The Effect of Mesotrione and Atrazine on Photochemical Efficiency of Centipedegrass (*Eremochloa ophiuroides*).

J. Scott McElroy, Plant Sciences Department, University of Tennessee

ABSTRACT

Atrazine is often used during the establishment of centipedegrass for control of annual weeds such as crabgrass (*Digitaria* spp.). Tank-mixing of mesotrione with photosynthesis inhibiting herbicides such as atrazine have been shown to be synergistic. Research was conducted to evaluate the effect of atrazine and mesotrione, both alone and in tank-mixture, on centipedegrass photosystem II (PSII) efficiency when applied 2 weeks after emergence from seed. PSII efficiency was measured with a pulse-modulated fluorometer under light-adapted conditions. Mesotrione alone at the highest rate of 0.28 kg/ha reduced PSII efficiency at 7 days after treatment (DAT), but no visual injury symptoms were seen and PSII efficiency normalized by 14 DAT. No other mesotrione alone treatments reduced PSII efficiency. All atrazine treatments (0.28 to 2.1 kg/ha), whether alone or in mixture, reduced PSII efficiency of centipedegrass for 28 days. Tank-mixtures of mesotrione plus atrazine, however, were more deleterious on centipedegrass development compared to alone applications.

INTRODUCTION

- Centipedegrass: Warm-season turfgrass species, often difficult to establish due to competition from uncontrolled weed species, primarily crabgrass (*Digitaria* spp.) and goosegrass (*Eleusine indica*). Atrazine is one of the primary herbicides used in establishment of centipedegrass for control of annual grasses.

- Atrazine: PSII inhibiting herbicide that directly inhibits movement of electrons from PSII to PSI along the electron transport chain. Results in massive free radical generation and overload.

- Mesotrione: Herbicide that indirectly inhibits phytoene desaturase, a key step in the formation of all carotenoids and xanthophylls. Directly inhibits the formation of tocopherols and tocotrienols.

- Carotenoids and xanthophylls: Key components in photosynthesis, including light-harvesting, non-photochemical quenching, construction of the photosynthetic apparatus, and free radical sequestration.

- Tocopherols and tocotrienols: Key antioxidants in turfgrass.

- Synergism: Atrazine and mesotrione combinations are known to be synergistic due to the concomitant free radical generation and reduced buffering for free radical sequestration.

RESEARCH GOAL

Evaluate centipedegrass tolerance to mesotrione, atrazine, and mesotrione-atrazine combinations utilizing the metrics of photochemical efficiency and turfgrass cover.

MATERIALS AND METHODS

- Centipedegrass was seeded with approximately 50 seed per pot into 10 cm diameter pots filled with Sequatchie loam soil.

- Seed emerged approximately 14 days after seeding. Pots were fertilized with a complete fertilizer (20-20-20 plus micronutrients) at 25 kg N/ ha at emergence.

- Treatments were applied 14 days after emergence (DAE) utilizing a single flat fan nozzle applied at 280 L/ha.

- Following application pots were sub-irrigated for 3 days after application. After which, normal overhead irrigation was resumed.

- Photochemical efficiency, in the form of quantum yield of PSII (Fv/Fm), was measured under light-adapted conditions using a pulse-modulate fluorometer (Opti-Sciences, http://www.optisciences.com). Three measurements per pot were taken every 7 days for 28 days (Maxwell and Johnson 2000).

- Percent turf cover of the pot also analyzed utilizing digital analysis (Karcher and 2004).

Figure 1. Surrounding with red cardboard allowed for the isolation of soil surface and grass for digital image analysis.

Figure 2. Response of centipedegrass to atrazine alone, mesotrione alone, and combined 28 days after treatment.

Figure 3. Effect of mesotrione, atrazine, and combinations on Fv/Fm of centipedegrass. Fv/Fm has been transformed to a percent increase (positive) or decrease (negative) relative to untreated centipedegrass (0%). All herbicide rates are given in kg ai/ha. LSDs are provided as a means of comparing across all herbicide treatments within a given timing.

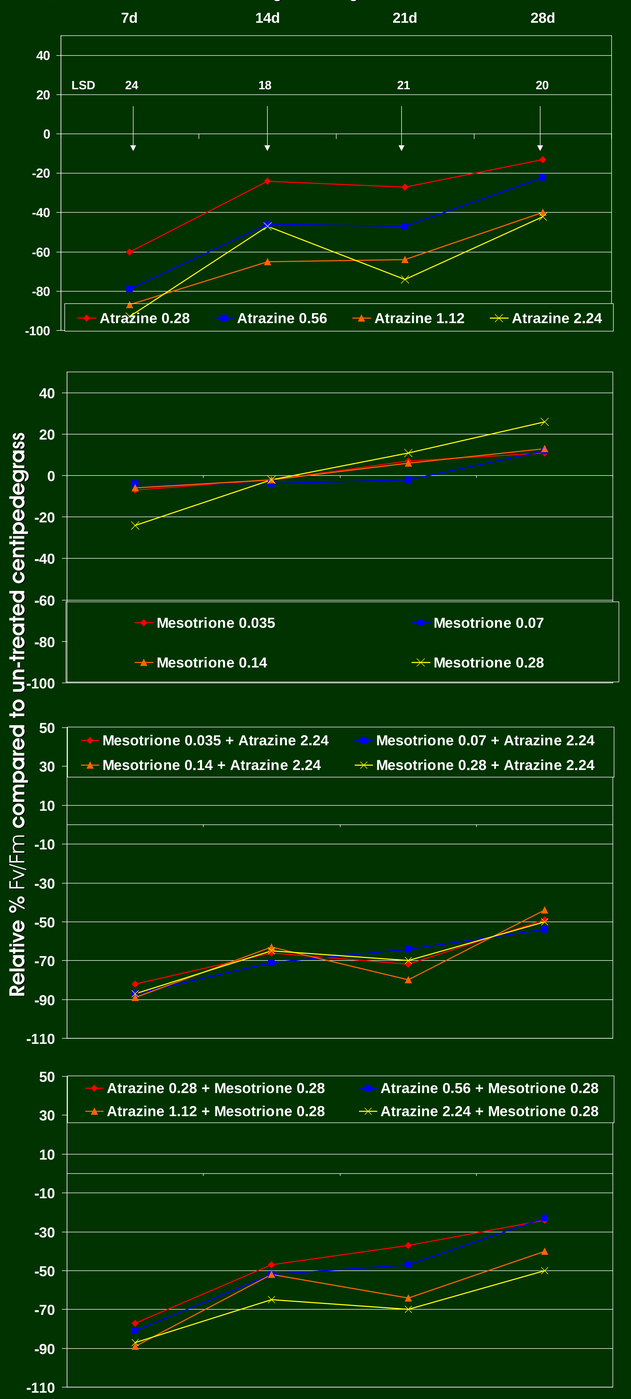

Table 1. Effect of mesotrione and atrazine on turf cover of pot soil surface 28 days after treatment.

	Mesotrione Rate	Atrazine Rate	Turf Cover
	kg/ha		%
Atrazine	0.28		31
	0.56		35
	1.12		31
	2.24		27
Mesotrione		0.035	34
		0.07	38
		0.14	38
		0.28	45
Combinations	0.28	0.28	39
	0.56	0.28	38
	1.12	0.28	28
	2.24	0.035	18
	2.24	0.07	24
	2.24	0.14	19
	2.24	0.28	14
Non-Treated			37
LSD			14

RESULTS

- **All atrazine containing treatments reduced** Fv/Fm **at 7 DAA > 60% (Figure 3). All mesotrione alone treatments reduced** Fv/Fm less than all atrazine containing treatments.

- Low rates of atrazine (0.28 kg/ha) plus high rates of mesotrione (0.28 kg/ha) were more detrimental to Fv/Fm over time than a high rate of atrazine (2.24 kg/ha) plus a low rate of mesotrione (0.035 kg/ha). Tank-mixtures were also the most detrimental to turf cover as well (Table 1).

- Fv/Fm **of mesotrione treated plants recovered by 28 DAA. It is also noted that** Fv/Fm of plants treated with mesotrione 0.28 kg/ha was greater than the non-treated. Atrazine alone at 0.28 kg/ha was the only atrazine containing treatment to completely normalize by 28 DAA.

CONCLUSIONS

- While utilized for weed management in centipedegrass when applied preemergence, atrazine is detrimental to PSII efficiency and to overall plant health when applied early postemergence. Thus, the use of atrazine should be limited to at seeding, preemergence applications when utilized for seeding establishment.

- Mesotrione is a potential safer alternative to atrazine for use early postemergence on newly seeded centipedegrass.

LITERATURE CITED

Karcher, D.E. and M.D. Richardson. 2005. Batch analysis of digital images to evaluate turfgrass characteristics. Crop Sci. 45:1536-1539.

Maxwell, K. and G.N. Johnson. 2000. Chlorophyll fluorescence– A practical guide. J. Exp. Bot. 51:659-668.