Tenacity™ Emerges as a New Herbicide for Turfgrass Establishment

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In February 2008, Tenacity was labeled for use on golf courses and sod farms in Wisconsin. The active ingredient is mesotrione, a compound with origins from the bottle brush plant. Its low use rate and low environmental toxicity place are cause for it to be considered as a reduced risk herbicide. Mesotrione is classified as a plastoquinone inhibitor, which affects numerous biological processes in plants such as carotenoid (pigment) production. The result is usually whitened plants as chlorophyll production is inhibited (Fig. 1). Additional information on the origin and environmental aspects of mesotrione can be found in Stier, 2004.

Mesotrione was primarily thought of as a post-emergent herbicide, and indeed its label includes post-emergent applications. However, earlier research indicated its potential for use as a pre-emergent herbicide during turfgrass establishment. Currently siduron is the only herbicide that can be used at time of seeding cool-season turfgrasses. However, siduron has a use rate measured in oz per thousand square feet compared to mesotrione's use rate of oz per acre, and has a greater environmental risk than mesotrione. While we've been evaluating mesotrione for potential turf use for at least four years, 2007 was the first time we tested its potential to be used as a pre-emergent herbicide at time of seeding.

Fig. 1. Pre-emergent application of mesotrione causes bleaching of yellow nutsedge as it emerges, resulting in effective weed control during turf establishment.

How we did it

We set up a field study at the O.J. Noer Turfgrass Research and Educational Facility in Verona, WI, on a silt loam soil with pH approximately 7.8. The experimental design was a randomized strip-block with four replications. Perennial ryegrass and a 3 way mix 'Madison Parks' were planted in strips across each replication so that half of each herbicide treated plot was seeded to perennial ryegrass and half was seeded to the 3 way mix. Individual grass/herbicide plots measured 5 ft x 5 ft. A one foot border was left between each area treated with herbicide to eliminate the effects of overspray.

The perennial ryegrass cultivars were Harrier (34.7%), Peregrine (34.13%), and SR4600 (28.6%). The Madison Parks mixture had Kentucky bluegrass (KBG), perennial ryegrass, and fine fescues: Odyssey KBG (10%), Arcadia KBG (5%), Mercury KBG (5%), SR2100 KBG (5%), America KBG (5%), Cannon KBG (10%), Wild Horse KBG (10%), SR5210 creeping red fescue (15%), Boreal creeping red fescue (10%), SR4550 perennial ryegrass (15%), and Cutter perennial ryegrass (15%). Grass strips were seeded using a drop spreader on 17 May. The 3 way mix was seeded at a rate of 4 lb seed/1000 ft^2 and the perennial ryegrass was seeded at a rate of 7 lbs seed/1000 ft^2. Starter fertilizer was applied at a rate of 1 lb P_2O_5/1000 ft^2 just prior to seeding. The grass seed was lightly raked in following seeding and herbicide treatments were applied over the dried soil and seed.

Herbicide treatments were applied using a CO_2 powered backpack sprayer at 42 PSI tank pressure with a 3 nozzle spray boom capable of spraying a 5 ft swath. Nozzles used were XR TeeJet 8004VS nozzles. All treatments were applied in water equivalent to 1 gal/1000 ft^2. We covered the entire study area with Futerra® erosion control blankets and applied 1/2 inch water using an automatic in-ground irrigation system. For the remainder of the establishment period irrigation was supplied 5 times per day for 2 minutes each time. We mowed the plots for the first time on 13 June. Two treatments received sequential applications on 14 June (Table 1). The second herbicide treatment was given 2 hours to dry on the leaf surface before being watered in with 1/2 inch of water. Afterwards, irrigation was supplied once weekly to replace 100% of the estimated evapotranspiration rate.

We evaluated phytotoxicity to turf and percent turf cover at 1, 2, 3, 4, 6, and 8 weeks after seeding. Turfgrass phytotoxicity was rated on a scale from 1-10 where 1=no phyto, 10=totally dead, and >3=unacceptable. Percent cover was rated on a scale from 0-100% where 0=bare soil, and 100=dense healthy turf. Percent control of various weeds was rated at 2, 3, 4, 6, and 8 weeks after treatments. Weeds rated included broadleaf weeds, crabgrass, and yellow nutsedge. The percentage of weeds in each plot was estimated visually and percent control was calculated by dividing the percent of weeds in treated plots by the percent in the control plot for that replication, multiplying the dividend by 100, and subtracting the product by 100.

Table 1. Treatment list for evaluating mesotrione as a pre-emergent herbicide at time of seeding cool-season turfgrass mixtures, Verona, WI, 2007.

Trt #	Trteatment	Rate(oz a.i./A)	Timing
1	Mesotrione 4 SC†	2.5	Seeding
2	Mesotrione 4 SC	3.0	Seeding
3	Mesotrione 4 SC	4.0	Seeding
4	Siduron	48.0	Seeding
5	Mesotrione 4 SC	2.5 + 2.5	Seeding + 1st mowing
6	Mesotrione 4 SC	3.0 +3.0	Seeding + 1st mowing
7	Untreated Control		

†Non-ionic surfactant was added to all mesotrione treatments at 0.25% v/v.

Table 2. Effect of herbicide treatment on turfgrass phytotoxicity. Rating scale: 1-10 where 1=no phyto, 10=totally dead and >3=unacceptable. Verona, WI 2007.

Treatment	Rate(oz a.i./A)	25 May	31 May	7 June	14 June
1. Mesotrione 4 SC†	2.5	1.1 b	1.1 b	1.1 b	1.0 b
2. Mesotrione 4 SC	3.0	1.0 b	1.0 b	1.3 b	1.1 b
3. Mesotrione 4 SC	4.0	4.5 a	4.9 a	5.9 a	4.1 a
4. Siduron	48.0	1.0 b	1.0 b	1.1 b	1.0 b
5. Mesotrione 4 SC	2.5 + 2.5	1.4 b	1.2 b	1.0 b	1.0 b
6. Mesotrione 4 SC	3.0 +3.0	1.3 b	1.0 b	1.1 b	1.0 b
7. Untreated Control		1.0 b	1.0 b	1.0 b	1.0 b
LSD (0.05)		0.47	0.82	0.66	0.39

Means followed by the same letter are not significantly different at $P \leq 0.05$.

Table 3. Interaction between herbicide treatment and grass type on percent turf cover. Rating scale: 0-100% where 0=bare soil, 100=healthy dense turf. Verona, WI 2007.

			% Cover	
Trteatment	Rate(oz a.i./A)	Grass Type	31 May	9 July
1. Mesotrione 4 SC	2.5	Perennial Rye	30.0 ab	100.0 a
2. Mesotrione 4 SC	3.0	Perennial Rye	27.5 bc	100.0 a
3. Mesotrione 4 SC	4.0	Perennial Rye	15.0 d	92.0 c
4. Siduron	48.0	Perennial Rye	26.3 c	100.0 a
5. Mesotrione 4 SC	2.5 + 2.5	Perennial Rye	31.3 a	100.0 a
6. Mesotrione 4 SC	3.0 +3.0	Perennial Rye	28.8 abc	100.0 a
7. Untreated Control		Perennial Rye	31.3 a	99.3 ab
1. Mesotrione 4 SC	2.5	3 way mix	6.3 e	97.3 ab
2. Mesotrione 4 SC	3.0	3 way mix	6.3 e	98.5 ab
3. Mesotrione 4 SC	4.0	3 way mix	2.8 f	76.3 d
4. Siduron	48.0	3 way mix	6.3 e	97.3 ab
5. Mesotrione 4 SC	2.5 + 2.5	3 way mix	6.3 e	98.3 ab
6. Mesotrione 4 SC	3.0 +3.0	3 way mix	6.3 e	98.0 ab
7. Untreated Control		3 way mix	7.0 e	94.5 bc
LSD within TRT			5.48	2.57
LSD among TRT			2.66	4.63

Means followed by the same letter are not significantly different at $P \leq 0.05$.

What we found

The only significant injury to turf occurred with the highest rate of mesotrione tested, 4 oz a.i. per acre (Table 2). The 2.5 and 3.0 oz a.i. per acre rates did not cause essentially any phytotoxicity, similar to siduron. The split-shot applications also did not cause injury, even though the second application was made to young turfgrass less than one month old.

Phytotoxicity from the high rate of herbicide appeared to be related to the amount of perennial ryegrass in the turf stand. Our results showed perennial ryegrass was damaged by the high rate of mesotrione, but turf cover was still good seven weeks after seeding (Table 3). In fact, Table 3 shows plots seeded to only perennial rye-

grass had faster turf cover than the plots seeded to the 3-way mixture due to the rapid establishment rate of perennial ryegrass compared to Kentucky bluegrass and fine fescue. Some of our other research indicated that fine fescues may also be susceptible to phytotoxicity from mesotrione, but effects are transient (data not shown). In fact, the label for Tenacity notes that it should be used cautiously when applied to young stands of fine fescue. Phytotoxicity was observed as a lack of germination, bleached or purple color to the turf, and reduced growth. Some researchers have reported injury to annual bluegrass, and indeed this is noted on the label.

All rates and timings of mesotrione performed well at controlling broadleaf weed populations (Table 4). Broadleaf weed control sometimes resulted in better turf cover because the grass didn't have to compete with the weeds. Yellow nutsedge was controlled at or near 100% by mesotrione, while control by siduron was only about 50% (data not shown). In some of our other studies, mesotrione has adequately controlled crabgrass when applied as a pre-emergent herbicide, however, there wasn't enough crabgrass in this particular study to document crabgrass control.

Table 4. Effect of herbicide treatment on broadleaf weed control. Rating scale: 0-100% where 0=no reduction in weeds compared to the control, 100=no broadleaf weeds. Verona, WI 2007.

Trteatment	Rate(oz a.i./A)	31 May	14 June	9 July
1. Mesotrione 4 SC†	2.5	79.2 a	87.5 a	75.0 a
2. Mesotrione 4 SC	3.0	100.0 a	87.5 a	87.5 a
3. Mesotrione 4 SC	4.0	100.0 a	100.0 a	100.0 a
4. Siduron	48.0	68.8 ab	87.5 a	75.0 a
5. Mesotrione 4 SC	2.5 + 2.5	100.0 a	100.0 a	100.0 a
6. Mesotrione 4 SC	3.0 +3.0	100.0 a	100.0 a	100.0 a
7. Untreated Control		37.5 b	50.0 b	0.0 b
LSD (0.05)		38.94 b	31.04	28.46

Means followed by the same letter are not significantly different at $P \leq 0.05$.

Conclusion

Mesotrione appears to be sufficiently safe for use when establishing Kentucky bluegrass, perennial ryegrass, and mixtures containing Kentucky bluegrass, perennial ryegrass, and fine fescues. Additional work is needed to determine its safety on fine fescues alone, both at time of seeding and on established turf, particularly for different fine fescue species as well as cultivars. A label for lawn turf may be forthcoming in the next year or so.

References

Stier, J. New chemistry for selective control of creeping bentgrass. *The Grass Roots* 33(6):4-5, 7.