CHEMICAL UPDATE WORKSHEET

Chemical Name:	**Trifluralin**
CAS #:	**1582-09-8**
Revised By:	RRD Toxicology Unit
Revision Date:	August 19, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	335.29	335.29	EPI	EXP
Physical State at ambient temp	Solid	Solid	MDEQ	
Melting Point (˚C)	---	49.00	EPI	EXP
Boiling Point (˚C)	---	NA	NA	
Solubility (ug/L)	8100	184	EPI	EXP
Vapor Pressure (mmHg at 25˚C)	0.000049	4.58E-05	EPI	EXP
HLC (atm-m^3/mol at 25˚C)	2.60E-5	1.03E-04	EPI	EXP
Log Kow (log P; octanol-water)	5.3	5.34	EPI	EXP
Koc (organic carbon; L/Kg)	1.62E+5	1.639E+04	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm^2/s)	0.08	2.15E-02	W9	EST
Diffusivity in Water (Dw; cm^2/s)	8.0E-6	5.41E-06	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (˚C)	NA	151	PC	EXP
Lower Explosivity Level (LEL; unitless)	NA	NA	NA	NA
Critical Temperature (K)		NA	NA	NA
Enthalpy of Vaporization (cal/mol)		NA	NA	NA
Density (g/mL, g/cm^3)		1.294	PC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm^2)	NA	1.85E-06	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm^2)	NA	1.85E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm^2)	NA	2.34E-06	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm^2)	NA	2.34E-06	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Reference Dose (RfD) (mg/kg/day)	5.1E-3	2.4E-2	OPP, 2013	
RfD details	12-month dog feeding study (Hoechst Aktiengesellschaft , 1984); Critical effect = increased liver weights and increased methemoglobin. NOAEL = 30 mg/kg x 0.017 kg/kg bw = 0.51 mg/kg-day; UF = 100; *Value adjusted from IRIS using MDNR food consumption rate of 0.017 kg/kg bw for beagle dogs. CCD/RfD date: 4/20/89.	**Tier 1 Source** **EPA-OPP:** **Basis:** OPP (2004 and 2013), chronic population adjusted dose (cPAD)/ chronic RfD = 0.024 mg/kg-day. IRIS (3/2015) refers to EPA-OPP for toxicity updates of trifluralin. **Critical Study**: Adams, E.; Bernhard, N.; Jordon, W. (1992) A Chronic Toxicity Study of Trifluralin (Compound 036352) Administered Orally to Beagle Dogs for One Year (Supp.): Lab Project Number: D07190. Unpublished study prepared by Lilly Research Labs. 470 p. (MRID No. 42447001) **Method(s)**: Beagle dogs were exposed to 0, 0.75, 2.4, and 40 mg/kg/day trifluralin orally (by capsules) for 1 year. **Critical effect**: increased frequency of abnormal stool, decreased body weights and body weight gains, and decreased erythrocytes and hemoglobin and increased thrombocytes (males) **End point or Point of Departure (POD):** NOAEL = 2.4 mg/kg/day **Uncertainty Factors**: UF = 100 (10 each for intraspecies variability and interspecies extrapolation) **Source and date:** USEPA-OPP Reregistration Eligibility Decision (RED) (4/1996) and "Report of the Food Quality Protection Act (FQPA) Tolerance Reassessment Progress and Risk Management Decision for Trifluralin," (8/31/2004) and OPP Memorandum: Trifluralin: Acute, Chronic, and Cancer Aggregate Dietary (Food and Drinking Water) Exposure and Risk Assessments for the Section 3 Registration Action on Oilseed Crop Group 20 (4/2/2013). **Tier 1 and 2 IRIS:** Per IRIS (7/1/1989), RfD = **7.5E**-03 mg/kg-day. **Critical Study**: Hoechst Aktiengesellschaft. 1984a. MRID No. 00151908. Available from EPA. Write to FOI, EPA, Washington, DC 20460. **Method(s)**: Beagle dogs (6/sex/dose) were fed diets containing 0, 30, 150, or 750 ppm (0, 0.75, 3.75, and 18.75 mg/kg/day) of trifluralin for 12 months.		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		Critical effect: increased liver weights and methemoglobin **End point or Point of Departure (POD):** NOEL = 30 ppm (0.75 mg/kg/day) **Uncertainty Factors**: UF = 100 (10 each for intraspecies variability and interspecies extrapolation) **Source and date:** IRIS, Last revision date - 7/1/1989. An EPA screening-level review in 2002 identified one or more significant new studies. IRIS (3/2015) refers to EPA-OPP for toxicity updates of trifluralin. **EPA-OPP:** OPP (EPA-HQ-OPP-2012-0304-0009) also derived an acute aRfD = 1.0 mg/kg-day for females 13-50 years of age: **Critical Study**: Byrd, R. (1984) A Teratology Study (II) of Trifluralin (El-152, Compound 36352) Administered Orally to Dutch Belted Rabbits: Study B01784. Unpublished study prepared by Lilly Research Labs. 223 p. (MRID No. 00152421) **Method(s)**: Dutch Belted rabbits were given oral doses of 0, 100, 225 or 500 mg/kg/day of trifluralin on gestation days 6-28. **Critical effect**: increased total litter resorptions **End point or Point of Departure (POD):** Maternal NOAEL = 100 mg/kg/day **Uncertainty Factors**: UF = 100 (10 each for intraspecies variability and interspecies extrapolation) **Source and date:** EPA-OPP Reregistration Eligibility Decision (RED) (4/1996) and "Report of the Food Quality Protection Act (FQPA) Tolerance Reassessment Progress and Risk Management Decision for Trifluralin," (8/31/2004), and OPP Memorandum: Trifluralin: Acute, Chronic, and Cancer Aggregate Dietary (Food and Drinking Water) Exposure and Risk Assessments for the Section 3 Registration Action on Oilseed Crop Group 20 (4/2/2013). **Tier 2 Sources:** **PPRTV:** No PPRTV record available at this time. **MRL:** No MRL record available at this time. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD/RRD (4/20/1989), RfD = 5.1E-3 mg/kg-day. See Part 201 Value RfD details.		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Oral Cancer Slope Factor (CSF) (mg/kg-day)$^{-1}$)	4.5E-3	2.96E-3	USEPA-OPP, 2013	
CSF details	2-year chronic dietary dose bioassay (Emerson et. al, 1980); Combined renal pelvis carcinomas and urinary bladder papilloma in male & female F344 rats. Class C. Revised species scaling factor of (BWh/BWa) to the 0.25 power used for q* calculation. RD calculation date: 1/25/2000.	**Basis:** Per USEPA-OPP (2013)**, Q_1*** (also known as CSF) = 2.96E-3 (mg/kg/day)$^{-1}$. IRIS (3/2015) refers to EPA-OPP for toxicity updates of trifluralin. **Critical Study (ies)**: Emmerson, J.L.; Pierce, E.C.; McGrath, J.P.; et al. (1980) The Chronic Toxicity of Compound 36352 (Trifluralin) Given as a Component of the Diet to Fischer 344 Rats for Two Years: Studies R-87 and R-97. (Unpublished study received Sep 18, 1980 under 1471-35; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:243289-A, 243290) (MRID 00044337) **Method(s)**: Fischer 344 rats using dietary doses of 0, 813, 3250 or 6500 ppm for two years. 1) *Dose response data*: *Tumor Type* – thyroid follicular cell adenoma and renal carcinomas; *Test Species* – male rats; *Route* - oral 2) *Extrapolation method*: The carcinogenic risk was quantified by the Q1* approach. **Carcinogen Weight-of-Evidence (WOE) Class**: C, Possible Human Carcinogen **IRIS WOE Basis**: based upon an increase in combined malignant and benign urinary bladder tumors in females, renal pelvis carcinomas in male rats, and thyroid gland follicular cell tumors (adenomas plus carcinomas combined) in males. **Source and Date**: USEPA-OPP Reregistration Eligibility Decision (RED) (4/1996) and "Report of the Food Quality Protection Act (FQPA) Tolerance Reassessment Progress and Risk Management Decision for Trifluralin," (8/31/2004), and OPP Memorandum: Trifluralin: Acute, Chronic, and Cancer Aggregate Dietary (Food and Drinking Water) Exposure and Risk Assessments for the Section 3 Registration Action on Oilseed Crop Group 20 (4/2/2013). **Tier 1 and 2 Sources**: **IRIS:** Per IRIS (1993), CSF = 7.7E-3 (mg/kg-day)$^{-1}$ **Critical Study**: Emmerson, J.L., E.C. Pierce, J.P. McGrath, et al. 1980. The chronic toxicity of compound 36352 (trifluralin) given as a compound of the diet to the Fischer 344 rats for two years. Studies R-87 and R-97 (unpublished study received		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		September 18, 1980 under 1471-35; submitted by Elanco Products Co., Division of Eli Lilly and Co., Indianapolis, IN). **Method(s)**: F344 rats (60 /sex) received dietary doses of 0, 813, 3250 and 6500 ppm for 2 years. 1) *Dose response data*: *Tumor Type* - combined renal pelvis carcinomas, urinary bladder papilloma and/or thyroid adenomas and carcinomas ; *Test Species* - rat/F344, male; *Route* - diet 2) *Extrapolation method*: linearized multistage procedure, extra risk **Carcinogen Weight-of-Evidence (WOE) Class**: C; possible human carcinogen. **IRIS WOE Basis**: based on the induction of urinary tract tumors (renal pelvis carcinomas and urinary bladder papilloma) and thyroid tumors (adenomas/carcinomas combined) in one animal species (F344 rats) in one study. Trifluralin is structurally similar to ethalfluralin, a carcinogen in the rat. **Source and Date**: IRIS, Last Revision date - 10/01/1993 **PPRTV:** No PPRTV record available at this time. **MRL:** NA; MRLs are for non-cancer effects only. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD, RRD CSF = 4.5E-3 (mg-kg-day)$^{-1}$. See Part 201 RfD details.		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	--	3.0E+3	OPP 2013/MDEQ, 2015	
RfC/ITSL details	NA	**Tier 1 Source**: **EPA-OPP:** **Basis:** OPP is a Tier 1 source. OPP short term (1-30 days) inhalation Level of Concern (LOC) for margin of exposure (MOE) = 100 based on the NOAEL = 300 mg/m^3 (81 mg/kg-day) (EPA-HQ-OPP-2012-0304-0008). MDEQ calculates the RfC = 3.0E-0 mg/m^3 (3.0E+3 µg/m³) based on the NOAEL divided by a UF of 100. See details below. **Critical Studies**: Ullman, L. (1987) 30-Day Repeated Dose Inhalation Toxicity Study		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		with HOE 38474 OH at 210 in Rats: Amended Version of Previously Submitted Study Acc. No. 258996: Laboratory Project No. 005488, Report No. A 22688 and A 36084. Unpublished study prepared by Research & Consulting Co. Ag. 711 p. (MRID 40392312) **Method(s)**: 30-Day Inhalation Study in rats **Critical effect**: increased methemoglobin and bilirubin in females and dyspnea and ruffled fur in males and females. **End point or Point of Departure (POD):** NOAEL = 300 mg/m^3 (81 mg/kg-day) **Uncertainty Factors**: UF = 100 (10 each for intraspecies variability and interspecies extrapolation); FQPA factor = 1 **Source and date:** EPA-OPP Reregistration Eligibility Decision (RED) (4/1996) and "Report of the Food Quality Protection Act (FQPA) Tolerance Reassessment Progress and Risk Management Decision for Trifluralin," (8/31/2004), and OPP Memorandum: Trifluralin: Acute, Chronic, and Cancer Aggregate Dietary (Food and Drinking Water) Exposure and Risk Assessments for the Section 3 Registration Action on Oilseed Crop Group 20 (4/2/2013). **Tier 1 and 2 Sources:** **IRIS:** Per IRIS (10/01/1993), no value at this time. **PPRTV:** No PPRTV record available at this time. **MRL:** No MRL record available at this time. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD/AQD no value at this time.		
Inhalation Unit Risk Factor (IURF) ((µg/m^3)$^{-1}$)	--	NA	MDEQ, 2015	
IURF details	NA	**Carcinogen Weight-of-Evidence (WOE) Class**: C; possible human carcinogen. **IRIS WOE Basis**: based on the induction of urinary tract tumors (renal pelvis carcinomas and urinary bladder papilloma) and thyroid tumors (adenomas/carcinomas combined) in one animal species (F344 rats) in one study. Trifluralin is structurally similar to ethalfluralin, a carcinogen in the rat. **Source and Date**: IRIS, Last Revision date - 10/01/1993		Complete

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		Tier 1 and 2 Sources: **IRIS:** Per IRIS (10/01/1993), no value at this time. **PPRTV:** No PPRTV record available at this time. **MRL:** NA; MRLs are for non-cancer effects only. **Tier 3 Source:** **MDEQ:** Per DEQ-CCD/AQD, no value at this time.		
Mutagenic Mode of Action (MMOA)? (Y/N)	--	NO	USEPA, 2015	
MMOA Details	--	NA Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		
Developmental or Reproductive Effector? (Y/N)	No	The chronic RfD or RfC is not based on a reproductive-developmental effect; however, an acute aRfD = 1.0 mg/kg-day is available for females 13-50 years of age to account for maternal toxicity.	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	Critical Study: Byrd, R. (1984) A Teratology Study (II) of Trifluralin (El-152, Compound 36352) Administered Orally to Dutch Belted Rabbits: Study B01784. Unpublished study prepared by Lilly Research Labs. 223 p. (MRID No. 00152421) Method(s): Dutch Belted rabbits were given oral doses of 0, 100, 225 or 500 mg/kg/day of trifluralin on gestation days 6-28. Critical effect: increased total litter resorptions		
State Drinking Water Standard (SDWS) (ug/L)	--	NO	SDWA, 1976	
SDWS details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
Secondary Maximum Contaminant Level (SMCL) (ug/L)	--	NO	SDWA, 1976 and USEPA SMCL List	
SMCL details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		

	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
Is there an aesthetic value for drinking water? (Y/N)	NO	Not evaluated.	NA	
Aesthetic value (ug/L)	NA	NA	NA	
Aesthetic Value details	NA	NA		
Phytotoxicity Value? (Y/N)	NO	Not evaluated.	NA	
Phytotoxicity details	NA	NA	NA	
Others				

(C) Chemical-specific Exposure Factors

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABSgi)	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABSgi details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AEd)	---	0.1	MDEQ, 2015	
AEd details				
Ingestion Absorption Efficiency (AEi)		0.5	MDEQ, 2015	
AEi Details				
Relative Source Contribution for Water (RSC_W)		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC_S)		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC_A)		1.0	MDEQ, 2015	
Others				

(D) Rule 57 Water Quality Values and GSI Criteria

Current GSI value (µg/L)	NA
Updated GSI value (µg/L)	NA
Rule 57 Drinking Water Value (µg/L)	NA

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)		
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)		
Wildlife Value (WV)		
Human Cancer Values for Drinking Water Source (HCV-drink)		
Human Cancer values for non-drinking water source (HCV-Non-drink)		
Final Chronic Value (FCV)		
Aquatic maximum value (AMV)		
Final Acute Value (FAV)		

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 website
2. MDEQ Rule 57 table

(E) Analytical Information

	Value	Source
Target Detection Limit – Soil (μg/kg)	200	MDEQ, 2015
Target Detection Limit – Water (μg/L)	30	MDEQ, 2015
Target Detection Limit – Air (ppbv)	NA	MDEQ, 2015
Target Detection Limit – Soil Gas (ppbv)	NA	MDEQ, 2015

CHEMICAL UPDATE WORKSHEET ABBREVIATIONS:

CAS # - Chemical Abstract Service Number.

Section (A) Chemical-Physical Properties

Reference Source(s):

CRC	Chemical Rubber Company Handbook of Chemistry and Physics, 95th edition, 2014-2015
EMSOFT	USEPA Exposure Model for Soil-Organic Fate and Transport (EMSOFT) (EPA, 2002)
EPA2001	USEPA (2001) Fact Sheet, Correcting the Henry's Law Constant for Soil Temperature. Office of Solid Waste and Emergency Response, Washington, D.C.
EPA4	USEPA (2004) User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February 22, 2004.
EPI	USEPA's Estimation Programs Interface SUITE 4.1, Copyright 2000-2012
HSDB	Hazardous Substances Data Bank
MDEQ	Michigan Department of Environmental Quality
NPG	National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards
PC	National Center for Biotechnology Information's PubChem database
PP	Syracuse Research Corporation's PhysProp database
SCDM	USEPA's Superfund Chemical Data Matrix
SSG	USEPA's Soil Screening Guidance: Technical Background Document, Second Edition, 1996
USEPA/EPA	United States environmental protection agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.
W9	USEPA's User Guide for Water9 Software, Version 2.0.0, 2001

Basis/Comments:

EST	estimated
EXP	experimental
EXT	extrapolated
NA	not available or not applicable
NR	not relevant

Section (B) Toxicity Values/Benchmarks

Sources/References:

ATSDR	Agency for Toxic Substances and Disease Registry
CALEPA	California Environmental Protection Agency
CAL DTSC	California Department of Toxic Substances Control
CAL OEHHA	CAEPA Office of Environmental Health Hazard Assessment
CCD	MDEQ Chemical Criteria Database
ECHA	European Chemicals Agency (REACH)
OECD HPV	Organization for Economic Cooperation and Development HPV Database
HEAST	USEPA's Health Effects Assessment Summary Tables
IRIS	USEPA's Integrated Risk Information System
MADEP	Massachusetts Department of Environmental Protection
MDEQ/DEQ	Michigan Department of Environmental Quality
DEQ-CCD/AQD	MDEQ Air Quality Division
DEQ-CCD/RRD	MDEQ Remediation and Redevelopment Division
DEQ-CCD/WRD	MDEQ Water Resources Division
MNDOH	Minnesota Department of Health

NJDEP	New Jersey Department of Environmental Protection
NYDEC	New York State Department of Environmental Conservation
OPP/OPPT	USEPA's Office of Pesticide Programs
PPRTV	USEPA's Provisional Peer Reviewed Toxicity Values
RIVM	The Netherlands National Institute of Public Health and the Environment
TCEQ	Texas Commission on Environmental Quality
USEPA	United States Environmental Protection Agency
USEPA OSWER	USEPA Office of Solid Waste and Emergency Response
USEPA MCL	USEPA Maximum Contaminant Level
WHO	World Health Organization
WHO IPCS	International Programme on Chemical Safety (IPCS/INCHEM)
WHO IARC	International Agency for Research on Cancers
NA	Not Available.
NR	Not Relevant.

Toxicity terms:

BMC	Benchmark concentration
BMCL	Lower bound confidence limit on the BMC
BMD	benchmark dose
BMDL	Lower bound confidence limit on the BMD
CSF	Cancer slope Factor
CNS	Central nervous system
IURF or IUR	Inhalation unit risk factor
LOAEL	Lowest observed adverse effect level
LOEL	Lowest observed effect level
MRL	Minimal risk level (ATSDR)
NOAEL	No observed adverse effect level
NOEL	No observed effect level
RfC	Reference concentration
RfD	Reference dose
p-RfD	Provisional RfD
aRfD	Acute RfD
UF	Uncertainty factor
WOE	Weight of evidence

Section (C) Chemical-specific Absorption Factors

MDEQ	Michigan Department of Environmental Quality
USEPA RAGS-E	United States Environmental Protection Agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

Section (D) Rule 57 Water Quality Values and GSI Criteria

GSI	Groundwater-surface water interface
NA	A value is not available or not applicable.
ID	Insufficient data to derive value
NLS	No literature search has been conducted