

Type	Selective and systemic, post-emergent herbicide.
Controls	Clethodim controls grasses without harming most broadleaf plants.
Mode of Action	Clethodim inhibits the initial stages of lipid synthesis for cell membrane production in the meristems of grass plants.

Thurston County Review Summary:

Herbicides containing clethodim as the sole active ingredient pass Thurston County's review criteria. Clethodim is considered high in hazard for the potential to move off the site of application with rain or irrigation water although, it is considered low in hazard for persistence (likely to reach half of the applied concentration within one week). It is also considered low in hazard for bioaccumulation, human toxicity, and risk to non-target organisms.

MOBILITY

Property	Value	Reference	Rating
Solubility (mg/L)	5,450	1	High
Soil Sorption (Kd=mL/g)	1 - 2	2	High
Organic Sorption (Koc=mL/g)	40	1	High

Mobility Summary:

Clethodim is soluble in water and can be expected to adhere poorly to all soil types. The hazard for clethodim to move off the site of application with rain or irrigation water is rated high.

PERSISTENCE

Property	Value	Reference	Rating
Vapor Pressure (mm Hg)	0.0000001	7	High
Biotic or Aerobic Half-life (days)	1 to 2.6	7	Low
Abiotic Half-life (days)	2.8	1	Low
Terrestrial Field Test Half-life (days)	3	1	Low
Hydrolysis Half-life (days)	26 to 300	7	High
Anaerobic Half-life (days)	23 soil 214 sediment	1 and 7	Moderate
Aquatic Field Test Half-life (days)	Not found		

Persistence Summary:

Clethodim is broken down quickly in surface soil but may persist longer if it leaches into deep soil or enters water bodies. The hazard of persistence is rated low.

BIOACCUMULATION

Property	Value	Reference	Rating
Bioaccumulation Factor	Not found		
Bioconcentration Factor	3.5	2	Low
Octanol/Water Partition Coefficient	4.14	1	Moderate

Bioaccumulation Summary:

Clethodim has a moderate attraction to fats and oil but testing with fish indicates that it does not accumulate in their tissue. Metabolism studies with rats indicate that clethodim is rapidly metabolized and eliminated with about 1% remaining unchanged and stored in body tissue (within one day). The hazard of bioaccumulation is rated low.

ACUTE TOXICITY HAZARD - ECOTOXICITY

Test Subject	Value	Reference	Rating
Mammalian (LD50)	1,360 mg/kg	7	Moderate
Avian (LD50)	>2,000 mg/kg	7	Low
Honey bee or insect (LD50)	>100 ug/bee	7	Low
Annelida -worms (LC50)	454 mg/kg	1	Moderate
Fish (LC50)	18 mg/L	7	Moderate
Crustacean (LC50)	>100 mg/L	1	Low
Mollusk (LC50)	Not found		
Amphibian (LD50 or LC50)	Not found		

Acute Toxicity Summary:

Single-dose toxicity testing indicates that clethodim is low in toxicity to birds and bees but is moderately toxic to some mammals and fish. Risk assessments for non-target organisms could not be found but the EPA stated that; "Available fish and wildlife data indicate that the proposed uses on cotton and soybeans will result in minimal hazard to nontarget and endangered beneficial insect, avian, freshwater fish and mammalian species." (Reference 7).

ACUTE TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Adult applicator using hand wand sprayer	75 mg/kg/day	4.7 mg/kg/day	16	Skin absorption	8	Low
Exposure to treated vegetation not evaluated						
Exposure to treated drinking water not evaluated						
Multiple short-term exposures not evaluated						

Acute Toxicity Risk Assessment Summary

When assessing short-term toxicity of clethodim, the EPA stated; "There were no effects observed in oral toxicity studies including developmental toxicity studies in rats and rabbits that could be attributable to a single dose (exposure)." Reference 3. Because of this, the EPA did not perform risk assessments for single-dose exposures or one-time contact to treated vegetation. And, although there are no restrictions for the use of clethodim herbicides and no identified high-risk exposures, Health Canada requires a 12-hour re-entry interval after applications of all clethodim products.

Short-term or intermediate-term exposures to applicators using low pressure handwand sprayers is calculated to be 16 to 73 times less than the EPA's dose of concern. These exposures assumed the maximum application rate for turf and garden use and a two-hour exposure.

The hazard for toxicity from short-term exposures to clethodim following an herbicide application is rated low.

CHRONIC TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	"not likely to be carcinogenic to humans"	Low cancer hazard	3	Low
Mutagenicity	5,000 mg/kg	None noted	5	Low
Neurotoxicity - (NOAEL)	"no evidence of neurotoxicity"	None noted	3	Low
Endocrine Disruption	Not listed	- -	4, 5	Low
Developmental Toxicity (NOAEL)	100 mg/kg/day	Reduced ossification	6	Check risk
Reproductive Toxicity (NOAEL)	220 mg/kg/day	None noted	6	Low
Chronic Toxicity (NOAEL)	1 mg/kg/day	Liver toxicity	3	Check risk

Chronic Toxicity Summary:

Long-term toxicity testing indicates that clethodim is not a reproductive toxicant and developmental toxicity was observed along with maternal toxicity. Clethodim is not considered carcinogenic, mutagenic, neurotoxic, nor is it a known endocrine disruptor.

CHRONIC TOXICITY - Risk Assessment

Subject and Scenario	Dose of Concern	Exposure	Margin of Safety	Route	Reference	Rating
Exposure to treated vegetation not evaluated						
Multiple long-term exposures not evaluated						
Exposure to treated drinking water not evaluated						
Long-term occupational exposure was not evaluated						

Chronic Toxicity Risk Assessment Summary:

The EPA only evaluated the long-term exposures to clethodim from eating treated crops and drinking contaminated water. Thurston County's review criteria does not take into account dietary exposures and there were no other risk assessments performed by the EPA (or any other agency). Since clethodim is expected to reach half of the applied concentration within one week, it is unlikely that a long-term exposure could result from contacting treated vegetation. Thurston County considers the hazard for toxicity from long-term exposures to clethodim from herbicide use low in hazard.

Degradation Products:

Identified metabolites include: clethodim sulfoxide, clethodim sulfone, and clethodim oxazole sulfone.

Comments:

Clethodim is known to be a mild eye irritant (EPA toxicity category III) and a moderate skin irritant (EPA toxicity category IV), but is not considered a skin sensitizer (Reference 3 and 7).

References

1. International Union of Pure & Applied Chemistry (IUPAC). Pesticide Properties Database (Accessed 8/25/2010). <http://sitem.herts.ac.uk/aeru/iupac/>
2. Health Canada. Re-evaluation Note; Clethodim. Revision 2010-04. 2 March 2010.
3. USEPA. Federal Register: May 12, 2010 (Volume 75, Number 91). [EPA-HQ-OPP-2009-0307; FRL-8822-7] "Clethodim; Pesticide Tolerances".
4. Illinois EPA. "Endocrine Disruptors Strategy" February 1997.
5. Scorecard - The Pollution Information Site. Health Effects / Endocrine Toxicants (Accessed 8/25/2010). <http://www.scorecard.org/health-effects/>
6. Caris, M. Health Canada, Bureau of Chemical Safety. CLETHODIM.
7. USEPA. 1992. Office of Pesticides and Toxic Substances, Fact Sheet Number 230: Clethodim. Washington DC.
8. USEPA. Federal Register: April 8, 1998 [63 FR 17101] "Clethodim; Time-Limited Pesticide Tolerance".