



**Stingray**<sup>TM</sup>

AQUATIC HERBICIDE



**Technical  
Guide**

**FMC**

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## CHEMISTRY AND PHYSICAL PROPERTIES

**Chemical Name:** Ethyl  $\alpha$ ,2-dichloro-5-[4(difluoromethyl)-4,5-dihydro-3-methyl-5-oxo-1H-1,2,4-triazol-1-yl]-4-fluorobenzenepropanoate

**Common Name:** Carfentrazone-ethyl

**Chemical Family:** Aryl triazolinone

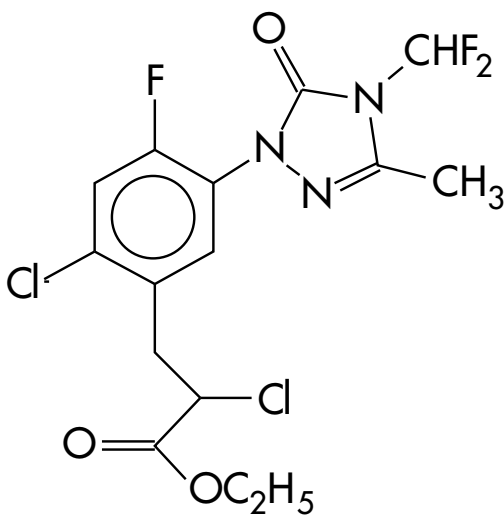
**Chemical Abstract Service Registry Number:**  
128639-02-1

**Vapor Pressure:**  $1.2 \times 10^{-7}$  Pa at 25°C/ $8.03 \times 10^{-10}$  mm Hg at 25°C

**Solubility in water:** 12  $\mu$ g/ml at 68°F.

**Stability:** Stable under normal storage conditions.

**Chemical Structure:**



## MODE OF ACTION

Herbicides control plants by disrupting different functions of the plant cell.

Carfentrazone-ethyl, the active ingredient in Stingray™, is a light-dependent herbicide that inhibits the enzyme protoporphyrinogen oxidase (commonly abbreviated as protox). Inhibition of the protox enzyme induces the formation of peroxides which attack the lipids and proteins of the cell membrane. This disruption causes leakage of cell contents, resulting in drying and disintegration on terrestrial plants within 24 to 48 hours. The process and onset of action is slower on aquatic weeds than it is for terrestrial plants.

## SYMPTOMOLOGY

Carfentrazone-ethyl is a rapid-acting, post-emergent, contact herbicide. In terrestrial uses, carfentrazone-ethyl formulations provide the burn down that is characteristic of the aryl triazolinones.

Foliage of susceptible terrestrial plants treated with carfentrazone-ethyl formulations lose their turgidity within hours and become necrotic within 24–48 hours. Plant death generally occurs within 7 days on terrestrial plants.

Injury symptoms generally appear over a longer period of time on aquatic weeds. Leaf bronzing and limited necrosis appear on water lettuce 2 to 5 days after application and blackening of the leaves appears on water hyacinth from 5 to 10 days after application. Significant leaf necrosis on mature leaves of water lettuce generally occurs from 3 to 4 weeks after treatment.

Proper coverage is critical to the performance of Stingray. The use of adjuvants and appropriate spray volume (>20 GPA) are critical to effective weed control. Weeds with high nodal regeneration must receive a second application unless using the product as a tank mix partner with a systemic herbicide. Carfentrazone-ethyl does not possess systemic properties, therefore, perennial plants may resprout from rhizomes or tubers. In such cases, carfentrazone-ethyl combinations with systemic products have proven to be effective for perennial weed control.

## PEST SPECTRUM

Stingray controls and suppresses several floating and emergent, broad-leaved aquatic weeds as indicated in the following table:

### Product Application Rate per Acre

**6.7 - 13.5 fl. oz per acre**  
**(0.1 - 0.2 lbs. ai/A)**

Water Lettuce	<i>Pistia Stratiotes</i>
Water Hyacinth	<i>Eichhornia crassipes</i>
Water Fern	<i>Salvinia minima</i>
Giant Salvinia	<i>Salvinia molesta</i>
Mosquito fern	<i>Azolla caroliniana</i>
Water spinach	<i>Ipomoea aquatica</i>
Watermeals	<i>Wolffia spp.</i>
Duckweed	<i>Lemna species</i>
Alligatorweed	<i>Alternanthera philoxeroides*</i>
Water primrose	<i>Ludwigia octovalvis*</i>

#### \*Suppression

A screening program is currently underway to evaluate efficacy on the following aquatic weeds:

Pennyworts (*Hydrocotyle spp.*)  
 Indian hygrophila (*Hygrophila polysperma*)  
 Common frog's bit (*Limnobium spongia*)  
 Parrot's feather (*Myriophyllum brasiliense*)  
 Smartweed (*Polygonum spp.*)  
 Water fern (*Salvinia minima*)  
 Southern naiad (*Najas guadalupensis*)  
 Eurasian water milfoil (*Myriophyllum spicatum*)

## NON TARGET PLANTS

Stingray is selective to non-target grass species. When applied at a rate range of 0.03 to 0.16 lb ai/A it does not harm turfgrass species such as bahiagrass, bermudagrass, St. Augustine grass, knotgrass or torpedograss. Similar applications did not harm pickerelweed, an aquatic broadleaved weed. Additional field testing will confirm impact to other non-target species such as the bulrushes.

## ADJUVANTS

The use of adjuvants will enhance the activity of Stingray by increasing spray coverage on leaf surfaces. Methylated seed oils, crop oil concentrates, and non-ionic surfactants increase coverage, resulting in quick initial brown out of foliage and are recommended. Adjuvants that improve adherence to the leaf surface will also improve effectiveness.

## TANK MIXES

For broad spectrum weed control, Stingray should be applied as a foliar broadcast spray in combination with systemic herbicides, such as 2,4-D, diquat, glyphosate, imazapyr and triclopyr. Studies on terrestrial weeds have shown that mixing carfentrazone-ethyl with systemic herbicides also enhances the performance of these products.

## WEED RESISTANCE MANAGEMENT

Stingray has a different mode of action from other registered aquatic herbicides. Using Stingray in combination with products having different modes-of-action in tank mixes will reduce the potential development of weed resistance to any single product in the tank mix.

## SPRAY VOLUME

Because Stingray is a rapid-acting, contact herbicide, spray coverage is an important factor in the effectiveness of the product. Studies have demonstrated that volumes of 20 GPA or more are ideal for applications of Stingray.

## RESIDUAL CONTROL

Because Stingray is a contact herbicide with no systemic properties, single applications will not control weeds that have high nodal regeneration capability. Second applications or tank mixes may be necessary to control resprouting weeds.

## RAIN FASTNESS

The quick contact action of Stingray results in the product being rainfast within one hour after application.

## DEGRADATION AND DISSIPATION PATHWAYS

**Volatility:** Carfentrazone-ethyl is considered to be non-volatile and non-flammable because it has a low boiling point (662-671°F). Therefore, there is no significant loss from leaf surfaces following applications. Rapid herbicidal action on the leaf surface further reduces volatility potential.

**Hydrolysis:** Carfentrazone-ethyl is stable at pH5, moderately stable at pH7 (half-life = 8.6 days), and hydrolysis is rapid at pH9 (half-life = 3.6 hours).

**Photolysis:** The aqueous photolysis half-life of carfentrazone-ethyl and carfentrazone-ethyl-chloropropionic acid is less than 8.3 days at pH5.

**Plant Metabolism:** Carfentrazone-ethyl is metabolized in plants by hydrolysis, oxidation/decarboxylation, dechlorination, dehydrochlorination, hydrogenolysis and conjugation. Carfentrazone-ethyl's metabolic pathway in plants is conversion of parent to carfentrazone-ethyl-chloropropionic acid, followed by degradation 3-hydroxymethyl-carfentrazone-ethyl-chloropropionic acid, carfentrazone-ethyl-propionic acid and 3-desmethyl-carfentrazone-ethyl-chloropropionic acid.

**Animal Metabolism:** Carfentrazone-ethyl is metabolized in animals by hydrolysis, oxidation/decarboxylation, dechlorination, dehydrochlorination, hydrogenolysis and conjugation. Carfentrazone-ethyl's metabolic pathway in animals is conversion of parent to carfentrazone-ethyl-chloropropionic acid, followed by degradation 3-hydroxymethyl-carfentrazone-ethyl-chloropropionic acid and carfentrazone-ethyl-propionic acid.

## PERSISTENCE AND ENVIRONMENTAL RISK

**Water:** Hydrolysis and photolysis are the major routes of degradation in water. When applied to water, carfentrazone-ethyl is rapidly hydrolyzed to the first major metabolite, carfentrazone-ethyl-chloropropionic acid, in a matter of hours. The parent herbicide and carfentrazone-ethyl-chloropropionic acid had a calculated half life of 3.45 and 4.50 days in two separate pond dissipation studies in which Stingray was applied to half the pond. In both studies carfentrazone ethyl was not found in sediment and only traces of the first major metabolite were found.

## ACUTE TOXICITY

**Toxicity Classification:** The Environmental Protection Agency classifies pesticides according to their acute toxicity and requires that a signal word indicating the acute toxicity category of the pesticide be displayed prominently on the product label.

### Toxicity Classification and LD<sub>50</sub> Ranges in the U.S.

Toxicity Classification	Label Signal Word	Oral LD <sub>50</sub> (mg/kg)	Dermal LD <sub>50</sub> (mg/kg)
I	Danger	<50	<200
II	Warning	50 – 500	200 – 2,000
III	Caution	500 – 5,000	2,000 – 5,000
IV	Caution	>5,000	5,000

Carfentrazone-ethyl is low in toxicity by acute oral, dermal and inhalation routes, is minimally irritating to eyes, and non-irritating and non-sensitizing to skin. It is not mutagenic, not a developmental toxin, not a reproductive toxin, and is non-carcinogenic.

### Acute Toxicity of Carfentrazone-ethyl Technical

Test	Species	Results	Toxicity Classified
Oral Toxicity	Rat	LD <sub>50</sub> > 5000 mg/kg	IV - Caution
Dermal Toxicity	Rat	LD <sub>50</sub> > 4000 mg/kg	III - Caution
Inhalation Toxicity <sup>a</sup>	Rat	LC <sub>50</sub> > 5.09 mg/L	IV - Caution
Skin Irritation	Rabbit	Nonirritating	IV - Caution
Eye Irritation	Rabbit	Minimally Irritating	IV- Caution
Skin Sensitization	Guinea Pig	Not a Sensitizer	NA <sup>b</sup>
Acute Neurotoxicity	Rat	NOEL neurotoxicity = 500 mg/kg	NA

<sup>a</sup> Purity of carfentrazone-ethyl tested was 91.7%.

<sup>b</sup> Not applicable.

## HUMAN EXPOSURE PROFILE

Carfentrazone-ethyl has low acute toxicity, is not oncogenic, neurotoxic, or teratogenic, and does not cause developmental or reproductive effects.

Carfentrazone-ethyl is metabolized rapidly and extensively in mammals.

Dietary exposure is negligible due to its low use rate and rapid dissipation.

Occupational exposure and risk are negligible as indicated by the lack of toxicological endpoints of concern.

**MAGNITUDE OF RESIDUE IN FISH**

The magnitude of residues of carfentrazone-ethyl in bluegill sunfish, channel catfish, freshwater clams and northern crayfish were determined at a maximum application rate of 0.3 lb a.i./surface acre. No parent herbicide was found in any of the edible tissues.

**ENVIRONMENTAL TOXICOLOGY**

**Aquatic:** Carfentrazone-ethyl technical has a moderate level of toxicity to aquatic life and fish species.

**Acute Toxicity of Carfentrazone-ethyl Technical**

Species	Exposure Period	LC <sub>50</sub> (mg/L)	NOEC (mg/L)
Bluegill Sunfish	96 hours	2.0	1.5
Rainbow Trout	96 hours	1.6	1.2
Silverside	96 hours	1.14	0.440
Daphnia	48 hours	>9.8 <sup>a</sup>	2.2
Mysid	96 hours	1.17	0.616
Oyster	96 hours	2.3	0.616

<sup>a</sup> Maximum attainable concentration due to water solubility

**Wildlife:** In the event that animals or wildlife should graze in a carfentrazone-ethyl treated area, due to the low toxicity and rapid excretion of carfentrazone-ethyl, studies indicate that there is little cause for concern.

**Avian Toxicity:** Carfentrazone-ethyl is practically non-toxic to birds, including waterfowl. The acute oral LD<sub>50</sub> is >2,250 mg/kg in bobwhite quail, and the subacute dietary LC<sub>50</sub> is >5,620 mg/kg in bobwhite quail and mallard duck. No mortalities or adverse effects were observed at any dose level. In bobwhite quail and mallard reproduction studies there were no mortalities or effects on any reproductive parameter up to and including the top dose level of 1000ppm.

**Honeybees:** Studies indicate that carfentrazone-ethyl is practically non-toxic to honeybees.

**Earthworms:** Studies indicate that carfentrazone-ethyl is practically non-toxic to earthworms.



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**Always read and follow label directions.**