEC (*i.e.*, "No-Observed-Adverse-Effect-Concentration") is the highest test concentration at which none of the observed effects were statistically different from the control. The NOEC is the No-Observed-Effects-Concentration. For non-listed plants, only acute exposures are assessed (*i.e.*, EC<sub>25</sub> for terrestrial plants and EC<sub>50</sub> for aquatic plants); for listed plants either the NOAEC or EC<sub>05</sub> is used.

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<sup>6</sup> <http://www.abcbirds.org/abcprograms/policy/toxins/aims/aims/index.cfm>

#### **7.4. Integration of Exposure and Effects**

Risk characterization is the integration of exposure and ecological effects characterization to determine the potential ecological risk from the use of trifluralin and the potential for direct and indirect effects to non-target organisms in aquatic and terrestrial habitats. The exposure and toxicity effects data are integrated in order to evaluate the risks of adverse ecological effects on non-target species. For the assessment of trifluralin risks, the risk quotient (RQ) method is used to compare exposure and measured toxicity values (see **Appendix F**). EECs are divided by acute and chronic toxicity values. The resulting RQs are then compared to the Agency's Levels of Concern (LOCs) (U.S. EPA, 2004b). These criteria are used to indicate when the use of trifluralin, as directed on the labels, has the potential to cause adverse direct or indirect effects to non-target organisms. In addition, incident data from EIS, aggregate incident reports, and AIMS will be considered as part of the risk characterization.

#### **7.5. Deterministic and Probabilistic Assessment Methods**

The quantitative assessment of risk will primarily depend on the deterministic point-estimate based approach described in the risk assessment. Depending on the risk manager's need for additional information regarding risk, an effort may be made to further describe risk using probabilistic tools that the Agency has developed. These tools have been reviewed by FIFRA Scientific Advisory Panels<sup>7</sup> and have been deemed as appropriate means of refining assessments where deterministic approaches have identified risks.

#### **7.6. Endangered Species Assessment**

Consistent with the Agency's responsibility under the Endangered Species Act (ESA), the Agency will evaluate risks to Federally-listed threatened and/or endangered (listed) species from registered uses of trifluralin. This assessment will be conducted in accordance with the Overview Document (U.S. EPA, 2004b), provisions of ESA, and the Services' *Endangered Species Consultation Handbook* (USFWS/NMFS, 1998).

The action area is used to identify all listed (threatened and endangered) species and designated critical habitat that could be affected by the Federal action. The Federal action is the authorization or registration of pesticide use or uses as described on the label(s) of pesticide products containing a particular active ingredient. The action area is defined by the Endangered Species Act as, "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR §402.2). Based on an analysis of the Federal action, the action area is defined by the actual and potential use of the pesticide.

In the case of nationwide ecological risk assessment conducted for trifluralin under registration review, the action area will encompass the entire United States and its territories. The purpose of defining the action area as the entire United States and its territories is to ensure that the initial area of consideration encompasses all areas where trifluralin may be used now and in the future, including the potential for off-site transport via spray drift and downstream dilution. Additionally, the concept of a nationwide action area takes into account the potential for direct

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<sup>7</sup> <http://www.epa.gov/scipoly/sap/index.htm>

and indirect effects and any potential modification to critical habitat based on ecological effect measures associated with reduction in survival, growth, and reproduction, as well as the full suite of sublethal effects available in the effects literature. It is important to note that the nationwide action area does not imply that direct and/or indirect effects and critical habitat modification are expected to or are likely to occur over the full extent of the action area, but rather to identify all listed species and critical habitat that may potentially be affected by the action. The Agency will use more rigorous analysis including consideration of available land cover data, toxicity data, and exposure information to determine areas where individual listed species and designated critical habitat may be affected or modified via endpoints associated with reduced survival, growth, or reproduction.

### **7.7. Endocrine Disruptor Screening Program**

As required by FIFRA and FFDCA, EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints which may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of its reregistration decision for trifluralin, EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), trifluralin is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a “naturally occurring estrogen, or other such endocrine effects as the Administrator may designate.” The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. Trifluralin was included on that list and has been issued an order to conduct the Tier 1 testing. Once all required Tier 1 and Tier 2 data have been received and reviewed, the endpoints and safety factors used for risk assessment purposes will be examined and a new risk assessment performed if necessary. For further information on the status of the EDSP, the policies and procedures, the list of 67

chemicals, future lists, the test guidelines and the Tier 1 screening battery, please visit our website<sup>8</sup>.

## **7.8. Human Health Drinking Water Assessment**

A drinking water assessment will be conducted to support future human health dietary risk assessments of trifluralin. The drinking water assessment will incorporate model estimates of trifluralin and any major degradates of concern in surface water and ground water. Concentrations of trifluralin residues in surface waters will be estimated using PRZM/EXAMS (see description above, **section 7.2**). Percent Cropped Area (PCA) adjustment factors are used to account for the maximum fractional area within a watershed that may be planted with a modeled crop, and are used to modify drinking water concentrations predicted by PRZM and EXAMS (US EPA, 2010).

An Estimated Drinking Water Concentration (EDWC) of trifluralin residues in ground water will be estimated using EFED's Tier I aquatic model SCI-GROW (Screening Concentration in Ground Water). SCI-GROW is a regression model used as a screening tool to estimate pesticide concentrations found in ground water used as drinking water. The output of SCI-GROW represents the concentrations that might be expected in shallow unconfined aquifers under sandy soils, which is representative of the ground water most vulnerable to pesticide contamination likely to serve as a drinking water source. The drinking water assessment will also include available surface and ground water monitoring data with consideration of changes in use patterns that may have occurred.

## **7.9. Preliminary Identification of Data Gaps**

According to the Code of Federal Regulations 40 (CFR40 2007) Part 158 Subpart D (data requirements for pesticides) environmental fate and non-target organism effects data are required for trifluralin based on its terrestrial use. Available studies submitted to fulfill environmental fate and ecological effects guideline requirements, as well as outstanding data gaps for trifluralin, are defined in **Sections 7.9.1** and **7.9.2**.

Further information on data required to fulfill the Agency's guideline requirements for trifluralin and its formulated products is presented as the Data Call-in (DCI) table in **Appendix C**. In addition to providing the guideline number and study title for required data, the DCI table provides a rationale for requiring the data, an explanation of how the data will be used, and a brief description of the how the data could impact the Agency's future decision-making.

### **7.9.1. Fate Data Gaps**

The adequacy of the submitted environmental fate data was evaluated relative to Agency's guidelines for environmental fate studies. These studies are generally characterized as supplemental, i.e. scientifically sound but not entirely consistent with current guideline recommendations. The submitted environmental fate data did not meet all of the standards identified in the guidelines. However, submitted data provide sufficient information to assess

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<sup>8</sup> <http://www.epa.gov/endo/>

environmental fate properties and are sufficient for exposure characterization. Therefore, new studies are not required as environmental exposure conclusions are unlikely to be substantially affected. However, aerobic aquatic and anaerobic aquatic metabolism studies and a field volatility study are needed to reduce uncertainties for exposure assessment. **Table 7.1** identifies environmental fate studies by MRID that offer data for each guideline requirement, as well as study classifications and whether or not further data are needed in order to support risk assessment (*i.e.*, whether there is a data gap).

<b>Table 7.1. Status of Available Environmental Fate Data and Remaining Data Gaps</b>					
<b>Guideline</b>	<b>Description</b>	<b>MRID</b>	<b>Classification</b>	<b>Data Gap?</b>	<b>Comments</b>
835.2120 161-1	Hydrolysis	00131135 40334708 40405008	Supplemental In review In review	No	--
835.2240 161-2	Photodegradation in Water	40560101	Supplemental	No	--
835.2410 161-3	Photodegradation in Soil	40597801 40751301	Supplemental	No	--
835.4100 162-1	Aerobic Soil Metabolism	41240501	Supplemental	Partially fulfilled	The aerobic soil metabolism studies were performed on three soils. OCSPP guidance recommends that this test be performed with four soils. Because OCSPP uses an upper 90 <sup>th</sup> percentile estimate of soil metabolism half-lives based on available study data for modeling purposes, additional data can reduce uncertainty related to the exposure assessment as well as the half-life value used in modeling. One additional soil is needed for the aerobic soil metabolism study to satisfy the data requirement.
835.4200 162-2	Anaerobic Soil Metabolism	41240502	Supplemental	No	--
835.4300 162-4	Aerobic Aquatic Metabolism	---		Yes	Data are needed for sediment-water systems, one each at a neutral and an acidic pH.
835.4400 162-3	Anaerobic Aquatic Metabolism	---		Yes	Data are needed for sediment-water systems, one each at a neutral and an acidic pH.
835.1410	Volatility- Laboratory	43915701 40673601 A-C	Acceptable Supplemental	No	---
835-8100	Volatility- field	40673601 D-F	Supplemental	No	---

**Table 7.1. Status of Available Environmental Fate Data and Remaining Data Gaps**

Guideline	Description	MRID	Classification	Data Gap?	Comments
835.1230 835.1240 163-1	Leaching Adsorption /Desorption		Supplemental	No	--
835.6100 164-1	Terrestrial Field Dissipation	41781901	Supplemental	No	--
		41661101	Supplemental		
		42309101	Supplemental		
	Analytical Method - Soil	155978	Supplemental	No	--
Analytical Method - Water	Supplemental				
Analytical Method- Sediment	Supplemental				
850.1730	Accumulation in Fish	40673801	Supplemental	No	---

**7.9.2. Effects Data Gaps**

Although many submissions have been made to provide data on the effects of trifluralin to aquatic and terrestrial organisms, data gaps still exist and are included in **Tables 7.2 to 7.4**, below. In the event that the data recommended for request are not received, EFED will attempt to conservatively estimate toxicity to the various taxonomic groups through the use of ECOSAR, the acute-to-chronic ratio (ACR) method, and use of data from other dinitroaniline herbicides. However, it should be noted that all of these methods induce some amount of uncertainty, and risk may have to be assumed in the absence of submitted data for trifluralin in some instances.

**Table 7.2. Available Ecological Effects Data for Terrestrial Animals Exposed to Trifluralin and Remaining Data Gaps**

Guideline	Description	MRID	Classification	Data Gap?	Comments
850.2100	Avian oral toxicity	00137573	Acceptable	Yes <sup>1</sup>	<sup>1</sup> Acceptable avian data were submitted for the bobwhite quail, mallard duck, and pheasant. However, avian acute oral toxicity data are not available for passerines, which are required under 40 CFR Part 158.
		00160000	Acceptable		
		00160000	Acceptable		
850.2200	Avian dietary toxicity	00138858	Acceptable	No	
		00138857	Acceptable		
850.2300	Avian reproduction	00131134	Acceptable	No	
		403347-06	Acceptable		
		00131132	Acceptable		
		403347-04	Acceptable		
850.3020	Honey bee acute contact and oral toxicity	05001991	Acceptable	No	
850.3020	Honey bee acute contact toxicity	00028772	Supplemental		
870.1100	Mammalian oral toxicity	00157486	Acceptable	No	
870.3800	Mammalian reproduction toxicity	00151901	Acceptable	No	
		00151902			
		00151903			
870.1300	Mammalian inhalation toxicity	00155261	Acceptable	No	

**Table 7.3. Available Ecological Effects Data for Aquatic Animals Exposed to Trifluralin and Remaining Data Gaps**

Guideline	Description	MRID	Classification	Data Gap?	Comments
850.1075	Freshwater fish – Acute toxicity	400980-01	Supplemental	Yes <sup>1</sup>	<p><sup>1</sup>Studies utilized nominal concentrations. Due to trifluralin's ability to volatilize and sorb to surfaces, additional studies that measure the concentrations in water are recommended for request.</p> <p><sup>2</sup>Acceptable data are required for the use patterns.</p> <p><sup>3</sup>Although this mysid study is in review, a median lethal concentration was not established, possibly due to the fact that tested concentrations were not sufficiently high. Therefore, there is uncertainty as to the effects of trifluralin on the mysid shrimp.</p> <p><sup>4</sup>Because aquatic metabolism studies were not submitted, it is not possible to determine if acute whole sediment toxicity studies are necessary. If the aquatic metabolism studies yield half-lives of <math>\leq 10</math> days, then these studies are recommended for request.</p>
850.1075	Estuarine/marine fish – Acute toxicity	Not submitted	Not applicable	Yes <sup>2</sup>	
850.1010	Freshwater invertebrates – Acute toxicity	478070-07	Acceptable	No	
850.1025	Oyster shell deposition – Acute toxicity	Not submitted	Not applicable	Yes <sup>2</sup>	
850.1035	Estuarine/marine invertebrates – Acute toxicity	436620-01	In review	Yes <sup>2,3</sup>	
		406748-01	Acceptable	No	
850.1400	Freshwater fish – early life stage test	413862-02	Acceptable	No	
850.1500	Freshwater fish – full life cycle test	05008271	Acceptable	No	
850.1400	Estuarine/marine fish – early life stage test	424499-01	Supplemental	Yes <sup>2</sup>	
850.1300	Freshwater invertebrate – life cycle test	413862-01	Acceptable	No	
		05008271	Acceptable		
850.1350	Estuarine/marine invertebrates – life cycle test	Not submitted	Not applicable	Yes <sup>2</sup>	

**Table 7.3. Available Ecological Effects Data for Aquatic Animals Exposed to Trifluralin and Remaining Data Gaps**

Guideline	Description	MRID	Classification	Data Gap?	Comments
850.1735	Freshwater invertebrate – acute whole sediment	Not submitted	Not applicable	Yes <sup>4</sup>	
850.1740	Estuarine/marine invertebrate – acute whole sediment	Not submitted	Not applicable	Yes <sup>4</sup>	
Non-guideline	Freshwater and estuarine/marine invertebrate – chronic whole sediment	Not submitted	Not applicable	Yes <sup>5</sup>	

<sup>5</sup>Three species required using the following study guidance: 1) EPA 600/R-99/064 Test Method 100.4: *Hyaella azteca* 42-d Test for Measuring the Effects of Sediment Associated Contaminants on Survival, Growth, and Reproduction; 2) EPA 600/R-99/064 Test Method 100.5: Life-cycle Test for Measuring the Effects of Sediment-associated Contaminants on *Chironomus dilutus* or *C. tentans* in USEPA 2000 Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates; 3) *Leptocheirus plumulosus* in USEPA 2001 Method for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-associated Contaminants with the Amphipod *Leptocheirus plumulosus* EPA 600/R-01/020.

Protocols should be submitted for approval prior to testing for chronic studies. The preferred sediment is formulated; guidance for the formulated sediment can be found in OECD 218 Sediment-Water Chironomid Toxicity Test using Spiked Sediment. Based on test variability for the endpoints of concern and the need to establish a NOAEC/LOAEC, the following number of replicates and test animals are recommended: for the midge test with *C. dilutus*: 16 replicates containing 12 test organisms each (12 replicates at test initiation; 4 added at 10 days for auxiliary males); for the freshwater amphipod test with *H. azteca*: 12 replicates per treatment (4 for 28-d survival and growth and 8 for the remainder of the test) with 10 neonates per replicate; and for the *L. plumulosus*: 10 replicates per treatment with 20 neonates per replicate. For alternative test designs, the protocol should discuss the power of the test.

**Table 7.4. Available Ecological Effects Data for Plants Exposed to Trifluralin and Remaining Data Gaps**

Guideline	Description	MRID	Classification	Data Gap?	Comments
850.4225	Terrestrial Plant toxicity: Tier II seedling emergence	439844-01	Supplemental	Yes <sup>1</sup>	<sup>1</sup> Study measured fresh weights instead of dry weights, and a cotton endpoint could not be determined.
850.4250	Terrestrial Plant toxicity: Tier II vegetative vigor	419345-03	Supplemental	Yes <sup>2</sup>	<sup>2</sup> Study was conducted with technical grade active ingredient rather than typical end-use product, fresh weights were measured rather than dry weights, and several NOAECs were not definitive.
850.5400	Aquatic Plant Growth: algae	419345-02 428341-01 428341-02 428341-03	Supplemental Acceptable Supplemental Acceptable	Yes <sup>3</sup>	<sup>3</sup> A NOAEC was not established due to effects occurring at the lowest concentration tested for the following species: <i>Pseudokirchneriella subcapitata</i> , <i>Navicula pelliculosa</i> , and <i>Lemna gibba</i> .
850.4400	Aquatic Plant Growth: vascular plants	428341-04	Supplemental	Yes <sup>3</sup>	

*Avian Acute Oral Toxicity (OCSPP 850.2100)*

Acceptable acute avian oral toxicity data were submitted for exposures of bobwhite quail, mallard duck, and pheasant to trifluralin; however, data are not available for passerines, which are required under 40 CFR Part 158 (October 26, 2007) data requirements for conventional pesticides (72 FR 60934; U.S. EPA, 2007d). The Part 158 data requirements specify that acute avian oral toxicity data be submitted for either a mallard duck or bobwhite quail and a passerine species. Therefore, an avian oral toxicity test is required for passerine birds. A passerine study protocol should be submitted for review by EFED prior to initiation of this study.

*Freshwater Fish Acute Toxicity (OCSPP 850.1075)*

The available acute freshwater fish studies were classified as supplemental since nominal concentrations were reported, and there is uncertainty in the true toxicity value since trifluralin has the tendency to volatilize and sorb to surfaces. Therefore, EFED recommends requesting additional acute toxicity studies for two warm water species (bluegill sunfish and fathead minnow) and one cold water (rainbow trout) species. While the bluegill sunfish is likely to be more sensitive to trifluralin compared to the fathead minnow, the most sensitive chronic study utilized the fathead minnow; therefore, an acute study is also necessary for the fathead minnow to enable toxicity comparisons.

*Estuarine/Marine Fish Acute & Chronic Toxicity (OCSPP 850.1075 & 850.1400)*

No data were submitted that evaluate the acute effects of trifluralin on estuarine/marine fish. A study was submitted that evaluated chronic effects of trifluralin on estuarine/marine fish, but a NOAEC could not be established due to observed effects at the lowest concentration tested. In addition, insufficient data was submitted for a full review. Because the registered use patterns permit trifluralin to enter estuarine/marine environments, these data are required under 40 CFR Part 158. Therefore, EFED recommends that an estuarine/marine fish acute toxicity test and an estuarine/marine fish early-life stage toxicity test be requested.

*Estuarine/Marine Invertebrates Acute & Chronic Toxicity (OCSPP 850.1025, 850.1035 & 850.1350)*

No data were submitted that evaluate the acute effects of trifluralin on oyster shell deposition or the chronic effects of trifluralin on the life cycle of estuarine/marine invertebrates. In addition, the acute effects of trifluralin to the mysid are uncertain because the available study did not test sufficiently high concentrations (study in review). Because the registered use patterns permit trifluralin to enter estuarine/marine environments, these data are required under 40 CFR Part 158, and EFED recommends them for request.

*Freshwater & Estuarine/Marine Sediment-dwelling Invertebrates Acute & Chronic Toxicity (OCSPP 850.1735, 850.1740, and Non-guideline)*

Because aquatic metabolism studies were not submitted, it is currently not possible to determine if acute studies for sediment-dwelling invertebrates are necessary. If the aquatic metabolism studies show half-lives of  $\leq 10$  days, then freshwater and estuarine/marine acute studies are recommended for request because of trifluralin's tendency to sorb to sediment ( $K_d \geq 50$ ,  $\log K_{ow} \geq 3$ , and  $K_{oc} \geq 1000$ ). Chronic toxicity studies for freshwater and estuarine/marine sediment-dwelling invertebrates are recommended for request because the aerobic soil metabolism half-life is  $> 10$  days, the  $K_d \geq 50$ , the  $\log K_{ow} \geq 3$ , and the  $K_{oc} \geq 1000$ .

*Terrestrial Plant Toxicity (OCSPP 850.4225 & 850.4250)*

The Tier II vegetative vigor study was conducted using the technical grade active ingredient (TGAI) instead of a typical end-use product (TEP), and several NOAECs could not be determined. Therefore, a Tier II vegetative vigor study utilizing a TEP is recommended for request. In addition, for both the vegetative vigor and seedling emergence studies, fresh weights were measured rather than dry weights. In the seedling emergence study, an endpoint for cotton could not be determined. To reduce uncertainty, EFED recommends requesting a Tier II seedling emergence study conducted with a TEP that measures dry weights.

*Aquatic Plant Toxicity (OCSPP 850.4400 & 850.5400)*

A NOAEC was not observed in the vascular aquatic plant (*Lemna gibba*) study because effects were observed at the lowest concentration tested. In order to be protective of vascular plant species in the event that any are listed in the future, EFED recommends requesting an additional vascular plant study in order to establish a NOAEC. Similarly, NOAECs could not be calculated

for the non-vascular aquatic plants *Navicula pelliculosa* and *Pseudokirchneriella subcapitata*. In addition, problems with the study design prevent the *Pseudokirchneriella subcapitata* study from being used quantitatively. Therefore, EFED recommends requesting additional studies for these species.

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## Appendix A. Fate Bibliography

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- 41781901 Decker, O. (1990) Field Dissipation of Trifluralin Following Application of Treflan to Alfalfa Stubble: Lab Project Number: AAC8805. Unpublished study prepared by DowElanco. 187 p.
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## Appendix B. Effects Bibliography

### 71-1 Avian Single Dose Oral Toxicity

MRID	Citation Reference
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137573	Cochrane, R.; Hudson, H.; Emmerson, J.; et al. (1983) The Toxicity of Trifluralin (Compound 36352) to Bobwhite in a Fourteen-day Acute Oral Study: Study A02383. (Unpublished study received Feb 16, 1984 under 1471-70; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:252411-A)
40334701	Grimes, J.; Jaber, M. (1986) Trifluralin: An Acute Oral Toxicity Study with the Bobwhite: Final Report: Project No. 201-109. Unpublished study prepared by Wildlife International Ltd. 19 p.
40633803	Roberts, N.; Fairley, C. (1987) The Acute Oral Toxicity (LD50) of Triflurex Technical to the Bobwhite Quail: Report ID: ALP 2BT/87348. Unpublished study prepared by Huntingdon Research Centre Ltd. 37 p.

### 71-2 Avian Dietary Toxicity

MRID	Citation Reference
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40334702	Grimes, J.; Jaber, M. (1987) Trifluralin: A Dietary LC50 Study with the Mallard: Project No. 201-108. Unpublished study prepared by Wildlife International Ltd. 17 p.
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#### 71-4 Avian Reproduction

MRID	Citation Reference
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131134	Fink, R.; Beavers, J.; Brown, R. (1979) One-generation Reproduction Study--Bobwhite Quail: Compound 36352, Trifluralin: Project No. 151-102. Final rept. (Unpublished study received Sep 20, 1983 under 1471-70; prepared by Wildlife International Ltd., submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:251256-C)
40334704	Beavers, J.; Dukes, V.; Jaber, M. (1987) Trifluralin Technical: A One-generation Reproduction Study with the Mallard ( <i>Anas platyrhynchos</i> ): Project No. 228-102. Unpublished study prepared by Wildlife International Ltd. 90 p.
40334706	Beavers, J.; Dukes, V.; Jaber, M. (1987) Trifluralin Technical: A One-generation Reproduction Study with the Bobwhite ( <i>Colinus virginianus</i> ): Project No. 228-101. Unpublished study prepared by Wildlife International Ltd. 89 p.

#### 72-1 Acute Toxicity to Freshwater Fish

MRID	Citation Reference
58737	Worth, H.M.; Anderson, R.C. (1965) Toxicological studies with Trifluralin and Metabolites. <i>Pharmacologist</i> (Fall):150. (Also ~In~unpublished submission received 1965 under unknown admin. no.; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:130520-A)
76446	Worth, H.M.; Kehr, C.C., Carrel, J.P.; et al. (1966) Single Dose Studies with Trifluralin. (Unpublished study received Nov 17, 1966 under 7F0555; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:090692-C)
83649	Elanco Products Company (19??) Single Dose Effects. (Unpublished study received Nov 13, 1966 under 7F0555; CDL:090691-F)
91282	Worth, H.M. (1966) Trifluralin Toxicology: Status of Studies. (Unpublished study received Jun 1, 1966 under 6F0493; submitted by Elanco Products Co.,

Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:090566-A)

- 104847 West, H. (19??) The Acute Toxicity of HO46 to Goldfish: Study F-0-10-70. (Unpublished study received Jan 20, 1971 under 1471- 81; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:128701-A)
- 105709 Hill, R. (1964) Letter sent J. Leary dated Nov 11, 1964: Treflan E.C. (Unpublished study received Nov 11, 1964 under 1471-35; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:100792-A)
- 105736 Parka, S.; Worth, H. (1965) The Effects of Trifluralin to Fish. (Unpublished study received on unknown date under unknown admin. no.; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:110449-A)
- 105761 Elanco Products Co. (1963) Fish Toxicity: ?Trifluralin|: Experiment No. A-19. (Unpublished study received Sep 19, 1963 under 1471-35; CDL:120368-B)
- 105763 Elanco Products Co. (1965) Fish Toxicity Questions about Trefmid. (Compilation; unpublished study received May 16, 1968 under 1471-EX-28; CDL:126677-A)
- 105766 Elanco Products Co. (19??) ?Toxicity of Trifluralin on Fish|. (Un- published study received 1963 under unknown admin. no.; CDL: 130298-B)
- 105767 Hill, R. (1964) Letter sent to J. Leary dated Nov 11, 1964: Treflan E.C. (Unpublished study received Nov 11, 1964 under 1471-35; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:131122-A)
- 105768 West, H. (19??) The Acute Toxicity of HO46 to Goldfish: Study F-O- 10-70. (Unpublished study received Jan 20, 1971 under 1471-81; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:131125-A)
- 105769 West, H. (19??) The Acute Toxicity of Treflan 5G to Goldfish (Granules, 5% Active): Study F-O-10-70. (Unpublished study received Jan 20, 1971 under 1471-59; submitted by Elanco Prod- ucts Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL: 131126-A)
- 105778 Elanco Products Co. (1964) ?Toxicity of Treflan to Rainbow Trout and Bluegills|. (Compilation; unpublished study received Oct 8, 1964 under unknown admin. no.; CDL:128553-A)
- 108273 West, H. (19??) The Acute Toxicity of HO51, Preen, to Goldfish: Study F-O- 10-70. (Unpublished study received Jan 20, 1971 under 1471-21; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:131124-A)
- 124897 Worth, H.; Small, R.; Harris, P.; et al. (1966) The Toxicology of Some Metabolites of Trifluralin: Pre-RPAR Review Submission #3. (Unpublished study received Sep 14, 1977 under 1471-35; sub- mitted by Elanco Products Co., Div. of Eli Lilly and Co., In- dianapolis, IN; CDL:233222-G)

- 155974 Francis, P.; Jordan, W.; Grothe, D. (1985) Vertebral Column Lesions and Tissue Residues in Brown Trout (*Salmo trutta*) Exposed to Trifluralin for 24 Hours: Study F10883. Unpublished study prepared by Lilly Research Laboratories. 90 p.
- 155975 Francis, P.; Jordan, W. (1985) The Effect of Spinal Transection on the Occurrence of Vertebral Lesions in Brown Trout (*Salmo trutta*) Exposed to Trifluralin: Study F00385. Unpublished study prepared by Lilly Research Laboratories. 59 p.
- 165223 Elanco Products Co. (1970) Fish Toxicity: [Trifluralin and Its Formulations]. Unpublished compilation. 50 p.

## 72-2 Acute Toxicity to Freshwater Invertebrates

MRID	Citation Reference
114493	Walker, C. (1971) The toxicological effects of herbicides and weed control on fish and other organisms in the aquatic ecosystem. By U.S. Fish and Wildlife Service, Div. of Fishery Research, Branch of Pest Control Research. Pages 119-126, In Proc. Eur. Weed Res. Coun. 3rd Int. Symp. Aquatic Weeds; 1971. ?S.l.: s.n.]. (Also In unpublished submission received Jul 9, 1975 under 1F1105; submitted by Pennwalt Corp., Tacoma, WA; CDL: 094702-I)
45205102	Huckins, J.; Petty, J.; England, D. (1986) Distribution and impact of trifluralin, atrazine, fonofos residues in microcosms simulating a northern prairie wetland. <i>Chemosphere</i> 15(5):563-588.

## 72-3 Acute Toxicity to Estuarine/Marine Organisms

MRID	Citation Reference
127865	Armstrong, D.; Buchanan, D.; Caldwell, R. (1976) A mycosis caused by lagenidium sp. in laboratory-reared larvae of the dungeness crab, cancer magister, and possible chemical treatments. <i>Journal of Invertebrate Pathology</i> 28:329-336. (Also In unpublished submission received Apr 21, 1983 under 677-313; submitted by Diamond Shamrock Agricultural Chemicals, Cleveland, OH; CDL: 071552-D)
165225	Millemann, R.; Caldwell, C. (1975) Biological Effects of Pesticides on the Dungeness Crab. P. 4, 5a, 5b, 26, 28, and 33 of the above report of Contract No. 68-01-0188 prepared for EPA by Oregon State Univ., Dept. of Fisheries and Wildlife.
40674801	Adams, E.; Grothe, D. (1988) Acute Toxicity of Trifluralin to the Grass Shrimp ( <i>Palaemonetes pugio</i> ) in a Flow-through Test System: Laboratory Project ID: C01687. Unpublished study prepared by Lilly Research Laboratories. 32 p.
42449901	Parrish, P.; Dyer, E.; Enos, J.; et al. (1978) Chronic Toxicity of Chlordane,

Trifluralin, and Pentachlorophenol to Sheepshead Minnows (*Cyprinodon variegatus*): Lab Project Number: EPA-600/3-78-010. Unpublished study prepared by EG&G Bionomics 69 p.

42449902 Liu, D.; Lee, J. (1975) Toxicity of Selected Pesticides to the Bay Mussel (*Mytilus edulis*): Lab Project Number: EPA-660/3-75-016. Unpublished study prepared by Stanford Research Institute. 114 p.

#### 72-4 Fish Early Life Stage/Aquatic Invertebrate Life Cycle Study

MRID	Citation Reference
24296	Lawrence, J.M. (1965) Effects of Soil Applied Trifluralin on Fish Production in Pools. (Unpublished study received Apr 11, 1967 under unknown admin. no.; prepared by Auburn Univ., Agricultural Experiment Station, submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:107495-B)
24872	Lawrence, J.M. (1966) ?Toxicity of Trifluralin to Fish . (Unpub- lished study including published data, received 1975 under 2G1285; prepared in cooperation with Auburn Univ., Alabama Agri- cultural Experiment Station, submitted by Union Carbide Agricul- tural Products Co., Ambler, Pa.; CDL:095154-F)
24873	Parka, S.J.; Worth, H.M. (1965) The effects of Trifluralin to fish. Proceedings of the Southern Weed Conference 18:469-470. (Incom- plete study; also~In~unpublished submission received 1975 under 2G1285; submitted by Union Carbide Agricultural Products Co., Ambler, Pa.; CDL:095154-H)
27401	Christensen, C.; Rogers, W.; Colbert, F.; et al. (1976) Sward^(TM)I 50W for Preemergence Control of Annual Grasses and Some Broad- leaf Weeds in Mature Turfgrasses. (Unpublished study received Aug 12, 1976 under 1471-106; prepared in cooperation with Univ. of Florida, submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:224918-A)
29839	U.S. Fish and Wildlife Service (1964) Laboratory Studies. (Unpub- lished study received on unknown date under unknown admin. no.; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:131189-C)
53775	Worth, H.M.; Gibson, W.R.; Anderson, R.C. (1965) The Acute Toxicity of Benefin. (Unpublished study received Feb 1, 1966 under 7F0514; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:090606-C)
81054	Worth, H.M.; Harris, P.N.; Small, R.M.; et al. (1964) The Toxicolo- gy of Trifluralin. Progress rept. (Unpublished study received Mar 31, 1964 under 1471-35; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:100816-A)
105688	Holzer, F. (1966) Trifluralin: Fish Toxicity Experiments. (Unpub- lished study received May 24, 1966 under 6F0493; submitted by Elanco Products Co., Div.

of Eli Lilly and Co., Indianapolis, IN; CDL:092781-B)

- 40452601 Forbis, A. (1987) Chronic Toxicity of ?Carbon 14|-Dylox to Daphnia magna under Flow-through Test Conditions: ABC Final Report # 35738. Unpublished Mobay study no. 95075 prepared by Analytical Bio-Chemistry Laboratories, Inc. 291 p.
- 41386201 Grothe, D.; Mohr, R. (1990) The Chronic Toxicity of Trifluralin to Daphnia magna in a Static Renewal Life-Cycle Test: Lab Project Number: CO1589. Unpublished study prepared by Lilly Research Laboratories. 78 p.
- 41386202 Adams, E.; Cocke, P.; Gunnoe, M. (1990) The Toxicity of Trifluralin to Rainbow Trout (*Salmo gairdneri*) in a 48-Day Early Life- stage Study: Lab Project Number: FO2489. Unpublished study prepared by Lilly Research Laboratories. 86 p.
- 42439601 Meyerhoff, R. ; Gunnoe, M. (1992) The Toxicity of Trifluralin to Fathead Minnow (*Pimephales promelas*) in a 35-Day Vertebral Lesion Study: Lab Project Number: F00890. Unpublished study prepared by Lilly Research Laboratories. 148 p.

## 72-7 Simulated or Actual Field Testing

MRID	Citation Reference
24872	Lawrence, J.M. (1966) ?Toxicity of Trifluralin to Fish . (Unpub- lished study including published data, received 1975 under 2G1285; prepared in cooperation with Auburn Univ., Alabama Agri- cultural Experiment Station, submitted by Union Carbide Agricul- tural Products Co., Ambler, Pa.; CDL:095154-F)
105736	Parka, S.; Worth, H. (1965) The Effects of Trifluralin to Fish. (Unpublished study received on unknown date under unknown admin. no.; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:110449-A)
105763	Elanco Products Co. (1965) Fish Toxicity Questions about Trefmid. (Compilation; unpublished study received May 16, 1968 under 1471-EX-28; CDL:126677-A)
145029	Probst, G. (1984) Ecological Effects Field Monitoring Study: Tri- fluralin: Interim Report. Unpublished study prepared by Elanco Products Co. 25 p.
165223	Elanco Products Co. (1970) Fish Toxicity: [Trifluralin and Its Formulations]. Unpublished compilation. 50 p.
5001497	Sanders, H.O. (1970) Toxicities of some herbicides to six species of freshwater crustaceans. <i>Journal of the Water Pollution Control Federation</i> 42(8):1544-1550.
40809601	Meyerhoff, R.; Francis, P. (1988) Environmental Safety Assessment for the Agricultural Use of Trifluralin: Laboratory Project ID: EA0188. Unpublished study prepared by Lilly Research Labora- tories. 147 p.

42705401 Kordel, W. (1992) Review of the Available Data for Estimating Potential Damage to Aquatic Ecosystems Caused by the Use of Trifluralin: Lab Project Number: GHE-P 2915. Unpublished study prepared by Fraunhofer Institute for Environmental Chemistry and Ecotoxicology. 51 p.

**122-1 Seed Germination/Seedling Emergence and Vegetable Vigor**

MRID	Citation Reference
141258	Wright, W. (1964) Factors Influencing the Herbicidal Activity of Trifluralin in the Soil. Abstracted in Dissertation Abstracts XXV(2):199-201. Available from University Microfilms, Inc., Ann Arbor, MI, 64-8729.
142367	Hollist, R.; Foy, C. (1971) Trifluralin interacts with soil constituents. Weed Science 19(1):11-16.
41934501	Waldrup, T. (1990) Influence of Trifluralin on the Germination of Seeds of Ten Plant Species: Lab Project Number: 61990002. Unpublished study prepared by DowElanco. 13 p.

**122-2 Aquatic plant growth**

MRID	Citation Reference
41386203	Adams, E.; Cocke, P. (1990) Toxicity of Trifluralin to a Freshwater Green Alga ( <i>Selenastrum capricornutum</i> ) in a Static Test System: Lab Project Number: J00989. Unpublished study prepared by Lilly Research Laboratories. 43 p.
41934502	Adams, E.; Cocke, P. (1990) Toxicity of Trifluralin to a Freshwater Green Alga ( <i>Selenastrum capricornutum</i> ) in a Static Test System: Lab Project Number: J00989. Unpublished study prepared by Lilly Research Labs. 43 p.
45088212	Fairchild, J.; Ruessler, D.; Haverland, P. et al. (1996) Comparative Sensitivity of <i>Selenastrum capricornutum</i> and <i>Lemna minor</i> to Sixteen Herbicides. Archives of Environmental Contamination and Toxicology 32:353-357.

**123-1 Seed germination/seedling emergence and vegetative vigor**

MRID	Citation Reference
41934503	Waldrup, T. (1990) Influence of Trifluralin Postemergence Spray on the Vegetative Vigor of Ten Plant Species: Lab Project Number: 61990003. Unpublished study prepared by DowElanco. 19 p.
41934504	Waldrup, T. (1989) Influence of Trifluralin Preemergence Spray on Seedling Emergence and Vegetative Vigor of Ten Plant Species: Lab Project Number: 61990004. Unpublished study prepared by DowElanco. 23 p.

- 42695601 Schwab, D. (1993) Evaluating the Effects of Trifluralin on the Germination of Non-Target Terrestrial Plants: Lab Project Number: 40619. Unpublished study prepared by ABC Laboratories, Inc. 42 p.
- 43984401 Hansen, J.; Amaral, N.; Wright, J. (1996) Evaluating the Effects of Trifluralin on the Emergence and Early Seedling Growth of Non-Target Terrestrial Plants: Lab Project Number: RES95143: 95.296. Unpublished study prepared by Plant Sciences, Inc. and PTRL West, Inc. 146 p.

## 123-2 Aquatic plant growth

MRID	Citation Reference
42834101	Hughes, J.; Williams, T. (1993) The Toxicity of Trifluralin to <i>Skeletonema costatum</i> : Lab Project Number: DR-0055-6503: ES-2654: B460-153-3. Unpublished study prepared by Malcolm Pirnie, Inc. 36 p.
42834102	Hughes, J.; Williams, T. (1993) The Toxicity of Trifluralin to <i>Navicula pelliculosa</i> : Lab Project Number: B460-153-2: DR-0055-6503: ES-2655. Unpublished study prepared by Malcolm Pirnie, Inc. 36 p.
42834103	Hughes, J.; Williams, T. (1993) The Toxicity of Trifluralin to <i>Anabaena flos-aquae</i> : Lab Project Number: B460-153-1: DR-0055-6503: ES-2656. Unpublished study prepared by Malcolm Pirnie, Inc. 36 p.
42834104	Milazzo, D.; Servinski, M.; Brown, R.; et al. (1993) Trifluralin Technical Grade 95%: Toxicity to the Aquatic Plant, Duckweed, <i>Lemna gibba</i> L. G-3: Lab Project Number: DECO-ES-2653. Unpublished study prepared by Malcolm Pirnie, Inc. 32 p.
45020005	Kosinski, R. (1984) The Effect of Terrestrial Herbicides on the Community Structure of Stream Periphyton. <i>Environmental Pollution (Series A)</i> 36:165-189.
45020006	Kosinski, R.; Merkle, M. (1984) The Effect of Four Terrestrial Herbicides on the Productivity of Artificial Stream Algal Communities. <i>Journal Environmental Qual.</i> 13(1):75-82.

## 141 Non Target Insect- Honeybee

MRID	Citation Reference
00028772	University of California study – not listed in OPPIN – reviewed by Al Vaughan
05001991	Stevenson, J.H. 1978. Acute Toxicity of unformulated pesticides to worker honeybees.

## Appendix C. Data Call-In Justification Tables

The Environmental Fate and Effects Division (EFED) has completed Data Call-In (DCI) justification tables for the trifluralin environmental fate and effects data gaps (non-guideline studies) identified in the problem formulation phase of registration review. The following DCI tables provide rationale for requiring the data, an explanation of how the data will be used, and a brief description of how the data could impact the Agency's future decision-making.

### Environmental Effects Data:

<b>Guideline Number: Non-guideline<sup>1</sup></b> <b>Study Title: Freshwater and Estuarine/Marine Invertebrate Chronic Whole Sediment Toxicity Tests</b>
<b>Rationale for Requiring the Data</b>
Chronic toxicity data for trifluralin are not available for sediment-dwelling freshwater and estuarine/marine invertebrates. Since the current use patterns permit trifluralin to enter aquatic environments, these data are required under the 40 CFR Part 158 (Oct. 26, 2007). Trifluralin's chemical properties trigger the requirement for sediment toxicity studies (the aerobic soil metabolism half-life is > 10 days, the $K_d \geq 50$ , the $\log K_{ow}$ is $\geq 3$ , and the $K_{oc}$ is $\geq 1000$ ).
<b>Practical Utility of the Data</b>
<b>How will the data be used?</b> Chronic sediment toxicity data for freshwater and estuarine/marine invertebrate species will be used to refine the screening-level assessment by determining whether there are potential risks to sediment-dwelling invertebrates inhabiting freshwater and estuarine/marine environments from the use of trifluralin. If sediment toxicity data are not submitted for freshwater and estuarine/marine invertebrates, risk will be assumed for all sediment-dwelling invertebrates in freshwater and estuarine/marine environments potentially exposed to trifluralin.
<b>How could the data impact the Agency's future decision-making?</b> If future endangered species risk assessments are performed without these data, the Agency would have to assume that trifluralin "may affect" listed freshwater and estuarine/marine invertebrate species directly (and listed species from other taxa indirectly), and use of trifluralin and its formulated products may need to be restricted in areas where listed species could be exposed. The lack of these data will limit the flexibility the Agency and registrants have in coming into compliance with the Endangered Species Act and could result in use restrictions for trifluralin use that are unnecessarily severe.

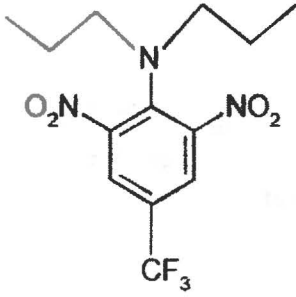
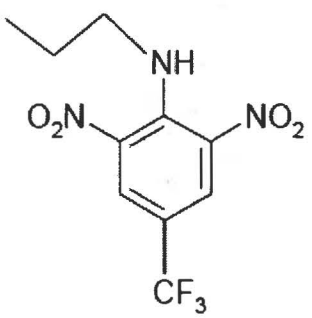
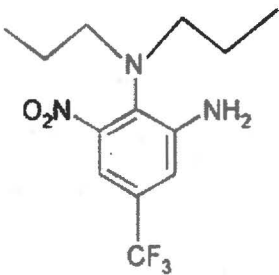
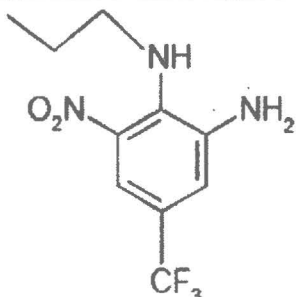
**Guideline Number: Non-guideline<sup>1</sup>**

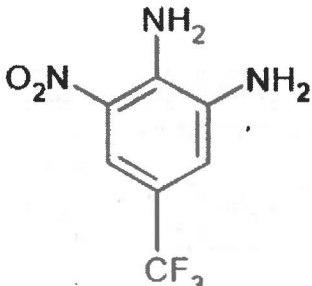
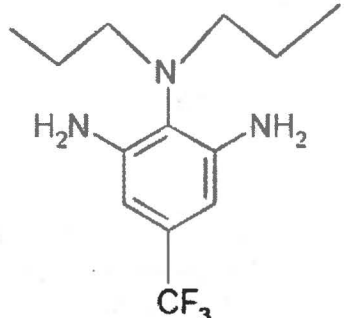
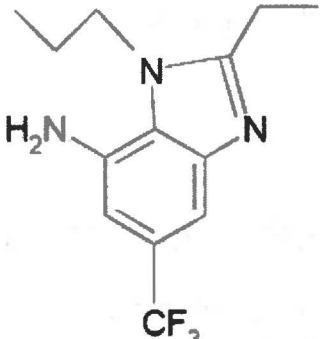
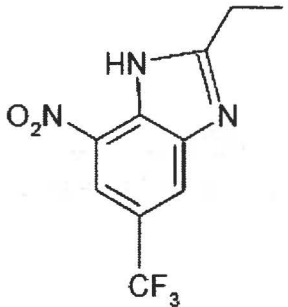
**Study Title: Freshwater and Estuarine/Marine Invertebrate Chronic Whole Sediment Toxicity Tests**

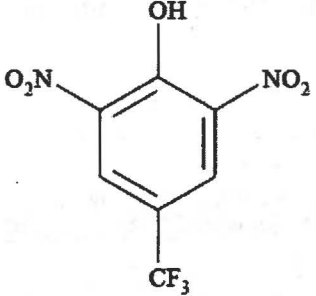
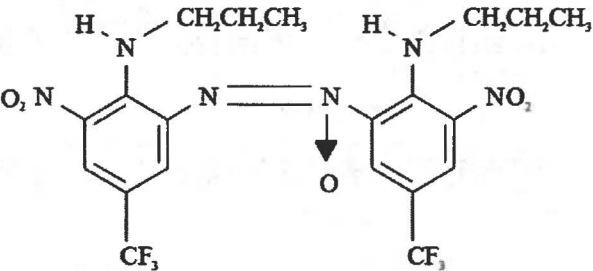
<sup>1</sup>Three species required for chronic test using the following study guidance: 1) EPA 600/R-99/064 Test Method 100.4: *Hyalella azteca* 42-d Test for Measuring the Effects of Sediment Associated Contaminants on Survival, Growth, and Reproduction; 2) EPA 600/R-99/064 Test Method 100.5: Life-cycle Test for Measuring the Effects of Sediment-associated Contaminants on *Chironomus dilutus* or *C. tentans* in USEPA 2000 Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates; 3) *Leptocheirus plumulosus* in USEPA 2001 Method for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-associated Contaminants with the Amphipod *Leptocheirus plumulosus* EPA 600/R-01/020.

Protocols should be submitted for approval prior to testing for chronic studies. The preferred sediment is formulated; guidance for the formulated sediment can be found in OECD 218 Sediment-Water Chironomid Toxicity Test using Spiked Sediment. Based on test variability for the endpoints of concern and the need to establish a NOAEC/LOAEC, the following number of replicates and test animals are recommended: for the midge test with *C. dilutus*: 16 replicates containing 12 test organisms each (12 replicates at test initiation; 4 added at 10 days for auxiliary males); for the freshwater amphipod test with *H. azteca*: 12 replicates per treatment (4 for 28-d survival and growth and 8 for the remainder of the test) with 10 neonates per replicate; and for the *L. plumulosus*: 10 replicates per treatment with 20 neonates per replicate. For alternative test designs, the protocol should discuss the power of the test.

Appendix D. The Molecular Structures of Trifluralin and its Degradates

Table A.1 Identification of Compounds in Plant and Animal Metabolism Study		
Common Name/Code	Chemical Name	Chemical Structure
Trifluralin	$\alpha,\alpha,\alpha$ -trifluoro-2,6-dinitro- <i>N,N</i> -dipropyl- <i>p</i> -toluidine	
TR-2	$\alpha,\alpha,\alpha$ -trifluoro-2,6-dinitro-Npropyl- <i>p</i> -toluidine 2,6-dinitro-Npropyl-4-trifluoromethylbenzenamine	
TR-4 <sup>1</sup>	$\alpha,\alpha,\alpha$ -trifluoro-5-nitro-N4,N4-dipropyl-toluene-3,4-diamine	
TR-5	$\alpha,\alpha,\alpha$ -trifluoro-5-nitro-propyltoluene-3,4-diamine	

<b>TR-6</b>	5-trifluoromethyl-3-nitro-1,2-benzenediamine	
<b>TR-7</b>	$\alpha,\alpha,\alpha$ -trifluoro-N4,N4-dipropyltoluene-3,4,5-triamine	
<b>TR-14</b>	7-amino-2-ethyl-1-propyl-5-(trifluoromethyl)benzimidazole	
<b>TR-15</b>	2-ethyl-7-nitro-5-trifluoromethylbenzimidazole	

<p>TR-20</p>	<p>TR-20 <i>α,α,α-trifluoro-2,6-dinitro-p-cresol</i></p>	
<p>TR-28</p>	<p>TR-28 <i>2,2'azoxybis( , , -trifluoro-6-nitro-N-propyl-p-toluidine</i></p>	

<sup>1</sup> Bolded degradates are major metabolites of trifluralin

## Appendix E. SIP Inputs and Outputs

**Table 1. Inputs**

Parameter	Value
Chemical name	trifluralin
Solubility (in water at 25°C; mg/L)	0.3
Mammalian LD <sub>50</sub> (mg/kg-bw)	5000
Mammalian test species	laboratory rat
Body weight (g) of "other" mammalian species	
Mammalian NOAEL (mg/kg-bw)	10
Mammalian test species	laboratory rat
Body weight (g) of "other" mammalian species	
Avian LD <sub>50</sub> (mg/kg-bw)	2000
Avian test species	mallard duck
Body weight (g) of "other" avian species	
Mineau scaling factor	1.15
Mallard NOAEC (mg/kg-diet)	500
Bobwhite quail NOAEC (mg/kg-diet)	1000
NOAEC (mg/kg-diet) for other bird species	
Body weight (g) of other avian species	
NOAEC (mg/kg-diet) for 2nd other bird species	
Body weight (g) of 2nd other avian species	

**Table 2. Mammalian Results**

Parameter	Acute	Chronic
Upper bound exposure (mg/kg-bw)	0.0516	0.0516
Adjusted toxicity value (mg/kg-bw)	3845.8028	7.6916
Ratio of exposure to toxicity	0.0000	0.0067
Conclusion*	<b>Drinking water exposure alone is NOT a potential concern for mammals</b>	<b>Drinking water exposure alone is NOT a potential concern for mammals</b>

**Table 3. Avian Results**

Parameter	Acute	Chronic
Upper bound exposure (mg/kg-bw)	0.2430	0.2430
Adjusted toxicity value (mg/kg-bw)	1038.4508	24.8063
Ratio of exposure to acute toxicity	0.0002	0.0098
Conclusion*	<b>Drinking water exposure alone is NOT a potential concern for birds</b>	<b>Drinking water exposure alone is NOT a potential concern for birds</b>

\*Conclusion is for drinking water exposure alone. This does not combine all routes of exposure. Therefore, when aggregated with other routes (*i.e.*, diet, inhalation, dermal), pesticide exposure through drinking water may contribute to a total exposure that has potential for effects to non-target animals.

## Appendix F. The Risk Quotient Method and Levels of Concern

The Risk Quotient Method is the means used by EFED to integrate the results of exposure and ecotoxicity data. For this method, Risk Quotients (RQs) are calculated by dividing exposure estimates by the acute and chronic ecotoxicity values (*i.e.*,  $RQ = EXPOSURE/TOXICITY$ ). These RQs are then compared to OPP's levels of concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. EFED has defined LOCs for acute risk, potential restricted use classification, and for endangered species.

The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on non-target organisms. LOCs currently address the following risk presumption categories:

- (1) acute - there is a potential for acute risk; regulatory action may be warranted in addition to restricted use classification;
- (2) acute restricted use - the potential for acute risk is high, but this may be mitigated through restricted use classification;
- (3) acute endangered species - the potential for acute risk to endangered species is high, regulatory action may be warranted; and
- (4) chronic risk - the potential for chronic risk is high, regulatory action may be warranted.

Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to non-target insects, or chronic risk from granular/bait formulations to mammalian or avian species.

The ecotoxicity test values (*i.e.*, measurement endpoints) used in the acute and chronic RQs are derived from required studies. Examples of ecotoxicity values derived from short-term laboratory studies that assess acute effects are: (1) LC50 (fish and birds), (2) LD50 (birds and mammals), (3) EC50 (aquatic plants and aquatic invertebrates), and (4) EC25 (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) the Lowest Observed Adverse Effect Concentration (LOAEC) (birds, fish, and aquatic invertebrates), and (2) the No Observed Adverse Effect Concentration (NOAEC) (birds, fish and aquatic invertebrates). The NOAEC is generally used as the ecotoxicity test value in assessing chronic effects. Risk presumptions, along with the corresponding RQs and LOCs are summarized in **Table F-1**.

**Table F-1. Agency risk quotient (RQ) metrics and levels of concern (LOC) per risk class.**

Risk Class	Risk Description	RQ	LOC
<b>Aquatic Animals (fish and invertebrates)</b>			
Acute	Potential for effects to non-listed animals from acute exposures	Peak EEC/LC <sub>50</sub> <sup>1</sup>	0.5
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	Peak EEC/LC <sub>50</sub> <sup>1</sup>	0.1
Acute Listed Species	Listed species may be potentially affected by acute exposures	Peak EEC/LC <sub>50</sub> <sup>1</sup>	0.05
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	60-day EEC/NOEC (fish)	1
		21-day EEC/NOEC (invertebrates)	
<b>Terrestrial Animals (mammals and birds)</b>			
Acute	Potential for effects to non-listed animals from acute exposures	EEC <sup>2</sup> /LC <sub>50</sub> (Dietary)	0.5
		EEC/LD <sub>50</sub> (Dose)	
Acute Restricted Use	Potential for effects to animals from acute exposures Risks may be mitigated through restricted use classification	EEC <sup>2</sup> /LC <sub>50</sub> (Dietary)	0.2
		EEC/LD <sub>50</sub> (Dose)	
Acute Listed Species	Listed species may be potentially affected by acute exposures	EEC <sup>2</sup> /LC <sub>50</sub> (Dietary)	0.1
		EEC/LD <sub>50</sub> (Dose)	
Chronic	Potential for effects to non-listed and listed animals from chronic exposures	EEC <sup>2</sup> /NOAEC	1
<b>Plants</b>			
Non-Listed	Potential for effects to non-target, non-listed plants from exposures	EEC/ EC <sub>25</sub>	1
Listed Plant	Potential for effects to non-target, listed plants from exposures	EEC/ NOEC	1
		EEC/ EC <sub>05</sub>	
<sup>1</sup> LC <sub>50</sub> or EC <sub>50</sub> . <sup>2</sup> Based on upper bound Kenaga values.			

## Appendix G. Trifluralin Incidents

A search for ecological incidents related to trifluralin use, conducted on April 13, 2012, yielded 83 incidents, which are summarized below.

### EIIS Pesticide Summary Report: General Information Trifluralin (036101)

Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
<b>AQUATIC</b>								
<i>FIELD</i>								
I002408-001	7/1/1995		OK	3	MA	EC	Broadcast, unincorporated	UNKNOWN
<i>HOME/LAWN</i>								
I006258-001	1/1/1997		IN	3	MA	N/R	N/R	3
<i>N/R</i>								
I002793-001	5/26/1995	LAFAYETTE	LA	4	MA	EC	ACCIDENTAL SPILL	143
<i>Soybean</i>								
I000254-001	6/12/1991	LUCAS	IA	1	RU	N/R	N/R	ALL
<i>UNDER ASPHALT</i>								
I002215-001	6/1/1995		TX	3	RU	EC	Spray	N/R
<b>PLANTS</b>								
<i>Agricultural Area</i>								
I006171-001			IA	3	UN	N/R	N/R	UNKNOWN
I005880-014		LAFAYETTE	WI	3	MA		Spray	UNKNOWN
I004845-001	1/1/1996		SD	3	RU	N/R	N/R	ALL

Friday, April 13, 2012

Certainty Code: 0=Unrelated, 1=Unlikely, 2=Possible, 3=Probable, 4=Highly Probable.

Legality Code: RU=Registered Use, M=Misuse, MA=Misuse (Accidental), MI=Misuse (Intentional), U=Unknown.

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Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
I003128-001	1/1/1996		MN	3	RU	N/R	N/R	6
I006186-005	1/1/1997		ND	3	RU	N/R	N/R	ALL
I006186-001	1/1/1997		ND	3	RU	N/R	N/R	ALL
I006186-006	1/1/1997		ND	3	RU	N/R	N/R	ALL
I006186-003	1/1/1997		ND	3	RU	N/R	N/R	ALL
I006186-004	1/1/1997		ND	3	RU	N/R	N/R	ALL
I006186-002	1/1/1997		MN	3	RU	N/R	N/R	ALL
I007255-002	4/1/1998		MN	3	RU		N/R	ALL
I007255-001	4/1/1998		ND	3	RU		N/R	ALL
I007755-019	5/15/1998	WILLIAMS	ND	2	RU		PPI/GROUND-BROADCAST	600ACRES
I009518-005	7/1/1999	FRESNO	CA	3	RU	N/R	Broadcast	78 ACRES
<i>ALFALFA</i>								
I003141-001			MI	3	RU			UNKNOWN
I014838-001		Reeves	TX	3	UN		N/R	3200 acres
I009517-002	10/1/1998	TEXAS	OK	3	RU	N/R	CHEMIGATION	ALL
I013636-049	4/23/2002	OWYHEE	ID	3	RU		Broadcast	50 out of 53 acres
<i>Asparagus</i>								
I015278-001	6/20/2003	Malheur	OR	2	RU	EC		67 acres
<i>BARLEY</i>								
I004809-001			ND	3	RU		N/R	UNKNOWN

Friday, April 13, 2012

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Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
I004839-001	1/1/1997		ND	3	RU	N/R	N/R	2
<i>Bean, dry</i>								
I003139-001			CA	3	RU			UNKNOWN
<i>beans</i>								
I000360-014	1/1/1993		MO	2	RU	EC	Soil incorporation	160 AC BEANS
<i>CORN</i>								
I006191-002			IA	3	RU		N/R	UNKNOWN
I006191-001			IL	3	RU		N/R	UNKNOWN
I006198-002			IA	3	RU		N/R	UNKNOWN
I006198-001			SD	3	RU		N/R	UNKNOWN
I006193-001			PA	3	RU		N/R	UNKNOWN
I006191-003			IL	3	RU		N/R	UNKNOWN
I006198-004			IA	3	RU		N/R	UNKNOWN
I000360-009	1/1/1993		IA	2	RU	EC	Soil incorporation	40 AC
I000360-007	1/1/1993		IA	2	RU	EC	Soil incorporation	40 AC
I000360-008	1/1/1993		IA	2	RU	EC	Soil incorporation	56 AC
I000360-006	1/1/1993		IA	2	RU	EC	N/R	150 ACRES
I009517-001	6/15/1999	JASPER	IA	2	RU	N/R	Broadcast	ALL
<i>CORN/SOYBEAN</i>								
I000663-001	7/1/1992	EMMET	IA	3	UN	WDG	Soil incorporation	350 ACRES

Friday, April 13, 2012

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Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
<i>COTTON</i>								
I006198-005			TX	3	RU		N/R	UNKNOWN
<i>dry beans</i>								
I000360-011	1/1/1993		WY	2	RU	EC	Soil incorporation	38 ACRES
I000360-005	1/1/1993		CO	2	RU	EC	N/R	UNSPECIFIED ACREAGE
I000360-010	1/1/1993		WY	2	UN	EC	Soil incorporation	30 AC DRY BEANS
<i>FIELD</i>								
I003113-001	1/1/1994		MT	3	RU	N/R	N/R	ALL
I003148-001	1/1/1996		ND	3	RU	N/R	N/R	ALL
I003145-001	1/1/1996		MN	3	RU	N/R	N/R	N/R
I003127-001	1/1/1996		IA	3	RU	N/R	N/R	ALL
I003126-001	1/1/1996		ID	3	RU	N/R	N/R	ALL
I004821-001	1/1/1997		KS	3	RU	N/R	N/R	ALL
I006448-001	10/1/1997		WI	3	RU	N/R	N/R	ALL
I007755-018	5/25/1998	MC KENZIE	ND	2	RU		PPI/GROUND- BROADCAST	250 ACRES
<i>N/R</i>								
I005879-006	6/16/1997	ALLAMAKEE	IA	2	UN		N/R	UNKNOWN
I009518-004	7/26/1999	MC KENZIE	ND	2	RU		Broadcast	285 ACRES
I010927-027	5/20/2000	TATTNALL	GA	3	MA	N/R	Spray	ALL

Friday, April 13, 2012

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Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
<i>PEANUT</i>								
I010936-022	4/28/2000	DAWSON	TX	2	UN	N/R	N/R	ALL
I011838-059	5/21/2001	CADDO	OK	2	UN			78 acres
<i>Pinto beans</i>								
I000360-004	1/1/1993		CO	2	RU	EC	N/R	540 ACRES BEANS
<i>RESIDENTIAL</i>								
I007008-001	4/4/1998	GALVESTON	TX	3	MA	N/R	Broadcast, unincorporated	110
<i>Soybean</i>								
I006198-003			IL	3	RU		N/R	UNKNOWN
I004837-001			IN	3	RU		N/R	12
I006198-006			NE	3	RU		N/R	UNKNOWN
I000051-001	6/21/1991	FRANKLIN	IA	3	MA	EC	SPRAY	Unknown
I007705-001	5/18/1998	MOWER	MN	3	RU	N/R	GROUND- BROADCAST	ALL
I009969-008	5/1/1999	JASPER	IA	3	RU	N/R	Broadcast	ALL
I010927-030	5/1/2000	FRANKLIN	IA	3	RU	N/R	Spray	180 ACRES
I014702-063	5/20/2003	Norman	MN	2	RU	EC	Broadcast	120 acres
I014702-062	5/20/2003	Clay	MN	2	RU	EC	Broadcast	120 acres
<i>Sugarcane</i>								
I006193-002			HI	3	RU		N/R	UNKNOWN

Friday, April 13, 2012

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Incident #	Date	County	State	Certainty	Legal.	Formul.	Appl. Method	Total Magnitude
<i>Tomato</i>								
I009518-001	5/7/1999	IMPERIAL	CA	3	RU	N/R	Broadcast	210 ACRES
I010927-032	3/3/2000	MERCED	CA	3	RU	N/R	Broadcast	ALL
<i>WHEAT</i>								
I006882-001			CA	3	RU		N/R	N/R
I003140-001			ND	3	RU			UNKNOWN
I004808-001			CA	3	RU		N/R	UNKNOWN
I000360-003	1/1/1993		ND	2	RU	N/R	N/R	UNSPECIFIED ACREAGE
I003125-001	1/1/1996		OR	3	RU	N/R	N/R	ALL
I009518-002	7/6/1999	MC HENRY	ND	2	RU	N/R	Broadcast	ALL 350 ACRES
I009518-003	7/26/1999	MC KENZIE	ND	2	RU	N/R	GROUND BNROADCAST	168 ACRES
I009518-006	8/19/1999	MC INTOSH	ND	3	RU	N/R	Broadcast	90 ACRES
I010927-020	4/18/2000	STARK	ND	3	MA	WDG	KNIVES, HARROW	ALL
I010927-031	4/29/2000	CAVALIER	ND	3	RU	N/R	Spray	ALL
<i>Wheat, spring</i>								
I013636-050	5/15/2002	PIERCE	ND	2	RU		Broadcast	150 out of 320 acres

Friday, April 13, 2012

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EIIS Pesticide Summary Report: Species Information  
**Trifluralin (036101)**

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
<b>AQUATIC</b>					
<i>FIELD</i>					
I002408-001	unknown fish		unknown	mortality	Runoff
<i>HOME/LAWN</i>					
I006258-001	n/r		3	mortality	TREATMENT
<i>N/R</i>					
I002793-001	bluegill	Lepomis macrochirus	22	mortality	Spill
	catfish	Ictaluridae	25	mortality	Spill
	eel	Anguilliformes	9	mortality	Spill
	gar	Lepisosteus spp.	2	mortality	Spill
	minnow	Cyprinidae	30	mortality	Spill
	shad	Clupeidae	55	mortality	Spill
<i>Soybean</i>					
I000254-001	bass	Micropterus spp.		mortality	Runoff
	bluegill	Lepomis macrochirus		mortality	Runoff
	channel catfish	Ictalurus punctatus		mortality	Runoff

Incident #	Species	Scientific Name	Magnitude	Response	Rt. Exposure
<i>UNDER ASPHALT</i>	crappie	Centrarchidae		mortality	Runoff
I002215-001	bass	Micropterus spp.	n/r	mortality	Runoff
	bluegill	Lepomis macrochirus	n/r	mortality	Runoff
	crappie	Centrarchidae	n/r	mortality	Runoff

## PLANTS

### *Agricultural Area*

I003128-001	soybean seed	Glycine max		stunted growth	TREATMENT
I004845-001	corn	Zea mays		mortality	TREATMENT
I005880-014	birch percifia shrubs	Betula sp.	unknown	discoloration discoloration	Drift Drift
I006171-001	corn	Zea mays	unknown	mortality	N/R
I006186-001	spring wheat	Triticum aestivum		plant damage	TREATMENT
I006186-002	corn	Zea mays		plant damage	TREATMENT
I006186-003	spring wheat	Triticum aestivum		reduced yield	TREATMENT
I006186-004					

<b>Incident #</b>	<b>Species</b>	<b>Scientific Name</b>	<b>Magnitude</b>	<b>Response</b>	<b>Rt. Exposure</b>
I006186-005	spring wheat	Triticum aestivum		plant damage	TREATMENT
I006186-006	spring wheat	Triticum aestivum		plant damage	TREATMENT
I007255-001	spring wheat	Triticum aestivum		plant damage	TREATMENT
I007255-002	spring wheat	Triticum aestivum		plant damage	TREATMENT
I007755-019	spring wheat	Triticum aestivum		plant damage	TREATMENT
I009518-005	sunflower		600 acres	plant damage	TREATMENT
	sudan grass		all 78 acres	plant damage	Treated directly
<i>ALFALFA</i>					
I003141-001	alfalfa	Medicago sativa	unknown	incapacitation	
	blue spruce	Picea pungens	unknown	incapacitation	
I009517-002	alfalfa	Medicago sativa	all 3851 acres	plant damage	Treated directly
I013636-049	alfalfa	Medicago sativa	50 acres out of 53	plant damage	Treated directly
I014838-001	alfalfa	Medicago sativa	3200 acres	plant damage	Treated directly
<i>Asparagus</i>					
I015278-001	potato		67 acres	plant damage	Carryover

<b>Incident #</b>	<b>Species</b>	<b>Scientific Name</b>	<b>Magnitude</b>	<b>Response</b>	<b>Rt. Exposure</b>
<i>BARLEY</i>					
I004809-001	barley	Hordeum vulgare	unknown	incapacitation	TREATMENT
I004839-001	barley	Hordeum vulgare		plant damage	TREATMENT
<i>Bean, dry</i>					
I003139-001	dry bean		unknown	incapacitation	APPLICATION
<i>beans</i>					
I000360-014	bean	Phaseolus	160 ac	plant damage	N/R
<i>corn</i>					
I000360-006	corn	Zea mays	150 ac.	plant damage	Carryover
I000360-007	corn	Zea mays	40 ac	plant damage	N/R
I000360-008	corn	Zea mays	56 ac	plant damage	Carryover
I000360-009	corn	Zea mays	40 ac	plant damage	Carryover
I006191-001	corn	Zea mays	n/r	plant damage	N/R
I006191-002	corn	Zea mays	unknown	plant damage	N/R
I006191-003	corn	Zea mays	unknown	plant damage	N/R

<b>Incident #</b>	<b>Species</b>	<b>Scientific Name</b>	<b>Magnitude</b>	<b>Response</b>	<b>Rt. Exposure</b>
I006193-001	corn	<i>Zea mays</i>	unknown	plant damage	N/R
I006198-001	corn	<i>Zea mays</i>	unknown	plant damage	
I006198-002	corn	<i>Zea mays</i>	unknown	plant damage	
I006198-004	corn	<i>Zea mays</i>	unknown	plant damage	
I009517-001	corn	<i>Zea mays</i>	all 200 acres	plant damage	Treated directly
<i>CORN/SOYBEAN</i>					
I000663-001	corn soybean	<i>Zea mays</i>	350 acres 350 acres	plant damage plant damage	Carryover Carryover
<i>COTTON</i>					
I006198-005	cotton	<i>Gossypium</i>	unknown	plant damage	
<i>Dry beans</i>					
I000360-005	dry bean		unspecified acreage	plant damage	N/R
I000360-010	dry bean		30 ac	plant damage	N/R
I000360-011	dry bean		38 ac	plant damage	N/R

<b>Incident #</b>	<b>Species</b>	<b>Scientific Name</b>	<b>Magnitude</b>	<b>Response</b>	<b>Rt. Exposure</b>
<i>FIELD</i>					
I003113-001	spring wheat	Triticum aestivum		mortality	TREATMENT
I003126-001	spring wheat	Triticum aestivum		plant damage	TREATMENT
I003127-001	corn	Zea mays		inhibited growth	TREATMENT
I003145-001	soybean seed	Glycine max	n/r	mortality	TREATMENT
I003148-001	spring wheat	Triticum aestivum		plant damage	TREATMENT
I004821-001	corn	Zea mays		plant damage	TREATMENT
I006448-001	corn	Zea mays		incapacitation	TREATMENT
I007755-018	spring wheat	Triticum aestivum	250 acres	plant damage	TREATMENT
<i>N/R</i>					
I005879-006	raspberry			plant damage	Drift
I009518-004	spring wheat	Triticum aestivum	285 acres	plant damage	Treated directly
I010927-027	cotton	Gossypium	all 125 acres	plant damage	Carryover
<i>PEANUT</i>					

<b>Incident #</b>	<b>Species</b>	<b>Scientific Name</b>	<b>Magnitude</b>	<b>Response</b>	<b>Rt. Exposure</b>
I010936-022	peanut	Arachis hypogaea	all 85 acres	plant damage	Treated directly
I011838-059	peanut	Arachis hypogaea	78 acres	plant damage	Treated directly
<i>Pinto beans</i>					
I000360-004	pinto bean	Phaseolus vulgaris	540 acres	plant damage	N/R
<i>RESIDENTIAL</i>					
I007008-001	rose	Rosa	109	plant damage	UNKNOWN
	spreading yew		1	plant damage	Runoff
<i>Soybean</i>					
I000051-001	ornamental		n/r	plant damage	Drift
	unknown plant		n/r	plant damage	Drift
I004837-001	soybean		unknown	plant damage	
I006198-003	soybean		unknown	reduced yield	
I006198-006	soybean		unknown	plant damage	
I007705-001	soybean seed	Glycine max		plant damage	TREATMENT
I009969-008	corn	Zea mays	all 465 acres	plant damage	TOXIC RESIDUE

<b>Incident #</b>	<b>Species</b>	<b>Scientific Name</b>	<b>Magnitude</b>	<b>Response</b>	<b>Rt. Exposure</b>
I010927-030	soybean		180 acres out of 275	plant damage	Treated directly
I014702-062	soybean		120 acres	plant damage	Treated directly
I014702-063	soybean		120 acres	plant damage	Treated directly
<i>Sugarcane</i>					
I006193-002	sugarcane		unknown	plant damage	APPLIED TO CROP
<i>Tomato</i>					
I009518-001	tomato		all 210 acres	plant damage	Treated directly
I010927-032	tomato		all 74 acres	plant damage	Treated directly
<i>Wheat</i>					
I000360-003	wheat		unspecified acreage	plant damage	N/R
I003125-001	spring wheat	Triticum aestivum		plant damage	TREATMENT
I003140-001	spring wheat	Triticum aestivum	unknown	incapacitation	
I004808-001	wheat		unknown	incapacitation	
I006882-001	wheat		unknown	reduced yield	Treated directly

<b>Incident #</b>	<b>Species</b>	<b>Scientific Name</b>	<b>Magnitude</b>	<b>Response</b>	<b>Rt. Exposure</b>
I009518-002	spring wheat	Triticum aestivum	350 acres	plant damage	Treated directly
I009518-003	spring wheat	Triticum aestivum	168 acres	plant damage	Treated directly
I009518-006	spring wheat	Triticum aestivum	all 90 acres	plant damage	Treated directly
I010927-020	wheat		all 240 acres	plant damage	Carryover
I010927-031	wheat		all 110 acres	plant damage	Carryover
<i>Wheat, spring</i>					
I013636-050	wheat, spring		150 out of 320 acres	plant damage	Treated directly

## **Uncertainties Related to the Use of Incident Information from the Ecological Incident Information System**

Incident data are used in risk assessments to provide evidence that the risk predictions from the screening level assessment are supported by actual effects in the field. Incident reports submitted to EPA since approximately 1994 have been tracked by assignment of incident numbers in an Incident Data System (IDS), microfiched, and then entered to a second database, the Ecological Incident Information System (EIIS). Additionally, there is an on-going effort to enter information to EIIS on incident reports received prior to establishment of current databases. Incident reports are not received in a consistent format (*e.g.*, states and various labs usually have their own formats), may involve multiple incidents involving multiple chemicals in one report, and may report on only part of a given incident investigation (*e.g.*, residues).

Incidents entered into EIIS are categorized into one of several certainty levels regarding the likelihood that a particular pesticide is associated with the incident: highly probable, probable, possible, unlikely, or unrelated. In brief, "highly probable" incidents usually require carcass residues and/or clear circumstances regarding the exposure. "Probable" incidents include those where residues were not available and/or circumstances were less clear than for "highly probable." "Possible" incidents include those where multiple chemicals may have been involved and it is not clear what the contribution was of a given chemical. The "unlikely" category is used, for example, where a given chemical is practically nontoxic to the category of organism killed and/or the chemical was tested for but not detected in samples. "Unrelated" incidents are those that have been confirmed to be not pesticide-related.

Incidents entered into the EIIS are also categorized as to use/misuse. Unless specifically confirmed by a state or federal agency to be misuse, or there was very clear misuse such as intentional baiting to kill wildlife, incidents are not typically considered misuse.

The number of documented kills in EIIS is believed to be a small fraction of total mortality caused by pesticides. Mortality incidents must be seen, reported, investigated, and have investigation reports submitted to EPA to have the potential for entry into the database. Incidents often are not seen, due to scavenger removal of carcasses, decay in the field, or simply because carcasses may be hard to see on many sites and/or few people are systematically looking. Poisoned animals may also move off-site to less conspicuous areas before dying. Incidents may not get reported to appropriate authorities capable of investigating the incident for a variety of reasons including the finder may not know of the importance of reporting incidents, may not know who to call, may not feel they have the time or desire to call, or may hesitate to call because of their own involvement in the kill. Incidents reported may not get investigated if resources are limited or may not get investigated thoroughly, with residue analyses, for example. Also, if kills are not reported and investigated promptly, there will be little chance of documenting the cause, since tissues and residues may deteriorate quickly. Reports of investigated incidents often do not get submitted to EPA, since reporting by states is voluntary.

Furthermore, the database relies heavily on registrant-submitted incident reports, and registrants are currently only required to submit detailed information on 'major' ecological incidents, while 'minor' incidents are reported aggregately.

Based on the 40 CFR (§159.184 Toxic or adverse effect incident reports), an ecological incident is considered 'major' if any of the following criteria are met:

**Fish or wildlife:**

- (A) Involves any incident caused by a pesticide currently in Formal Review for ecological concerns.
- (B) Fish: Affected 1,000 or more individuals of a schooling species or 50 or more individuals of a non-schooling species.
- (C) Birds: Affected 200 or more individuals of a flocking species, or 50 or more individuals of a songbird species, or 5 or more individuals of a predatory species.
- (D) Mammals, reptiles, amphibians: Affected 50 or more individuals of a relatively common or herding species or 5 or more individuals of a rare or solitary species.
- (E) Involves effects to, or illegal pesticide treatment (misuse) of a substantial tract of habitat (greater than or equal to 10 acres, terrestrial or aquatic).

**Plants:**

- (A) The effect is alleged to have occurred on more than 45 percent of the acreage exposed to the pesticide.

All other ecological incidents are considered 'minor' and only need to be aggregately reported. 'Minor' incidents reported by the registrants are not included in the EIIS database. Therefore, for example, an incident could affect 900 fish, 150 birds, 45 mammals, and 40% of an exposed crop and not be included in the EIIS database [unless is it reported by a non-registrant (*e.g.*, an incident submitted by a state agency – which are not systematically collected)]. Therefore, because the number of documented kills in EIIS is believed to be a small fraction of total mortality caused by pesticides, absence of reports does not necessarily provide evidence of an absence of incidents.