ChemicalWatch Factsheet

A Beyond Pesticides/ NCAMP Factsheet

Picloram

Picloram (4-amino-3,5,6-trichloropicolinic acid) is a systemic, persistent herbicide used for broadleaf weed and woody plant control, especially on rights-of-way. Produced by Dow Chemical Co. since 1963, this pesticide both by itself, and in combination with other herbicides like 2,4-D (Tordon 101™), has been associated with a number of reports of human poisonings and extensive groundwater contamination. In fact, EPA designated picloram a "restricted use" pesticide, a material only for use by certified applicators and those under their supervision, because of concern that picloram is likely to contaminate surface and groundwater supplies.

Picloram is absorbed through leaves and roots, and circulates throughout plants, so that it is not possible to wash off residues. It poisons plants by replacing the plant growth hormone indoleacetic acid in new growth, where it accumulates. Picloram kills by inhibiting protein synthesis in the plant so that it cannot make new tissues. However, most grasses are resistant to picloram. A 4:1 mixture of 2,4-D and picloram herbicides was used as a jungle defoliant in Viet Nam, where it was known as Agent White.

Picloram has a low acute toxicity to mammals, the reported rat oral LD50=8200 mg/kg. However, picloram is known to be irritating to human skin, and there have been numerous reports of other symptoms following human exposures, including: sore eyes and throat, itching and burning skin, skin rashes, persistent headaches, fatigue, deterioration of memory and vision, numbness in hands and feet, and even joint problems that mimic arthritis. Some of the reported symptoms persisted for years. Mixtures of 2,4-D and picloram seem to be more toxic than either chemical alone.

Mammalian metabolism is rapid. Excretion of picloram fed to dogs was almost complete in 2 days. Picloram does not bioaccumulate.

The long-term health effects of picloram, including carcinogenicity, are particularly controversial. EPA believes that the data base is too incomplete for the Agency to formulate either a positive or negative opinion on carcinogenicity, and in 1985 required repeat animal cancer tests to be run. However, there are those who disagree with this position. Dr. Melvin Reuber, then an independent pathologist, reviewed a study conducted by the National Cancer Institute (NCI), and found a high incidence of malignant liver and endocrine tumors in rats, and tumors of the spleen in mice. He also found a high incidence of dose-related testicular atrophy in rats and mice. EPA does not agree that the studies demonstrated positive chronic effects. .

EPA's 1985 Registration Standard required manufacturers to limit the concentrations of the carcinogenic contaminants hexachlorobenzene and nitrosamines (in amine salt formulations) to 200 ppm and 1 ppm, respectively.

EPA's reviews of the existing data found no evidence of reproductive problems or birth defects in animal tests.

This chemical is extremely persistent in soil, especially in cold, dry climates, and is only slowly degraded by microbes, even under the most favorable conditions. Reported soil half lives (T ½) range from 1-13 months depending on conditions.

chemicalWATCH Stats:

Chemical Class: Pyridinecarboxylic acid
Use: Feed crops, nonfood crops (including rights-of-way), forestry
Toxicity Rating: Slightly toxic
Signal Word: Caution
Health Effects: Liver and kidney effects. Contains the contaminants; hexachlorobenzene (probable human carcinogen – Group B2) and nitrosamines.
Environmental Effects: Moderately toxic to fish and slightly toxic to aquatic invertebrates. Extremely persistent in soil. Very high potential to leach to groundwater. High water solubility and high mobility through soil.

Dissipation is slow under conditions of low soil moisture, and in clay or sandy loam soils with low organic content. The major degradation pathway is photodegradation (exposure to light), and the rate of this process is also dependent on conditions. For example, T ½=5 days in one-inch deep containers, whereas in 12-foot deep non-circulating containers, T ½= 60 days.

Examination of six chemical properties predictive of a chemical's ability to pose a threat of groundwater contamination found that five were exceeded, while data were lacking for the sixth parameter. The water solubility and mobility of picloram through soil is high.

So far, picloram has been found in the groundwater of at least 10 states. Incidents of water contamination have been reported from the Squaw Creek area of Wyoming, at Turtle Mountain Indian Reservation in North Dakota, at commercial greenhouses in Kimbal, NE, repeatedly in West Virginia (where hearings were held on this issue in 1983), and in Ontario, Canada. As little as 1 part-per-billion in water was found to be enough to permanently damage plants. Also, because of its high persistence, picloram continues to appear in soil leachate for a long period of time, sometimes as long as several years.

Picloram is considered by EPA to be moderately toxic to fish, although most studies have found it to be relatively non-toxic to birds, aquatic invertebrates, and bees. EPA's Registration Standard on picloram stated, "that low concentrations will adversely affect the rate of yolk sac absorption and growth of [lake trout] fry."

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Update, November 2007:

Picloram and its three main derivatives (picloram triisopropanolamine salt, isooctyl picloram, and potassium picloram) were reregistered in 1995 by the EPA as "Restricted Use Pesticides" based on the hazards to non-target plants and can only be applied by certified applicators. There are no residential uses for picloram. The EPA classifies picloram as a Group E carcinogen - evidence of non-carcinogenicity, however it is structurally similar to DEHP (di(2-ethylhexyl)phthalate) which has been found to cause cancer in rodents. In EPA's assessment, it was reported that no evidence exists to support that picloram and its salts and ester are associated with significant reproductive or developmental toxicity. However, picloram has been linked to liver and kidney damage and decreased body weights in laboratory animals in many studies. Increases in the presence of tumors were obserevd in the adrenal, thyroid, pituitary glands and livers of rats, as well as in the reproductive gland in female rats given picloram. Monge et al. (2007) found evidence to suggest that parental exposure to picloram may even increase the risk of leukemia in children.

The effects of the commonly used mixture of picloram and 2,4-D on reproduction and development are well-documented. Studies by Blakley et al. found that preconceptional and gestational exposures to this mixture depresses embryonic development and fetal growth in mice. It has also been shown to be immunosuppressive. Testicular damage has also been observed in rats administered picloram and 2,4-D.

Picloram products contain the carcinogenic contaminants hexachlorobenzene (HCB) and nitroasmines, and the sole registrant of picloram products, DowElanco, has complied with the requirements of the 1985 Registration Standard to limit the levels of these compounds. HCB levels were certified to be less than 100 ppm (below the 200 ppm maximum) and the level of nitrosamines was measured to be less than 1 ppm. The resgistrant also agreed to conduct ground water monitoring for picloram.

Picloram is generally of moderate to low acute toxicity but is highly toxic by the inhalation route (Toxicity Category I). Skin irritation, redness, and swelling were observed in dermal studies on rabbits. EPA now requires applicators to wear personal protective equipment and has established reentry restrictions to treated areas. Product labels have been amended to mitigate risks posed by picloram products.

The use of picloram has resulted in increasing resistance among many grass and weed species, notably with the Yellow starthistle. Resistance to other herbicides, like clopyralid and dicamba also resulted after prolonged use of picloram.

Picloram *chemicalWATCH* Factsheet Bibliography

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BEYOND PESTICIDES
701 E Street, S.E., Suite 200, Washington DC 20003
202-543-5450 (v) • 202-543-4791 (f)
info@beyondpesticides.org • www.beyondpesticides.org