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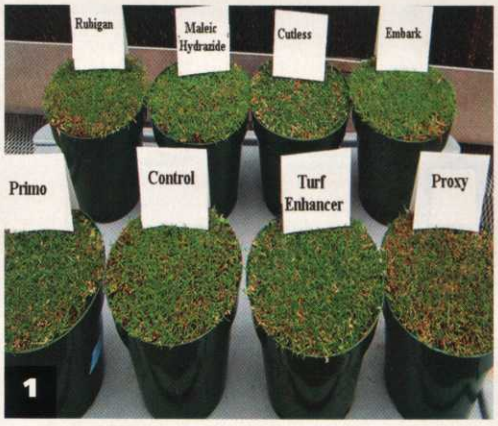
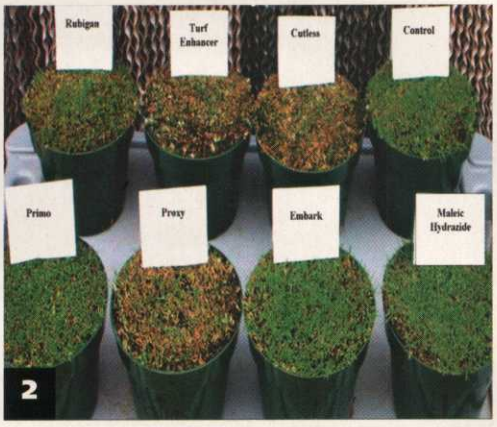
TifEagle bermudagrass after initial treatments (right) and repeated treatments (far right) with seven plant growth regulators.

(below) TifEagle bermudagrass after 12 weeks treated with paclobutrazol at .125, .25, and .375 pounds per acre at six-week intervals.





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Paclobutrazol study

Paclobutrazol is a popular growth regulator used on creeping bentgrass greens and is also effective for fairway height hybrid bermudagrass.

Monthly applications of paclobutrazol at .125 and .25 pounds of active ingredient per acre in a two-year field study showed no affect on root growth of a Penncross creeping bentgrass putting green (Fagerness and Yelverton, 2001). However, researchers have not examined paclobutrazol effects on bermudagrass putting-green root growth. The objective of this greenhouse experiment was to assess visual quality, root mass and clipping yield of TifEagle bermudagrass to repeat applications of three rates of paclobutrazol over a 12-week period.

TifEagle bermudagrass plugs were placed in 16-inch lysimeters with 8-inch diameters and built to USGA specification (USGA Green Section Staff, 1993) with 85:15 medium sand and peat moss root-zone mix. Plugs were allowed to grow for six weeks prior to treatments and were maintained at five-thirtyseconds of an inch mowing height.

Paclobutrazol was applied twice in six week intervals to separate lysimeters at .125, .25 and .375 pounds of active ingredient per acre.

Minor phytotoxicity occurred with .125 pounds of active ingredient per acre but turf quality was unaffected (Picture 3). Severe bermudagrass phytotoxicity occurred from paclobutrazol at .25 and .375 pounds of active ingredient per acre (Picture 3). Total clipping yield from 12 sampling dates was reduced 65 percent from .125 pounds of active ingredient per acre, 84 percent from .25 pounds of active ingredient per acre, and 93 percent from .375 pounds of active ingredient per acre (data not shown). Root mass after 12 weeks was also reduced 28 percent by .125 pounds of active ingredient per acre, 45 percent from .25 pounds of active ingredient per acre, and 61 percent from .375 pounds of active ingredient per acre as was root length by 17 percent (Figures 2 and 3, Picture 4). Turf discoloration and negative rooting responses advocate caution when using higher paclobutrazol rates on TifEagle bermudagrass.

Flurprimidol study

Cutless 50WP label recommends .375 to .5 pounds of active ingredient per acre for Tifgreen (328) bermudagrass and .5 to .75 pounds of active ingredient per acre for Tifway (419) bermudagrass. For creeping bentgrass, Cutless is labeled at .75 to 1 pounds of active ingredient per acre.

From the previous two studies, unacceptable phytotoxicity was observed on TifEagle bermudagrass from flurprimidol at .375 pounds of active ingredient per acre and paclobutrazol applied at .25 and .375 pounds of active ingredient per acre. For this study, single applications were applied of flurprimidol at .125, .25 and .375 pounds of active

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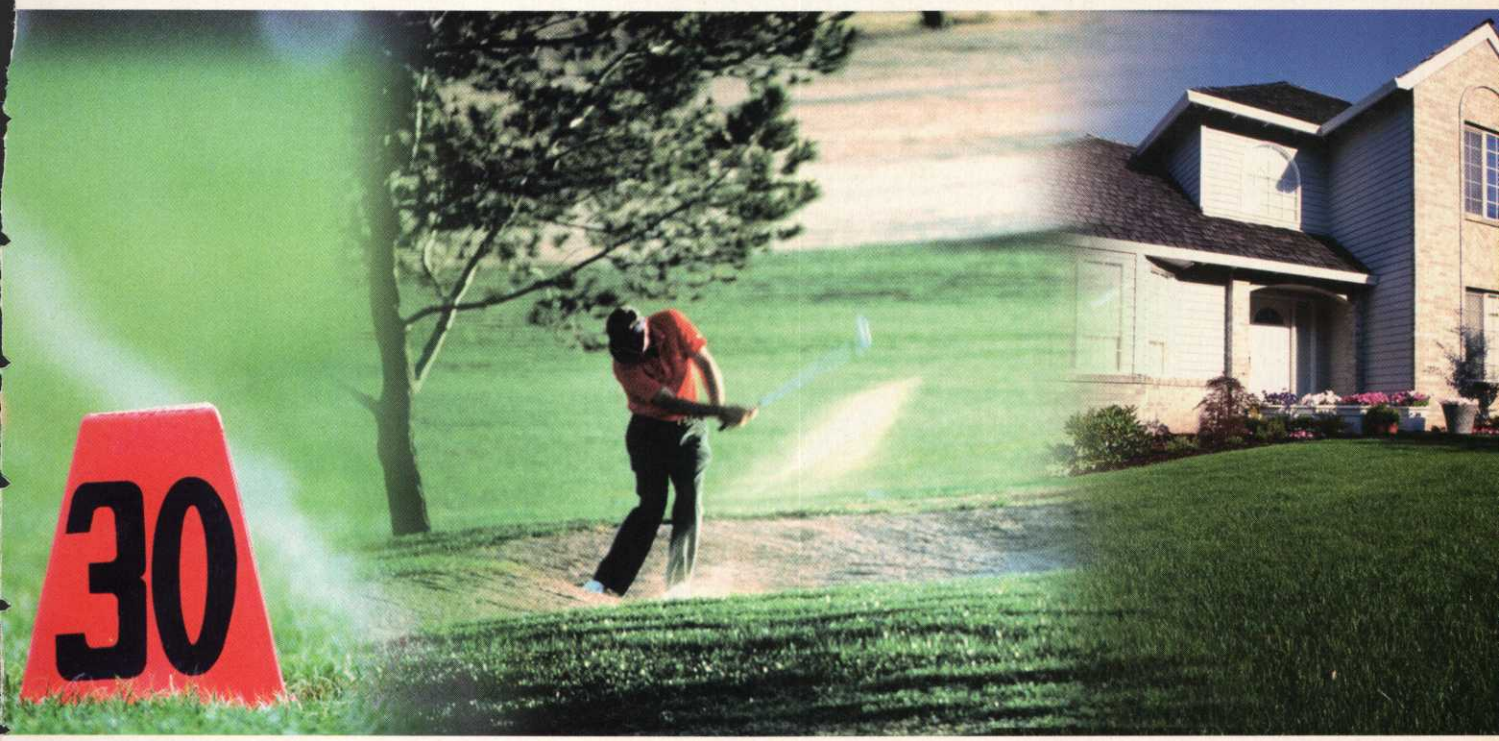
The Choice is Yours.



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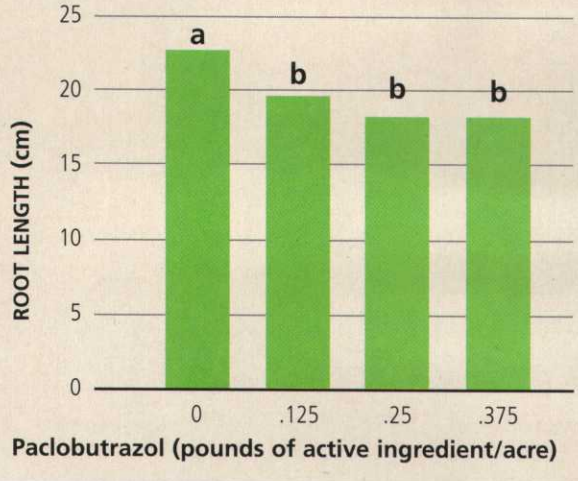
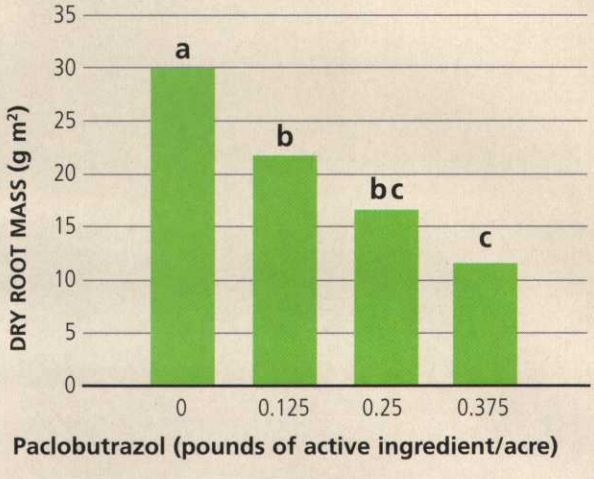
FIGURES 2 & 3

Root length (cm) and dry root mass (g m-2) after 12 weeks for TifEagle bermudagrass treated with paclobutrazol at six-week intervals in repeated greenhouse studies. Different letters indicate a significant difference at P = 0.10 according to Fishers Protected LSD test.





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ingredient per acre, compared with paclobutrazol at .125 pounds of active ingredient per acre.

Champion and TifEagle bermudagrass plugs were placed in lysimeters with 16-inch depths and 28 square-inch areas built to USGA specifications. No treatment/cultivar interaction occurred; therefore results are presented as means of flurprimidol rates.

Unacceptable turf injury from flurprimidol occurred from .25 and .375 pounds of active ingredient per acre over the six-week period (Picture 5). Final root samples from single applications of paclobutrazol at .125 pounds of active ingredient per acre were similar to untreated turf (data not shown). However, flurprimidol reduced root length 35 percent at .25 pounds of active ingredient per acre and 48 percent at .375 pounds of active ingredient per acre (Figure 4).

Dry root mass was reduced 38 percent from flurprimidol at .125 pounds of active ingredient per acre, 43 percent at .25 pounds of active ingredient per acre, and 44 percent at .375 pounds of active ingredient per acre (Figure 5). Root growth inhibition from PGRs, like flurprimidol, appears to be excessive on dwarf bermudagrass regardless of turf quality and clipping yield reductions.

Sensitivity of these grasses to labeled rates for

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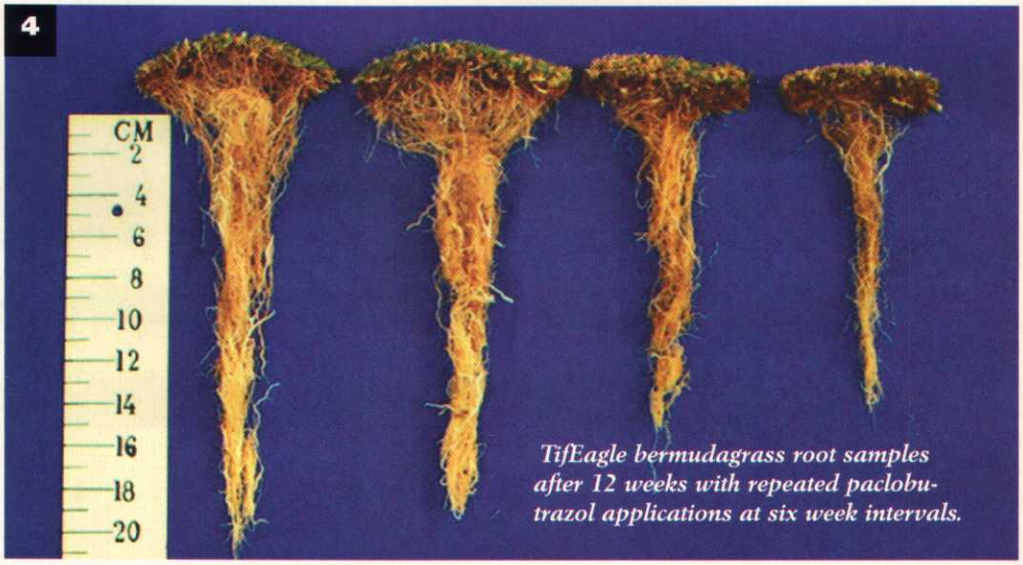

TifEagle bermudagrass root samples after 12 weeks with repeated paclobutrazol applications at six week intervals.

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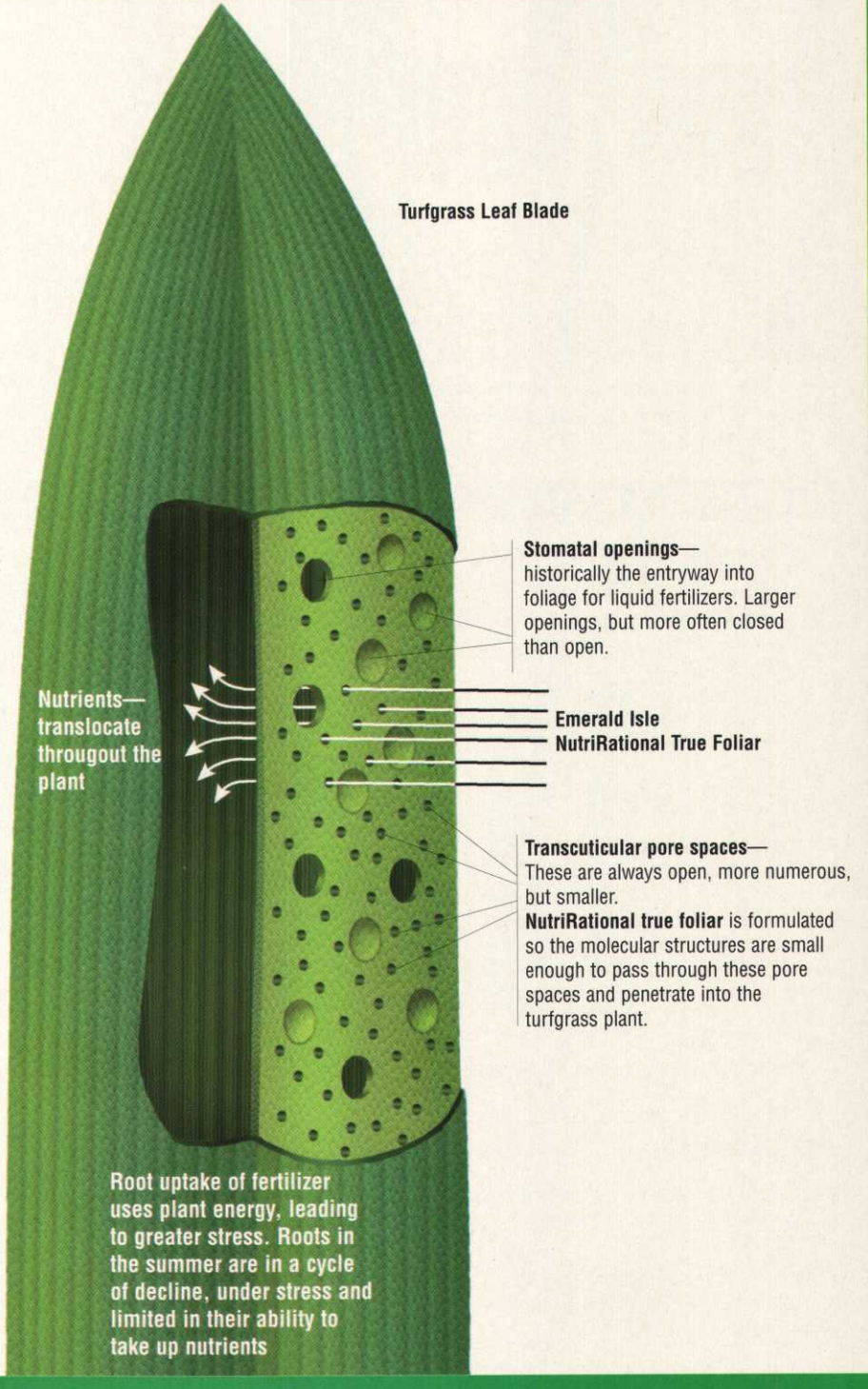

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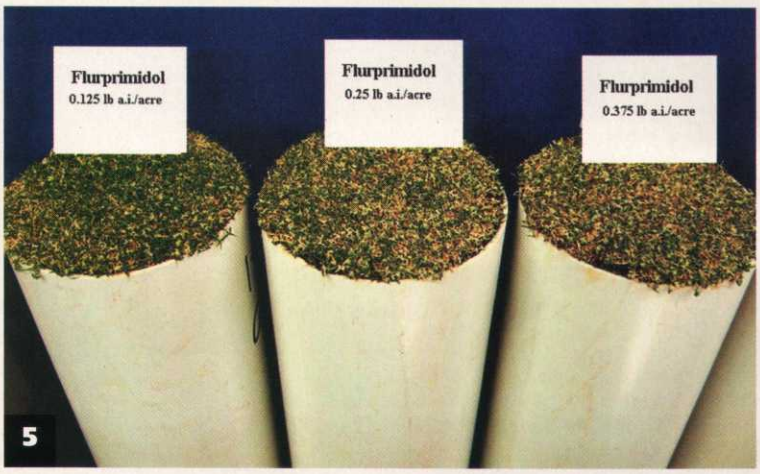


Champion bermudagrass response to flurprimidol (Cutless) at .125, .25 and .375 pounds of active ingredient per acre after six weeks.

Continued from page 74

Tifgreen bermudagrass and creeping bentgrass greens suggest future research should evaluate flurprimidol rates lower than .125 pounds of active ingredient per acre on dwarf varieties.

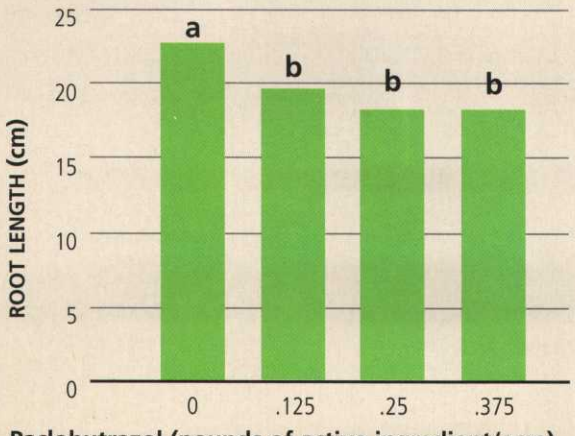
Results from these studies indicate the potential of extreme sensitivity of dwarf bermudagrass to PGR applications.

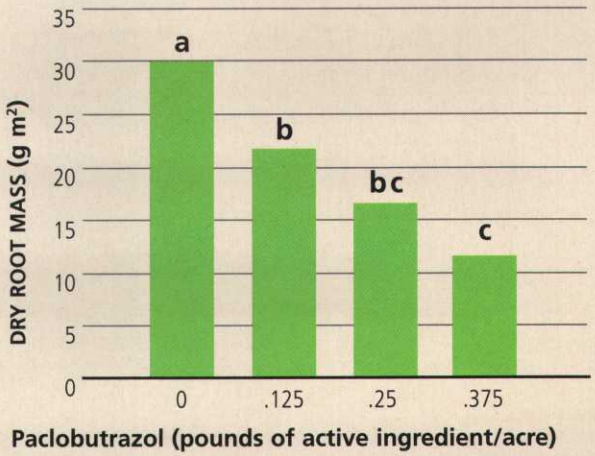
In the next article, we will discuss additional results using Primo (trinexapac-ethyl) at different rates and intervals on ultradwarf bermudagrass from several studies. Current field studies and future research will also be discussed.

McCullough is a graduate assistant, Liu is an associate professor and McCarty is a professor in the Department of Horticulture at Clemson University.

FIGURES 4 & 5

Root length (cm) and dry root mass (g m-2) after six weeks for TifEagle and Champion bermudagrass treated with single flurprimidol (Cutless) applications in a greenhouse study. Treatment x Cultivar interaction was not significant, therefore cultivars were combined. Different letters indicate a significant difference using Fischer's Protected LSD test at P = 0.05.





REFERENCES

Beard, J.B. 1973. *Turfgrass Science and Culture.* Prentice-Hall, Inc: Englewood Cliffs, N.J.

Beard, J.B. 2002. *Turf Management for Golf Courses – 2nd edition.* Ann Arbor Press, Chelsea, Mich.

Fagerness, M.J. and F.H Yelverton. 2001. "Plant growth regulator and mowing height effects on seasonal root growth of 'Penncross' creeping bentgrass." *Crop Sci.* 41:1901-1905.

Jiang, H. and J. Fry. 1998. "Drought responses of perennial ryegrass treated with plant growth regulators." *HortScience.* 33(2):270-273.

McCarty, L.B. 2001. *Best Golf Course Management Practices.* Prentice-Hall, Upper Saddle River, N.J.

McCarty, L.B. and G.L. Miller. 2002. *Managing Bermudagrass Turf: Selection, Construction, Cultural Practices and Pest Management Strategies.* Sleeping Bear Press, Chelsea, Mich.

Qian, Y.L. and M.C. Engelke. 1999. Influence of trinexapac-ethyl on 'Diamond' zoysiagrass in a shade environment. *Crop Sci.* 39:202-208.

United States Golf Association Green Section Staff. 1993. "USGA recommendations for a method of putting-green construction. The 1993 Revision." *USGA Green Section Record.* 31(2):1-3.

Watschke, T.L. M.G. Prinster, and J.M. Brenninger. 1992. "Plant growth regulators and turfgrass management" p. 557-588. *In:* Waddington, D.V., R.N. Carrow, and R.C. Shearman, (eds). *Agronomy Monograph No. 32. Turfgrass.* American Society of Agronomy. Madison, WI.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How to Suppress Seedheads on Annual Bluegrass Putting Greens

By J.A. Borger, T.L. Watschke, and M.D. Soika

To some degree, annual bluegrass (*Poa annua*) is present on most putting greens in the Mid-Atlantic. In fact, annual bluegrass can be the predominant species.

Although botanically, annual bluegrass is a winter annual and considered a weed in most turfgrass communities, it is often the desirable species on putting greens. When a turfgrass manager chooses to cultivate annual bluegrass as the dominant population, it's not considered a weed. In fact, if the desired turfgrass is annual bluegrass, then creeping bentgrass (*Agrostis stolonifera*) or any other turfgrass present in the sward should be considered a weed. Some of the highest-quality putting surfaces often consist of more than 80 percent annual bluegrass.

If annual bluegrass is the species of choice, the turfgrass manager must manage the seedhead production of the annual bluegrass because it can adversely affect the playability of the putting surface. In addition, when annual bluegrass produces a seedhead, carbohydrates are diverted to the production of that seedhead at the expense of growth in other areas of the plant. This diversion of carbohydrates is evident shortly after the seed matures and shatters from the plant.

If the seedhead is visible (beyond "boot" stage), PGRs cannot suppress that seedhead.

At this time, the annual bluegrass has become weakened and less competitive. As a result, the turfgrass manager must take extra care in the cultivation of the annual bluegrass to provide the necessary quality for the playing surface.

Mechanical cultivation (verticutting) can eliminate some of the seedheads on a putting green after emergence. Groomers or brushes attached to the greens mower will remove some of the seedheads, but these tactics do not prevent the formation of seedheads. When such mechanical means are employed, the equipment must be properly adjusted to avoid damage to the turfgrass plants. This mechanical removal of seedheads will need to continue until the seedhead production ceases.

Plant growth regulator (PGR) use has become more commonplace over the past several years and can be effective for the suppression of annual bluegrass seedheads (Picture 1).

PGR application timing is critical for success.

The green blocks are where annual bluegrass seedheads have been suppressed using PGRs.

(Left to right) Late "boot" stage, seedhead emerged, and early "boot" stage. Notice the position of the swollen area just below the leaves on the annual bluegrass plant during the late "boot" stage of seedhead development.

TABLE 1

Evaluations of selected treatments for chemical phytotoxicity, turf quality, and percent annual bluegrass seedhead suppression on an annual bluegrass/creeping bentgrass putting green.[1] (Source: Original research, Jeff Borger at The Penn State University, 2003)

TREATMENT	FORM	RATE oz/M	TIMING	5/2/03 PHYTO[2]	5/20/03 QUALITY[3]	5/20/03 SUPPRESSION[4]
PROXY	2SL	5	BOOT	8.7	8.2	88.3ab
PRIMO MAXX	1MEC	.125	BOOT			
PROXY	2SL	3	BOOT	8.7	6.7	73.3bcd
PRIMO MAXX	1MEC	.125	BOOT			
PROXY	2SL	3	BOOT/3WAT[5]	8.7	9.2	93.3a
PRIMO MAXX	1MEC	.125	BOOT/3WAT			
EMBARK T/O	0.2L	.9	BOOT	5.3	6.3	85ab
EMBARK T/O	0.2L	.9	BOOT	8.3	7.2	73.3bcd
FEROMEC	L	5	BOOT			
CHECK				10	5.7	0f
PROXY	2SL	5	BOOT	7.7	8.2	88.3ab
PRIMO MAXX	1MEC	.125	BOOT			
MACROSORB FOLIAR	L	4	BOOT			
PROXY	2SL	5	BOOT	9	8.5	86.7ab
PRIMO MAXX	1MEC	.125	BOOT			
MACROSORB FOLIAR	L	8	BOOT			
PROXY	2SL	3	BOOT	9.3	8.5	81.7a-d
PRIMO MAXX	1MEC	.06	BOOT			
MACROSORB FOLIAR	L	8	BOOT			

1 – Product use contained in this table may not be according to label recommendations.

2 – The rating scale is from 0 to 10 where 0 = complete phytotoxicity, 7 = acceptable, and 10 = no phytotoxicity.

3 – The rating scale is from 0 to 10 where 0 = worst quality, 7 = acceptable, and 10 = best quality.

4 – Means followed by same letter do not significantly differ ($P \leq 0.05$ Duncan's New MRT).

5 – This treatment was applied twice, once at the "boot" stage then again three weeks later.

Annual bluegrass will begin to form seedheads in the spring of the year. Therefore, the PGRs must be applied at the "boot" stage of development, which is prior to the seedhead emergence from the turfgrass plant. To determine the seedhead growth stage, a sampling of the annual bluegrass is necessary. Turfgrass managers who have managed the same site for several years have noticed earlier seedhead emergence on certain greens. Consequently, these greens can be used as an effective monitoring tool.

Three examples of seedhead development are shown in Picture 2. To determine the "boot" developmental stage, select an annual bluegrass plant from the site and remove the outer leaves. At the "boot" stage, a small stem will be evident growing from the crown of the plant (Picture 3). The annual bluegrass plant may also have a noticeable bulge at the base. This is the seedhead forming and also considered the "boot" stage of development (See Picture 4).

If the seedhead is visible (beyond "boot" stage), PGRs cannot suppress that seedhead. The window of timing ("boot" stage) for PGR application can range from one or two days to a week. Therefore, daily monitoring of the development stage is required. If the PGR

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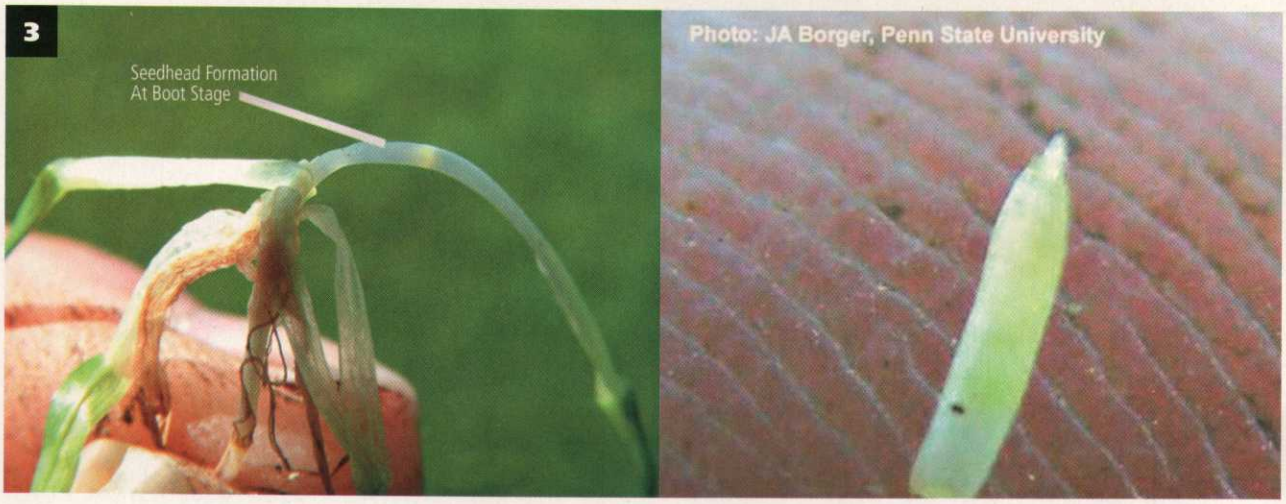

Seedhead formation within and excised from an annual bluegrass plant.

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application is made too early, then the annual bluegrass may produce seedheads later in the spring if a second PGR application is not made.

In most areas of the Mid-Atlantic region, one properly timed PGR application will effectively suppress annual bluegrass seedheads. Multiple PGR applications may be required where the seedhead production persists beyond the limits of a single PGR application.

When Proxy and Primo Maxx are tanked mixed, annual bluegrass seedheads can be suppressed on putting greens.

There are several other factors to consider when using PGRs to suppress annual bluegrass seedheads on putting greens. Some PGRs can be phytotoxic, causing a temporary yellowing or tip burn of the turfgrass. The phytotoxicity, combined with the amount of annual bluegrass seedhead suppression (plus other factors) can affect the overall quality of the putting surface. Quality is subjective. The turfgrass manager must decide the acceptable level of quality required for the putting surface.

Many researchers have documented the effectiveness of Embark Turf and Ornamental Growth Regulator (mefluidide) for the suppression of annual bluegrass seedheads. Embark T/O is a "class C" PGR (Watschke and DiPaola). This class of PGRs are mitotic inhibitors that prevent cell division, which is required for seedhead formation.

When applied alone, Embark T/O can suppress 85 percent or more of the annual bluegrass seedheads. However, there can be some temporary (seven to 10 days) phytotoxicity (turf yellowing) associated with the application. To reduce this temporary phytotoxicity, Embark T/O can be tanked mixed with Ferromec AC Liquid Iron (15-0-0), which contains nitrogen, iron and sulfur. When Ferromec is added, a general trend has been observed in which seedhead suppression decreases by 10 percent to 15 percent.

In the Mid-Atlantic region, a single application of Embark T/O, with or without Ferromec, usually suppresses seedhead formation for the season. However, some turf managers prefer two applications applied about four weeks apart because of the potential for prolonged seedhead development. Normally, seedhead suppression will last for about six weeks from a single application of Embark T/O.

There is inconsistency associated with the effectiveness of Proxy (ethephon) on the suppression of annual bluegrass seedheads. On the

An emerging annual bluegrass seedhead.