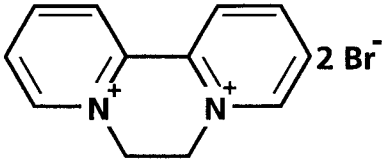




REWARD®

Landscape and Aquatic Herbicide

(37.3% Diquat Dibromide + 62.7% inerts)

<p>Chemical Structure</p> 	<p>Chemical Nomenclature: 1,1'-ethylene-2, 2'-bipyridium ion, dibromide salt; 6,7-dihydropyrido [1,2-a:2',1'-c] pyrazdium ion, dibromide salt CAS No.: 85-00-7 (dibromide) 2764-72-9 (cation) 6385-62-2 (dibromide monohydrate)</p> <p>Use: Non-selective contact herbicide and desiccant</p>
<p>Molecular Formula: C₁₂H₁₂N₂Br₂</p> <p>Molecular Weight: 344.0 g/mol (dibromide) 184.2 g/mol (cation) 362.0 g/mol (monohydrate)</p>	<p>Physical Properties:</p> <p>State: Liquid (red-brown) Boiling Point: 100°C Sp. Gravity: 1.22–1.27 g/ml @ 20°C pH: 6.0–7.5</p>
<p>Physicochemical Properties:</p> <p>Aq. Solubility: 718,000 mg/l @ 20°C Log Kow: -4.6 @ 20°C Log Koc: 4.5–6.9 ml/g Vapor Pres: 10⁻⁷ Torr; <10⁻⁸ Kpa @ 25°C</p>	<p>Chemical Stability:</p> <p>Aq. Photolysis (t_{1/2}): 74 days (lab) Aq. Hydrolysis (t_{1/2}): stable (acidic or neutral solutions) Volatility: non-volatile</p>
<p>Environmental Fate Profile: Reward® rapidly dissipates in water due to the naturally high water solubility and adsorptive characteristics of the active ingredient (diquat cation). Exposure is further reduced by microbial degradation in plants and water, and by photodegradation from the action of sunlight.</p> <p>Reported Pond-Water Dissipation Rate (t_{1/2}): <1–2 days</p>	<p>Ecotoxicological Profile:</p> <p>Birds: oral LD₅₀ = moderately toxic dietary LC₅₀ = moderately to slightly toxic Bees: contact LD₅₀ = practically non-toxic Fish: acute LC₅₀ = moderately toxic Invertebrates: acute EC₅₀ = highly to moderately toxic Plants/Algae: acute EC₅₀ = highly to moderately toxic</p>
<p>Application Rates: Applied at 1–2 pounds diquat cation per acre maximum; equivalent to an instantaneous maximum concentration of 0.37 mg cation/l (ppm cation). Instantaneous concentrations of 0.37 ppm cation fall to about 0.1 ppm after 24 hours and 0.01 ppm by 4 days.</p>	<p>Margin of Safety (Environmental Exposure): Based on an instantaneous maximum concentration of 0.37 mg cation/l, the corresponding 48 and 96 hour post-application margins of safety to bluegill sunfish are 376X (at 48 hours) and 1522X (at 96 hours), respectively.</p>

Environmental Overview

The safety of a chemical in the environment and potential risk to non-target plants and animals is a function of exposure to the chemical and toxicity. In the absence of chemical exposure, there is no opportunity for toxicological effects. Exposure is determined by the fate of the chemical in the environment. It is the fate characteristics of diquat dibromide, in conjunction with a moderate toxicity, that result in the exceptional environmental safety of diquat dibromide. In aquatic environments, diquat exposure is rapidly reduced after application by adsorption onto target plants. Exposure is further reduced by microbial degradation in plants and in water and by photodegradation from the action of sunlight. Similar degradation processes occur in terrestrial environments. Diquat rapidly and strongly binds to soil particles. In aquatic environments, diquat is also adsorbed to suspended sediments, including clay particles. Once adsorbed, diquat dibromide is no longer bioavailable and the opportunity for exposure to non-target species is minimized. In addition, diquat is immobile once adsorbed and does not move into surrounding soil or sediment or leach into groundwater. Therefore, there is minimal risk of contamination of surface water or groundwater. Following labeled application rates, the window of opportunity for exposure to non-target organisms is small because of the rapid dissipation of diquat. Laboratory toxicity studies that are conducted in the absence of mitigating environmental conditions show that diquat dibromide is only moderately toxic to aquatic organisms and terrestrial birds and wildlife. The toxicity of diquat dibromide has been extensively studied with more than 200 aquatic toxicity data points covering 26 species of fish and 20 species of aquatic invertebrates. Diquat is also rapidly excreted from organisms and does not bioaccumulate in aquatic organisms or cause biomagnification in food chains. Thus, when used according to label recommendations, diquat dibromide will not cause unreasonable risk to the environment.

Consumer Information

Common Questions and Answers on Reward

Q. Why is Reward diquat being recommended for aquatic weed control?

A. It is frequently decided that chemical treatment for weeds in lakes is necessary to preserve the recreational use of the lake during summer months. Other options are available, such as harvesting or dredging, but these are often dismissed as being ineffective or, in the case of dredging, too expensive. A draw-down of the water in the winter may be effective in reducing the weeds in areas left underwater during the draw-down. It is not feasible to draw the lake down much further because this would damage and eliminate habitat for populations of fish and other aquatic organisms. Mechanical harvesting is not effective against some of the weed species, since the fragments generated by the harvesting process can

root in new areas. It is also ineffective where the weed problem is severe due to the density of the vegetation. Also, mechanical harvesting indiscriminately damages fish and other aquatic organisms as they are caught in the weeds being removed. In contrast, Reward is in part registered on the basis of a worst-case scenario risk assessment where effects on any single non-target organism are unacceptable.

Q. How do State Departments of Agriculture regulate this type of activity?

A. The Department of Agriculture can regulate aquatic pesticide applications from three perspectives. First, the chemical to be used in the state must be registered by the State and Federal governments. The second area of regulation is the requirement that any aquatic application must receive the necessary approval and/or permits if required by the state. Consult the responsible state agencies (e.g., Department of Ecology, Fish and Game Agency or Department of Natural Resources) for further information. The review process may involve an assessment and/or comparison of the chemical, application rate, and water use of the area to be treated. The result assures that the appropriate herbicide is selected for the water body and type of weed species to be controlled and that the proper rate is used. The final area of regulation is the certification of pesticide applicators if required by the state. The applicators must pass a written and oral examination of the category of application they intend to perform.

Q. Can water be used for other purposes after treatment with diquat?

A. Yes. Diquat may only be used in accordance with label instructions which require certain time restrictions for some types of water use. There are no restrictions for recreational activities (swimming or fishing). The restrictions for potable water (drinking) do not exceed 3 days, non-food crop irrigation (e.g., turf, ornamentals, etc.) has a maximum of 3 days, livestock consumption has a maximum of 1 day, and food crop irrigation has a maximum of 5 days. Irrigation has the greatest restriction because of the possible concern for phytotoxicity to crop plants. Restrictions are based on not exceeding the Maximum Contaminant Level Goal (MCLG) of 0.02 mg cation/l.

Q. What type of plants are commonly treated?

A. The most common plants treated are exotic species often referred to as "noxious weeds" (e.g., hydrilla, watermilfoils, waterhyacinth, waterlettuce). These plants are not native to North America and consequently do not have as many natural enemies as many native plants. They can also spread and grow rapidly resulting in dense areas that are unsuitable habitat for fish and aquatic organisms. They also compete with the native vegetation and can eliminate natural plant populations

that provide habitat for fish and other aquatic organisms. This can seriously impair the recreational value of a lake, river, or pond invaded by these exotic weeds. Harvesting is not effective against some of the species, since the fragments generated by the harvesting process can spread the infestation to other locations when they root after drifting back into the lake. Often chemical control is the only effective and practical method of managing aquatic weeds.

Q. What are the characteristics of diquat?

A. Diquat is a commonly used aquatic herbicide and commonly marketed under the trade name Reward. It has been used widely throughout the world for weed control and as a crop desiccant for over 30 years, and consequently a considerable amount is understood about the properties and risk associated with the use of diquat. It is very water soluble, dissipates rapidly in the water, and kills plants by disrupting photosynthesis. A very important characteristic of diquat is its rapid and strong binding to soil or sediment particles. More than half the residues in aquatic bodies will have disappeared from the water phase within 12 hours. The binding of diquat to soil and sediment also means that its potential for leaching into groundwater is negligible.

Q. Will diquat accumulate in fish or the environment?

A. No. Diquat does not have any potential for bioaccumulation because of its very high solubility in water. It is rapidly excreted by fish and other animals if ingested. Consequently, there is no potential for biomagnification through food chains.

Q. Is diquat degraded after application? What is the method of degradation?

A. Yes. Diquat undergoes microbial degradation on plants, in water, and in sediment. Sunlight also degrades diquat by the process of photodegradation.

Q. What happens to diquat in the sediment?

A. Diquat becomes rapidly and strongly bound to sediment particles. Once adsorbed to sediments it is not bioavailable for uptake by aquatic organisms including plants. This lack of bioavailability is demonstrated by the fact that sensitive rooted plants repeatedly recolonize diquat treated areas.

Q. Usually very water-soluble materials are prone to leaching, why is diquat different?

A. Diquat is not prone to leaching through the soil profile because it binds very strongly and completely to soil particles. Diquat will not leach in any soil types. In fact, the soil adsorption values for diquat are an order of magnitude greater than required for chemical to be classified as immobile.

Q. How much diquat will be in the water?

A. Very little and usually only in a portion of the water body. The instantaneous maximum concentration will be approximately 0.37 ppm (parts per million) in shallow waters, 2 ft in depth. When that concentration is diluted through the 6 ft of average depth in the treated area, the concentration would be less than 0.2 ppm. Usually only "spot applications" or no more than 1/3 of the lake would be treated, leaving untreated areas of refuge for fish. However, these levels refer to the instantaneous concentrations. The actual exposure concentrations will be lower since absorption to target plants, adsorptions onto sediments, and removal from the water is very rapid.

Q. Will diquat deplete the oxygen in the water and suffocate fish?

A. No. The microorganism activity in decomposing plant material uses up oxygen, and oxygen depletion can occur if there are dense areas of decaying weeds covering the entire water body. Where weed beds are dense, diquat can only be applied to 1/2 to 1/3 of the water body, with 14 days between each application. Therefore, fish and other aquatic organisms will not be affected as there will be a refuge area.

Q. Is diquat toxic to fish?

A. No. The toxic dose of diquat to fish ranges from 0.5 to 240 ppm, depending on the species of fish and the hardness of the water. Given the expected concentrations from label directions, there is an adequate safety margin for fish, i.e., maximum concentrations possible from label use are considerably less than the fish toxicity values. Fish can be killed by oxygen depletion when very heavy weed populations are all killed at once. The decay process depletes the oxygen in the water, causing fish suffocation. However, this scenario is unlikely to occur because under these conditions the label states that only 1/3 to 1/2 of the dense areas are to be treated at one time, which gives the fish an untreated refuge.

Q. Why is "toxic to aquatic invertebrates" required on the label?

A. This statement is based on EPA labeling requirements for "Environmental Hazards." The toxicity statements triggered are based only on acute laboratory toxicity studies conducted with technical grade active ingredient in clean water. The toxic effects of the chemical in a real water situation is not considered. In aquatic systems, the properties of diquat cause it to become rapidly bound to particulate matter where it is unavailable to cause toxic effects.

Q. How do toxic effects on fish measured in the laboratory relate to actual effect in the environment?

A. They do not relate directly. Toxicity studies are conducted in the laboratory in clean water (sediment-free) where there is no sediment or plant material present to mitigate exposure. Toxicity in the actual pond will be considerably less, particularly for diquat, as diquat rapidly binds to sediment and plants, and becomes unavailable biologically. This can be seen in comparative laboratory studies conducted with *Hyalella azteca* (an amphipod that lives on the sediment surface) where the toxicity is 140X less in a test system that mimics a real water body (sediment present) in comparison to the regular "water-only" test system.

Q. What will happen if aquatic herbicides are not used to control noxious weeds?

A. Exotic weeds can completely devastate lakes and rivers if left unmanaged. These species have the capacity to completely eliminate communities of native plants and cause both direct and indirect effects in other animals such as invertebrates and fish. Managed aquatic vegetation beds can provide excellent habitat for invertebrates and fish in early life stages. In contrast, dense weed beds do not, as they severely impact the water quality including dissolved oxygen levels. There are several success stories where diquat has been used to treat a severe weed situation, allowing natural plant communities to recolonize and the lake to return to the balance necessary for healthy aquatic organism populations.

Q. Is diquat more harmful to fish and other aquatic organisms than mechanical weed harvesters?

A. No. Regulation of diquat by the US Environmental Protection Agency does not allow for effects on any individual organism. In fact, there also has to be a safety margin. In contrast, mechanical weed harvesters are not regulated, and in the process of harvesting weeds, many fish and invertebrates are physically destroyed.

Q. Is diquat harmful to microbial organisms?

A. No. Once bound to the sediment diquat is generally not bioavailable to living organisms including microbial organisms. Small amounts of diquat that do become available are actually degraded by microbial organisms.

Information Request	Fact
<i>What is the maximum amount of diquat that can be applied to a water body?</i>	2 gals/surface acre (4 lb cation) in 4 ft depth 1 gal/surface acre (2 lb cation) in 2 ft depth
<i>What is the typical worst case concentrations following application to water?</i>	0.37 ppm (max. label rate scenario of 2 gals/acre in 4 ft or 1 gal/acre in 2 ft)
<i>Does diquat persist in the water after application?</i>	0.37 ppm (instantaneous concentration) falls to about 0.1 ppm after 24 hours and to 0.01 ppm after 4 days
<i>How much diquat could enter a water body from surface runoff?</i>	0.78 ppb or 0.00078 ppm (from modeling a worst case scenario)
<i>How much diquat could enter a water body from spray drift after aerial application?</i>	80.1 ppb or 0.08 ppm (5% of maximum application rate)
<i>Does diquat bioaccumulate?</i>	Low fish bioconcentration factors of <2.5X. Low aquatic invertebrate bioconcentration factors of 32X. Rapid elimination of diquat following exposure in all organisms tested.
<i>What is the toxicity of diquat to fish?</i>	Slightly to moderately toxic.
<i>What is the toxicity of diquat to birds?</i>	Slightly to moderately toxic.

Call 1-800-395-8873 to contact your local Syngenta sales representative and learn more about Reward.



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