Toxicological Profile for Triclopyr

Chemical Formulation & Use Profile Triclopyr (3,5,6-trichloro-2-pyridyloxyacetic acid) is a selective herbicide used to control woody and broadleaf plants in agriculture, forestry, parkland, roadway, and residential settings. Triclopyr is in the pyridine carboxylic acid chemical family. Exposure to triclopyr causes irregular hormone behavior in plants, causing abnormal growth, and eventually death.[1] It is common in two forms: triethylamine salt (Garlon 3A) and butoxyethyl ester (most other commercial products). Triclopyr products are formulated as soluble concentrates, emulsifiable concentrates, liquids (pressurized and ready-to-use), granulars, wettable powders and pellets.[2]

Human Health Risk Summary

Acute Effects: Brief exposure to triclopyr has been found to cause severe eye damage, skin sensitization, dizziness and/or drowsiness, respiratory irritation, and gastrointestinal irritation.[3] Acute exposure has also been linked to blood, kidney, liver, and nervous system toxicity in animals.[4]

Chronic Effects: *Carcinogenicity*: Though not widely classified as a carcinogen, two unpublished studies on triclopyr ingestion by rats and mice have suggested increased frequency of mammary gland cancer at high doses.[5,6] *Reproductive/Developmental Toxicity:* In experimental animal studies, high doses of triclopyr have been shown to cause reproductive and developmental abnormalities, including: increased fetal death, skeletal malformations, as well as liver and kidney defects.[7]

Ecological Hazard Summary

Environmental Fate: Triclopyr is moderately persistent in soil, with an estimated half-life from 30-90 days, though it has been shown to persist for over a year depending on conditions.[8,9] In an aquatic setting, half-life ranges from several hours to 10 days depending on water-depth and sunlight conditions.[10] Adsorption to soil particles varies based on formula and soil type. Butoxyethyl ester has a greater potential for surface-water runoff and waterway contamination than the triethylamine salt, due to its low soil adsorption capacity.[11] Butoxyethyl ester and TCP (the most common breakdown product of triclopyr) may pose significant risks to groundwater and surface water sources.[12,13] *Risk to Non-Target Flora & Fauna*: Triclopyr has been shown to be moderately to highly toxic to freshwater plants and fish as well as some marine vertebrates and invertebrates when in butoxyethyl ester form, as well as in the degradate (TCP) form.[14] Salmonid species of fish have been shown to be more sensitive to both the ester form and TCP than other species tested.[15,16] Both fish and amphibian species have exhibited behavioral defects, reduced oxygen uptake and loss of motor control when exposed to low doses of triclopyr.[17,18,19,20] At least one study has indicated that mammal populations dwelling in forested areas treated with triclopyr have been significantly reduced.[21] Because triclopyr is a potent plant growth disruptor, unintended target plants may be destroyed due to spray drift, leaching, erosion and storm-caused translocation. Additionally, triclopyr has been shown to disrupt the normal growth and nutrient cycling properties of microorganisms, fungi, mosses and algae; all of which perform critical functions to maintain a healthy ecosystem.[22,23,24]

Toxicity of Inert Ingredients

Commercial triclopyr products are typically composed of 40-50% of the triclopyr acid or salt, and 50-60% of inert ingredients or surfactants. Many of these additives have shown to be significantly more toxic to both humans and animals than triclopyr itself. One of these compounds ethylenediamine tetraacetic acid (EDTA) has been shown to cause birth defects, cleft palate, and abnormal skeletons in test animals.[25] EDTA has also been shown to be 10-fold more toxic to fish than the Garlon formulation alone.[26] Another inert, triethylamine is extremely toxic to the eyes, skin and respiratory system.[27] At least one commercially available triclopyr products contains kerosene, which has been linked to severe gastrointestinal, respiratory and nervous system toxicity.[28]

Summary Triclopyr and commercially available products containing this herbicide are of particular concern to human health and the environment, due to: 1) potential toxicity from acute and chronic exposures, including eye, skin, respiratory and gastrointestinal injury; 2) potential adverse effects to non-target plants and animals, due to over-spray, drift, leaching, and translocation to aquatic habitats from weather and erosion factors; and, 3) the potentially extreme hazard to both humans and animals from exposure to "inert" ingredients in triclopyr products, such as EDTA, triethylamine, and kerosene.

Common Commercial Names Garlon 3A, Garlon 4, Crossbow, Brush-B-Gone, Weed B Gon, Pathfinder.

References

[1] Tu, M., et al. Weed Control Methods Handbook. The Nature Conservancy. April, 2001.
[2] USEPA/OPP. "Reregistration Eligibility Decision: Triclopyr." 1998.
[3] Ibid, pp. 6-9.
[4] National Library of Medicine/HSDB. "Triclopyr." Non-Human Toxicity Excerpts. Accessed: Apr., 2006.
[5] Tsuda, S.; Ebino, K.; Ikeda, M.; et al. (1987) Triclopyr: 22-month Oral Chronic Toxicity and Oncogenicity Study in Mice. Unpublished study prepared by The Institute of Environmental Toxicology. 1465 p.
[6] Eisenbrandt, D.; Firchau, H.; Wolfe, E.; et al. (1987) Triclopyr: 2-year Dietary Chronic Toxicity-oncogenicity Study in Fischer 344 Rats: Final Report: Laboratory Project No. HET K-042085-026. Unpublished study prepared by Dow Chemical Co. 1094 p.
[7] Ibid, ref. #2, pp 11-14.
[8] Kamrin, M.A. Pesticide Profiles. Triclopyr, Environmental Fate. Lewis Publishers, New York, NY. Pg. 526. 1997.
[9] Norris, L.C., et al. "Triclopyr Persistence in Western Oregon Hill Pastures." *Bulletin of Environmental Contamination & Toxicology*. 39:134-141. 1987.
[10] Petty, D.G., et al. "The aquatic fate of triclopyr in whole-pond treatments." *Pest Management Science*. 57(9):764-775. 2001.
[11] McCall, P.J., and P.D., Gavit. "Aqueous photolysis of triclpyr and its butoxyethyl and caculated environmental photodecomposition rates." *Environmental Toxicology & Chemistry*. 5:879-885. 1986.
[12] Ibid, ref. #2, pp. 62-64.
[13] U.S. Dept. of Justice. Drug Enforcement Administration. "Cannabis eradication in the contiguous United States and Hawaii." Supplement to the environmental impact statements. Washington, D.C., pp. 136-137. 1998.
[14] Ibid, ref. #2, pp. 40-50.
[15] Tarkowski, G.E. "Triclopyr butoxyethyl ester, Analysis of Risks to Endangered and Threatened Salmon and Steelhead,." Environmental Field Branch Office of Pesticide Programs, p. 11. Dec., 2004.
[16] Ibid – RED, p. 41-42
[17] Berrill, M., et al. "Effects of low concentrations of forest-use pesticides on frog embryos and tadpoles." *Environmental Toxicology and Chemistry*. 13(4):657-664. 1994.
[18] Morgan, J.D. et al. "Acute avoidance reactions and behavioral responses of juvenile rainbow trout to Garlon 4A, Garlon 3A, and Vision herbicides." *Environmental Contamination & Toxicology*. 10:73-79. 1991.
[19] Kreutzweiser, D.P. et al. "Field evaluation of triclopyr ester toxicity to fish." *Archives of Environmental Contamination & Toxicology*. 28:18-26. 1995.
[20] Johansen, J.A. and Geen, G.H. "Sublethal and acute toxicity of the ethylene glycol butyl esther ester formulation of triclopyr to juvenile coho salmon." *Archives of Environmental Contamination & Toxicology*. 19(4):610-616. 1990.
[21] Lautenschlager, R.A. et al. "Alternative conifer release treatments affect small mammals in northwestern Ontario." *Forestry Chronicle*. 73:99-106. 1997.
[22] Chakravarty, P. and Sidhu, S. "Effect of glyphosate, hexazinone, and triclopyr on in vitro growth of five species of ectomycorrhizal fungi." *European Journal of Forest Pathology*. 17:204-210. 1987.
[23] Newmaster, S.G. et al. "The effects of glyphosate and triclopyr on common bryophytes and lichens in northwestern Ontario." *Canadian Journal of Forest Research*. 29:1101-1111. 1999.
[24] Prezio, J., et al. "Effects of alternative conifer release treatments on terrestrial gastropods in regenerating spruce plantations." *Canadian Journal of Forest Research*. 29:1141-1148. 1999.
[25] Shepard, T.H. Catalog of Teratogenic Agents. 5th ed. Baltimore, MD: The Johns Hopkins University Press, p. 227. 1986.
[26] Abdelghani, A., et al. "Toxicity evaluation of single and chemical mixtures of Roundup, Garlon-3!, 2,4-D, and syndets surfactant to channel catfish, bluegill sunfish, and catfish." *Environmental Toxicology and Water Quality*. 12:237-243. 1997.
[27] U.S. Coast Guard, Department of Transportation. CHRIS - Hazardous Chemical Data. Volume II. Washington, D.C.: U.S. Government Printing Office, 1984-5.
[28] Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, p. III-223. 1984.