

Pesticide Toxicity Profile: Bipirydylum Herbicides¹

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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 bipyridylum herbicides registered for use in Florida.

General

The bipyridylum herbicides are a group of older herbicides; their phytotoxic properties were discovered in 1955 and paraquat was commercially produced in 1961. There are currently two bipyridylum herbicides registered for use in Florida: diquat and paraquat. They are contact, nonselective materials, causing a rapid wilting of foliage with a frostbitten appearance. Their mechanism of action is caused by the rapid destruction of plant cell membranes, particularly in sunlight. This action may occur in only a few hours following application. These herbicides are absorbed by the plant and are very limited in translocation to other tissues due to quick death. There are more than 50 commercial diquat products registered for use in Florida.

Diquat is used primarily as an aquatic herbicide, but also has agricultural uses primarily for desiccation

purposes in certain crops, including alfalfa, clover, potato, grain sorghum, and soybean. It also has some applications labeled for directed sprays to tree and fruit crops, and other sites where nonselective control is desired. It has no residual activity as it is quickly adsorbed onto soil surfaces, rendering it biologically unavailable. Following applications to water bodies, diquat can rarely be detected 10 days following application and is often below detection 3 days after treatment. Most of the various diquat products are formulated as soluble concentrates. Where residual activity and more broad-spectrum weed control are desired, there are products available as prepackages. For example, diquat prepackaged with glyphosate is available when a quick-kill of vegetation is desired. There are also homeowner products available commercially through retail lawn and garden centers.

Paraquat has preharvest desiccant uses, but is also important in situations where a quick kill of existing vegetation is desired prior to planting of practically any agricultural crop. It is useful as a post-directed spray for vegetation control in some crops. Unlike diquat, there are no aquatic applications registered for paraquat. It has similar behavioral

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The use of trade names in this publication is solely for the purpose of providing specific information. UF/IFAS does not guarantee or warranty the products named, and references to them in this publication does not signify our approval to the exclusion of other products of suitable composition. Use pesticides safely. Read and follow directions on the manufacturer's label.

patterns in soil as diquat. Paraquat products are formulated as emulsifiable and soluble concentrates. There are no homeowner products available as paraquat formulations are classified as restricted use.

Toxicity

Animal studies conclude diquat to be moderately toxic via ingestion and dermal absorption. However, in humans it may be fatal if absorbed through the skin and is harmful if swallowed or inhaled. Commercial product labels carry the signal word, "WARNING," while those registered for homeowner use are much less concentrated and have the signal word, "CAUTION." Diquat poisoning is much less common and fewer reported incidents have occurred as compared to paraquat. However, there are known severe toxic effects on the central nervous system that are not typical of paraquat poisoning. Diquat typically results in greater damage to the kidneys compared to paraquat. The most obvious symptoms of diquat injury are those neurologic effects, including nervousness, irritability, restlessness, disorientation, inability to recognize family members or friends, and diminished reflexes.

Because of its acute toxicity, paraquat is classified as restricted use. The toxicity of paraquat and its wide use patterns have caused particular concern for the potential of misuse and accidental and intentional poisonings. In its early years of use, paraquat was a popular agent for suicide, but recent intentional poisonings have declined due to emetics and added stench agents. Large doses of paraquat have life-threatening effects on all human organs. Its LD_{50} in humans is extremely low, approximately 3 to 5 mg/kg, which translates into as little as 10 to 15 ml of a 20% solution. Smaller doses of paraquat have the greatest impact on the lungs because that is the organ to where paraquat is quickly transferred, and is most lethal and the least treatable manifestation of toxicity. Toxicity from inhalation is rare; the primary mechanism is through the generation of free radicals with oxidative damage to the lung tissue. In patients who have ingested a very large amount of concentrated paraquat, some have died within 48 hours because of circulatory failure. When death does occur due to paraquat, it is usually because of the

delayed effects on the lungs and most commonly occur between 7 and 14 days. Diquat and paraquat are similar in their ecological effects, both being moderately toxic to birds, slightly toxic to fish, and relatively nontoxic to honeybees. Both diquat and paraquat require a great deal of skill and knowledge for proper treatment procedures of its victims. When ingested, immediate administration of an adsorbent is the one measure most likely used by medical professionals. Mammalian toxicities for the bipyridylium 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. Bipirydylum herbicide mammalian toxicities (mg/kg of body weight).

Common name	Rat oral LD ₅₀	Rabbit dermal LD ₅₀
Diquat	600	260
Paraquat	150	236 - 325

Table 2. Bipirydylum herbicide wildlife toxicity ranges.

Common name	Bird acute oral LD ₅₀ (mg/kg)*	Fish (ppm)**	Bee [†]
Diquat	MT	ST	PNT
Paraquat	MT	ST	PNT

*Bird LD₅₀ : PNT = >2,000; ST = 501 – 2,000; MT = 51 – 500; HT = 10 – 50; VHT = <10.
**Fish LC₅₀ : 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 bipirydylum herbicides.

Common name	Trade names*	Chemical name
Diquat	Reglone®, Reward®, Weedtrine®	1,1-ethylene-2,2-bipyridilium ion
Paraquat	Gramoxone®	1,1-dimethyl-4,4-bipyridinium ion

*Does not include manufacturers prepackaged mixtures.