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Flumioxazin: A pre-emergence herbicide option for warm-season turfgrasses

Annual bluegrass (*Poa annua*) is widely regarded as one of the most troublesome golf course weeds. There are many factors that make annual bluegrass a difficult-to-control weed. Pertinent to herbicidal control, the weed has a long germination period that can outlast the control period of many pre-emergent herbicides. Many times this long germination period requires multiple pre-emergence applications, follow-up post-emergent applications, or both to achieve complete control. Annual bluegrass can also exist as a short-lived perennial, limiting the usefulness of pre-emergent herbicides. Lastly, the weed has developed resistance to many herbicides use pre- and post-emergence, further complicating herbicidal control.

SureGuard is a new herbicide for the turfgrass market that offers a solution to some of these problems. Flumioxazin, the active ingredient in SureGuard, inhibits the protoporphyrinogen oxidase (PPO) enzyme in susceptible plants which eventually leads to the desiccation of the plant. This mode-of-action has both pre- and post-emergence activity. Pre-emergence control results from soil application where the herbicide is predominantly absorbed by the roots. Post-emergence control results primarily from foliar contact, which causes rapid desiccation and necrosis with negligible translocation.

This mode-of-action is similar to oxadiazon (Ronstar).

Summary points

- SureGuard (Flumioxazin) can be utilized for pre- and post-emergent annual bluegrass control
- Use is limited to dormant Bermudagrass unless induced dormancy can be tolerated
- Post-emergent control is limited to annual blue grass plants less than 2 tillers in size.

Above left: The non-treated plot from 2011. Above right: The plot after the November application.

Pictured top to bottom: The plot after the December application. The plot after the January application. The plot after the February application.

Managers familiar with Ronstar Flo will note that it should not be applied to actively growing turfgrass because it can lead to foliar necrosis. The same is true with flumioxazin. However, since both herbicides have limited translocatation within the plant, established grasses can recover. Therefore, application of both SureGuard and Ronstar Flo is restricted to dormant periods.

Flumioxazin may be an alternative to other herbicides currently available in Bermudagrass (*Cynodon sp.*) for annual bluegrass control. Having both pre- and post-emergent activity, it may be possible to apply flumioxazin after annual bluegrass germination has begun. That is, the post-emergent activity would control plants already emerged while the pre-emergent activity could control weeds not yet germinated. Post-emergent applications may control perennial biotypes of annual bluegrass and provide residual control. Additionally, there are no reports of annual bluegrass resistant to flumioxazin or other PPO-inhibitors, which could benefit managers with herbicide-resistant populations. Despite these beneficial aspects of flumioxazin, applications on Bermudagrass and other warm-season turfgrasses are limited to periods of dormancy which could limit application timings that are safe for use.

RESEARCH CONDUCTED. Research was conducted to evaluate application rate and timing of flumioxazin for annual bluegrass control in hybrid Bermudagrass (*Cynodon dactylon* × *C. transvaalensis*). Application timings evaluated were November, December, January, February, and March. At each application, flumioxazin was applied at 6 and 12 oz product per acre with nonionic surfactant at 0.25% v/v. Research was conducted at Auburn University during the 2010-2011 and 2011-2012 seasons and at the University of California, Riverside in 2011-2012. All locations had a history of annual bluegrass infestations. Data collected included annual bluegrass control, Bermudagrass injury, and overall sward quality.

A greenhouse study was also conducted to determine the maximum annual bluegrass size that flumioxazin can control post-emergently. Annual bluegrass plants were treated at pre-tiller (approximately 3 leaves), 1 to 2 tiller, and 4 to 6 tiller sizes. Treatments the same as the field study— flumioxazin at 6 and 12 oz product per acre with nonionic surfactant.

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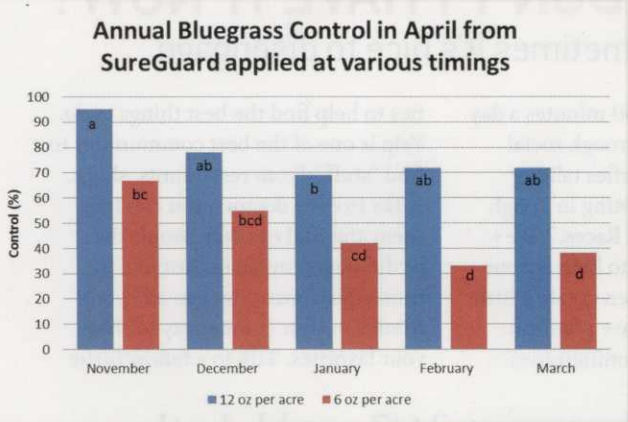
RESULTS. Flumioxazin at 12 oz per acre rate resulted in better annual bluegrass control than the 6 oz per acre rate. November and December application timings were the best for annual



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bluegrass control. Control from flumioxazin at 12 oz per acre applied in November was 95% or better through the following April and was 78% or better from December application. Other application timings resulted in less than 70% control, regardless of rate. These later application timings did not control emerged annual bluegrass plants due to their larger size which allowed them to recover after initial herbicide injury; conversely, earlier applications did control emerged plants.

Greenhouse research indicated that flumioxazin at 12 oz per acre can control annual bluegrass up to the 2 tiller growth stage. However, larger plants (4 to 6 tillers at application) were not controlled. flumioxazin at 12 oz per acre resulted in better control than when applied at 6 oz per acre. These findings agree with field research – that larger plants are not adequately controlled, and that control is better from 12 oz per acre, rather than 6.

In field research, annual bluegrass was flowering at the January, February, and March application timings. Having weeds present for so long before control is implemented would be unacceptable to golf course managers and users. Therefore the January, February, and March application timings are impractical if this herbicide is used as the sole chemical for annual bluegrass control.

Annual bluegrass generally begins germination in September, where the research was conducted. Therefore, some annual bluegrass plants were emerged for all application timings. Since flumioxazin has pre- and post-emergent activity, emerged annual bluegrass plants were controlled at the same time and with the same herbicide that the pre-emergence application was made.

Bermudagrass was dormant at all application timings except November. No Bermudagrass injury was observed except from the November application, which resulted in complete necrosis of the foliage. New, green foliage was not produced until spring green-up, due to the onset of the dormancy period. Therefore, flumioxazin induced dormancy of the Bermudagrass. Other research indicates that Bermudagrass will completely recover from flumioxazin injury in approximately 4 weeks. No adverse effects of any kind were observed during spring green-up from any treatment.

The induced Bermudagrass dormancy resulted in superior turfgrass quality through much of the dormant period because these plots were uniformly dormant, as opposed to a mottled, uneven dormancy that occurs when Bermudagrass naturally enters dormancy. Therefore, in one sense, the November application of flumioxazin resulted in unacceptable Bermudagrass injury, but in another sense, the treatment resulted in better turf quality during the dormant period. Understanding this issue prior to its occurrence may mitigate apprehensions of golf course managers.

Bermudagrass was near complete dormancy at the December application timing, so no injury was observed. Therefore in practice, it is likely that a mid- to late-November application timing is best in the environments that were studied. Optimal flumioxazin application timing is dependent on Bermudagrass dormancy and annual bluegrass maturity, which will vary by specific climate and geographic region.

SureGuard may have other valuable uses beyond what was evaluated in this study. Summer annual weeds, including crabgrass (*Digitaria* spp.) can be controlled with SureGuard. Early pre-emergence applications for crabgrass control (made before Bermudagrass spring green-up) may also have burn-down type control of other winter annual weeds. **GCI**

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The complete scientific publication of this research is: M.L. Flessner, J.S. McElroy, J.H. Baird and B.D. Barnes. 2013. Utilizing Flumioxazin for Annual Bluegrass (*Poa annua*) Control in Bermudagrass Turf. Weed Technol. In Press.