SETHOXYDIM

Herbicide Basics

Chemical formula: 2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one

Herbicide Family: Cyclohexanedione

Target Species: annual and perennial grasses

Forms: not available as a salt or ester

Formulations: EC, SL

Mode of Action: Lipid synthesis inhibitor

Water Solubility: 4,000 ppm

Adsorption potential: low

Primary degradation mech: Microbial metabolism and photolysis

Average Soil Half-life: 5 days

Mobility Potential: high

Dermal LD50 for rabbits: >5,000 mg/kg

Oral LD50 for rats: >2,676 mg/kg

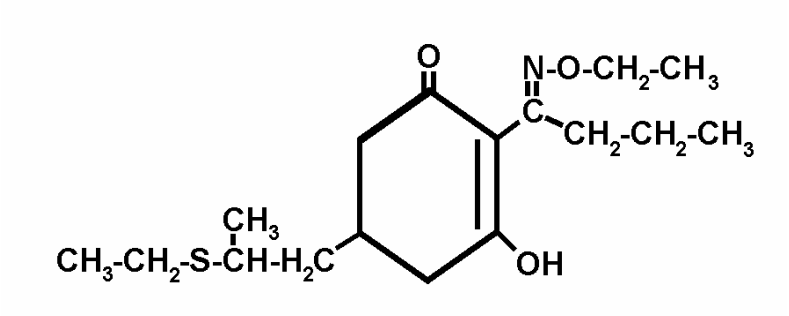
LC50 for bluegill sunfish: 100 mg/L

Trade Names: Poast®, Torpedo®, Ultima®, Vantage®, Conclude®, and Rezult®

Manufacturer: BASF, TopPro, Monterey

Synopsis

Sethoxydim kills grasses by preventing the synthesis of lipids, but it has little or no impact on broadleaf herbs or woody plants. Sethoxydim is readily degraded through microbial metabolism and photolysis, and possibly by hydrolysis. Numerous degradation products have been identified, some of which are also toxic to plants. The average half-life of sethoxydim in soils is four to five days, but half-lives can range from a few hours to 25 days. Because sethoxydim is water-soluble and does not bind strongly with soils, it can be highly mobile. No reports, however, were found referring to water contamination or off-site movement by sethoxydim. Sethoxydim is of relatively low toxicity to birds, mammals, and aquatic animals, and has little noticable impact on soil microbe populations. An oil adjuvant or non-ionic surfactant should be used to facilitate absorption of sethoxydim by plants.



Herbicide Details

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Use Against Natural Area Weeds: Sethoxydim is a selective herbicide used to kill and suppress annual and perennial grasses. It is applied as a post-emergent herbicide, and requires the addition of an oil adjuvant or nonionic surfactant for maximum effectiveness (WSSA 1994). According to manufacturers, sethoxydim can be used to control bahiagrass (*Paspalum notatum*), crabgrass (*Digitaria sanguinalis*), downy brome (*Bromus tectorum*), quackgrass (*Elytrigia repens*), annual ryegrass (*Lolium multiflorum*), wild oats (*Avena* spp.), and witchgrasses (*Panicum* spp.) (BASF 2000; TopPro 2000).

Sethoxydim can be highly mobile in the environment and has not been used extensively on TNC preserves. In Illinois, sethoxydim was applied against reed canarygrass (*Phalaris arundinacea*), and initial results indicate that significant control was achieved. In southwest Oregon, however, sethoxydim was applied against quackgrass (*Elytrigia repens*), but was less effective than fluazifop-p-butyl (Fusilade®) and is therefore not highly recommended for quackgrass control (Borgias et al. 2000).

Mode of Action: Sethoxydim is absorbed rapidly through leaf surfaces, transported in the xylem and phloem, and accumulated in meristematic tissues. Sethoxydim inhibits acetyl CoA carboxylase (much like the herbicide fluazifop-p-butyl), the enzyme responsible for catalyzing an early step in fatty acid synthesis. Non-susceptible broadleaf species have a different acetyl CoA carboxylase binding site, rendering them immune to the effects of sethoxydim. The inhibition of acetyl CoA carboxylase prevents fatty acid production, which leads to failure of cell membrane integrity, especially in regions of active growth. This results in a cessation of shoot and rhizome growth, leading to necrosis and death of shoot meristems and rhizome buds, and ultimately plant death.

Dissipation Mechanisms:
Summary: Sethoxydim is degraded readily by light and microbial metabolism. It is unclear what role hydrolysis plays in the removal of sethoxydim from the environment. Sethoxydim is water-soluble and does not bind readily with soils, and therefore has the potential to be mobile. Rapid degradation, however, generally limits extensive movement of sethoxydim in the environment. Sethoxydim is not highly volatile.

Volatilization
Sethoxydim does not readily volatilize when applied in the field (T. Lanini, pers. obs.). The potential to volatilize, however, increases with increasing temperature, increasing soil moisture, and decreasing clay and organic matter content (Helling et al. 1971).

Photodegradation
Sethoxydim is readily degraded by light (Shoaf & Carlson 1992). Photodegradation occurs in less than one hour in water and in less than four hours on soil (WSSA 1994; EXTOXNET 1996).

Microbial Degradation
Microbial metabolism is the primary means of degradation of sethoxydim in soils. Roslycky (1986) reports a half-life of sethoxydim in soils, due to microbial metabolism, that averages 25 days.

Adsorption
Sethoxydim is water-soluble and does not bind strongly with soil particles. Adsorption of sethoxydim to soil particles increases with increasing soil organic content (WSSA 1994).

Chemical Decomposition
Reports of sethoxydim's susceptibility to hydrolysis are conflicting (Campbell & Penner 1985; EXTOXNET 1996). EXTOXNET (1996) reports that the product Poast® is fairly stable in water. Campbell and Penner (1985), however, report that sethoxydim degrades rapidly in water at room temperature.

Behavior in the Environment
Summary: Sethoxydim is degraded rapidly by microbial degradation and photolysis. The half-life of sethoxydim in the field ranges from 5 to 25 days. Because it is water-soluble and does not bind strongly with soils, it can be highly mobile in the environment. In water, sethoxydim can be degraded by sunlight within several hours.

Soils
Sethoxydim is of low soil persistence. It is degraded in soils rapidly by microbial metabolism and photolysis. The half-life of sethoxydim in soils ranges from a few hours to 25 days (Roslycky 1986; Shoaf & Carlson 1992; Koskinen et al. 1993). Roslycky (1986) also found that degradation rates are rapid during the first few weeks following application, but then decrease, taking 50 days to reach 80% and 100 days to reach 90% degradation. Similarly, Koskinen et al. (1993) detected residues 38 days following application, while half-lives averaged less than one week.

Although sethoxydim is water-soluble and does not bind strongly with soils, significant movement of sethoxydim has not been documented, possibly because it degrades rapidly, before it can travel any noticable distance. Koskinen et al. (1993) reported that in three Minnesota soils, sethoxydim leached only minimal amounts with residues occasionally reaching 45 cm.

Water
In water, sethoxydim can be rapidly degraded by light in less than one hour (EXTOXNET 1996). Sethoxydim, because it binds weakly with soil particles, has the potential to move off-site and contaminate local waterways. No reports of water contamination, however, have been documented. If sethoxydim does enter an open water body, it can be degraded by sunlight in a matter of hours.

Vegetation
Sethoxydim is readily absorbed by plant roots and foliage and transported through the xylem and phloem to the meristematic tissues of the plant (WSSA 1994). It is hypothesized that in non-susceptible species, sethoxydim is metabolized rapidly to non-phytotoxic metabolites (WSSA 1994).

Environmental Toxicity
Birds and Mammals
Sethoxydim is slightly toxic to birds and mammals (EXTOXNET 1996). The LD50 for rats is 2,600-3,100 mg/kg. For bobwhite quail and mallard duck the LD50s are >5,620 and >2,510, respectively. Effects of chronic ingestion include anemia, and reproductive and teratogenic effects (EXTOXNET 1996).

Aquatic Species
Sethoxydim is moderately to slightly toxic to aquatic species (EXTOXNET 1996). The LC50 for bluegill sunfish and rainbow trout are 100 mg/L and 32 mg/L, respectively (EXTOXNET 1996). The LC50 for *Daphnia* is 1.5 mg/L (EXTOXNET 1996).

Other Non-Target Organisms
Roslycky (1986) investigated the effects of sethoxydim on populations of soil microbes. At sethoxydim concentrations <50 ppm, negligible response was noted in microbial populations. At higher concentrations (1000 ppm), soil actinomycetes and bacteria populations were stimulated, but fungal populations changed little (Roslycky 1986).

Application Considerations:
Because sethoxydim degrades rapidly, it should be used solely as a post-emergent herbicide. Sethoxydim is most effective when mixed with an oil adjuvant or nonionic surfactant (WSSA 1994). Marked increases in sethoxydim effectiveness have been reported with increases in humidity and temperature (Rhodes & Coble 1983; Coupland 1987). On the other hand, reduced soil moisture significantly reduced sethoxydim's effectiveness (Coupland 1987). Sethoxydim is rainfast (will not wash-off plants) within 10-15 minutes of application (Rhodes & Coble 1983; Coupland 1987).

Safety Measures:
Sethoxydim is slightly toxic if ingested, can cause skin and eye irritation, and inhalation of dusts or vapors can cause irritation of the throat and nose. Care should be taken to avoid splashing or other exposure of skin and eyes to the herbicide.

Human Toxicology:
Although some of the effects of chronic exposure to sethoxydim have been identified in rabbits and dogs, EXTOXNET (1996) concluded that chronic effects in humans from expected exposure levels were unlikely. Sethoxydim is not mutagenic or carcinogenic in humans. The U.S. EPA reports that the level of toxicity of sethoxydim to mammals is low, and that sethoxydim is practically nontoxic if absorbed through the skin. It can however, cause skin and eye irritation. Sethoxydim is slightly toxic by ingestion, and inhalation can cause irritation to the throat, nose, and upper respiratory system. Symptoms of sethoxydim poisoning include loss of coordination, sedation, tears, salivation, tremors, blood in the urine, and diarrhea.

References
BASF. 2000. Poast Herbicide Label. C & P Press.
Borgias, D., R. Dovel, R. Huddleston, N. Rudd, and D. Salzer. 2000. Management and monitoring of Elytrigia repens (L.) Nevski [quackgrass], invading the habitat of Astragalus applegatei [Applegate's milk-vetch], a listed endangered species, on Ewauna Flat Preserve, Klamath County, Oregon. The Nature Conservancy or Oregon, ELRE Final Report.
Campbell, J. R., and D. Penner. 1985. Abiotic transformations of sethoxydim. Weed Sci. 33:435-439.
Coupland, D. 1987. Influence of environmental factors on the performance of sethoxydim against. Weed Res. 27:329-336.
EXTOXNET. 1996. Sethoxydim. Pesticide Information Profiles. Extension Toxicology Network. http://ace.orst.edu/info/extoxnet/.
Helling, C. S., P. C. Kearney, and M. Alexander. 1971. Behavior of pesticides in soil. Adv. Agron. 23:147-240.
Rhodes, G. N., and H. D. Coble. 1983. Environmental factors affecting the performance of sethoxydim. Proc. S. Weed Sci. Soc. pg. 154-155.
Roslycky, E. B. 1986. Microbial response to sethoxydim and its degradation in soil. Can. J. Soil Sci. 66:411-419.
Shoaf, A. R., and W. C. Carlson. 1992. Stability of sethoxydim and its degradation products in solution, in soil, and on surfaces. Weed Sci. 40:384-389.
TopPro. 2000. Vantage Herbicide Label. C & P Press.
WSSA. 1994. Herbicide handbook. Weed Society of America. Champaign, Illinois. 352 pp.

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