Developing Weed Management Programs for Creeping Bentgrass Fairways Using Low Environmental Impact Herbicides

James Brosnan and Matthew Elmore
University of Tennessee

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Objectives:

Reduce creeping bentgrass injury from low environmental impact herbicides using herbicide safeners.

Creeping bentgrass (CBG) (Agrostis stolonifera L.) is the most widely used cool–season turfgrass species on golf course fairways and tees in the United States. Despite widespread popularity, CBG is tolerant of few postemergence herbicides. This forces turfgrass managers to tolerate moderate injury from herbicides used to control graminaceous weeds or use more laborious methods of removal. Herbicide development is currently focused on providing superintendents with herbicides that pose minimal environmental impact and can be used effectively at lower application rates than older alternatives; examples include amicarbazone, pinoxaden and topramezone. However, few of these products are safe for use on CBG.

Figure 1. Representative effectiveness of a herbicide safener (Treated on the left and Control on the right).

Turfgrasses naturally contain enzymatic systems to detoxify xenobiotics (synthetic chemicals within the plant). Selectively enhancing the ability of CBG, but not target weeds to more rapidly detoxify herbicides would provide more versatile options for selective weed control.

The herbicides amicarbazone, bispyribac–sodium, fenoxaprop–ethyl, imazapic, topramezone and quinclorac were evaluated to determine their potential to be safened against CBG. Comprising five different modes of action and six different chemical classes, these herbicides were selected in that they offer a favorable environmental profile (i.e., low mammalian toxicity, low use rate, etc.) but are not safe for use on CBG at rates required to achieve effective weed control. Herbicides were also selected because their control of weeds in CBG is selective, but improvement in selectivity is desirable. The application of safeners in conjunction with herbicides may increase the rate of herbicide metabolism in CBG.

Phase 1

The objective of Phase 1 was to determine which herbicides have the potential to be safened on creeping bentgrass. Research was initiated in greenhouses in 2012 at the University of Tennessee (Knoxville, TN) on ´Penncross´ creeping bentgrass maintained at a 0.5–inch height. Amicarbazone (1.05 oz/A), bispyribac–sodium (1.6 oz/A), fenoxaprop–ethyl (0.5 oz/A), imazapic (0.63 oz/A), topramezone (0.53 oz/A), and quinclorac (15 oz/A) were applied alone or in combination with the broad–spectrum safeners naphthalic anhydride (NA) and isoxadifen–ethyl

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(isoxadifen). Herbicide application rates listed above were expected to cause unacceptable CBG injury but control problematic broadleaf and grassy weeds based on preliminary experiments. Safeners were applied either at herbicide application or 3 days prior to herbicide application in a 5:1 and 10:1 safener:herbicide ratio.

Treatments were applied with NIS at 0.25 % v/v and water (23 GPA) using a spray chamber to mature CBG grown in cone–tainers filled with a peat moss, perlite, vermiculite growing medium.

Treatments were evaluated visually on a 0 (no injury) to 100% (complete control) scale at 7, 14 and 21 DAT. Plant were clipped to a 0.5–inch height at 21 DAT and the verdure was collected, dried and weighed to determine its biomass.

CBG visual injury from topramezone and amicarbazone was reduced by isoxadifen and NA. Safener application rate and application timing did not affect CBG injury. This initial experiment determined topramezone and amicarbazone were suited for further investigation into their potential to be safened.

Figure 1. During 2012, research was initiated in greenhouses to determine which herbicides have the potential to be safened on creeping bentgrass.

Phase 2

In additional experiments, topramezone and amicarbazone and pinoxaden (1.3 oz/A) were evaluated with the safeners benoxacor, cloquintocet–mexyl, fenchlorazole–ethyl, isoxadifen, mefenpyr–diethyl, and NA in a 5:1 safener:herbicide ratio. Pinoxaden was included as it demonstrated safening potential in other experiments. Treatments were applied and evaluated using the same methodology as described for the first experiment. The objective of this experiment was to determine optimal safener–herbicide combinations. The safener cloquintocet–mexyl reduced visual CBG injury from topramezone from 23 to 12% and increased biomass of pinoxaden–treated plants at 14 days after treatment. Further investigation of topramezone, pinoxaden and amicarbazone is warranted.

Summary

- Preliminary experiments suggest amicarbazone, topramezone and pinoxaden can be safened against creeping bentgrass.
- The safener cloquintocet–mexyl reduced creeping bentgrass injury from both topramezone and pinoxaden application.
- More data regarding the weed control efficacy of these safener–herbicide combinations is required.
- More data regarding the efficacy of herbicide safeners at lower rates under field conditions in required.

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