benfluralin (benefin)

Review Date: 08/12/2013
CAS #: 1861-40-1

Type	Pre-emergent synthetic herbicide
Controls	Controls grasses and other weed species within residential turf, around ornamental plants, along right-of-ways, within crops, etc.
Mode of Action	Mitotic disruptor - growth inhibitor (Reference 2). Inhibits hormone-induced enzymes and uncouples oxidative phosphorylation (Reference 4).

Thurston County Review Summary:

Benfluralin is rated high in hazard and products containing it fail Thurston County's pesticide review criteria. Benfluralin is rated high in hazard for its potential to cause toxicity to birds at expected environmental concentrations following applications to turf and other non-crop vegetation.

MOBILITY

Property	Value	Reference	Value Rating
Water Solubility (mg/L)	0.065	1	Low
Soil Sorption (Kd=mL/g)	Value not found		
Organic Sorption (Koc=mL/g)	9,840 to 11,660	1	Low

Mobility Summary:

Benfluralin is not soluble in water and is expected to bind tightly to soil. The potential for benfluralin to leave the site of application with rain or irrigation water is low, unless it is transported with eroding soil.

PERSISTENCE

Property	Value	Reference	Value Rating
Vapor Pressure (mm Hg)	0.000066	2	Moderate
Biotic or Aerobic Half-life (days)	20 to 86	2	Moderate to high
Abiotic Half-life (days)	<13 (soil) <1 (aqueous)	1	Low
Terrestrial Field Test Half-life (days)	22 to 79	2	Moderate to high
Hydrolysis Half-life (days)	Stable	1	High
Anaerobic Half-life (days)	12 (<2 aquatic)	1	Moderate (aquatic = low)
Aquatic Field Test Half-life (days)	Value not found		

Persistence Summary:

Benfluralin has the potential to dissipate into the air, so granular products are formulated to resist dissipation and liquid products are incorporated into the soil also to reduce dissipation. In aquatic environments, benfluralin is likely to degrade rather quickly by photolysis in the water column, but slowly in sediments (moderate persistence). In soil, benfluralin can take over 60 days to degrade to half of the applied concentration. Overall, benfluralin is rated high in hazard for persistence based on it rate of soil degradation.

BIOACCUMULATION

Property	Value	Reference	Value Rating
Bioaccumulation Factor	Value not found		
Bioconcentration Factor	1,580 (whole fish)	2	Moderate
Octanol/Water Partition Coefficient	log Kow = 5.19	1	High

Bioaccumulation Summary:

The octanol/water partition coefficient (log Kow = 5.19) indicates that benfluralin will bind well to fish or animal fat and tissue and has the potential to accumulate. Bioconcentration studies with fish showed that there was a moderate amount of accumulation in the whole fish. When a contaminated fish is moved to clean water, benfluralin is removed from the fish (depurated) in less than one day. This rapid depuration rate is very limiting in accumulation potential. Metabolism studies with animals indicate that up to 17% of the parent chemicial and its metabolites are eliminated in urine and up to 75% is eliminated in feces (Reference 4), but the EPA did not state how long it takes for these chemicals to be eliminated.The hazard for bioaccumulation is rated moderate.

ACUTE WILDLIFE TOXICITY VALUES and Risk Assessment

Test Subject	Value	Reference	Value Rating
Mammalian (LD50)	>10,000 mg/kg-bw	2	Low
Avian (LD50)	>2,000 mg/kg	1	Low
Honey bee or insect (LD50)	>100 ug/bee	1	Low
Annelida -worms (LC50)	>500 mg/kg	1	Moderate or low
Fish (LC50)	<0.03 ppm	2	Very high
Crustacean (LC50)	2.18 ppm (product)	2	Moderate
Mollusk (LC50)	Value not found		
Amphibian (LD50 or LC50)	Value not found		

Acute Toxicity Testing and Ecotoxicity Summary:

Single-dose toxicity testing indicates that benfluralin is low in toxicity to mammals, birds and beneficial insects, moderately toxic to some aquatic organisms, but highly toxic to fish (Reference 2).

Risk to birds from potential long-term (chronic) exposures to benfluralin was evaluated by the EPA for applications to turf (which was used to represent vegetation without berries, fruit, nuts, or that isn't a crop). The risk was calculated for low (3 pounds active ingredient/acre), medium (6 and 9 pounds active ingredient/acre), and to high (12 pounds active ingredient/acre) application rates. One assessment calculated exposures assuming the chemical was completely within the top 1 centimeter of soil and a second calculated exposures when the chemical was distributed evenly within the top 7 centimeters of soil. Risk to birds exceeded the EPA's level of concern for all application rates when the chemical is entirely within the top 1 centimeter of soil, but it is not if it is evenly distributed within the top 7 centimeters. Risk to birds is likely to be higher for applications of granular products compared to the risk from liquid products due to the potential for direct ingestion of the granules; to reduce this risk the EPA requires that granular products be watered in after application. Potential risk to small animals that eat treated vegetation or insects exceeds the EPA's level of concern calculated for chronic exposures. The EPA also noted that due to the potential for benfluralin to accumulate in organisms, there is a potential that earthworms may accumulate up to fifteen times the concentration in soil and pose a risk to birds and animals that eat worms (Reference 2). The potential risk of toxicity to birds from exposures to benfluralin from expected environmental concentrations is rated high in hazard by Thurston County's pesticide review criteria.

ACUTE HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Belly grinder application to 0.5 acres (max rate)	Inhalation	1 mg/kg/day	mg/kg/day	750	2	Low
Shaker can application to 1,000 square feet	Inhalation	1 mg/kg/day	mg/kg/day	220	2	Low
Child's hand-to-mouth activities in treated turf	Ingestion	1 mg/kg/day	mg/kg/day	22	2	Low
Hand & object-to-mouth activities in treated turf	Ingestion	1 mg/kg/day	mg/kg/day	18	2	Low

Acute Toxicity Risk Assessment Summary:

Post-application inhalation exposures are expected to be minimal and risk from these potential exposures was not evaluated by the EPA (Reference 2). Applying benfluralin to the skin did not produce toxicity to test animals (even at concentrations up to 1,000 mg/kg/day), therefore the EPA did not evaluate risk of toxicity from skin exposures (Reference 2).

Risk from incidental ingestion of benfluralin, following residential turf grass application, was evaluated by the EPA for potential exposures by children. For a child contacting treated turf or from hand-to-mouth activities occuring after contacting treated turf or soil, the calculated exposures are rated low in hazard. Potential risk to residential applicators is also calculated to be low in hazard.

CHRONIC HUMAN TOXICITY HAZARDS

Property	Value	Adverse Effect	Reference	Rating
Carcinogenicity	Suggestive evidence	"Suggestive evidence"	2	Moderate
Mutagenicity	Up to 5,000 ug/plate	Negative for mutagenic effects	4	Low
Neurotoxicity - (NOAEL)	Value not found	Suggestive evidence determined to be age related	2	Low
Endocrine Disruption	136 mg/kg/day (LOAEL)	Thyroid toxicity	2	Check risk
Developmental Toxicity (NOAEL)	7.2 mg/kg/day (inhalation)	No developmental toxicity	4	Check risk
Reproductive Toxicity (NOAEL)	Value not found	Pup weight loss with maternal toxicity	2	N/A
Chronic Toxicity (NOAEL)	0.5 mg/kg/day	Kidney lesions	2	Check risk

Chronic Toxicity Hazard Summary:

The EPA noted that there was toxicity to the thyroid observed at "high dose levels" that was not observed at lower doses (Reference 2). Effects to the thyroid indicate the potential for endocrine disruption. Because the toxic effect to the endocrine system is dose related, the hazard is rated based on the risk assessment that is protective of the toxic effect that is observed at the lowest dose (which is kidney toxicity and not endocrine disruption). The toxic effect that was observed at the lowest dose in long-term dietary testing of benfluralin was kidney lesions at a dose of 5.4 mg/kg/day (Reference 2).The EPA's Agency Cancer Assessment Review Committee placed benfluralin in the category of "suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential" (Reference 2). Reproductive toxicity in the form of pup weight loss was observed at maternally toxic doses and there was no observed developmental toxicity (Reference 2). Although the data was not provided, the EPA stated that benfluralin lacked evidence of mutagenic potential (Reference 2).

CHRONIC HUMAN TOXICITY - Risk Assessment

Subject and Scenario	Route	Dose of Concern	Exposure	Margin of Safety	Reference	Value Rating
Apply granular with backpack spreader	Inhalation	0.072 mg/kg/day	0.019 mg/kg/day	3.8	2	Moderate
Load granular with tractor spreader	Inhalation	0.072 mg/kg/day	0.012 mg/kg/day	6.2	2	Moderate
Apply granular with tractor spreader	Inhalation	0.072 mg/kg/day	0.008 mg/kg/day	8.8	2	Moderate
Load & apply granular with tractor spreader	Inhalation	0.072 mg/kg/day	0.02 mg/kg/day	3.6	2	Moderate

Chronic Toxicity Risk Assessment Summary:

The EPA determined that long-term (chronic) exposures or lifetime exposures are not expected and that exposures of greater than 30 days are unlikely because benfluralin is used before planting or is seasonally timed (Reference 2). Therefore, the EPA only evaluated risk from potential short-term (1-30 days) or intermediate-term (1-6 months) exposures. Potential intermediate-term occupational exposures that are considered for Thurston County ratings are for mixing, handling, applying or re-entering treated right-of-way areas, turf grass, or ornamental plantings.

Occupational exposure assessments were calculated from granular applications to turf at 2 pounds active ingredient/acre for 5 acres, landscape ornamental applications at 3 pounds active ingredient/acre (10 acres for backpack sprayer, 5 acres for push spreader, 1 acre for belly grinder), and right-of-way treatments at 6 pounds active ingredient/acre (80 acres).

Metabolites and Degradation Products:

The EPA stated that benfluralin has 26 chemical degradates but none of them are of toxicological interest (Reference 2).

Comments:

Benfluralin is a very strong acid and is considered an eye irritant (EPA Toxicity Category III), a skin irritant (EPA Toxicity Category III), and a skin sensitizer (Reference 2).

References

1. International Union of Pure & Applied Chemistry. Pesticide Properties Database. Benfluralin (Ref: EL-110). Date accessed 8/12/2013.
2. USEPA. Office of Prevention, Pesticides and Toxic Substances. Reregistration Eligibility Decision for Benfluralin, List B. Case 2030, July 2004.
3. USEPA. Benfluralin: Health Effects Decision (HED) Metabolism Assessment Review Committee (MARC) Decision Document 29-Apr-2003.
4. USEPA. Office of Prevention, Pesticides and Toxic Substances. Benfluralin: Human Health Risk Assessment (Revised). October 30, 2003.