New Options for Annual Bluegrass Control in Overseeded Bermudagrass Putting Greens

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Abstract. Annual bluegrass (Poa annua L.) continues to be a problem in bermudagrass golf greens overseeded with roughstalk bluegrass (Poa trivialis L. ‘Sabre’) due to weed encroachment from adjacent fairways, lack of selective herbicide options, and weed diversity. A 2-year study was conducted on an overseeded ‘Tifgreen’ bermudagrass putting green to evaluate effects of herbicide treatments on overseeding and annual bluegrass control. Excellent annual bluegrass control (≥70%) and acceptable turfgrass cover (≥70%) was achieved with oxadiazon at 2.2 kg·ha⁻¹ a.i. applied 60 days before overseeding (DBO). Fenamirox (AS) at 4.1 kg·ha⁻¹ a.i. (30 + 15 DBO) followed by 1.4 kg·ha⁻¹ a.i. 60 days after overseeding (DAO) and dithiopyr at 0.6 kg·ha⁻¹ a.i. (60 DBO + 120 DAO) also provided acceptable results. Dithiopyr at 0.4 kg·ha⁻¹ a.i. (30 DBO + 120 DAO), dithiopyr at 0.3 kg·ha⁻¹ a.i. (30 DBO + 30 + 120 DAO), and fenamirox (G) at 2.0 kg·ha⁻¹ a.i. (45 + 30 DBO) followed by 0.8 kg·ha⁻¹ a.i. 60 DAO provided inconsistent annual bluegrass control (55% to 75% in 1999 and 87% to 95% in 2000), but offered acceptable turfgrass cover (≥70%) each year. The remaining treatments were generally ineffective and provided <50% annual bluegrass control one or both years. Oxadiazon applied 60 DBO at 2.2 kg·ha⁻¹ a.i. provides an excellent option for annual bluegrass control in overseeded bermudagrass putting greens.

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light and frequent irrigation (<0.25 cm, three times daily) was applied to maintain moist conditions until seedlings emerged and became established. The site was seeded with ‘Sabra’ roughstalk bluegrass at 488 kg·ha⁻¹ on 5 Oct. 1998 and 9 Oct. 1999. During the study, turf was mowed daily at 0.48 cm and fertilized every 2 weeks with a 50% soluble nitrogen source (16N–4P–8K) at 24 kg·ha⁻¹ of N.

The 12 treatments consisted of varying rates/timing of pronamide, aqueous suspension (AS) fenarimol, granular (G) fenarimol, oxadiazon, and dithiopyr (Tables 1 and 2) plus a control (no herbicide). All sprayable herbicides were applied using a CO₂ pressurized sprayer calibrated to deliver 187 L·ha⁻¹ through 8003 flat fan nozzles. Granular herbicides were applied in multiple directions using a hand shaker.

Visual estimates of turfgrass coverage were based on a scale of 0% (brown turf or bare soil) to 100% (completely uniform dense turf). Ratings were made in mid-December and again in February of the following year, 2 and 4 months after overseeding (MAO). Annual bluegrass control ratings were based on a scale of 0% (no control) to 100% (complete control). Weed control ratings commenced when seedheads were evident in February (4 MAO) with subsequent ratings in March (5 MAO) and April (6 MAO).

The experimental design was a randomized complete block with 2 × 2.0-m plots and three replications with independent randomizations performed each year. A combined analysis of results for the 2 years was performed, and a treatment means separation was performed using the multiple comparisons with the best (MCB) procedure (Hsu, 1984). This procedure selects treatments into a subset such that the “best” herbicide treatment is included with $P = 0.95$.

**Results and Discussion**

**Turfgrass cover.** Turfgrass coverage for pronamide applied at 2.2 kg·ha⁻¹ a.i. 60 DBO was comparable to the untreated 2 and 4 MAO (Table 1). Fenarimol did not reduce roughstalk bluegrass coverage, regardless of formulation, rate, or timing. Oxadiazon applied at 2.2 kg·ha⁻¹ a.i. 30 d after overseeding (DAO) and at 1.1 kg·ha⁻¹ a.i. 60 DBO and 30 DAO reduced roughstalk bluegrass stand with turfgrass cover of only 29% and 45%, respectively, at 4 MAO, but oxadiazon applied at 2.2 kg·ha⁻¹ a.i. 60 DBO did not adversely affect turfgrass cover compared to the untreated. Although not investigated in this study, field experience suggests application precision of oxadiazon is critical. When applying 2.2 kg·ha⁻¹ a.i., less overseeding grass has been observed in overlapped areas. Applying 1.1 kg·ha⁻¹ a.i. oxadiazon in two directions often minimizes overlapping problems.

**Table 1. Turfgrass coverage of ‘Tifgreen’ bermudagrass golf green 2 and 4 months after overseeding (MAO) with roughstalk bluegrass (Poa trivialis L.) 5 Oct. 1998 and 9 Oct. 1999.**

| Treatment       | Rate (kg·ha⁻¹ a.i.) | Timing⁴ | Turfgrass coverage⁵ (%)
|-----------------|--------------------|---------|------------------------|
| Untreated       |                    | 2 MAO   | 4 MAO                  |
| Pronamide       | 2.2                |         | 78'                    |
| Fenarimol (AS)  | 4.1 fb 4.1 fb 1.4  | 45B + 30B + 60A | 71' 68'  |
| Oxadiazon       | 2.2                | 60B     | 69'                    |
| Oxadiazon       | 2.2                | 30A     | 47                    |
| Oxadiazon       | 1.1 fb 1.1         | 60B + 30A | 55        |
| Dithiopyr       | 0.3 fb 0.3         | 30B + 120A | 77' 73' |
| Dithiopyr       | 0.3 fb 0.3 0.3 fb 0.3 | 30B + 30A + 120A | 40 42 |
| Dithiopyr       | 0.4 fb 0.4         | 30B + 120A | 79' 73' |
| Dithiopyr       | 0.6 fb 0.6         | 30B + 120A | 75' 70' |
| Fenarimol (G)   | 1.4 fb 1.4 fb 1.4  | 45B + 30B + 60A | 76' 61' |
| Fenarimol (G)   | 2.0 fb 2.0 fb 0.8  | 45B + 30B + 60A | 71' 64' |

¹Turfgrass coverage ratings based on a visual scale of 0% to 100%, where 0% = no turf and 100% = complete uniform dense turf.

²Means in a column followed by an * were selected by the MCB procedure with $P = 0.95$ that the “best” treatment is selected.

³Treatment means are specific days before overseeding (B) or days after overseeding (A).

⁴fb = followed by.

The only dithiopyr treatment that reduced roughstalk bluegrass coverage was applied at 0.3 kg·ha⁻¹ a.i. and also included a sequential application 30 DAO. Turfgrass coverage 2 and 4 MAO for this treatment averaged only 41%, while all other dithiopyr treatments averaged ≈72% roughstalk bluegrass coverage. This research indicates that sequential applications of oxadiazon and dithiopyr should be delayed beyond 30 DAO to minimize negative effects on roughstalk bluegrass establishment. Turfgrass cover reductions from December to February were mainly due to browning of bermudagrass from heavy frost.

**Annual bluegrass control.** In the Southeastern United States, annual bluegrass typically ceases vegetative growth in late January through February and begins flowering and producing numerous seedheads. Pronamide has been used on the study site for over 15 years until seedlings emerged and became evident. The site was seeded with ‘Sabre’ ryegrass at 488 kg·ha⁻¹ on 5 Oct. 1999 and excellent control (95%) in 2000, in inconsistent control following continued pronamide use possibly related to reduced pesticide efficacy for lower dinitroaniline herbicides. Dithiopyr (EC) 2.2 kg·ha⁻¹ a.i. oxadiazon is critical. When applying 2.2 kg·ha⁻¹ a.i. 60 DBO and 30 DAO, control 6 MAO was 65% in 1999 but only 18% in 2000. Murphy (2001) observed that annual bluegrass control was ≥90% 6 MAO when 2.2 kg·ha⁻¹ a.i. oxadiazon was applied 8 weeks before overseeding (WBO) perennial ryegrass in bermudagrass fairways. Yelverton and McCarty (2001) also reported similar results for 2.2 kg·ha⁻¹ a.i. oxadiazon applied 8 WBO. When applications of 2.2 kg·ha⁻¹ a.i. oxadiazon were delayed from late summer to early fall, annual bluegrass control decreased from 99% to 21% (Yelverton, 2000). This reduction was attributed to minimal post-emergence activity provided by oxadiazon.

Dithiopyr applied at 0.6 kg·ha⁻¹ a.i. 30 DBO and 120 DAO provided 70% control by 6 MAO in 2000. Inconsistent control following continued pronamide use possibly reflects the presence of a resistant annual bluegrass biotype. Much is known about herbicide resistance in annual bluegrass biotypes, especially to triazine and dinitroaniline herbicides. When a particular class of compounds has been continuously applied for 7 to 10 years, selection for resistant biotypes can begin and slowly spread (McCarty, 1999). Enhanced biodegradation is another explanation for reduced pesticide efficacy and may have contributed to pronamide’s inconsistency in this study.

Fenarimol (AS) provided good annual bluegrass control with ratings of 82% and 92% at 6 MAO in 1999 and 2000, respectively (Table 2). The low rate of granular fenarimol failed to provide adequate control either year, while the high rate provided 88% annual bluegrass control through April in 2000. Inconsistent control with fenarimol (G) is possibly due to inadequate coverage or release of chemical from the prilled material.

Control of annual bluegrass with oxadiazon treatments was highly variable for the two years (Table 2). Oxadiazon applied at 2.2 kg·ha⁻¹ a.i. 60 DBO provided ≥90% control at 4, 5, and 6 MAO. However, the same rate of oxadiazon applied 30 DAO was ineffective and provided only 23% and 0% control 6 MAO in 1999 and 2000, respectively. When oxadiazon was applied in split applications of 1.1 kg·ha⁻¹ a.i. 60 DBO and 30 DAO, control 6 MAO was 65% in 1999 but only 18% in 2000. Murphy (2001) observed that annual bluegrass control was ≥90% 6 MAO when 2.2 kg·ha⁻¹ a.i. oxadiazon was applied 8 weeks before overseeding (WBO) perennial ryegrass in bermudagrass fairways. Yelverton and McCarty (2001) also reported similar results for 2.2 kg·ha⁻¹ a.i. oxadiazon applied 8 WBO. When applications of 2.2 kg·ha⁻¹ a.i. oxadiazon were delayed from late summer to early fall, annual bluegrass control decreased from 99% to 21% (Yelverton, 2000). This reduction was attributed to minimal post-emergence activity provided by oxadiazon.

In summary, 0.6 kg·ha⁻¹ a.i. dithiopyr applied 30 DBO and 120 DAO and 2.2 kg·ha⁻¹ a.i. oxadiazon applied 60 DBO provided excellent...
Table 2. Annual bluegrass (Poa annua L.) control in overseeded 'Tifgreen' bermudagrass golf green during 1999 and 2000.

| Treatment       | Rate (kg·ha⁻¹ a.i.) | Timing   | 1999     |          |          | 2000     |          |          |
|-----------------|---------------------|----------|----------|----------|----------|----------|----------|----------|
|                 |                     |          | February | March    | April    | February | March    | April    |
| Fenarimol (AS)  | 4.1 fb + 4.1 fb + 1.4 | 45B + 30B + 60A | 88%      | 82%      | 82%      | 92%      | 90%      | 92%      |
| Pronamide       | 2.2                 | 60B      | 18       | 30       | 37       | 67%      | 70%      | 70%      |
| Oxadiazon       | 2.2                 | 60B      | 93%      | 90%      | 90%      | 92%      | 92%      | 90%      |
| Oxadiazon       | 2.2                 | 30A      | 8        | 23       | 23       | 8        | 2        | 2        |
| Oxadiazon       | 1.1 fb + 1.1        | 60B + 30A | 65%      | 63%      | 65%      | 17       | 22       | 18       |
| Dithiopyr       | 0.3 fb + 0.3        | 30B + 120A | 40       | 67%      | 58       | 88%      | 88%      | 90%      |
| Dithiopyr       | 0.3 fb + 0.3 fb + 0.3 | 30B + 30A + 120A | 27       | 30       | 30       | 77%      | 80%      | 75%      |
| Dithiopyr       | 0.4 fb + 0.4        | 30B + 120A | 77%      | 71%      | 78%      | 95%      | 95%      | 95%      |
| Dithiopyr       | 0.6 fb + 0.6        | 30B + 120A | 88%      | 90%      | 92%      | 95%      | 95%      | 95%      |
| Fenarimol (G)   | 1.4 fb + 1.4 fb + 1.4 | 45B + 30B + 60A | 28       | 37       | 27       | 48       | 47       | 45       |
| Fenarimol (G)   | 2.0 fb + 2.0 fb + 0.8 | 45B + 30B + 60A | 68%      | 53       | 47       | 85%      | 88%      | 88%      |

*Annual bluegrass control based on a visual scale of 0% to 100%, where 0% = no control, 70% = minimum acceptable, and 100% = complete control.

*Means in a column followed by an * were selected by the MCB procedure with P = 0.95 that the “best” treatment is selected.

*Treatments made at specific days before overseeding (B) or days after overseeding (A). Roughstalk bluegrass was seeded on 5 Oct. 1998 and 9 Oct. 1999.

fb = followed by.

(>90%) annual bluegrass control with the least negative effects on roughstalk bluegrass stand. Fenarimol (AS) controlled annual bluegrass >80% throughout the entire study with little disruption in overseeding cover. No reduction in roughstalk bluegrass cover was evident when oxadiazon was applied 60 DBO. Sequential applications of dithiopyr and oxadiazon 30 DAO severely reduced overseeding cover. Continued research is needed on appropriate timings of these herbicides.

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