

2,4-D 2-ethylhexyl ester [2-EHE]

Review Date: 4/28/2009

Type	Terrestrial herbicide - selective, systemic, post-emergent, plant growth regulator.
Controls	For control of broadleaf weeds in non-crop areas, lawns, ponds, ditch banks, pastures, rangelands, also for control of trees by injection.
Mode of Action	2,4-D is thought to increase cell plasticity and the rate of protein and ethylene production; resulting in abnormally rapid cell division and lethal tissue damage.

Thurston County Review Summary:

The hazards associated with the herbicide active ingredient 2,4-D [2-EHE] are considered; high for mobility, moderate for persistence, and low for bioaccumulation. Exposures to 2,4-D after an herbicidal application to lawn can expose children and adults to concentrations that are considered high in hazard for toxicity. These potential exposures cause herbicides with 2,4-D as an active ingredient to fail Thurston County's review criteria.

MOBILITY

Property	Value	Reference	Rating
Solubility (mg/L)	0.09	3	Low
Soil Sorption (Kd=mL/g)	<3	3	High
Organic Sorption (Koc=mL/g)	<120	3	High

Mobility Summary:

2,4-D [2-EHE] is not very soluble in water but is expected to convert to 2,4-D acid within the first few minutes following application. 2,4-D acid is moderately soluble in water and adheres very poorly to all soil types, therefore the hazard for it move off the site of application with water is considered high in hazard.

PERSISTENCE

Property	Value	Reference	Rating
Vapor Pressure (mm Hg)	Not found		
Biotic or Aerobic Half-life (days)	6	3	Low
Abiotic Half-life (days)	Not found		
Terrestrial Field Test Half-life (days)	1-30 (mean = 6)	3	Low
Hydrolysis Half-life (days)	Stable	3	High
Anaerobic Half-life (days)	41-333	3	High
Aquatic Field Test Half-life (days)	15	3	Moderate

Persistence Summary:

2,4-D is not likely to dissipate into the air after it is applied to plants or soil. If there is no rain following an application then 2,4-D will likely degrade to half the original concentration within a week, although, in some field studies it has taken up to four weeks. If it rains within a week of its application the active ingredient may leach into the soil and increase its persistence considerably. The persistence hazard of 2,4-D [2-EHE] and 2,4-D acid is considered low to moderate.

BIOACCUMULATION

Property	Value	Reference	Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	<7	4	Low
Octanol/Water Partition Coefficient	log Kow = 5.78	3	High

Bioaccumulation Summary:

2,4-D [2-EHE] has a fairly high affinity to bind to organic matter, although it is expected to quickly convert to 2,4-D acid which has a low affinity to organic matter. Bioconcentration studies show that accumulation in tissue is short lived and the calculated bioconcentration factor is low. The hazard for bioaccumulation is considered low.

ACUTE TOXICITY

Test Subject	Value	Reference	Rating
Mammalian (LD50)	866 mg/kg	3	Moderate
Avian (LD50)	500 mg/kg	2	Moderate
Honey bee or insect (LD50)	"practically non-toxic"		Low
Annelida -worms (LC50)	Not found		
Fish (LC50)	250 mg/L	2	Low
Crustacean (LC50)	184 mg/L	1	Low
Mollusk (LC50)	Not found		
Amphibian (LD50 or LC50)	"practically non-toxic"	3	Low

Acute Toxicity Summary:

Potential exposures to adults mixing and applying 2,4-D products, adults performing yardwork in treated turf, or children playing in lawns treated with a 2,4-D herbicide is rated as high in hazard for toxicity. Single-dose toxicity testing of 2,4-D indicates that it is moderately toxic to mammals and birds, and practically non-toxic to bees, frogs, and aquatic organisms.

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Adult mixing + applying with hose end sprayer	0.025 mg/kg/day	0.014 mg/kg/day	1.8	Dermal, inhalation	3	High
Child 's skin contacting treated turf	0.025 mg/kg/day	0.013 mg/kg/day	1.9	Dermal (skin)	3	High
Adult performing yardwork after turf treatment	0.025 mg/kg/day	0.025 mg/kg/day	None	Dermal (skin)	3	High
Child performing hand + object to mouth activities	0.067 mg/kg/day	0.061 mg/kg/day	1.1	Dermal + ingestion	3	High

Acute Toxicity Risk Assessment Summary

For lack of an adequate assessment of developmental toxicity an additional 10-fold safety factor (uncertainty factor) was added to the EPA's risk assessment scenarios. The dose of concern was calculated using an uncertainty factor of 1,000 and the No Observeable Adverse Effect Level (NOAEL) of 67 mg/kg/day from a neurotoxicity study for single-dose toxicity, and a NOAEL of 25 mg/kg/day from a short-term reproductive test.

The short-term exposure to a child entering treated turf grass can cause an exposure that is more than half of the EPA's dose of concern, which Thurston County rates as high in hazard. The short-term exposure to an adult performing yardwork in treated turf is also considered high in hazard for toxicity.

The risk to a residential applicator, mixing a product and using a hose-end sprayer for a broadcast application to 0.5 acres of turf, is considered high in hazard. Mixing and spraying a ready-to-use product with a hose-end sprayer (or ready-to-use sprayer) or applying granular formulations by hand or with a belly grinder (to 0.023 acres) is considered moderate in hazard. Only applications with granular product using a broadcast spreader, or mixing and applying with a hand-held pump are considered low in hazard to the applicator.

CHRONIC TOXICITY

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	D	Not classifiable as to human carcinogenicity	3	Low
Mutagenicity	No evidence	No evidence	3	Low
Neurotoxicity - (NOAEL)	67	ataxia, retinal degeneration, +	3	Check risk
Endocrine Disruption	"suspected" Illinois EPA		3	Check risk
Developmental Toxicity (NOAEL)	5	alterations in hematology +	3	Check risk
Reproductive Toxicity (NOAEL)	25	skeletal abnormalities	3	Low
Chronic Toxicity (NOAEL)	5	alterations in hematology +	3	Check risk

Chronic Toxicity Summary:

A re-evaluation of the carcinogenic potential was conducted for the USEPA's 2005 Reregistration Eligibility Decision (RED) document and the classification changed from 2B "probable human carcinogen" to D "not classifiable to human carcinogenicity" and is not considered a mutagen (Reference 3). There is the potential that 2,4-D causes endocrine disruption but no study has proven a correlation, further testing may be required by the EPA.

There are no long-term exposures expected from residential use of 2,4-D herbicides, so the hazard for toxicity from a long-term exposure is considered low although exposures from one to thirty days in duration are considered high in hazard.

CHRONIC TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Women (13-49 yrs) skin contact with treated turf.	0.025 mg/kg/day	0.024 mg/kg/day	1.04	Dermal (skin)	3	High
No combined exposure was evaluated						
Drinking water exposure not evaluated						
Dietary exposure was not evaluated						

Chronic Toxicity Risk Assessment Summary:

"Short-term" exposure scenario assessment conducted for 2,4-D is 1-30 days in duration so it is included in this chronic toxicity section and not the acute toxicity section (1-6 day exposures). Short-term exposure to women ages 13-49, to treated turf grass, are at EPA's level of concern and are considered high in hazard.

Degradation Products:

1,2,4-benzenetriol, 2,4-dichlorophenol (2,4-DCP), 2,4-dichloroanisole (2,4-DCA), 4-chlorophenol, chlorohydroquinone (CHQ), volatile organics, bound residues, and carbon dioxide (Reference 3).

Comments:

Some 2,4-D products are considered corrosive and can cause irreversible eye damage (EPA Category I), slight skin irritants (EPA Category IV) but are not considered skin sensitizers (Reference 2 and 3).

References

1. Nufarm Americas Inc. "Riverdale Solution Water Soluble IVM" Product label.
2. Nufarm Americas Inc., Material Safety Data Sheet. Solution Water Soluble. Revised February 2006.
3. USEPA. Prevention, Pesticides and Toxic Substances (7508C). Reregistration Eligibility Decision for 2,4-D. June 2005.
4. USEPA Technical Fact Sheet on: 2,4 - D. URL: <http://www.epa.gov/safewater/dwh/t-soc/24-d.html>. November 28th, 2006.
5. International Union of Pure & Applied Chemistry (IUPAC). Pesticide Properties Database, Glyphosate (Ref: Mon 0573). <http://sitem.herts.ac.uk/aeru/iupac/>