New Chemistry for Selective Control of Creeping Bentgrass

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When I lived outside of Los Angeles during the mid-1980s I always admired my mom's bottle-brush plants (*Callistemon rigidus*). These small trees had attractive foliage and beautiful red flowers that looked like the business end of a large test tube brush. Little did I know this unique plant had other characteristics which could someday benefit the turf industry.

The bottle brush plant has given us a potentially exciting new chemistry for weed control in turf. Scientists investigating the lack of weeds near bottle brush plants assayed numerous compounds from the plant and ultimately identified one, leptospermone, as the source of the allelopathy. Interestingly enough, the same compound has been used as a pharmaceutical for certain childhood diseases! Because greenhouse tests yielded only moderate control of test weed species, chemists began analyzing the leptospermone structure. Scientists found that by substituting a few atoms of the molecule, they could enhance the activity 20 times of the original leptospermone. The resulting product was called mesotrione.

Mesotrione belongs to the chemical family known as the Callistomones. This is the newest class of herbicides to be introduced for turf weed management. Mesotrione kills weeds by inhibiting a compound known as plastoquinone, a controlling molecule for many biochemical processes in plants. The net effect of mesotrione is to prevent the production of plant pigments known as carotenoids. These are

the same pigments that give us the strikingly orange tree foliage in autumn. Carotenoids are important to the plant because they protect chlorophyll (the green pigment responsible for photosynthesis) from destruction by sunlight. Without carotenoids, chlorophyll is degraded and the weeds die from lack of photosynthesis. We see the activity as a bleaching—affected leaves turn white several days after application. This is the same mode of action as another compound we've tested (isoxaflutole) but is more environmentally friendly.

Mesotrione has a relatively low soil sorption (Kd = 0.3-5) and an octanol:water partitioning coefficient of 73 as a median value. These characteristics indicate a potential for the compound to leach in soil, however, the water solubility is low (160 mg/Liter) and the half-life is short, only about 15-21 days in soil. Given these characteristics and its source of origin, mesotrione has a Reduced Risk Status as determined by the Environmental Protection Agency (EPA). The potential for labeled use on turf in the U.S. looks good.

Both roots and foliage can absorb mesotrione, making it suitable for use as both a pre- and post-emergent product. Mesotrione is a true systemic with movement through both xylem and phloem, meaning all plant parts, even below-ground structures like rhizomes, can be affected.

Most of the initial research focused on pre-emergent weed control. Weeds such as broadleaf plantain, white clover, and purslane speedwell are readily controlled by pre-emergent activity. Further investigation showed weeds such as yellow woodsorrel, henbit, creeping Charlie, mouse-ear and common chickweed can be controlled post-emergent. Research by Dr. Shawn Askew at Virginia Polytechnical Institute (VPI) indicates a number of other weeds can be suppressed, though not necessarily killed, by post-emergent applications: white clover, yellow nutsedge, zoysiagrass, dandelion, and orchardgrass. Mesotrione does not seem to affect annual bluegrass, rough bluegrass, Kentucky bluegrass, tall fescue, hard fescue, or perennial ryegrass.

Other research indicates post-emergent applications may be useful to control barnyardgrass and even creeping bentgrass. Selective control of creeping bentgrass in bluegrass fairways would be a huge boon to those golf courses which struggle with keeping bentgrass out of the fairways. Currently only non-selective herbicides are available for controlling bentgrass, an obstacle which has caused more than one golf course to undergo a costly renovation.

We conducted a study in 2003 to investigate the potential for selective removal of creeping bentgrass and/or supina bluegrass (*Poa supina*) in a fairway-height turf. On 27 June 2003, we applied several new and conventional herbicides to a mixed stand of creeping bentgrass and supina bluegrass (Table 1). The 5-year old turf had been maintained at 0.5 inch height, received 3 lb N per 1000 ft^2 annually, and was irrigated 3 times weekly at 100% ET. Each treatment was applied a second time on 22 July. Both applications were made using XR 8004 flat fan nozzles with a carrier volume of 1 gal water per 1000 ft^2. Phytotoxicity ratings were collected two weeks after the final application and the percent cover of plants were rated 4 weeks after

Table 1. Conventional and experimental herbicides for selective control of creeping bentgrass and supina bluegrass at fairway heights, Madison, WI, 2003.

Trade name	Common name	Formulation	Rate
Mon 44951	---	75 WG	0.04 lb ai/A
Balance	Isoxaflutole	4 SC	0.18 lb ai/A
Corbel*	Fenpropimorph	80 EC	1.78 pt/A
Velocity	Bispyribac-sodium	80 WP	0.1 lb ai/A
Prograss	Ethofumesate	5 EC	3 fl oz/1000 ft^2
---	Mesotrione	4 SC	0.5 lb ai/A
Vantage	Sethoxydim	1 EC	0.8 fl oz/1000 ft^2
Roundup Pro	Glyphosate	4 EC	8 fl oz/A
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*Available in United Kingdom.

Table 2. Phytotoxicity and control of creeping bentgrass (CBG) and supina bluegrass (SBG) in mixed stands maintained at 0.5 inch height, O.J. Noer Turfgrass Research & Educational Facility, Madison, WI, 2003. Products were applied on 27 June and 22 July 2003.

	% Injury		% Control	
	---------8 August--------		--------21 August-------	
Treatment	CBG	SBG	CBG	SBG
Mon 44951	13.9	28.3	21.2	-28.1
Isoxaflutole	28.7	6.2	78.1	-81.8
Fenpropimorph	0.0	6.9	-12.0	19.1
Bispyribac-sodium	5.8	45.3	-4.2	9.7
Ethofumesate	2.8	3.1	6.1	-1.0
Mesotrione	37.1	1.1	94.1	-61.1
Sethoxydim	32.1	0.8	98.8	-53.6
Glyphosate	61.1	42.5	61.8	-555.0
Control	2.1	0.0	-1.8	6.8
LSD (0.05)	7.4	9.9	14.2	22.8

the final application in order to determine percent control.

Mesotrione and sethoxydim (Vantage) provided excellent control of creeping bentgrass with minimal to no harm of supina bluegrass (Table 2). Isoxaflutole (Balance) had good efficacy against bentgrass, providing 78% control compared to only 62% control with the low rate of glyphosate. None of the compounds tested effectively controlled supina bluegrass though fenpropimorph appeared the most promising. Supina bluegrass recovered from injury caused by compounds such as isoxaflutole, mesotrione, sethoxydim, and even the ultra-low rate of glyphosate, often filling in voids caused by bentgrass removal (incidentally, label rates of glyphosate are 100% effective at controlling supina bluegrass).

We applied a split-shot application of the products approximately 3 weeks apart. Studies conducted in several other states indicate single applications are relatively ineffective. Secondly, we used the projected label rate of 0.5 lb ai per acre for our study. Following review by the EPA, the proposed label rate may be limited to a total of 0.5 lb ai per acre annually, with a limit of 0.25 lb ai per acre in single applications. Studies conducted this year at VPI and the University of Nebraska indicated rates of 0.187 to 0.25 lb ai per acre still effectively controlled creeping bentgrass in Kentucky bluegrass turf when applications were repeated at 2 to 3 week intervals (Askew, *personal communication*; Gaussoin, *personal communication*).

The anticipated introduction of mesotrione into the turf market is exciting for several reasons. Due to increasingly tight restrictions and registration costs, few new herbicides are being developed for turf. Mesotrione not only introduces a new chemistry, but its humble plant origins make it appear less a concoction of man than of nature. The extremely low use rate (0.25 lb ai or less per acre) means significantly less total product overall will be used, about 10X less compared to many conventional pesticides. The low use rate is important because the pesticide industry is constantly evaluated by the amount of product used—a decline in pounds of active ingredient used annually sends a well-received message to the public. Finally, and perhaps most exciting of all, mesotrione will be the first effective compound for selective control of creeping bentgrass in bluegrass fairways. Though current plans are to label it for the professional market (e.g., golf course) homeowners would find it useful as well. The selective control and low toxicity of the product also removes one of the primary stumbling blocks for acceptance of Roundup Ready creeping bentgrass®. Opponents of the technology have argued no other low-toxicity alternative exists for removing bentgrass: mesotrione adds the benefit of selective removal. Clearly, mesotrione is one up-and-coming compound to watch.