Control of common duckweed and watermeal by a new flumioxazin formulation – Interim report

Interim Report

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Introduction

Floating plants are increasingly becoming widespread problems in waterways in the southern United States. Nuisance problems are often exacerbated with increased nutrient inputs into waterbodies from point and non-point sources. Common duckweed (*Lemna minor*) and watermeal (*Wolffia* spp.) are two such floating aquatic plants that thrives in high nutrient environments. Infestations of these species can shade submersed aquatic plants and cause oxygen depletions in the water column (Parr et al. 2002) resulting in fish kills. Common duckweed and watermeal are also aesthetically displeasing to most land owners or pond managers. Herbicide applicators consider these species some of the most difficult aquatic plants to control. Currently, watermeal does not have management recommendations that produce consistent and predictable results. Additionally, floating plants are quite capable of re-colonizing a site rapidly after control efforts have been carried out as more plants may drift into the site due to water and wind currents.

The aquatic herbicide diquat is one of the most frequently prescribed herbicides for control of watermeal and common duckweed, however it has at times resulted in poor or variable control. Also, one of the two known cases of herbicide resistance in aquatic environments was documented with diquat in the Landoltia genus, a cousin to watermeal and common duckweed. With little information available on control options, additional data are needed to identify new herbicides that may be more efficacious and or reliable for control of these species and that would give resource managers a new tool to control these species should herbicide resistance to diquat arise in them. Flumioxazin has been available as a water dispersible granule since 2010, however a new liquid formulation of the active ingredient has recently been developed.

The purpose of this study was to verify the efficacy of liquid flumioxazin on common duckweed and watermeal as a foliar application.

Materials and Methods

Common duckweed was obtained from a pond located approximately two miles south of Starkville, MS. Watermeal was obtained from stock cultures at the Aquatic Plant Research Facility at the R.R. Foil Plant Research Center at Mississippi State University. In total 40 aquaria were used to conduct this trial: 20 for each species. Plants were placed in aquaria (40 L volume) and allowed to grow for approximately one month until they had covered >95% of the surface area of each aquaria. Each aquaria was amended weekly with 10 mg of slow release fertilizer to maintain plant growth.

Prior to herbicide application, pretreatment biomass (one per aquaria) was harvested using a 2.54 cm^2 diameter PVC sampling similar to that used by Wersal and Madsen (2009). Biomass from each tank was placed in a paper bag, and dried at 70C for five days then biomass weight was recorded.

After the growth period and pretreatment harvest, remaining plants were treated via foliar spray (Table 1). Treatments were applied using water as a carrier in a fine foliar spray at a total spray volume of 935.4 L/Ha (100 gal/acre). An MSO surfactant was included in the herbicide solution at a rate of 0.5% v:v. Additionally, carrier water in each treatment was buffered to a pH range of 6.5-7.0 to ensure that flumioxazin wouldn’t break down prior to herbicide applications. After each treatment the sprayer was flushed three times with only carrier water to ensure all herbicide residues were removed from the sprayer hose and nozzle.

There were four herbicide applications plus an untreated reference for a total of five treatments per species (Table 1). Each treatment was replicated four times. Four weeks after treatment (WAT) samples were harvested, dried, and weighed from each aquaria using the same method as pre-treatment specimens.

An analysis of variance (ANOVA) was used to test for statistical differences in treatment means (Analytical Software 2009). Any differences in means that were detected were further separated using a Fishers Least Significant Difference test (Analytical Software 2009).

Results and Discussion

All of the herbicide treatments significantly reduced common duckweed in the same manner when compared to reference plants at four WAT (Figure 1). However, common duckweed was not seen at all in aquaria treated with diquat. Only diquat and the two higher rates of flumioxazin reduced watermeal biomass when compared to reference plants (Figure 1). The low rate of flumioxazin had the same level of control for watermeal as the reference treatment and other treatments (Figure 1).

This work suggests that liquid flumioxazin applied as a foliar spray can control populations of common duckweed and watermeal. Adding flumioxazin to treatment protocols should be considered to reduce the chances of herbicide resistance occurring in populations of common duckweed and watermeal. Care should be taken to ensure that carrier water is buffered to an appropriate pH as flumioxazin is known to break down rapidly in waters with higher pH values (Mudge and Haller 2010).

Future studies should investigate the use of herbicide tank mixes that include flumioxazin on common duckweed, watermeal, and other floating plant species. Future studies should also investigate the herbicide rates used here as field studies to determine if results seen here are consistent under natural conditions.

Acknowledgments

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Tables and Figures

Table 1. Herbicide treatments tested in this study.

HERBICIDE	RATE
Reference	-
Flumioxazin	0.22 L/Ha (3 oz/acre)
Flumioxazin	0.44 L/Ha (6 oz/acre)
Flumioxazin	0.88 L/Ha (12 oz/acre)
Diquat	9.4 L/Ha (128 oz/acre)

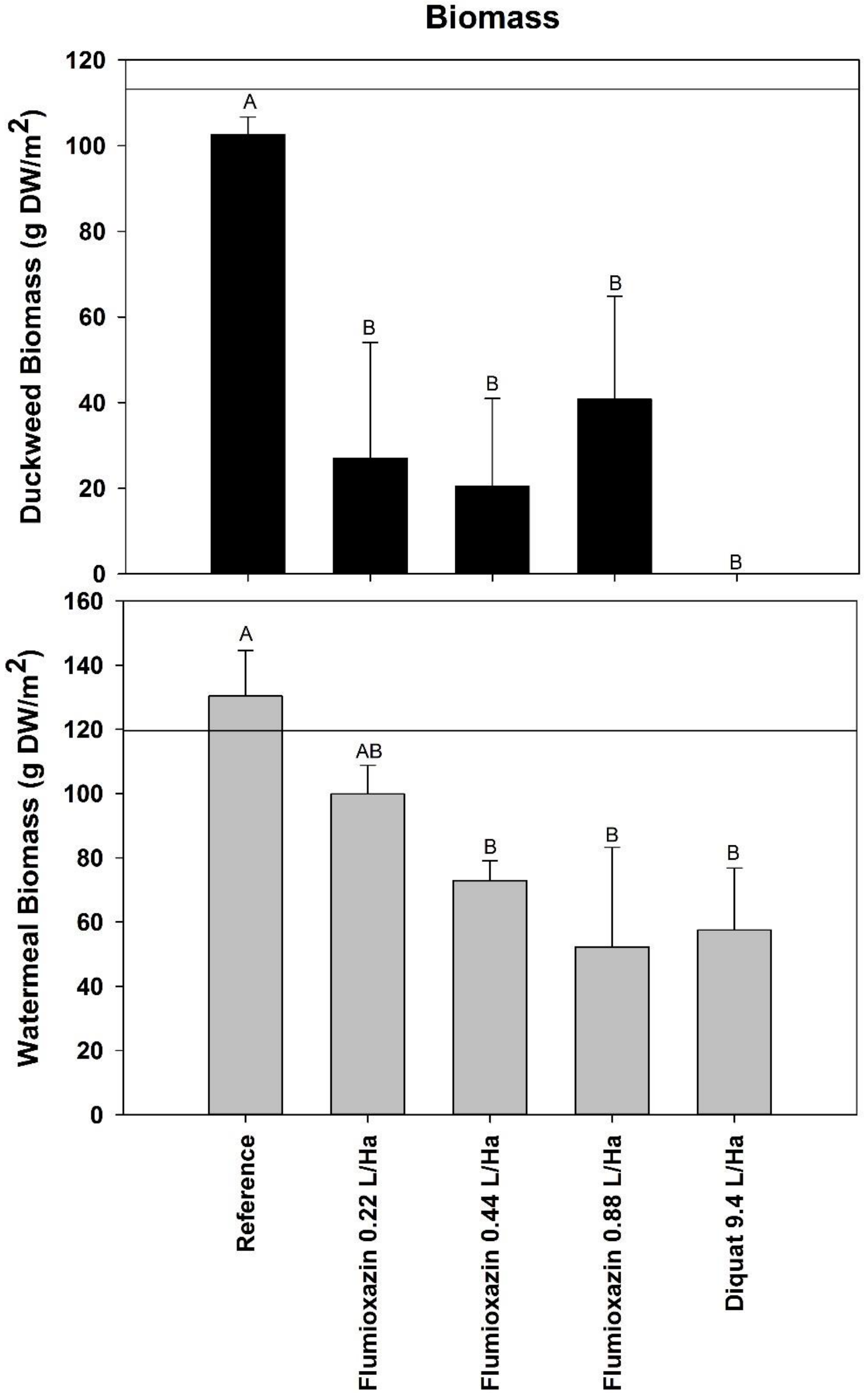

Figure 1. Common duckweed and watermeal biomass at four WAT. The solid lines are pre-treatment biomass levels. Error bars are one standard error of the mean. Tests were conducted at the $p = 0.05$ level of significance. Bars sharing the same letter are not significantly different from one another.