2,4-D BEE (butoxyethyl ester)

Review Date: 4/28/2009

Type	Aquatic 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 BEE are considered; high for mobility, at least moderate for persistence, and low for bioaccumulation. Exposures to 2,4-D after an aquatic herbicidal application can expose people to concentrations that are considered high in hazard for toxicity. These potential exposures cause aquatic herbicides with 2,4-D BEE as an active ingredient to fail Thurston County's review criteria.

MOBILITY

Property	Value	Reference	Rating
Solubility (mg/L)	569 (acid form)	3	Moderate
Soil Sorption (Kd=mL/g)	<3	3	High
Organic Sorption (Koc=mL/g)	<120	3	High

Mobility Summary:

2,4 D BEE is not very water soluble, does not bind strongly to sediment, and is considered high in hazard for mobility. Liquid products of 2,4-D BEE are expected to convert to 2,4-D acid within a day of being applied to water, granular products will have some pellets drop to the bottom and dissolve slowly before converting to the acid form. 2,4-D acid which is moderately soluble in water and also adheres very poorly to all sediment, therefore the hazard for both forms of 2,4-D to move off the site of application with water is considered high in hazard.

PERSISTENCE

Property	Value	Reference	Rating
Vapor Pressure (mm Hg)	2.4 E -6	3	Moderate
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 BEE can be expected to convert to 2,4-D acid in the water column within 1 day of an aquatic application but it will take another two weeks for the acid form to reach half of its original concentration. Granular products containing 2,4-D BEE have been detected in sediments up to 186 days after treatment. The persistence hazard of 2,4-D BEE and 2,4-D acid is considered moderate in the water column and high in sediment.

BIOACCUMULATION

Property	Value	Reference	Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	<7	4	Low
Octanol/Water Partition Coefficient	Log Kow = 4.17	3	Moderate

Bioaccumulation Summary:

2,4-D BEE has a moderate affinity to bind to organic matter but 2,4-D has a low affinity to bind to organic matter, and bioconcentration studies show that accumulation in tissue is short lived and the calculated bioconcentration factor is low. The hazard for bioaccumulation of 2,4-D is considered low.

ACUTE TOXICITY

Test Subject	Value	Reference	Rating
Mammalian (LD50)	949 mg/kg	3	Moderate
Avian (LD50)	500 mg/kg	2	Moderate
Honey bee or insect (LD50)	"practically non-toxic"	3	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 and children swimming in a waterbody treated with a 2,4-D aquatic herbicide, is considered high in hazard for toxicity. Concentrations of 2,4-D at the time if an aquatic application exceed EPA's level of concern for some aquatic organisms (crustaceans). Single-dose toxicity testing of 2,4-D indicates that it is moderately toxic to mammals and birds and low in hazard to bees, frogs, and aquatic organisms.

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Applicator / handler exposure was not evaluated	0.025 mg/kg/day	0.0026 mg/kg/day	9.8	Dermal + inhalation	3	Low / Moderate
Adult swimming in treated water	0.025 mg/kg/day	>0.025 mg/kg/day	None	Dermal + ingestion	3	Fail
Child swimmer	0.067 mg/kg/day	>0.067 mg/kg/day	None	Dermal + ingestion	3	Fail
Aggregate exposure not evaluated						

Acute Toxicity Risk Assessment Summary

For lack of an adequate assessment of developmental toxicity an additional 10-fold safety factor was added to the EPA's risk assessment scenarios (for a total safety factor of 1,000).

The short-term exposure scenario of a child or adult swimming in treated water can result in an exposure equal to the EPA level of concern. This means there is no safety margin beyond the EPA's level of concern, which Thurston County rates as high in hazard and fails the review criteria. The same exposure to an adult is rated as moderate in potential toxicity hazard.

The worst-case scenario for an adult mixing 2,4-D herbicide for a 30 acre aquatic application (wearing all protective equipment listed on the label), is considered moderate to low in hazard.

CHRONIC TOXICITY

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	D	Not classifiable as to human carcinogenicity	3	Pass
Mutagenicity	No evidence	No evidence	3	Pass
Neurotoxicity - (NOAEL)	67	ataxia, retinal degeneration, +	3	Conditional
Endocrine Disruption	"suspected" IL EPA		3	Conditional
Developmental Toxicity (NOAEL)	5	alterations in hematology +	3	Conditional
Reproductive Toxicity (NOAEL)	25	skeletal abnormalities	3	Pass
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 aquatic use of 2,4-D BEE herbicides, so the hazard for toxicity from a long-term exposure is considered low.

CHRONIC TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Post-application contact exposure was not assessed						
Aggregate exposure not evaluated						
Drinking water exposure not evaluated						
Dietary exposure was not evaluated						

Chronic Toxicity Risk Assessment Summary:

There are no intermediate or long-term exposures expected from aquatic uses of 2,4-D herbicides, so the hazard for toxicity from a long-term exposure is considered low.

DegradationProducts:

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 severe eye irritants (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.