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Effect of Two Endothall Formulations on Waterlettuce (*Pistia stratiotes*)[1]

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INTRODUCTION

Waterlettuce (*Pistia stratiotes* L.), a free-floating aquatic macrophyte, consists of a rosette of light yellow-green pubescent leaves radiating from an underwater stolon. Probably introduced into the United States from South America (3), the plant is now found throughout the state of Florida and along the Gulf Coast into Texas. Other scattered populations of waterlettuce exist throughout the southern U. S., but due to extreme susceptibility to cold, its range does not extend into northern climes (6). Within its naturalized range waterlettuce is capable of extensive infestation in small bodies of water. Its ability to form dense mats of vegetation, often in conjuction with waterhyacinth [*Eichhornia crassipes* (Mart. Solms.], may impede water flow, limit boat traffic and other recreational use and adversely affect water chemistry by lowering dissolved oxygen and pH (6,1).

A wide range of herbicides have been employed to control waterlettuce. Weldon and Blackburn (5) reported that diquat (6,7-dihydrodipyrido[1,2-α:2′,1′-*c*] pyrazinediium ion) provided effective initial control at treatment rates of 0.6, 1.7, and 2.8 kg/ha. However, regrowth was rapid and extensive at the lowest rate after 3 weeks. Additional work with several other herbicides, including (2,4-dichlorophenoxy)acetic acid (2,4-D) provided unsatisfactory results. Furthermore, the addition of a variety of wetting agents did little to improve herbicide efficacy. Thayer and Haller (4) reported limited success in waterlettuce control when applying 4.5 kg/ha 2,4-D plus 1% v/v of various surfactants. Diquat and glyphosate [N-(phosphonomethyl) glycine] proved effective at 1.1 and 4.5 kg/ha, respectively. Applications of endothall (7-oxabicyclo[2.2.1] heptane-2,3-dicarboxylic acid) at 3.4 kg/ha provided approximately 80% control at 15 days post-treatment, however regrowth occurred rapidly as new plants regenerate from the central bud. A recommendation under section 2(ee) of the Federal Insecticide Fungicide and Rodenticide Act was recently obtained for use of dipotassium endothall to control waterlettuce in Florida and many other states. In this study, the efficacy of this herbicide was evaluated in both spring and winter treatments under South Florida conditions. In parallel work, the monoamine endothall formulation was applied for comparison.

MATERIALS AND METHODS

Waterlettuce was collected locally and established in outdoor tanks until treatment. Twenty-one concrete tanks (0.8 m wide by 2.2 m long by 0.6 m deep) with a surface area of 1.7 x 10^{-4} ha were filled with approximately 900 liters water from a surface pond on the Fort Lauderdale Research and Education Center grounds (5). Each tank was then planted with waterlettuce which grew and covered the surface of the water. Fertilizer [8-6-12 (N:P:K)] formulated as a commercial slow-release preparation (Osmocote®)[3] was added at 250 g per tank at the beginning of the experiment. Foliar applications of Orthene® [acephate (O,S-dimethyl acetylphosphoramidothioate] were made weekly at approximately 1.0 kg/ha to control insect damage.

The waterlettuce was treated on December 12, 1985 when the plants were approximately 1 year old and had completely covered the water surface in the tank. The herbicides were applied broadcast using a platform sprayer[4] equipped with a hand-held boom at rates of 1.7, 3.4, and 6.7 kg a.e./ha. All treatments were applied with a carrier volume of 467 L/ha using a flat-fan[5] nozzle orifice number 11002. The carrier in all treatments was pondwater (5). A nonionic surfactant X-77® (alkylarylpolyoxyethylene glycol, fatty acid, and isopropanol) was added to the carrier for an effective concentration of 0.05% (v/v). All treatments were completely randomized and replicated three times.

For the spring treatment, plants were treated while still immature (approx. 2 months old) on April 8, 1986. Herbicide treatment rates and procedures remained as described above. A commercial water-soluble 20-20-20 (N:P:K) fertilizer (Peters®) and a chelated iron powder (Sequestrene 138®) were applied monthly to provide approximately 5 mg/L N and 1 mg/L Fe in water. These nutrient levels approximate those used in the winter treatments.

During both trials each tank was evaluated for visual damage at 2, 4 and 6 weeks post-treatment. Ratings were on a 0 to 100% scale, with 0% representing no injury and 100% representing death of the entire plant population. The data was compiled and analyzed using SAS[6]. ANOVA was used to test for differences between seasons, weekly evaluations, chemical formulations and treatment rates.

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[3]Mention of a trademark name, proprietary product, or scientific equipment does not constitute a guarantee of warranty by the U. S. Department of Agriculture or the University of Florida, and does not imply its approval to the exclusion of other products that may also be suitable.

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RESULTS AND DISCUSSION

Full model ANOVA indicated no main or interactive effects between formulations. ANOVA was rerun excluding formulation and a summary of results is presented in Table 1. All main and interactive effects for rate, season and week proved significant. Little difference was noted in R^2 values between the full and abbreviated models (R^2 = 0.99 and 0.98, respectively).

Table 1 presents damage ratings for waterlettuce treated with dipotassium and monoamine formulations of endothall in both spring and winter treatments. By week 6 in the spring treatment there was 100% control at 6.7 kg a.e./ha of both formulations. Rates of 1.7 and 3.4 kg a.e./ha provided good initial control, but limited regrowth was evident at the lowest rate of both formulations after 4 weeks.

Similar herbicide treatments proved more effective on waterlettuce in the winter trial. Extensive plant damage was observed after 2 weeks and nearly 100% control was obtained at all treatment rates of both formulations after 4 weeks.

In summary, both formulations of endothall provided excellent control of waterlettuce at treatment rates of 1.7 kg a.e./ha or higher. No differences were detected between formulations with regards to efficacy or development of plant damage. However, seasonal differences did exist. The winter treatment proved to be more effective with minimum problems of regrowth. A previous study by Rosemond et al. (2) indicated a similar seasonal response of waterlettuce to glyphosate, with winter treatments also being much more effective.

TABLE 1. CONTROL OF WATERLETTUCE BY TWO ENDOTHALL FORMULATIONS IN SPRING AND WINTER TREATMENTS.

Formulation	Rate (Kg a.e./ha)	Visual Damage Rating Weeks Posttreatment 2	4	6
		Spring Treatment		
Control	0.0	2	5	3
Dipotassium endothall	1.7	57	83	88
	3.4	78	93	98
	6.7	90	98	100
Monoamine endothall	1.7	50	83	87
	3.4	85	98	98
	6.7	92	100	100
		Winter Treatment		
Control	0.0	7	12	8
Dipotassium endothall	1.7	88	97	97
	3.4	98	100	100
	6.7	95	100	100
Monoamine endothall	1.7	92	97	98
	3.4	95	100	100
	6.7	98	100	100

ANALYSIS OF VARIANCE

Effects (df)	F-value	(prob. >F)
Rate (3)	2464.5	(0.0001)
Season (1)	97.5	(0.0001)
Week (2)	51.8	(0.0001)
Rate*Season (3)	19.7	(0.0001)
Rate*Week (6)	8.0	(0.0001)
Season*Week (2)	16.1	(0.0001)
Rate*Season*Week (6)	4.4	(0.0004)

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