New Formulation and Application Strategies for *Poa annua* Control with Velocity Herbicide

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Back in the 2004 September/October issue of *The Grass Roots* we first introduced research on a new turf herbicide, bispyribac-sodium, to remove annual bluegrass from creeping bentgrass fairways (Stier, 2004). The herbicide has been available to Wisconsin superintendents for the past two years under the trade nameVelocity™.

In our 2004 article we demonstrated that an 80% wettable powder (WP) formulation of bispyribac-sodium provided up to 80% annual bluegrass control. A WDG (wettable dry granule) formulation, while much more desirable to handle for mixing/loading purposes, performed relatively poorly and provided only about 30% control. In 2006 we conducted another battery of tests to evaluate the efficacy of a new SG (soluble granule) formulation. The SG formulation is more desirable from a handling standpoint than a WP as it's less messy to measure and contamination of clothing and surrounding surfaces is virtually nil compared to a WP. In addition, the solubility of the SG formulation means constant agitation is not needed as with WPs. Finally, the SG formulation is less abrasive to nozzles than the WP.

Climatic conditions, receptiveness of weeds to be controlled by an herbicide, and spray conditions or technique can often influence product effectiveness. In our 2004 report we found that two or three applications (14 days apart) of bispyribac-sodium at 30 or 45 g ai/A per application provided significantly better control than four applications (14 days apart) of 20 g ai/A per application or 1 or 2 applications of either 45 or 30 g ai/A, respectively. However, sometimes multiple applications at a lower rate can be more effective than a single or fewer applications at a higher rate because more actual product might eventually get into the plant. Furthermore, multiple applications of a lower herbicide rate can sometimes be less injurious to desirable grass (e.g., creeping bentgrass) than fewer applications applied at a higher rate.

Our 2004 study also showed bispyribac-sodium was capable of controlling dollar spot disease, a type of activity highly unusual for an herbicide. Enough research has been conducted on this unique aspect of the product that dollar spot control is now listed on the Velocity label.

Our objectives this past year were to determine the effectiveness of an SG formulation, applied at either 10 or 30 g ai/A per application, at either 2 or 14 day intervals, to achieve a total of 60 g ai/A for the year. We also collected data on dollar spot control of the SG.

Table 1. Application methods to compare efficacy of 60 g ai/A of bispyribac-sodium for *Poa annua* Control with Velocity Herbicide trial at the O.J. Noer Turfgrass Research and Education Facility in Verona, WI, 2006.

Trt	Product	Rate/Application	Timing	Application Dates
1	Velocity 17.6 SG	10 g ai/A	6 apps 2 day interval	June 8, 10, 12, 14, 16, 19
2	Velocity 17.6 SG	10 g ai/A	6 apps 7 day interval	June 8, 15, 23, 29, July 5, 11
3	Velocity 17.6 SG	30 g ai/A	2 apps 2 day interval	June 8, 10
4	Velocity 17.6 SG	30 g ai/A	2 apps 7 day interval	June 8, 15
5	Velocity 17.6 SG	30 g ai/A	2 apps 14 day interval	June 8, 23
6	Untreated Control	---	---	None

Table 3. Percent *Poa annua* control, Verona, WI, 2006.

Treatment	Jun 11	Jun 16	Jun 23	Jun 29	Jul 11	Jul 26	Aug 8	Sep 9
1	0	3.8	8.8 b	52.5 a	89.3a	86.3 a	90.3 a	77.1 ab
2	0	17.7	3.1 b	11.5 b	50.4 b	77.9 a	94.6 a	87.3 a
3	0	15.8	23.3 a	44.2 a	57.5 b	68.3 a	72.5 bc	58.3 b
4	0	10.8	20.0 a	37.1 a	65.4 b	61.3 a	67.9 c	56.7 bc
5	0	17.3	4.2 b	7.3 b	67.1 ab	67.1 a	83.4 ab	79.4 ab
6	0	0.0	0.0 b	0.0 b	0.0 c	21.9 b	42.7 d	32.3 c
LSD (0.05)	ns	ns	10.1	20.7	23.8	25.9	13.8	24.4

Percent *P. annua* control is presented here as the percentage of the initial *P. annua* in each treatment that was controlled by the treatment application. Means followed by the same on letter within columns are not significantly different at $P \leq 0.05$. The shading emphasizes the best treatments for *P. annua* control.

MATERIALS AND METHODS

We conducted the study at the O.J. Noer Turfgrass Research and Education Facility in Verona, Wisconsin on a mixed stand of creeping bentgrass (*Agrostis stolonifera*) and annual bluegrass (*Poa annua*). Most if not all of the P. annua appeared to be the annual biotype though some perennial biotype may have been present. The soil type was a silt loam with pH about 7.5. Established about 1997, the turf has been mown at 1/2" three times per week, receives 3 lbs N/M/year and is not treated with additional fungicide. Irrigation was applied to prevent drought stress.

Six treatments were arranged in a randomized complete block design with four replications (Table 1). Treatments were applied beginning on 8 June, 2006 with a CO_2 -powered backpack sprayer, using XR TeeJet 8004 VS nozzles, at 38 PSI, in water carrier to provide 1.5 gallons spray volume/1000 square feet. Bentgrass tolerance, percent *Poa annua* control, and dollar spot control were evaluated at approximately 3, 7, 14, 21, 28, 42, and 56 days after initial treatments began. In addition bentgrass quality was rated multiple times throughout the growing season on a scale from 1-9, where 1=dead turf, 9=best quality turf, and 6=acceptable turf quality. Percent *Poa annua* control was determined by visually rating the percentage of living *Poa annua* in the plot on a given rating date then using the number in the following equation to determine percent control: 100*[1-(%*poa* on rating date/initial %*poa*)]. Bentgrass tolerance was rated on a scale from 1-9, where 1=no injury, 9=dead turf, and 3 or greater = unacceptable injury. Dollar spot control was determined by counting the number of dollar spots on a given plot and comparing to the control plot in the same replication using the following equation: 100*[1-(# spots on trt. X / #spots on control plot)]. Soil (2" depth) and air temperatures were recorded at each application date.

RESULTS AND DISCUSSION

Percent *Poa annua* control for each treatment is presented in Table 3. In this study all of the treatments received the same overall rate of Velocity, however, treatments were split into two or six applications at various timings (Table 1). Air temperatures ranged from ideal (20.6°C = 69°F) to supraoptimal (30°C = 86°F) for turf growth during the treatment period. Some research suggests that *P. annua* control may be improved when Velocity is applied at slightly above optimal temperatures because *P. annua* is less heat-tolerant than creeping bentgrass and control will therefore be improved. While temperature at time of application is important to maximize product absorption, the effect of temperatures in the days following application are unknown. Studies are needed to determine the translocation and metabolism of bispyribac-sodium under different temperature regimes in controlled environments such as growth chambers.

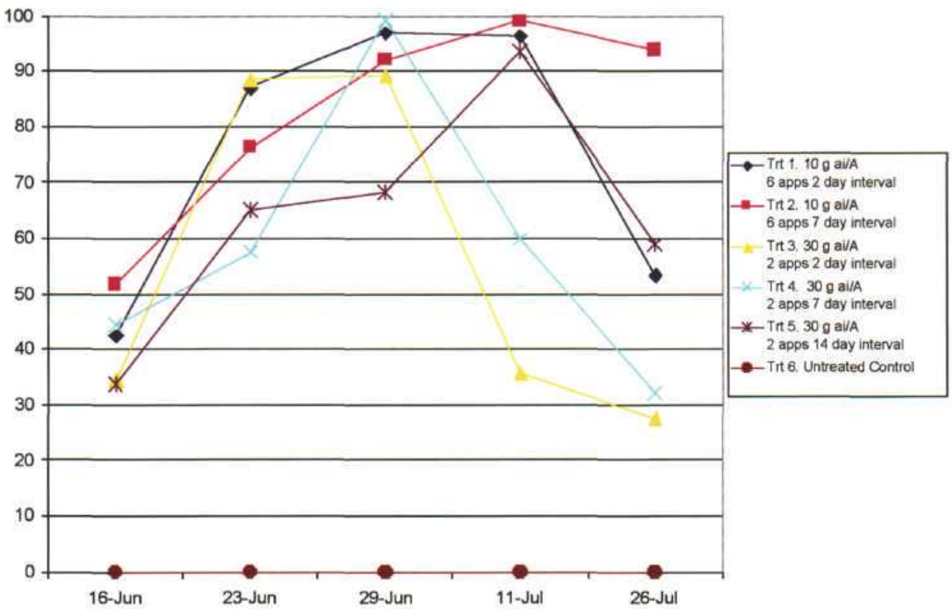

Figure 2. Dollar spot control between 16 June and 26 July, Verona, WI 2006. (Scale: 0-100%).

Soil temperatures ranged between 20-26°C (68-79°F) which were above the optimum for cool-season turf growth during the treatment period (ideally 10-18°C = 50-60°F). By eight days after the initial treatment (DAIT) all treatments were providing some control of *P. annua*. At 14 DAIT treatments 3 and 4, which were 2 applications on a 2 and 7 day interval respectively, were providing over 20% *P. annua* control which was greater than all other treatments. At around 21 DAIT, treatment 1, which consisted of 6 applications on a two day interval, had caught up to treatments 3 and 4 in terms of *P. annua* control. On 11 July (42 DAIT), the last of the treatment applications had been made and treatments 1 and 5 were showing the greatest *Poa annua* control. The rating taken on 26 July showed that all Velocity treatments were providing statistically equal control of *Poa annua* and all treatments were significantly better than the control. Control of *Poa annua* in treatment 6 (the untreated control) was due to severe dollar spot disease which was affecting the *P. annua* more than the creeping bentgrass. The *Poa annua* control ratings between 26 July and 9 September were probably the most meaningful because at this point all treatments had been made and had been given time to take effect. Ultimately, multiple applications of 10 g ai/A at 2 and 7 day intervals gave better than 90% control while two applications of 30 g ai/A at 14 day intervals also gave good control, approximately 80%. *P. annua* populations partially recovered later in the summer when 30 g ai/A treatments were made at 2 and 7 day intervals. The multiple lower rates probably gave better control than higher rates with fewer applications because the higher rates killed more of the leaf tissue quickly, probably reducing the total amount of product to enter the plant over the course of the study. The 30 g ai/A rate was most successful when applied at a 14 day intervals, likely because new leaf growth occurred during the interval which was able to absorb more of the product at the second application. The overall control of *P. annua* (highs of 80-90%) was similar to our previous work and mirrors what many other tests have found. What is uncertain is if the remaining 10-20% of the *P. annua* population was resistant to the bispyribac-sodium, or if these were "escapes" which received insufficient chemical because they were growing under an existing turf canopy and/or had large enough crowns that effectively diluted the chemical and allowed some buds to survive, or if the plants were seedlings that germinated after the Velocity application. Ultimately we need to know if the perennial biotypes are more resistant than the annual types, and if annual use results in development of resistant populations.

Beginning June 23, dollar spot pressure was uniform enough to detect differences in terms of dollar spot control between the treatments. All treatments provided some dollar spot control, ranging from approximately 60 to 90% (Fig. 2). There may be an interaction between application rate, frequency, and dollar spot pressure though our test was not designed to provide this information. Dollar spot control decreased within 3-4 weeks after the final application when disease pressure was moderate (June and July). Dollar spot control decreased within one week after the final application of 10 g ai/A (Trt 2) when dollar spot pressure became severe in August (Table 4). Treatment 2, 10 g ai/A applied at 7 day intervals for a 42 day period, provided excellent control (>90%) beginning two to three weeks after the initial treatment and which lasted until 8 August, about 1 week after the final treatment. These data suggest that 10 g ai/A of bispyribac-sodium may substitute for conventional dollar spot fungicides, though control may need to be supplemented with fungicides early in the season if dollar spot

Table 4. Percent dollar spot control, Verona, WI, 2006.

Treatment	Jun 11	Jun 16	Jun 23	Jun 29	Jul 11	Jul 26	Aug 8	Ave 6/23-7/26
1	33.3 a	42.6 a	87.1 a	97.0 a	96.4 a	53.4 ab	0	83.5 ab
2	30.0 a	51.7 a	76.2 ab	92.0 a	99.1 a	93.8 a	30.0	90.2 a
3	29.9 a	34.5 a	88.4 a	89.2 a	35.7 a	27.5 bc	20.0	60.2 b
4	4.9 a	44.5 a	57.6 b	99.2 a	59.9 a	32.1 bc	0	62.2 b
5	24.7 a	33.8 a	65.0 ab	68.2 a	93.6 a	58.9 ab	0	71.4 ab
6	0.0 a	0.0 a	0.0 c	0.0 b	0.0 b	0.0 c	0	0.0 c
LSD (0.05)	ns	ns	27.5	32.4	30.2	41.1	ns	23.8

Percent dollar spot control is presented her as percent control in comparison to the level of disease pressure present in the control plot of each replication. Means followed by the same on letter within columns are not significantly different at $P \leq 0.05$. Green shading emphasizes the best treatment for dollar spot control.

pressure is severe. Given the public pressure to reduce pesticide use, information on dollar spot management with reduced fungicide input during a Velocity-treatment program would be beneficial to golf course superintendents. If the early spring fungicide application is sufficient to significantly reduce the initial amount of the dollar spot fungus, its possible a Velocity program beginning in June would be sufficient to control dollar spot until late July or early August, resulting in perhaps only 2 to 4 fungicide applications during the year for dollar spot control. Granted, other diseases may still require fungicides to be used May through July though such applications might only need to be on a case-by-case basis as dollar spot is the most commonly treated disease.

Similar to our 2004 study, we saw some moderate but short-term phytotoxicity to bentgrass (Table 5). A rating of 3 or above was given if there was unacceptable phytotoxicity to the creeping bentgrass present in a given treatment. High rates or low rates at 2 day intervals resulted in the most phytotoxicity. Considerably less injury was obtained when the low rate (10 g ai/A) was applied at 7 day intervals. Less injury probably occurred when the application intervals were spread out because the bentgrass was able to metabolize and detoxify the active ingredient prior to the next application and/or develop new growth which essentially diluted the product in the plant.

Bentgrass quality ratings were taken to help determine the best timing of application (Table 6). In July and August treatment 2 provided the best turf quality out of the 6 treatments. The increased quality in treatment 2 was largely due to the control of dollar spot.

CONCLUSION

The objective of this study was to evaluate multiple applications of Velocity SG for control of annual bluegrass on bentgrass fairways. The SG formulation worked quite well to control *P. annua* as well as dollar spot disease. Treatment 2, which was 6 applications of 10 g ai/A on a 7 day interval, provided the best overall *Poa annua* control with minimal bentgrass injury and the longest-term dollar spot control. Treatment 1 also performed well suggesting that splitting the total rate up into 6 applications at low rates provides better control of *Poa annua* than making 2 applications at higher rates. Treatment 5, which was 2 applications of 30 g ai/A on a 14 day interval also provided good control of *Poa annua* showing that making the applications of the high rate at longer intervals improves efficacy.

REFERENCES

Stier, J. 2004. Velocity: A potentially new herbicide for selective removal of *Poa annua*. *The Grass Roots* 33(5):4-5.

Table 5. Phytotoxicity of Velocity herbicide applied to bentgrass fairway turf beginng 8 June 2006, Verona, WI.

Treatment	Jun 11	Jun 16	Jun 23	Jun 29	Jul 5	Jul 11	Jul 26	Aug 8
1	1.5 a	4.0 a	4.0 a	2.3 a	1.0 b	1.0	1.0	1.0
2	1.5 a	2.5 b	1.0 c	1.5 b	1.5 a	1.0	1.0	1.0
3	2.3 a	3.8 a	1.5 c	1.3 b	1.0 b	1.0	1.0	1.0
4	1.5 a	3.0 ab	2.3 b	1.3 b	1.0 b	1.0	1.0	1.0
5	1.8 a	3.0 ab	1.0 c	2.8 a	1.0 b	1.0	1.0	1.0
6	1.3 a	1.0 c	1.0 c	1.0 b	1.0 b	1.0	1.0	1.0
LSD (0.05)	ns	1.1	0.7	0.6	0.4	ns	ns	ns

Means followed by the same on letter within columns are not significantly different at $P \leq 0.05$. (Scale: 1-9, 1 = no phytotoxicity, 9 = totally dead, 3 = unacceptable.)

Table 6. Quality of creeping bentgrass fairway turf treated with Velocity herbicide, Verona, WI, 2006.

Treatment	July 5	July 26	Aug 8	Sep 9
1	6.9 a	5.5 b	4.9 bc	6.5 a
2	7.0 a	6.5 a	5.9 a	6.4 a
3	6.1 b	5.3 bc	5.3 b	6.3 a
4	7.0 a	4.8 c	4.6 c	6.3 a
5	7.0 a	5.3 bc	5.0 bc	6.4 a
6	5.9 b	4.9 bc	4.9 bc	6.5 a
LSD (0.05)	0.4	0.7	0.6	ns

Means followed by the same on letter within columns are not significantly different at $P \leq 0.05$. (Scale: 1-9, 1 = dead turf, 9 = perfect turf quality, 6 = acceptable turf quality)