

Effect of Heat on Cogongrass Viability

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INTRODUCTION

Cogongrass [*Imperata cylindrica* (L.) Beauv.] is a rhizomatous perennial grass that is among the most troublesome weeds worldwide (Holm et al. 1977). It grows in tropical, subtropical, and some temperate regions of the world (Bryson and Carter 1993). Following introduction into the southern U.S., cogongrass has spread at an alarming rate and is now an invasive weed in many states of the Coastal Plain Region of the southeastern U.S. (Byrd and Bryson 1999; Dickens 1974). Cogongrass spreads mainly by seed and rhizomes (Dozier et al. 1998). Its extensive fibrous, creeping, and scaly rhizomes promote survival during periods of stress. Once established, cogongrass is extremely competitive with neighboring plant communities and thrives in infrequently cultivated areas, utility right-of-ways, roadsides, forests, pastures, mining areas, pine plantations, parks, and other natural and recreational areas (Colie and Shilling 1993; Dozier et al. 1998; Willard et al. 1990).



Extensive research has been conducted on biological properties of cogongrass such as reproductive characterization and capabilities (Holm et al. 1977; Hubbard 1944; McDonald et al. 1996), shade tolerance (Gaffney 1996; Patterson 1980), temperature tolerance (Wilcut et al. 1988), growth potential (Brown 1944; Sajise 1972; Soerjani 1970), and allelopathy (Koger and Bryson 2004; Koger et al. 2004). Research has determined that the best control strategies include repeated tillage and multiple applications of glyphosate and/or imazapyr per year over several years (Byrd and Bryson 1999). The Mississippi Department of Transportation and other agencies that oversee large tracts of land and right-of-ways are currently searching for more cost effective methods to kill cogongrass. One method that has been suggested is heat treatment of cogongrass contaminated soil.



The objectives of this research were to determine the effectiveness of heat for killing cogongrass rhizomes and evaluate survival and mortality with tetrazolium chloride test rather than a greenhouse bioassay. Because tetrazolium chloride (ISTA 1985) has been used to determine seed viability, we hypothesized that it might provide a chemical test to determine cogongrass rhizome viability.

MATERIALS AND METHODS

Rhizomes were harvested from a patch of cogongrass maintained for 6 years in a containment area at Stoneville, MS, and grown on a Dundee silt loam (fine-silty, mixed, thermic Aeric Ochraqualf) with pH 6.3; 1.1% organic matter; soil textural fractions of 26% sand, 56% silt, and 18% clay; and a cation exchange capacity of 15 cmol/kg. Rhizomes of 0.6 to 0.7 cm diam were cut into 10-cm-long segments and subjected to temperatures of 52, 65, 79, 93, 107, 121, 149, 177, and 187 C for 0.5, 1, 1.5, 2, 2.5, 5, 10, 15, 20, 25, and 30 min. Following heat treatment, five rhizome segments were cut in half and placed in a vial with 5 ml 1% tetrazolium chloride (ISTA 1985), and five rhizomes were placed in 8 by 15 cm trays in a Bokset sandy loam soil (Mollic Hapludalfs) and Jiffy Mix Plus¹ at 50/50 v/v, covered lightly with the soil-Jiffy Mix mixture, and allowed to sprout in the greenhouse at Stoneville, MS. Soil was watered lightly as needed. The greenhouse was maintained at temperatures of 20/30 C night/day with no supplemental lighting. Fresh and dry weight of rhizomes and leaves were recorded at 6 wk. Cogongrass rhizomes treated with tetrazolium chloride in vials were placed in the dark for 24 h, then removed, split longitudinally, and visually determined to be pink or not, with pink representing viable tissue. The experiment was conducted as a factorial design with four replications and repeated. All data were analyzed according to analysis of variance.



¹Jiffy Mix Plus, a registered trademark of Jiffy Products of America, Inc. 951 Swanson Dr., Batavia, IL 60510-4202.

RESULTS

Cogongrass rhizome mortality increased with increasing temperature and longer duration of heat exposure (Table 1). Cogongrass rhizome mortality was 100% at 65, 79, 93, 107, 121, 149, 177, and 187 C at time periods \geq 2.5, 5, 2.5, 2.5, 2.5, 2, 2, and 1 min, respectively. Cogongrass rhizome mortality (control) was \geq 97% at 65 C and exposures times \geq 10 min. Cogongrass control was 99% for 149 and 177 C at heat treatment periods of 1.5 min. Temperatures of 79, 107, 121, 149, and 177 C provided 50, 68, 13, 41, and 42% control at 2.5, 2, 1.5, 1, and 1 min., respectively.

Table 1. Effects of temperature on cogongrass viability.

Temp (C)	Time of exposure (Min.)										
	0.5	1	1.5	2	2.5	5	10	15	20	25	30
	Control (%)										
52	0	0	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	97	98	99	100	100	100
79	0	0	0	0	50	100	100	100	100	100	100
93	0	0	0	0	100	100	100	100	100	100	100
107	0	0	0	68	100	100	100	100	100	100	100
121	0	0	13	29	100	100	100	100	100	100	100
149	0	41	99	100	100	100	100	100	100	100	100
177	0	42	99	100	100	100	100	100	100	100	100
187	0	100	100	100	100	100	100	100	100	100	100

All plants survive. All plants killed.



The tetrazolium chloride was ineffective in predicting viability of cogongrass rhizomes following heat treatments (Table 2). Of the 99 treatment combinations of temperature and duration of temperature, the tetrazolium chloride test predicted 100% mortality correctly 5 times and correctly determined 100% survival of cogongrass rhizomes 25 times when compared to the standard greenhouse bioassay (Table 1 and 2). The tetrazolium chloride test provided a false positive or negative 69 times for 100% cogongrass rhizome survival or mortality; therefore, the tetrazolium chloride test was not a useful tool in determining the effectiveness of heat to kill cogongrass rhizomes.

CONCLUSIONS

Based on these data, cogongrass rhizomes were effectively killed with heat treatments. The duration of heat required for cogongrass mortality was less as temperature was increased. A standard greenhouse bioassay for cogongrass rhizome mortality was more accurate than a chemical test using tetrazolium chloride. Additional research may yield an effective chemical test to determine cogongrass rhizome mortality.

Table 2. Percent of cogongrass rhizomes stained by tetrazolium chloride following various temperatures and exposure time intervals.

Temp (C)	Time of exposure (Min.)										
	0.5	1	1.5	2	2.5	5	10	15	20	25	30
	Tetrazolium chloride stained (%)										
52	100	100	100	95	100	98	100	100	100	100	100
65	98	98	100	100	100	100	100	100	100	100	100
79	100	100	95	97	97	95	95	95	95	100	100
93	100	100	100	100	98	98	90	93	85	88	88
107	100	100	100	100	100	100	98	90	98	95	95
121	100	100	100	100	100	88	75	85	70	50	70
149	100	98	100	98	90	80	85	35	22	18	13
177	100	100	100	90	80	75	35	10	3	0	0
187	98	98	95	95	85	60	50	25	0	0	0

All tested positive; none tested positive.

ACKNOWLEDGEMENTS

We thank Paige Goodlett, Lakesha Horton, and Amelia Nichols for technical assistance.

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