PI-83

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Pesticide Toxicity Profile: Chlorophenoxy Herbicides[1]

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This document provides a general overview of human toxicity, provides a listing of laboratory animal and wildlife toxicities and a cross reference of chemical, common and trade names of the chlorophenoxy herbicides registered for use in Florida.

General

The chlorophenoxy herbicides are a group of older herbicides, with their discovery and use dating back to the 1940s. They are used singly or in combination with other active ingredients to control broadleaf weeds in turfgrass, pasture, rights-of-way, corn, soybean (preplant only), small grains, and fence rows. Current chlorophenoxy herbicides registered for use in Florida include 2,4-D, 2,4-DB, MCPA, and mecoprop (MCPP). Malformation, twisting, and curvature of plant foliage are typical symptoms of the chlorophenoxy herbicides. These herbicides are absorbed by the plant and translocated to the younger tissues. Perennial weed control is better achieved in fall, when large amounts of nutrients are being transported to the roots. Numerous studies have been conducted to determine the mechanism of action of the chlorophenoxy herbicides, but the exact mode remains very elusive. It is known that the chlorophenoxy herbicides are auxin mimics causing hyperplastic growth.

2,4-D

There are approximately 100 commercial 2,4-D products registered for use in Florida, packaged singly or in combination with other active ingredients. The first 2,4-D product was registered for use in the U.S. in 1948. Various products are formulated as emulsifiable acids, amine salts, mineral salts, and esters. Amine forms of 2,4-D are soluble in water and present the least volatility hazard of causing harm to desirable vegetation. Esters, in contrast to amine formulations, are essentially insoluble in water and relatively volatile. Their vapors may kill or injure susceptible plants (Figures 1 – 3), and where the vapors are confined, they may inhibit the germination of seed. Concern for drift is a primary reason for their regulation by the Florida Department of Agriculture and Consumer Services (EDIS Document SS-AGR-12, Florida's Organo-Auxin Herbicide Rule – 2005). Esters are more likely to cause injury to crop plants as compared to amine formulations. The ester formulations are

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generally preferred for controlling difficult vegetation, such as woody species. Regardless, the rates for essentially all 2,4-D formulations are expressed as acid equivalents in pounds per gallon. There are numerous turfgrass fertilizers impregnated with 2,4-D available to homeowners.

Figure 1.a

Figure 1.b

MCPA

MCPA has many of the same use patterns as 2,4-D and most products containing MCPA are premixed with 2,4-D and other herbicides. It is also available in amine and ester formulations. It is used as a specialty herbicide in the U.S. on a small scale. MCPA is less injurious to cereal grain crops and has been labeled for weed control use in small-seeded legumes, such as clover. It was first registered in the U.S. in 1973.

2,4-DB

2,4-DB was first registered in the U.S. in 1958. It is registered for use as a foliar treatment to peanut and soybean. It is also formulated as amines and low-volatile esters. 2,4-DB is not highly phytotoxic,

Figure 1.c

Figure 1. Ester vapors may kill or injure susceptible plants.

per se; however, it undergoes beta-oxidation within plants and soils to form 2,4-D. Some plants are able to make this conversion rapidly, resulting in injury or control, while others, such as peanut and soybean, react slowly making them more tolerant of the effects.

MCPP

MCPP is an abbreviation for mecoprop. It acts relatively slowly compared to the other chlorophenoxy herbicides. In most cases, it is prepackaged with other herbicidal active ingredients.

Toxicity

The chlorophenoxy herbicides are regarded as a family of relatively safe pesticides in terms of acute, chronic, and long-term effects. For acute oral, dermal, and inhalation effects, they are classified Category III or IV. As single ingredients, they are not classified by the EPA as restricted use pesticides. Some products carry the signal word, “DANGER” on their labels due to corrosiveness and causing irreversible eye damage. 2,4-D has not been classified as a human

carcinogen by the EPA Cancer Peer Review Committee. Acute symptoms of 2,4-D toxicity can be fatigue and weakness and perhaps nausea. Symptoms vary with the different commercial products because of the specific amounts and types of additives such as surfactants and solvents. 2,4-D has a very limited ability to cause teratogenic effects and extensive testing for mutagenicity has found it to be non-mutagenic. 2,4-DB is placed in the following acute toxicity categories: oral III; dermal III; inhalation IV; eye irritation III; and, dermal irritation IV. EPA determined that there is reasonable certainty that no harm to any population subgroup will result from aggregate exposure to 2,4-DB when considering dietary exposure. 2,4-DB does not pose great ecological concerns; it is only slightly toxic to fish. MCPA is classed category III or IV, depending on form. Three of its four forms are classified as strong eye irritants. Acute and chronic dietary risk is not a concern. All available evidence indicates that MCPA does not cause cancer. It appears that the compound poses little mutagenic risk to humans. Ecologically, MCPA is the most toxic to birds, but only considered to be moderately toxic. MCPP has a low acute toxicity to test animals. It is irritating to skin and eyes, causing redness and swelling and can cause cloudy vision. MCPP is a teratogen in rats at moderate to high doses. Studies show that MCPP may be mutagenic at very high doses. It is not clear if occupational exposures cause cancer. There is no information available for its chronic and reproductive effects. Mammalian toxicities for the chlorophenoxy herbicides are shown in Table 1. Table 2 lists the toxicities to wildlife by the common name of the pesticide. Table 3 provides a cross listing of many of the trade names that these products are registered and sold by in Florida.

Additional Information

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Table 1. Chlorophenoxy herbicide mammalian toxicities (mg/kg of body weight).

Common name	Rat oral LD_{50}	Rabbit dermal LD_{50}
2,4-D	500 – 949	---
2,4-DB	>2,000	>10,000
MCPA	900 – 1160	>4,000
MCPP	1,000 – 1,166	>2,000

Table 2. Chlorophenoxy herbicide wildlife toxicity ranges.

Common name	Bird acute oral LD_{50} (mg/kg)*@	Fish (ppm)**	Bee†
2,4-D	PNT	PNT	PNT
2,4-DB	PNT	ST	PNT
MCPA	MT	PNT	PNT
MCPP	ST	PNT	PNT

*Bird LD_{50}: PNT = >2,000; ST = 501 – 2,000; MT = 51 – 500; HT = 10 – 50; VHT = <10.

**Fish LC_{50}: PNT = >100; ST = 10 – 100; MT = 1 – 10; HT = 0.1 – 1; VHT = <0.1.

†Bee: HT = highly toxic (kills upon contact as well as residues); MT = moderately toxic (kills if applied over bees); PNT = relatively nontoxic (relatively few precautions necessary).

Table 3. Cross reference list of common, trade and chemical names of chlorophenoxy herbicides.

Common name	Trade names*	Chemical name
2,4-D	Weedar®, Weedone®	2,4-dichlorophenoxyacetic acid
2,4-DB	Butoxone®, Butyrac®	4-(2,4-dichlorophenoxy)butyric acid
MCPA	Many	4-chloro-o-tolyloxyacetic acid
MCPP	Many	Potassium (RS)-2-(2-methyl-4-chlorophenoxy)propionate

*Does not include manufacturers' prepackaged mixtures.