TURFGRASS TRENDS

PLANT GROWTH REGULATORS

Ultradwarf Bermudagrass PART 1

How sensitive is it to PGRs?

By Patrick McCullough, Haibo Liu and Bert McCarty

Pressure to consistently produce ideal putting-green quality has superintendents including regular plant growth regulator (PGR) applications in their management programs.

PGRs are compounds that reduce growth by modifying turfgrass hormone synthesis. For fairways, tees and roughs, PGR applications reduce mowing requirements, which minimize labor and equipment operation (Watcshke et al., 1992). PGRs are also used to promote smooth and uniform putting surfaces by reducing diurnal shoot growth fluctuations (McCarty, 2001).

Challenges superintendents face with ultradwarf bermudagrass varieties include maintaining appropriate fertility, managing thatch/mat development and promoting root growth. Dwarf bermudagrass varieties show some sensitivity to herbicide and PGR practices previously acceptable for traditional bermudagrass cultivars.

Root growth inhibition from PGRs appears to be excessive on dwarf bermudagrass regardless of turf quality and clipping yield reductions.

Hybrid bermudagrass (*Cynodon dactylon* (L.) Pers. x C. *transvaalensis* Burtt-Davey) is the warm-season turfgrass used most commonly on putting greens in the warm, humid climatic regions (Beard, 2002). Bermudagrass putting-green quality has long been considered inferior to fine-textured creeping bentgrass (*Agrostis palustris* Huds.) because of the inabilities of cultivars such as Tifgreen and Tifdwarf to withstand routine mowing heights lower than three-sixteenths to one-quarter inch (Beard, 1973).

Problems also exist from genetic instabilities of these cultivars leading to off-type patches of different color and texture, causing greens to become mosaic and difficult to play (McCarty and Miller, 2002; Beard, 2002).

Dwarf bermudagrass varieties have recently been introduced that tolerate mowing heights of one-eighth inch or closer on a consistent basis (McCarty and Miller, 2002). Dwarf bermudagrass is characterized by fine leaf textures, high shoot densities and low growth habits suitable for close mowing and producing ball roll distances once exclusive to creeping bentgrass greens (McCarty and Miller, 2002; Beard, 2002). However, management programs designed for Tifdwarf and Tifgreen bermudagrass putting greens appear questionable for successful long-term ultradwarf bermudagrass culture.

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FIGURE 1

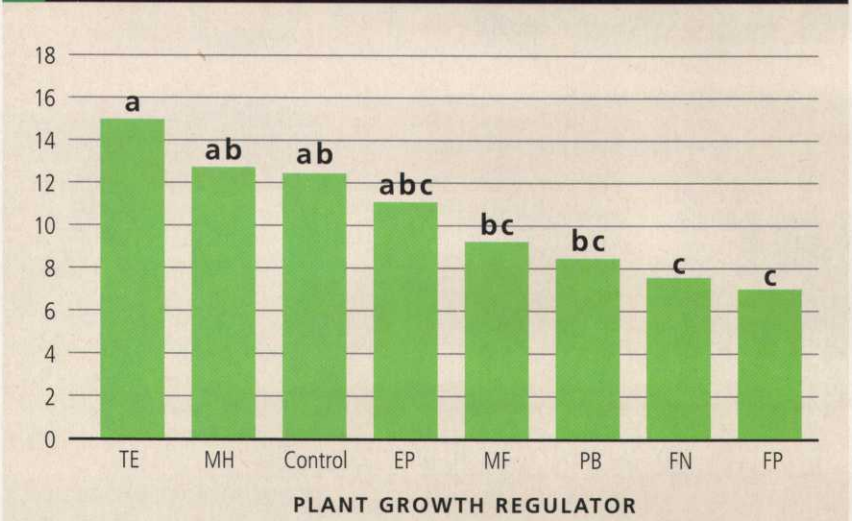

Figure 1: Dry root weight (g m-2) averaged across three studies for TifEagle bermudagrass treated with seven growth regulators. Different letters indicate a significant difference at P = 0.05 according to Fishers Protected LSD test. Abbreviations: MF, mefluidide; FN, fenarimol; EP, ethephon; MH, maleic hydrazide; TE, trinexapac-ethyl; PB, paclobutrazol; FP, flurprimidol.

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Turfgrass color and quality enhancements are commonly observed from regular PGR use, enhancing tolerances to shade, drought and other physiological stresses (Qian and Engelke, 1999; Jiang and Fry, 1998). Growth inhibitors used in turf are divided into two categories: Type I and Type II. Type I compounds, including maleic hydrazide and mefluidide, inhibit cell division and are used predominantly as seedhead and foliar suppressant inhibitors in low maintenance turf areas. Inconsistent performance, turf injury and root-growth reductions have limited the use of these compounds. Type II growth regulators inhibit gibberellic acid, a hormone necessary for stem elongation, and present less likelihood of leaf burn compared with Type I compounds (McCarty, 2001).

As dwarf bermudagrass varieties continue to expand as putting-green turf, concerns exist for incorporating appropriate PGRs into management programs. Turf discoloration and negative rooting responses from PGRs may limit their potential for routine dwarf bermudagrass maintenance. Currently, no PGRs are labeled for use on ultradwarf bermudagrass. Thus, university research is warranted on these responses.

The objectives of our research were to:

(1) provide initial screening of PGRs on ultradwarf bermudagrass for future field and greenhouse research;

(2) compare labeled PGR rates of traditional bermudagrass and creeping bentgrass greens on ultradwarf bermudagrass; and

(3) examine morphological responses of ultradwarf bermudagrass to growth inhibition.

PGR greenhouse studies

Preliminary greenhouse screening studies were conducted to determine the immediate effects of seven plant growth regulators on clipping yield, visual quality and root mass of TifEagle bermudagrass after six weeks.

Growth regulators tested included trinexapac-ethyl (Primo), flurprimidol (Cutless), paclobutrazol (Turf Enhancer, Trimmit), mefluidide (Embark), maleic hydrazide (Royal MH-30), ethephon (Proxy) and fenarimol (Rubigan). Due to the lack of labeled rates for growth regulators on ultradwarf bermudagrass, rates for previous bermudagrass cultivars, bentgrass greens and low rates for higher-mowed hybrid bermudagrass were applied (Figure 1).

Two applications of each compound were made over a six-week period in three separate studies to TifEagle bermudagrass plugs placed in 5-inch deep pots with 28 square-inch areas. PGR applications for all studies were made with a greenhouse spray cabinet.

Visual quality was unacceptable with repeat fenarimol, flurprimidol and paclobutrazol applications (Pictures 1 and 2). Ethephon, a PGR that induces ethylene, had unacceptable turf quality one week after application.

Total dry weight clippings from six weekly samples were reduced 56 percent from trinexapac-ethyl, 86 percent from paclobutrazol, 88 percent from flurprimidol, 25 percent from mefluidide, 46 percent from maleic hydrazide, and 41 percent from ethephon (data not shown).

After six weeks, root mass was reduced 49 percent by fenarimol and 43 percent by flurprimidol, while all other PGRs had root mass similar to untreated turf (Figure 1). TifEagle bermudagrass treated with trinexapac-ethyl averaged 45 percent more root mass compared to mefludide, paclobutrazol, fenarimol, and fluprimidol (Figure 1). Trinexapac-ethyl was the only compound to reduce clippings and enhance turf quality without negative effects on rooting in three studies.

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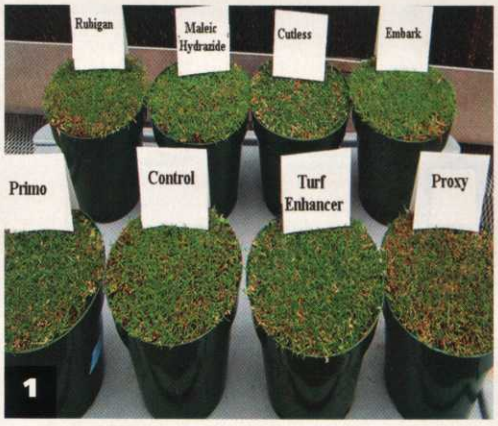
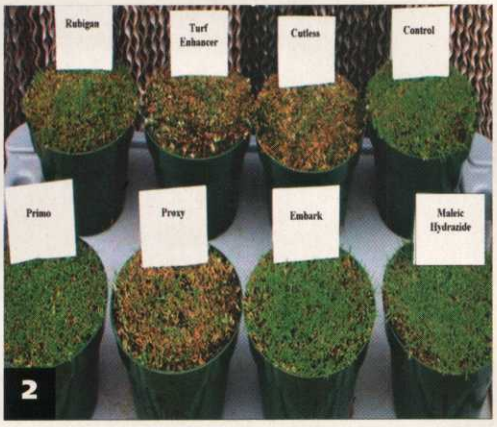
TifEagle bermudagrass after initial treatments (right) and repeated treatments (far right) with seven plant growth regulators.

(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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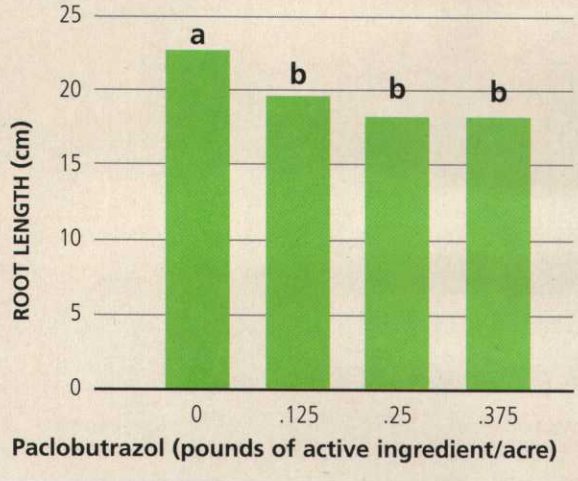
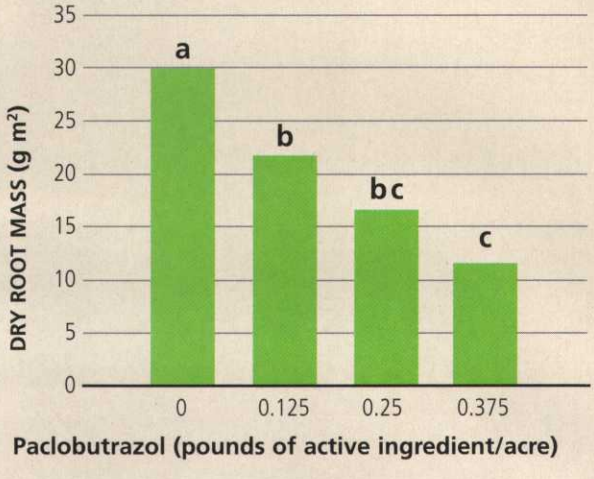
FIGURES 2 & 3

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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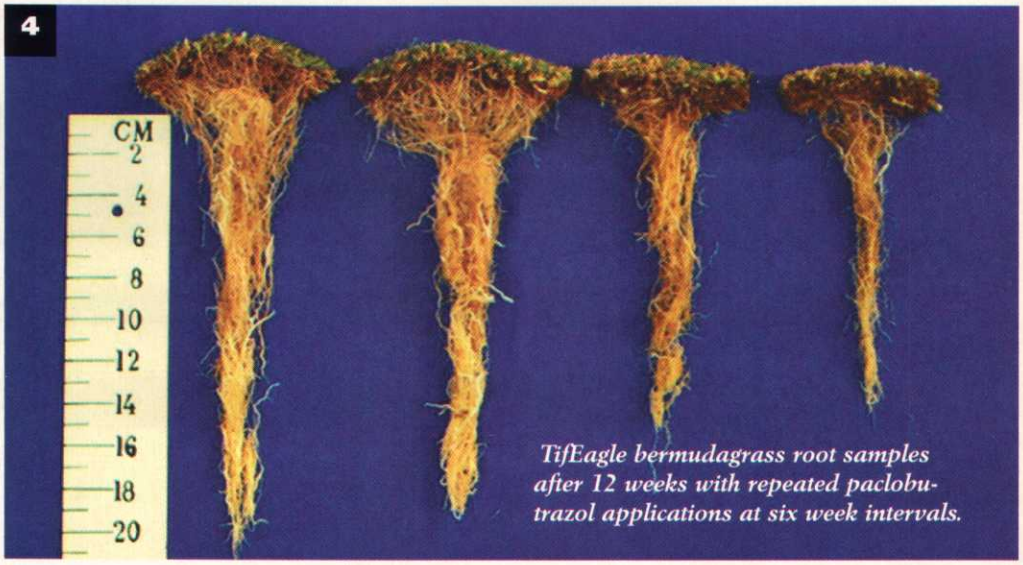
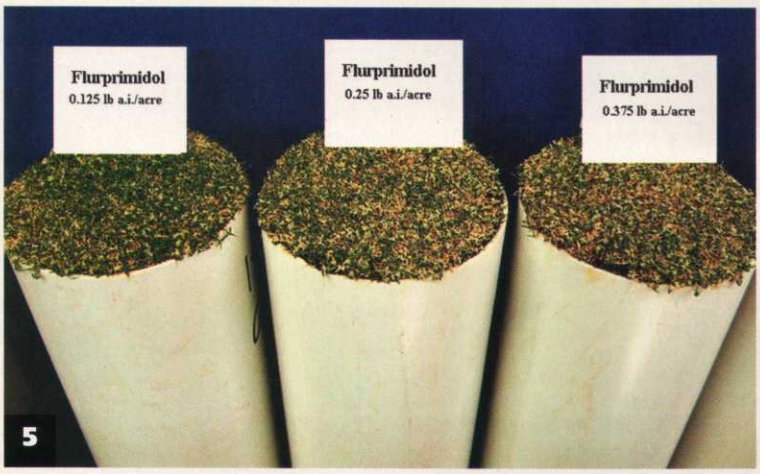


TifEagle bermudagrass root samples after 12 weeks with repeated paclobutrazol applications at six week intervals.



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

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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.

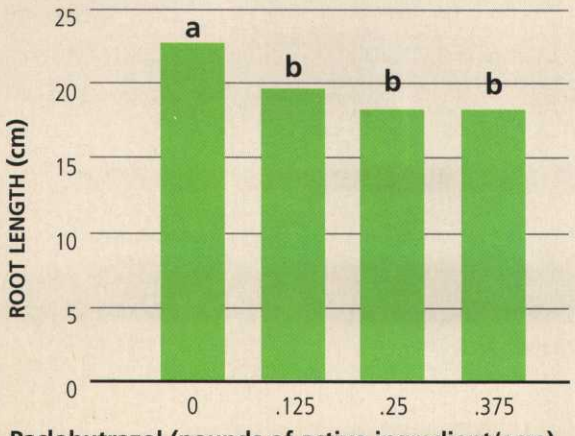
Results from these studies indicate the potential of extreme sensitivity of dwarf bermudagrass to PGR applications.

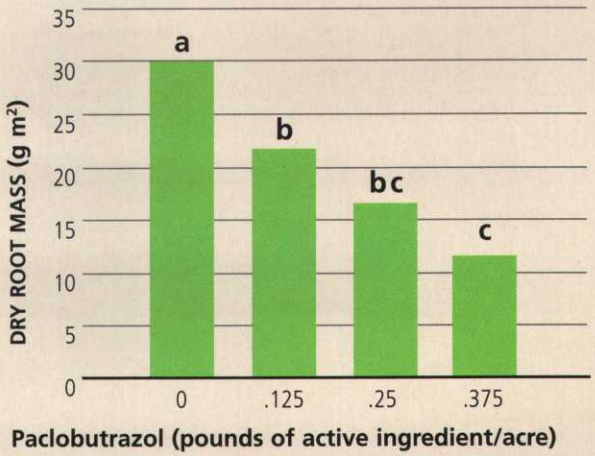
In the next article, we will discuss additional results using Primo (trinexapac-ethyl) at different rates and intervals on ultradwarf bermudagrass from several studies. Current field studies and future research will also be discussed.

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.