

Pesticide Toxicity Profile: Triazole Pesticides¹

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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 triazole pesticides registered for use in Florida.

General

The triazole fungicides have gained a renewed interest, particularly in areas of the United States under the threat of Asian soybean rust, a new fungal pathogen introduced via South America. This chemical family of fungicides, introduced in the 1980s, consists of numerous members – difenoconazole, fenbuconazole, myclobutanil, propiconazole, tebuconazole, tetraconazole, triadimefon, and triticonazole. At the time of this publication, full federal registration of tetraconazole is pending. As a fungicide group, they are some of the most widely used in the world. In Florida, they are important tools against diseases of turfgrasses, vegetables, citrus, field crops and ornamental plants. Homeowner products are available for use as well, and may be readily obtained at garden and nursery retail centers. They are applied as foliar sprays and

seed treatments, but are diverse in use, as they may be applied as protectant or curative treatments. If applied as a curative treatment, triazole applications must be made early in the fungal infection process. Once the fungus begins to produce spores on an infected plant, the triazoles are not effective. Although the triazoles don't have the degree of systemic movement of many herbicides, they are xylem-mobile. They are readily taken up by leaves and move within the leaf. Carbon-14 labeling studies have shown that three droplets of a labeled rate of triazole fungicide applied to a soybean trifoliolate leaf covered the entire leaf within one day, and at 3 and 7 days after application the fungicide concentration had increased within the leaf. At day 14, fungicide concentration reached near peak levels. The triazoles are very specific in their mode of action – they inhibit the biosynthesis of sterol, a critical component for the integrity of fungal cell membranes. Because their site of action is very specific, there are resistance concerns. Applicators of triazoles are advised to rotate fungicide chemical families in their disease management programs, not simply rotate to a different member of the triazole family. Product formulations of the triazole fungicides include dry and liquid flowables, wettable

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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.

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powders, water soluble powders, and emulsifiable concentrates.

Toxicity

Most triazole product labels list either the signal word CAUTION or WARNING on their labels. Those products having the signal word WARNING have precautionary statements regarding substantial but temporary eye injury. Appropriate protective measures regarding eyewear use for applicators and handlers are listed on those labels. One product that contains mycobutanil lists DANGER as the signal word due to irreversible eye damage. Triazole product material safety data sheets state that brief contact may cause slight skin irritation and redness. By the oral route of exposure, these triazoles would be considered as having low toxicity. Inhalation of dusts can cause irritation of the nose, lungs, and throat. For mycobutanil, in animals, effects were reported on the following organs: testes, adrenal gland, kidney, and thyroid. Mycobutanil did not cause cancer or birth defects; only doses that caused significant toxicity to parent animals caused reproductive effects on laboratory animals. Increased incidence of liver tumors at extremely high doses was reported in laboratory studies involving male mice who had been exposed to propiconazole or tebuconazole. There were no reproductive, developmental or chronic effects reported with either propiconazole or tebuconazole. Additionally, tebuconazole is considered to not cause any mutagenic or genotoxic effects; however, EPA has classified it as a "possible human carcinogen" because of the liver effects seen with mice. The main concern with triadimefon is its potential to cause birth defects, although data suggest that in humans such effects would occur only at moderate to high doses of exposure. Ecologically, the main concern with the triazoles is with fish and other aquatic organisms. Their labels will carry statements expressing this concern in the Environmental Hazards section. Of this pesticide family, only difenoconazole is considered to be highly toxic to fish. Most of the triazoles are considered to be practically nontoxic to birds and bees. Mammalian toxicities for the triazole fungicides 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 some of

the trade names that these products are registered and sold by in Florida.

Additional Information

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Table 1. Triazole fungicide mammalian toxicities (mg/kg of body weight).

Common name	Rat oral LD ₅₀	Rabbit dermal LD ₅₀
Difenoconazole	1,453	2,010
Fenbuconazole	>2,000	>5,000 (rat)
Mycobutanil	1,600	>5,000 (rat)
Propiconazole	1,517	>4,000
Tebuconazole	1,700	>2,000
Triadimefon	569	2,000
Triticonazole	>2,000	>2,000

Table 2. Triazole fungicide wildlife toxicity ranges.

Common name	Bird acute oral LD ₅₀ (mg/kg)*	Fish (ppm)**	Bee [†]
Difenoconazole	PNT	HT	PNT
Fenbuconazole	ST	PNT	PNT
Mycobutanil	PNT	MT	PNT
Propiconazole	PNT	MT	PNT
Tebuconazole	PNT	MT	PNT
Triadimefon	PNT - ST	ST	PNT
Triticonazole	PNT	ST	PNT

* Bird LD₅₀: Practically nontoxic (PNT) = >2,000; slightly toxic (ST) = 501 – 2,000; moderately toxic (MT) = 51 – 500; highly toxic (HT) = 10 – 50; very highly toxic (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 triazole fungicides.

Common name	Trade names*	Chemical name
Difenoconazole	Dividend®	3-chloro-4-[methyl-2-(1H-1,2,4-triazol-1-ylmethyl)-1,3-dioxolan-2-yl]phenyl 4-chlorophenyl ether
Fenbuconazole	Enable®	a-(3-(4-chlorophenyl)ethyl)-a-phenyl-(1H-1,2,4-triazole)-1-propanenitrile
Mycobutanil	Eagle®, Nova®, Systhane®	a-butyl-a-(4-chlorophenyl)-1H-1,2,4-triazole-1-propanenitrile
Propiconazole	Banner®, Orbit®, PropiMax®, Tilt®	1-[[2-(2,4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-yl]methyl]-1H-1,2,4-triazole
Tebuconazole	Elite®, Folicur®	a-[2-(4-chlorophenyl)-ethyl]-a-(1,1-dimethylethyl)-1H-1,2,4-triazole-1-ethanol
Triadimefon	Bayleton®, Strike®	1-(4-chlorophenoxy)-3,3-dimethyl-1-(1H-1,2,4-triazol-1-yl)-2-butanone
Triticonazole	Charter®	5-[(4-chlorophenyl)methylene]-2,2-dimethyl-1-(1H-1,2,4-triazol-1-ylmethyl)cyclopentanol

*Does not include manufacturers' prepackaged mixtures.