



Michigan Aquatic Managers Association

Dedicated to the Professional Management of Michigan's Aquatic Resources

The Illicit Use of Diuron on Off Label Aquatic Sites

And Recommendations for Action by the Michigan Department of Agriculture and Rural Development

Abstract:

Diuron is a very effective and useful herbicide. However, the Federal label does not permit the use of this herbicide in any typical residential setting or aquatic site. Despite these prohibitions, diuron (Karmex) is readily available to Michigan homeowners and it appears that it is commonly used as an aquatic herbicide, despite Federal Label restrictions. The Michigan Aquatic Managers Association would strongly support any action taken by the Michigan Department of Agriculture and Rural Development to register diuron as a restricted use herbicide (RUP) because it would help to reduce the amount of illicit use of the compound in Michigan and because such action is not expected to adversely impact legitimate and labeled uses of the herbicide.

History of Aquatic Herbicide Uses in Michigan:

Over fifty years ago, and before the USEPA pesticide registration program, there were several herbicides that were routinely used for aquatic weed control. Diquat dibromide, various forms and formulations of endothall and 2,4-D were in common use and continue to be used today as EPA registered aquatic herbicides. Several other herbicides were also in common use throughout the late 1950's and into the 1960's. These included sodium arsenate, diuron (Karmex), and forms of Simazine. Simazine was registered for use as an aquatic herbicide under the trade name of Aquazine in 1968. However, all aquatic use registrations were cancelled by voluntary action of the manufacturer after significant environmental concerns were identified in 1992. Diuron was never registered as an aquatic herbicide and all uses of sodium arsenate have since been discontinued. Today, certain forms of simazine and diuron continue to be registered for various uses in Michigan, but none of these registrations include aquatic sites. Simazine is the active ingredient in Princep and the Michigan registrations are maintained by Syngenta.

Diuron Characteristics:

Diuron, N^c-(3,4-dichlorophenyl)-N, N-dimethylurea (diuron) is classified as a phenylurea herbicide and is known to interfere with photosynthesis. Its water solubility is considered to be moderate at of 42 mg /L at 20°C, hence it would be considered to be a good aquatic herbicide. The vapour pressure of diuron is 0.009 mPa at 25° C and has a calculated Henry's law constant of 0.000051 Pam³ /mol suggesting that diuron is not volatile from water or soil (Giacomazzi and Cochet, 2004). Very often the terrestrial rate of 4 to 15lbs per acre is used in aquatic sites due to the fact there is no specific aquatic application rate listed. Toxicity tests indicate that diuron is toxic to fish species at concentrations as low as 0.71 (mg/L) or 4.8 lbs. per acre foot. Common use rates in Michigan ponds range as high as 4 lbs. to 8 lbs. per acre and suggest that some users may experience fish kills after minor miscalculation of pond depth or treatment area. Diuron has a low to moderate potential for bioconcentration in fish tissue, but would not be expected to be a concern at low use rates. Aquatic invertebrates were affected by diuron concentrations of 0.16 mg a.i./L. Aquatic plants were affected at concentrations as low as 0.0013 mg a.i./L. Amphibians were less sensitive to diuron than any other aquatic taxa.

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Federal and State Registrations:

Karmex is the most common form of diuron that is currently in use in Michigan and registrations are maintained by E.I. Dupont De Nemours and Co. and Makhteshim-Agan of N America Inc. Makhteshim-Agan acquired all of Dupont's non-mixture diuron business in 2011 when total annual sales were estimated at \$35M. Diuron was developed by DuPont in 1951 and there may be as many as 20 worldwide producers. The US EPA pesticide label for Karmex (EPA Reg. No. 352-692) is complex and includes numerous references to State regulations of specific uses. It is used in a broad range crop and non-cropland sites and at dose rates that are as high as 15 lbs. per acre, but it is typically used at dose rates that are less than 8 lbs. per acre. Diuron has also received a Section 18 exemption from the US EPA for use in aquaculture facilities for the control of cyanobacteria to prevent "off-taste" impact they have on the fish in those facilities. Diuron is also incorporated into coatings that are used as a Marine antifoulants. Plant species selectivity depends upon treatment timing and application rates.

Karmex is listed as a Class III pesticide by the US EPA and is considered to be a likely carcinogen. Diuron is considered a priority hazardous substance by the European Commission (Malato et al., 2002). Countries including the UK, Sweden, Denmark and France have restricted the use of diuron in antifouling paints (Konstantinou and Albanis, 2004; Giacomazzi and Cochet, 2004).

The Federal Label explicitly prohibits the use of diuron in residential settings or aquatic sites. The following is excerpted from the pesticide label:

"Do not use on home plantings of trees, shrubs, or herbaceous plants or lawns, walks, driveways, tennis courts, or similar areas. Prevent drift of dry powder or spray to desirable plants. Do not contaminate any body of water."

"Do not apply directly to water, to areas where surface water is present, or to intertidal areas below the mean high water mark."

"Karmex DF is not to be used on turfgrass at residential sites (including homes, apartment complexes, condominium grounds, daycare facilities, schools, parks, recreational areas, and sports fields)."

Illicit Use on Aquatic Sites:

Diuron is known to have varying impacts on aquatic plants and algae depending upon the application rate. At lower dose rates (~ 1 lbs. per acre) it is an effective algaecide and will have only minor impacts on most higher aquatic plants. At higher applications rates, near 4 lbs. per acre, Diuron is a very broad spectrum herbicide. Virtually all aquatic higher plants and algae are killed by these higher range application rates with the notable exception of some diuron resistant, gelatinous blue green algae. The water in ponds and lakes that are treated at these high rates typically become dark with fine particulate organic matter. Continuous use at higher application rates can lead to the development of nuisance blooms of dark black blue green algae (cyanobacteria) blooms. Various forms of blue green algae can be toxic to humans, pets and wildlife. Once these blooms form, they are very resistant to any control and unsightly conditions can persist for years. These unsightly blooms seem to be the chief complaint among users.

It is easy to purchase diuron from local merchants, such as hardware stores, seed stores, and elevators. It is also easy to purchase from online sources. Diuron is inexpensive and is typically sold in 5 lb. bags that sell for between \$6.50 to \$8 USD per lb.. Typically, it is applied at rates of 4 to 8lbs per acre and no registered aquatic herbicide can produce the same outcomes at such a low cost.

The internet provides various perspectives on the illicit use of diuron for aquatic weed control. It seems to be common knowledge that the toxicology and ecotoxicology of diuron is generally good, although it is listed as a likely carcinogen by the US EPA. Internet merchant sites commonly provide testimonials to the effectiveness of diuron as an aquatic herbicide. And, these are very easy to find. Various blogs address issues related to fisheries concerns, but these seem to be ignored by many users. However, there are internet reports of fish kills and these seem to be derived from the fact that typical application rates are very near the rates that are known to kill some fish species. The risk to fisheries is compounded by the fact that it is very broad-spectrum at higher application rates that may contribute to oxygen depressions as aquatic vegetation decays. Higher dose rates will also select for the predominance of very unsightly blooms of gelatinous blue green algae that are resistant to all known control agents. These blooms can overwhelm pond ecosystems and create an aesthetic nuisance that resemble a sewage lagoon. Again, there is no known remedy for the development of these conditions.

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The easy accessibility, extreme low cost, effectiveness, and long-term weed control that are possible with diuron are all factors that seem to support the continued illicit use of diuron for aquatic weed control. Occasional fish kills, unsightly gelatinous algae blooms, and the possible link to human cancers do not seem to have significantly reduced illicit use in aquatic sites.

Summary:

Diuron (Karmex) is registered for various uses in Michigan, but these uses are restricted to terrestrial weed control in agriculture settings and non-agricultural areas that are typically managed by professional land managers. The federal label prohibits the use of diuron in any typical homeowner or residential setting or aquatic sites. It is conceivable that the primary “homeowner” use of diuron in Michigan may be for aquatic weed control because there are many better alternatives to diuron for homeowner use on terrestrial sites. There are hundreds of products for use to control aquatic plants and algae that are properly tested, properly labeled and registered by U.S. EPA and MDARD. These products can be used legally, with a reasonable and proven margin of safety. Unregulated use can result in fish kills and the development of persistent aesthetic nuisance conditions in ponds and retention basins. The ready accessibility of diuron at elevators, feed stores, and hardware stores has certainly helped to sustain these illicit uses. It is recommended that the Michigan Department of Agriculture and Rural Development register diuron and its derivatives as a restricted use pesticide (RUP) to help prevent the illicit use of diuron in aquatic sites. Because most legal uses are performed by persons that are already certified pesticide applicators, such an action is not expected to negatively impact the proper use of diuron in Michigan.

References:

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- Konstantinou, I. K., Albanis, T. A. (2004). Worldwide occurrence and effects of antifouling paint booster biocides in aquatic environment. *Env. Int.* 30, 235-248.
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