Using PGRs to reduce *Poa annua* competition

Over a period of years, some plant growth regulators can reduce the presence of annual bluegrass to 5% to 15% in a creeping bentgrass stand.

Bruce Branham, Ph.D.
William Sharp

Plant growth regulators have received considerable attention as a method to diminish the amount of annual bluegrass in a mixed stand of creeping bentgrass and annual bluegrass (1,2,4). When PGRs were initially introduced, they were applied once in the spring and again in late summer to reduce growth when conditions were best for grass growth. As superintendents worked with the PGRs, they realized that more consistent growth regulation could be obtained by applying them regularly throughout the growing season.

Some confusion has arisen over which PGRs can be used to reduce annual bluegrass and the optimal way to use these PGRs. Our research can provide some guidance for superintendents.

Basics of PGR usage

Different types of PGRs yield different growth-suppression characteristics. The most widely used PGRs suppress the production of the plant hormone gibberellin. These PGRs exist in many chemical forms. Three are currently labeled for use on golf course turf: Trimmit or Turf Enhancer (paclobutrazol), Cutless (flurprimidol), and Primo (trinexapac-ethyl). All these PGRs work in the same manner — they suppress the production of gibberellic acid, the hormone responsible for cell elongation. Following treatment with these PGRs, growth is initially suppressed for about two weeks; then, the turf begins to grow more rapidly but is still suppressed (this phase lasts approximately two more weeks); finally, the turf resumes normal growth unless another PGR application is made. If the PGR application is not made or is delayed too long, the turf can grow at a rate faster than untreated turf; this has been termed "rebound growth." Each PGR follows this pattern, but some are more effective — that is, they maintain longer periods of growth suppression — than others.

Other PGRs have different modes of action than the anti-gibberellins mentioned above, but the anti-gibberellins are widely used on golf courses because of their turf safety and consistent performance. In a sense, these products alter turfgrass growth and reduce clippings while often improving turf quality. PGRs can increase chlorophyll content in turfgrass plants, thereby producing a darker green turf.

PGRs and *Poa annua* control

Although the first PGRs used in turf were evaluated for growth regulation, the first commercially successful turf PGRs were growth regulators used primarily for annual bluegrass control. Annual bluegrass is the worst weed problem in turf and for many years there were no post-emergence controls. Two active ingredients introduced in the late 1980s, flurprimidol and paclobutrazol, appeared to offer some control of annual bluegrass and are the focus of this article.

The purpose of this research was to determine the relative response of two turfgrass species, annual bluegrass (perennial type) (*Poa annua* var. *reptans* (Hausskn.) Timm) and creeping bentgrass

(*Agrostis stolonifera* L.), to three plant growth regulators. In order to determine the relative response of each species, separate, pure stands of either annual bluegrass or creeping bentgrass were treated with various PGR regimes.

Materials and methods

The trials were conducted during the 2003 and 2005 growing seasons. In 2003, only Primo and Trimmit were included in the trial. In 2005, Cutless was added to the trial. Three rates of each PGR were applied to separate stands of either annual bluegrass or creeping bentgrass mowed at 0.5-inch height of cut, generally with a three-week application interval. In 2003, treatments were first applied on April 18; the last application was on Sept. 12. In 2005, the first application was made on April 28, and the last one was on Sept. 1. All treatments were applied using a backpack CO_2-pressurized sprayer.

In 2003, the trial was conducted on Dominant Plus, a blend of three creeping bentgrass cultivars (64% Providence, 20% SR 1020 and 16% SR 1119), and in 2005, the trial was conducted with Backspin creeping bentgrass.

The annual bluegrass was a wild type that has been prevalent at our research center for many years. The research center was established at the present site in the 1960s and has been under continuous turf production ever since. The annual bluegrass exhibited morphological characteristics similar to perennial-type *Poa annua*.

Clippings were collected twice per week, and fresh and dry weights were recorded. Data on visual turf injury and turf quality were collected weekly. Within each species, the experimental design was a randomized complete block design with three replications.

Results and discussion

We have presented most of the data as a percentage of the control by species (that is, when clippings collected from a PGR-treated plot weighed the same as those from the untreated plot, the PGR treatment would be 100% of the control). This means of expressing the data removes the control and permits us to compare treatments directly, so we can see how each species responds to the different PGRs (Table 1).

Primo

Primo appears to regulate both species to approximately the same degree. Primo is a very good growth regulator, but its use in an annual bluegrass reduction program will not produce a significant reduction in the annual bluegrass population. In fact, recent research has shown that Primo may increase annual bluegrass populations by improving the health of the annual bluegrass plants (3). Therefore, where annual bluegrass is a desirable component of the turf, a growth regulator program using Primo will be beneficial.

Trimmit and Cutless

The two other PGRs, Trimmit and Cutless, both reduce annual bluegrass growth more than creeping bentgrass growth (Table 1). Over time, this allows creeping bentgrass to grow more than annual bluegrass and to increase its population in the stand. Examination of a typical season-long growth response curve (Figure 1) reveals some important points.

Application intervals. First, note the length of time between spring applications. The interval between applications was supposed to be three weeks, but turf injury on annual bluegrass from the highest rates of Cutless and Trimmit was so severe that repeat applications were delayed for an additional three weeks, for a total of six weeks between the first and second application in 2005 and between the second and third application in 2003. All PGRs seem to exhibit more growth regulatory activity in spring than in the warmer summer months. Initial rates of application of Trimmit and Cutless should be reduced in spring or injury to annual bluegrass will be excessive. When applying these products for the first time in the spring, we recommend rates of 4-8 ounces/acre (0.029-0.058 milliliter/square meter) for both Trimmit and Cutless. If the *Poa annua* percentage has been reduced by previous PGR usage, then

% control

PGR	Rate (ounces product/acre)	% control, season average			
		2005		2003	
		Creeping bentgrass	Annual bluegrass	Creeping bentgrass	Annual bluegrass
Control		100	100	100	100
Trimmit	8	97	68	96	84
Trimmit	16	74	38	79	51
Trimmit	24	59	24	65	31
Primo	2.2	106	111	103	100
Primo	6.5	81	98	79	77
Primo	10.9	89	83	70	74
Cutless	8	93	69		
Cutless	16	75	55		
Cutless	24	60	41		
Trimmit	8,16, 24	72	39		
Trimmit	8, 16 at 4-week interval	103	49		
LSD	17	10	21	29	

Table 1. Effect of repeated PGR applications on the growth of annual bluegrass and creeping bentgrass. Data are presented as a percent of the control (untreated turf).

initial rates of 8 ounces/acre (0.058 milliliter/square meter) should still be sufficient.

Spring activity. Second, note that in spring 2003, Trimmit shows little differential growth suppression at 8 ounces/acre (0.058 milliliter/square meter) (Figure 1). Both species show very similar levels of growth suppression throughout the spring. The spring applications do not seem to benefit either species very much. In 2005, the six-week delay between the first and second application permitted the creeping bentgrass to come out of regulation, and a difference in growth suppression between the two species was observed (Figure 1).

Selective species regulation. The third point is the length of time after an application that the growth of a species is below the growth of the control, that is, below 100%. In Figure 1, at the lowest rate of Trimmit used, annual bluegrass rarely goes above 100% (that is, it rarely grows at the rate of the control) for the entire period of the experiment. Conversely, for about half of clipping measurements, Trimmit-treated creeping bentgrass is growing faster than untreated creeping bentgrass. Annual bluegrass is not only regulated more severely, but it also takes longer to come out of regulation than does creeping bentgrass.

Cutless appears to regulate both species a little better in spring, but the ability of Cutless to regulate annual bluegrass seems to wane when temperatures rise in summer (Figure 2). In addition, at 8 ounces/acre (0.058 milliliter/square meter), Trimmit and Cutless provided similar seasonal suppression of growth for both species, but Trimmit appeared to provide better growth regulation of annual bluegrass at 16 and 24 ounces/acre (0.117 and 0.175 milliliter/square meter) (Table 1). Both Trimmit and Cutless have the same mode of action, but they are not the same product and some differences in activity should be expected.

These graphs show that most of the selective species regulation occurs in the summer, and that spring applications do not give the same level of selective regulation. Therefore, using higher rates of these products in spring would be counterproductive — not only would there be more turf injury, but creeping bentgrass also would not benefit as much because it is nearly as well regulated as annual bluegrass in spring. However, I still believe these products should be used in spring, even though both species are regulated to about the same extent. The growth data for untreated creeping bentgrass and untreated annual bluegrass show that untreated annual bluegrass has a bit of growth spurt in spring that most likely permits it to gain some ground on untreated creeping bentgrass.

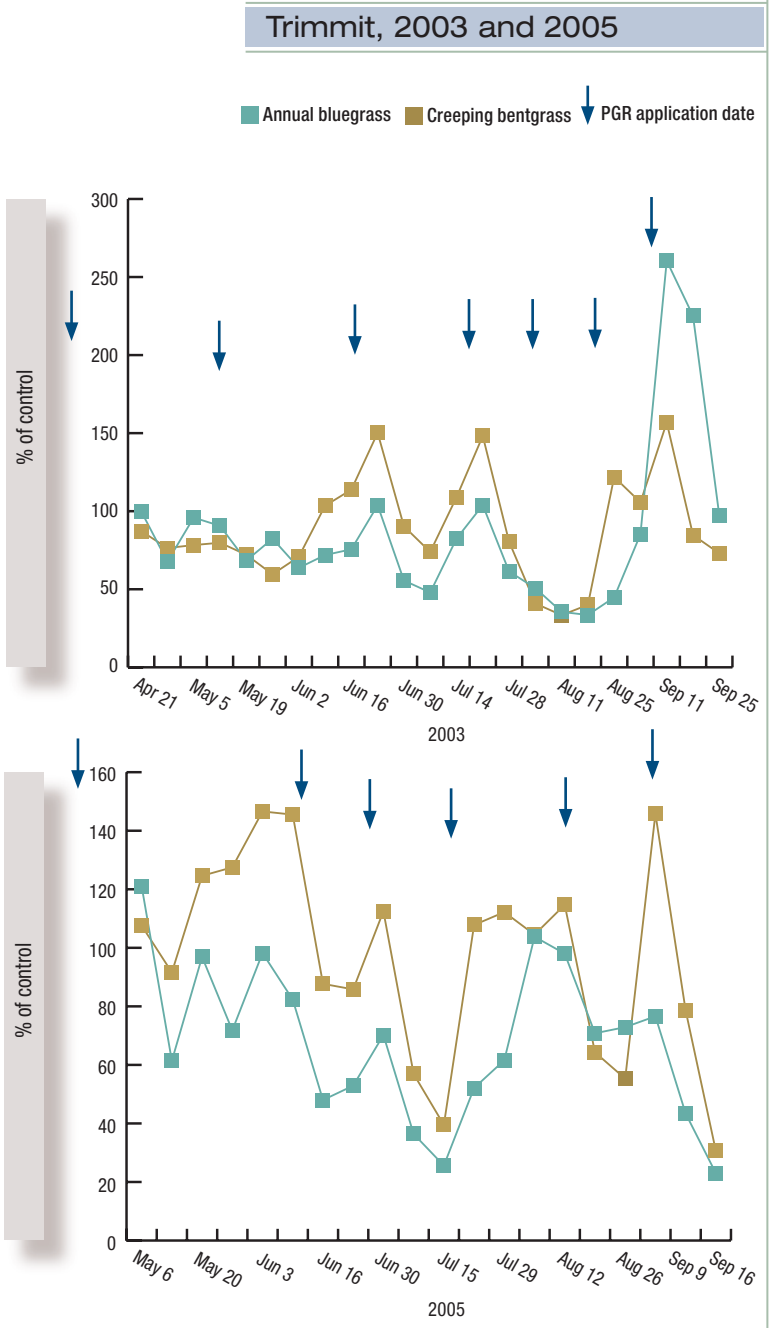

Figure 1. Seasonal growth responses of annual bluegrass and creeping bentgrass in 2003 and 2005 to sequential applications of Trimmit at 8 ounces/acre.

Putting it into practice

How can superintendents use this information? How should they modify their current PGR programs?

Application intervals

First, our data indicate that annual bluegrass and creeping bentgrass differ significantly in their responses to Cutless and Trimmit. To maximize

the differential growth response between the two species, application rates and intervals between applications should be changed based on the season. Changing the interval between applications from three to four weeks allows the creeping bentgrass to come out of regulation and grow more rapidly while annual bluegrass remains regulated and is usually growing more slowly than untreated annual bluegrass (Figure 3).

Note that in late July and early August, both species came out of regulation in a big way. Creeping bentgrass was actually growing at four times the rate of the untreated creeping bentgrass turf! And annual bluegrass treated with Trimmit was growing at nearly twice the rate of untreated annual bluegrass. This program was effective in allowing creeping bentgrass to outgrow and outcompete annual bluegrass throughout the summer, but growth regulation was lost. Higher rates would be needed to reduce growth rates.

When the interval between applications is increased to four weeks, treated creeping bentgrass is often growing faster than untreated creeping bentgrass (that is, greater than 100% of control) and should be able to crowd out annual bluegrass more effectively. The three-week application interval has been developed, mainly through experimentation by superintendents, to provide consistent regulation of creeping bentgrass. However, if the goal is to reduce the amount of annual bluegrass in fairways, consistent regulation is not as important as attaining maximum differential growth to permit the creeping bentgrass as much advantage as possible. Lengthening the period between applications to four weeks should make creeping bentgrass more competitive, as long as you can keep up with the mowing.

Application rates

The second point to consider is varying the rates of application throughout the growing season. Early spring applications can cause serious turf injury, particularly to annual bluegrass. Creeping bentgrass also can be discolored in the spring when rates of Cutless or Trimmit are too high. When initiating a program in April or May, remember that temperatures can be highly variable. Beginning such a program at rates above 8 ounces/acre (0.058 milliliter/square meter) may not cause a problem if the spring conditions are warm, but if temperatures are unseasonably cool, turf injury could result. Better to be safe and always keep the first application at 8 ounces/acre (0.058 milliliter/square meter) or less. Summer applications are rapidly metabolized by both species, and higher rates are tolerated, and needed, to maintain consistent growth regulation. However, after Aug. 15, nights are getting longer and cooler, and rates may need to be reduced to avoid overregulation in the fall.

In our trial, application rates of Trimmit were increased from 8 to 16 to 24 ounces/acre (0.058 to 0.117 to 0.175 milliliter/square meter) over the growing season. The first two applications were at 8 ounces/acre (0.058 milliliter/square meter), the next two were at 16 ounces/acre (0.117 mil-

Both Trimmit and Cutless will increase leaf blade width with repeated use. This photo shows the effects of repeated applications of Trimmit at 24 ounces/acre (left) compared to untreated turf (right). The creeping bentgrass in the Trimmit-treated plot has noticeably wider leaf blades.
Photos by B. Branham

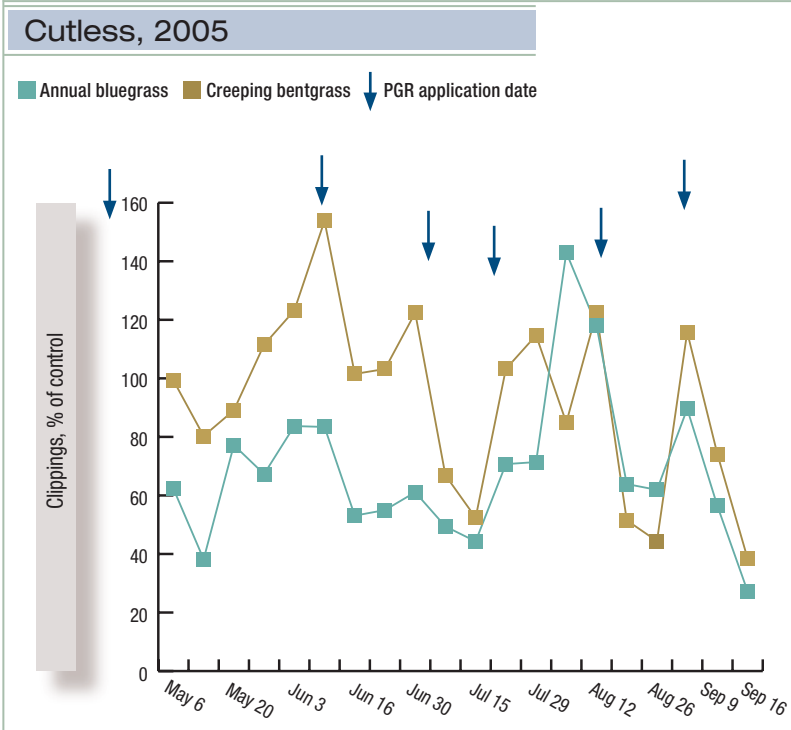

Figure 2. Seasonal growth responses of annual bluegrass and creeping bentgrass in 2005 to sequential applications of Cutless at 8 ounces/acre.

liliter/square meter), and the final two were at 24 ounces/acre (0.175 milliliter/square meter). This approach yielded better turf quality while limiting early-season turf discoloration. Turf quality was rated weekly over the course of the experiment, and annual bluegrass treated with constant rates of 8, 16, or 24 ounces Trimmit/acre (0.058 to 0.117 to 0.175 milliliter/square meter) had average turf quality ratings of 7.0, 6.3, or 5.0, respectively, on a scale of 1-9, where 9 is the best quality. However, with the variable rate approach, average annual bluegrass turf quality was 6.7. Thus, higher overall quality was achieved, even though Trimmit application rates reached 24 ounces/acre (0.175 milliliter/square meter) by the middle of the summer.

Percent annual bluegrass

Finally, application rates should vary based on the amount of annual bluegrass in the turf. The rates recommended provide excellent growth regulation of creeping bentgrass but overregulate annual bluegrass. Thus, Cutless or Trimmit can seriously reduce annual bluegrass quality, whereas they do not affect and may improve creeping bentgrass quality. At the beginning of an annual bluegrass reduction program when annual bluegrass populations are relatively high, use lower rates of these PGRs, particularly in the spring, to avoid serious reductions in turf quality. We recommend rates as low as 4 ounces product/acre (0.029 milliliter/square meter) for an initial spring application on turf that contains 50% or more annual bluegrass. Spring applications may need a wider interval between applications — four or even five weeks — to allow the turf to recover before additional applications are made. As the conversion proceeds, higher rates can be tolerated, because the proportion of annual bluegrass in the turf will have decreased.

We view this approach as a multiyear process that, if regularly followed, can reduce annual bluegrass populations to the 5% to 15% range. Once annual bluegrass populations reach this low level, the PGR program should be tailored exclusively for creeping bentgrass. Higher rates in the summer should be a part of the program. These growth regulators offer the possibility of a seamless transition, without turf loss, from a turf that may contain mostly annual bluegrass to one in which annual bluegrass is a minor component. Using selective herbicides to remove annual bluegrass is often impractical when annual bluegrass is present in amounts greater than about 20% of the turf. These growth regulator programs offer an option to effectively reduce annual bluegrass populations while maintaining good turf quality.

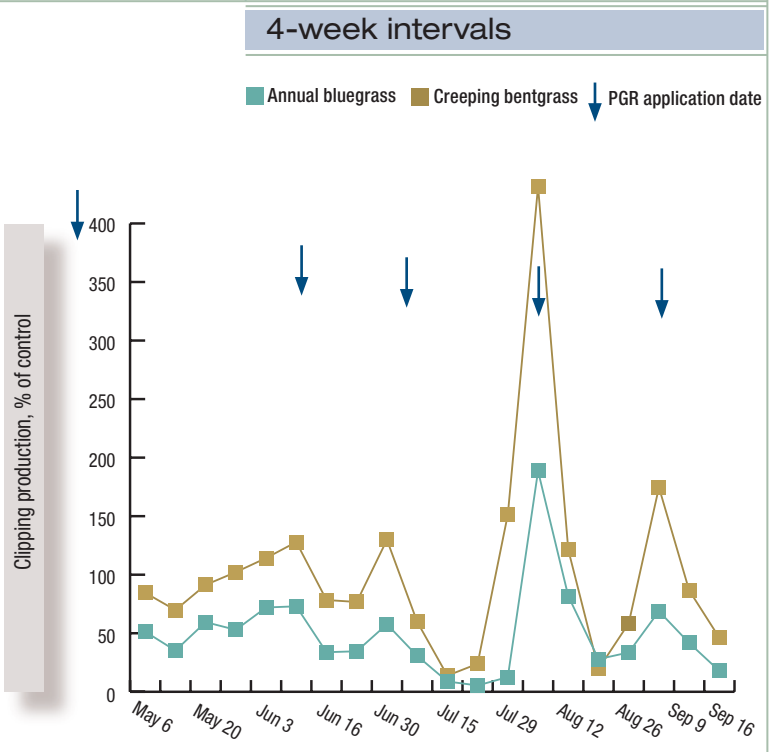

Figure 3. Response of annual bluegrass and creeping bentgrass to Trimmit applied on four-week intervals, with an initial application of 8 ounces/acre and subsequent applications of 16 ounces/acre.

Putting greens

This research was conducted on fairway-height grasses. What will happen on putting green turf? We can speculate that the same principles will be in effect, although the transition will be slower than it is on fairways because of the lower mowing heights and increased mowing frequency. Regardless of the height of cut, creeping bentgrass still must outgrow annual bluegrass. This is more difficult on greens because mowing six to seven times each week effectively reduces the rate at which creeping bentgrass can crowd out annual bluegrass.

Although the same principles apply, the concerns about reduction in turf quality are even greater for putting greens. Using Trimmit or Cutless will reduce annual bluegrass on greens, but the process may be slower than it is for fairways. Differential regulation on greens may cause additional problems for superintendents. Severely regulating annual bluegrass in the spring can cause seedheads to remain below the height of cut, resulting in bumpy putting surfaces. In addition, differential regulation can result in a bumpy putting surface when creeping bentgrass outgrows annual bluegrass. On putting greens, letting the

Annual bluegrass can be injured from late-season applications of Trimmit, but Primo does not cause the bleaching seen here. The third plot from the right and the plot on the far right are controls, and the third plot from the left was treated only with Primo. The other plots were treated with Trimmit alone or a combination of Trimmit and Primo.

creeping bentgrass come out of regulation is not a good idea because of the effects on putting quality. Until annual bluegrass becomes a minor component of the turf, the application interval on greens would be best kept at three weeks.

Fall applications

How late in the fall can Trimmit or Cutless be applied? The answer depends on the amount of annual bluegrass present. Late-fall applications of Trimmit or Cutless can bleach annual bluegrass for the remainder of the fall and into the next spring. However, we have not observed this bleaching on creeping bentgrass. Where the majority of turf is creeping bentgrass, applications of Trimmit and Cutless can be made as late as early October in central Illinois. However, avoid using higher rates in fall applications to prevent overregulation of the turf.

Caveat

Finally, one caveat regarding our research. We measured clipping production but not creeping bentgrass stolon growth. We assumed that clipping production and stolon growth are highly correlated, but if that is not the case, then some of our conclusions may be incorrect.

Funding

We wish to acknowledge the support of Syngenta and the Illinois Turfgrass Foundation for supporting this research.

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Bruce Branham (bbranham@uiuc.edu) is an associate professor and William Sharp is a research specialist in agriculture in the department of natural resources and environmental sciences, University of Illinois, Urbana-Champaign.

The research says

- ➔ Although PGRs suppress growth, two in particular, Cutless and Trimmit, are used to selectively suppress annual bluegrass in creeping bentgrass.
- ➔ In spring, initial rates of Cutless and Trimmit should be 8 ounces/acre (0.058 milliliter/square meter) or less to avoid turf injury. Rates can be increased in the summer when high temperatures result in reduced PGR activity.
- ➔ To promote differential species growth, application intervals of four weeks may be effective.
- ➔ Where annual bluegrass is 50% or more of the turf, application rates should be reduced to avoid serious reductions in turf quality.
- ➔ Following a multiyear program of PGR use can reduce annual bluegrass levels to 5% to 15%.