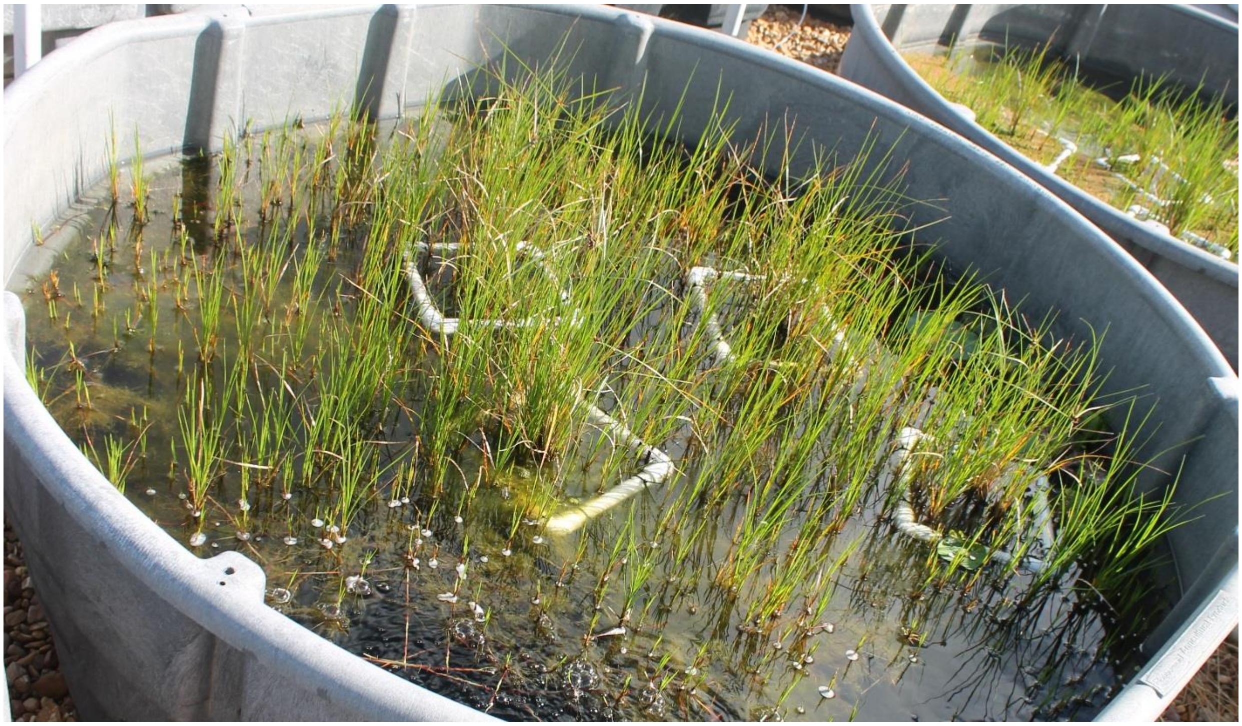
Control of Cuban bulrush (*Oxycaryum cubense*) through submersed herbicide applications – Interim Report



An interim report to the Florida Fish and Wildlife Conservation Commission

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Introduction

Cuban bulrush (*Oxycaryum cubense*) is a perennial invasive aquatic plant species native to South America (Bryson et al. 1996) that is spreading across Florida and the Southeastern US (Anderson 2007, Bryson et al. 1996, Lelong 1988, Thomas and Allen 1993, Turner et al. 2003, and Cox et al. 2010). In FL, and elsewhere, Cuban bulrush is known to form large floating islands (tussocks) that can block boat launches, impede navigation along river channels, negatively affect drainage canals, and degrade fishery habitat by lowering dissolved oxygen under the tussock (Mallison et al. 2001). Cuban bulrush is capable of outcompeting and displacing native and other invasive species for resources thereby disrupting ecosystem processes (Robles et al. 2007). Cuban bulrush is capable of sexual and asexual reproduction (Haines and Lye 1983). During initial colonization it exists as an epiphytic species that utilizes other aquatic plants or structures for habitat (Tur 1971). However, once a plant mat has captured enough sediment from the water column in the root/rhizome network the species is capable of surviving independent of other structures as a floating tussock (Haines and Lye 1983). Portions of these tussocks can break off, float away, and start new infestations of Cuban bulrush elsewhere.

Limited data exist concerning selective chemical control (herbicides) methods that are effective at controlling Cuban bulrush. To date, only one study examining chemical control of Cuban bulrush has been published in a peer review journal (Watson and Madsen 2014). Watson and Madsen (2014) evaluated the efficacy of 10 foliar applied herbicides to control Cuban bulrush but did not investigate selective or submersed control options.

This work was conducted to investigate short and long-term selective submersed chemical control options for Cuban bulrush. Results reported here are only for the short-term portion of this study.

Materials and Methods

This study was conducted at the Aquatic Plant Research Facility at Mississippi State University's R. R. Foil Plant Research Center (MSU North Farm). Cuban bulrush was grown in 1,140 L (300 gal) outdoor mesocosms with American lotus (*Nelumbo lutea*), a native species that it co-occurs with. Mesocosms were filled to a volume of 216 L (41 cm or 16 inch depth). Enough plant material was established so that multiple plant harvests (short and long term) could be carried out during the course of the study.

Cuban bulrush was establish in garden netting stretched across 0.1 m^2 (13 in) frames that were floated on the water surface of each mesocosm. Four frames of Cuban bulrush were established per mesocosm. American lotus seeds were collected from natural populations in Lake Columbus on the Tennessee-Tombigbee Waterway near Columbus, MS. Seeds were scarified with a belt sander and floated in a bucket of pond water for seven days to stimulate sprouting. Sprouted seeds were planted in 3.78 L (1 gal) pots[1] filled with sand and amended with a slow release fertilizer[2] to stimulate growth. Two pots of lotus were established in mesocosms with Cuban bulrush. Plants were given one month to establish prior to herbicide treatments.

There were 10 herbicide treatments and a non-treated reference for a total of 11 treatments (Table 1). Each treatment was replicated three times. Additionally, three extra mesocosms were established for pre-treatment harvests. In total there were 36 mesocosms.

American lotus harvest consisted of separating plant tissues into above and belowground biomass. Cuban bulrush plant tissues were harvested and separated into emergent (shoots and reproductive structures) and submersed tissues (stolons and roots). Harvested tissues were placed in labeled paper bags, dried in a forced air oven for five days at 70C, and then weighed. After the pre-treatment harvest, mesocosms were exposed to static submersed herbicide applications. Eight weeks after treatment (WAT), the first post-treatment harvest (short term) was carried out to assess short-term effects of herbicides on treated plants. Plants were harvested and processed in the same manner as pretreatment specimens.

Statistical analysis was performed via an analysis of variance (ANOVA) procedure in a commercially available statistical software package[3]. Any differences detected in treatment means by ANOVA were further separated by a Fisher's Least Significant Difference Test at the 0.05 level of significance (Analytical Software 2009).

Results and Discussion

None of the herbicides significantly reduced belowground or submersed tissues at eight WAT for either species (Figures 1 and 2). However, all herbicides reduced aboveground biomass of American lotus when compared to reference plants (Figure 1). All herbicides except imazamox[4] significantly reduced Cuban bulrush emergent tissues when compared to reference plants (Figure 2). Imazamox had the same level of control as diquat[5], endothall[5], flumioxazin[7], 2,4-D[8], penoxsulam[9], bispyiribac-sodium[10], and carfentrazone-ethyl[11]. Triclopyr[12] and fluridone[13] yielded greater control than imazamox but not the other herbicides.

This work suggests that submersed herbicide applications can control populations of Cuban bulrush but may also harm desirable plant species in the short term. The fact that no herbicides affected belowground tissues of lotus or submersed tissues of Cuban bulrush suggest that plants could recover from herbicide applications due to nutrient reserves stored in these tissues. However, some of the herbicides used require more time than the eight WAT plants were given before symptomology occurs. Therefore, plants receiving these treatments may not have had sufficient time for effects due to herbicides to appear on belowground or submersed tissues (respectively) of each species. The 52 WAT harvest will determine if any of the herbicides used can deliver long term control of Cuban bulrush.

It is important to note that Cuban bulrush spread rapidly across the mesocosms, which may lead to interspecific competition with American lotus during the remainder of this study. Additionally, a majority (>95%) of the Cuban bulrush plants had not yet flowered. Watson and Madsen (2014) noted that Cuban bulrush plants treated pre-flowering were more susceptible to many herbicides than plants treated post-flowering. Future studies should investigate the submersed use of herbicides post-flowering on Cuban bulrush.

Sources of Materials

[1]Poly-Cel Horticultural Growing Containers, Hummert International, 4500 Earth City Expressway, Earth City, MO 63045.

[2]Osmocote® Coated Fertilizer, Everris, Israeli Chemicals Ltd., Millenium Tower, 23 Aranha Street, Tel Aviv 61070, Israel.

[3]Statistix 9.0, Analytical Software, 2105 Miller Landing Road, Tallahassee, FL 32312.

[4]Clearcast® Aquatic Herbicide, SePRO Corporation, 11550 North Meridian Street, Suite 600, Carmel, IN 46032.

[5]Harvester® Aquatic Herbicide, Lonza Water Treatment, Muenchensteinerstrasse 38, 4002 Basel, Switzerland.

[6]Aquathol K® Aquatic Herbicide, United Phosphorous Inc., 630 Freedom Business Center Drive, King of Prussia, PA 19406.

[7]Clipper SC® Aquatic Herbicide, Nufarm Americas Inc., 11901 South Austin Avenue, Alsip, IL, 60803.

[8]Navigate® Aquatic Herbicide, Lonza Water Treatment, Muenchensteinerstrasse 38, 4002 Basel, Switzerland.

[9]Galleon® Aquatic Herbicide, SePRO Corporation, 11550 North Meridian Street, Suite 600, Carmel, IN 46032.

[10]Tradewind™ Aquatic Herbicide, Valent USA Corporation, 1600 Riviera Avenue, Suite 200, Walnut Creek, CA, 94596.

[11]Stingray® Aquatic Herbicide, SePRO Corporation, 11550 North Meridian Street, Suite 600, Carmel, IN 46032.

[12]Navitrol® Aquatic Herbicide, Lonza Water Treatment, Muenchensteinerstrasse 38, 4002 Basel, Switzerland.

[13]Sonar® AS Aquatic Herbicide, SePRO Corporation, 11550 North Meridian Street, Suite 600, Carmel, IN 46032.

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Turner BL, Nichols H, Denny G, Doron O. 2003. Atlas of the vascular plants of Texas. Volume 2: Sida botanical miscellany 24. Fort Worth, TX: Botanical Research Institute of Texas. 888 pp.

Watson AL, Madsen JD. 2014. The effect of the herbicide and growth stage on Cuban club-rush (*Oxycaryum cubense*) control. J. Aquat. Plant Manage. 52:71-74.

Tables and Figures

Table 1. Herbicides, translocation type, rates, and formulations used as treatments.

HERBICIDE	TRANSLOCATION	RATE	FORMULATION
Reference	-	-	-
Diquat	Contact	0.37 ppm	Liquid
Endothall	Contact	2.0 ppm	Liquid
Triclopyr	Systemic	1.5 ppm	Liquid
Flumioxazin	Contact	0.4 ppm	Liquid
Imazamox	Systemic	0.075 ppm	Liquid
Fluridone	Systemic	0.02 ppm	Liquid
2, 4-D (BEE)	Systemic	2.0 ppm	Granular
Penoxsulam	Systemic	0.04 ppm	Liquid
Bispyribac-sodium	Systemic	0.045 ppm	Wetable Powder
Carfentrazone-ethyl	Contact	0.2 ppm	Liquid

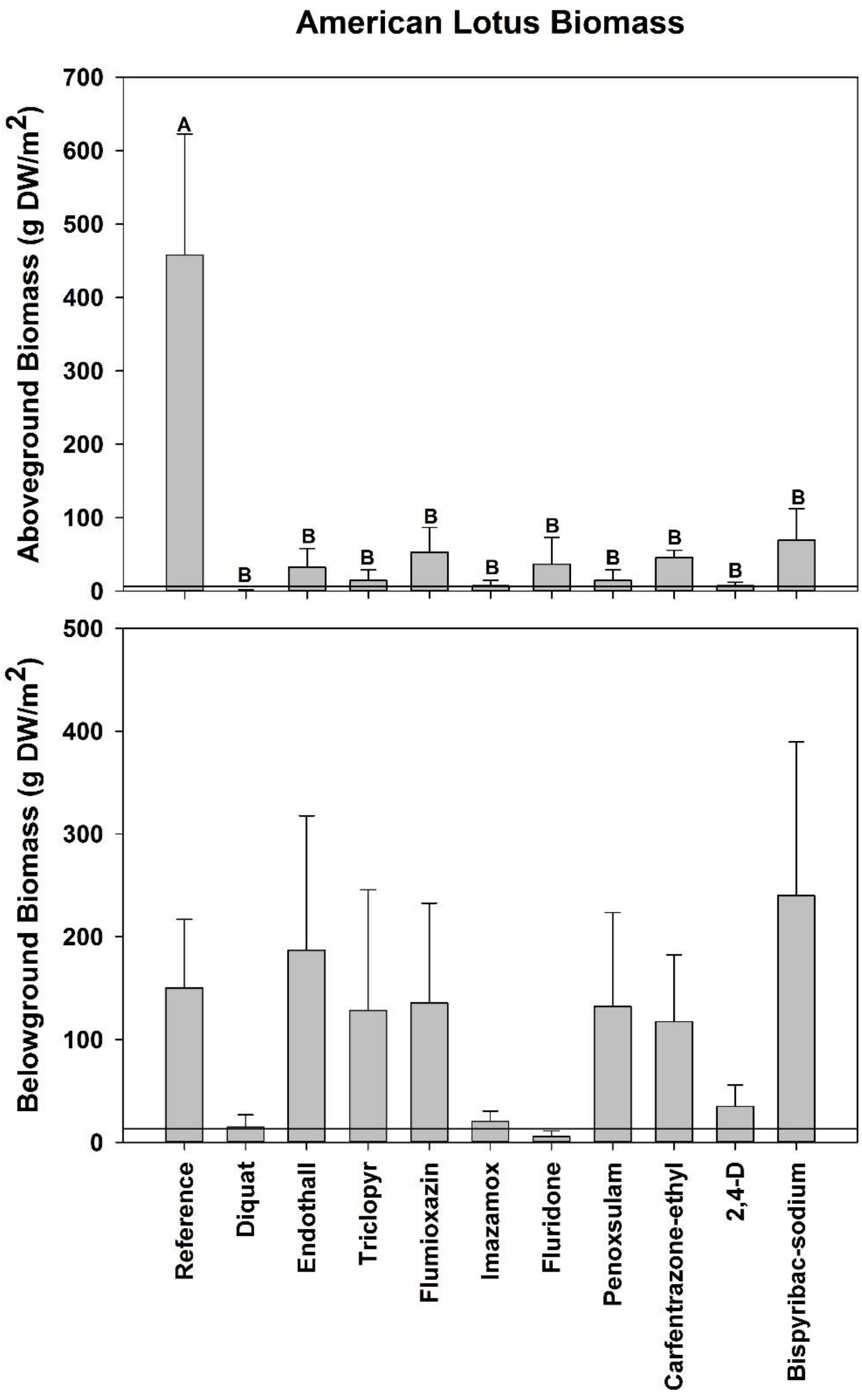

Figure 1. American lotus biomass at eight WAT. The solid lines are pre-treatment biomass levels. Error bars are one standard error of the mean. Tests were conducted at the p = 0.05 level of significance. Bars sharing the same letter are not significantly different from one another.

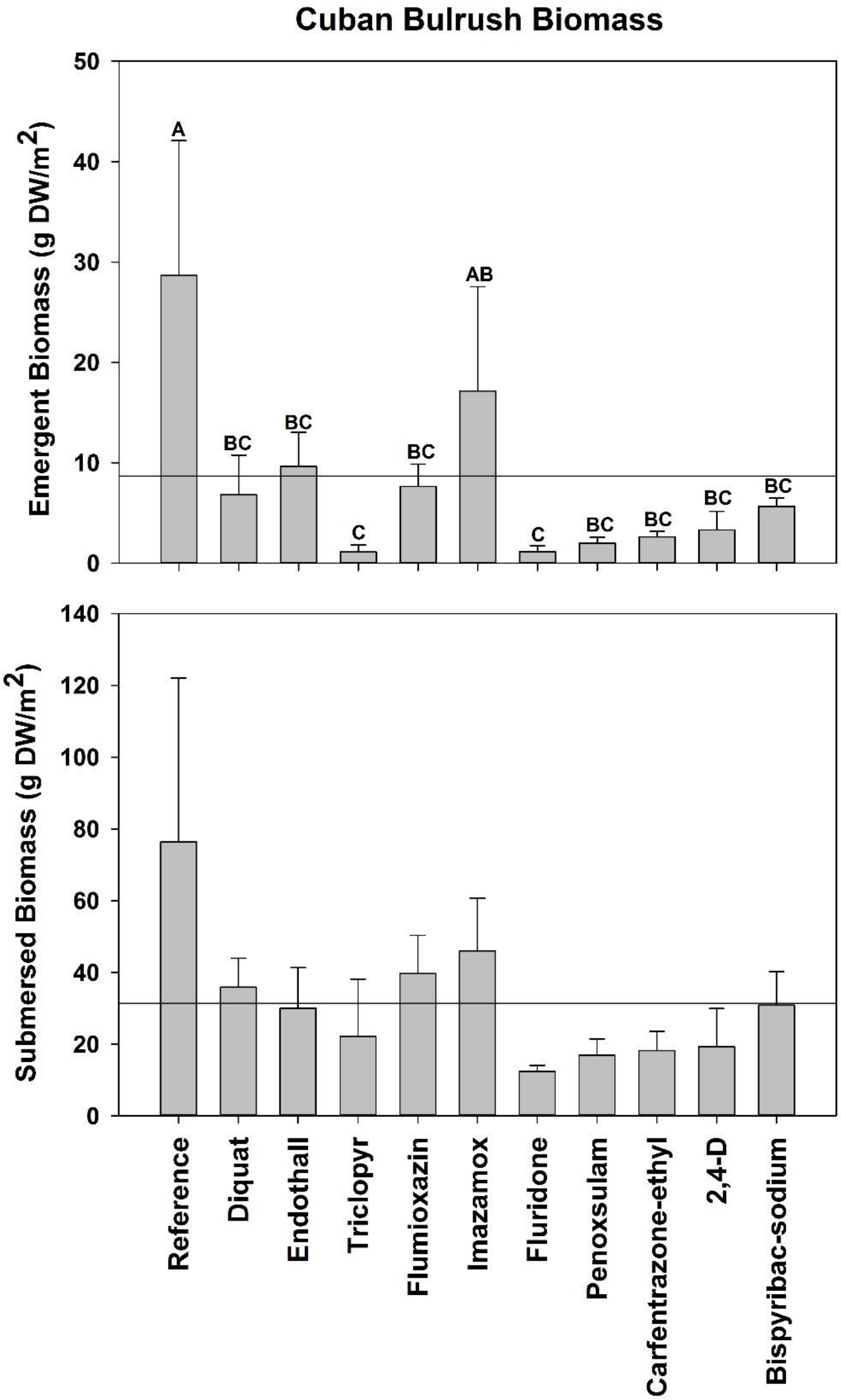

Figure 2. Cuban bulrush biomass at eight WAT. The solid lines are pre-treatment biomass levels. Error bars are one standard error of the mean. Tests were conducted at the p = 0.05 level of significance. Bars sharing the same letter are not significantly different from one another.