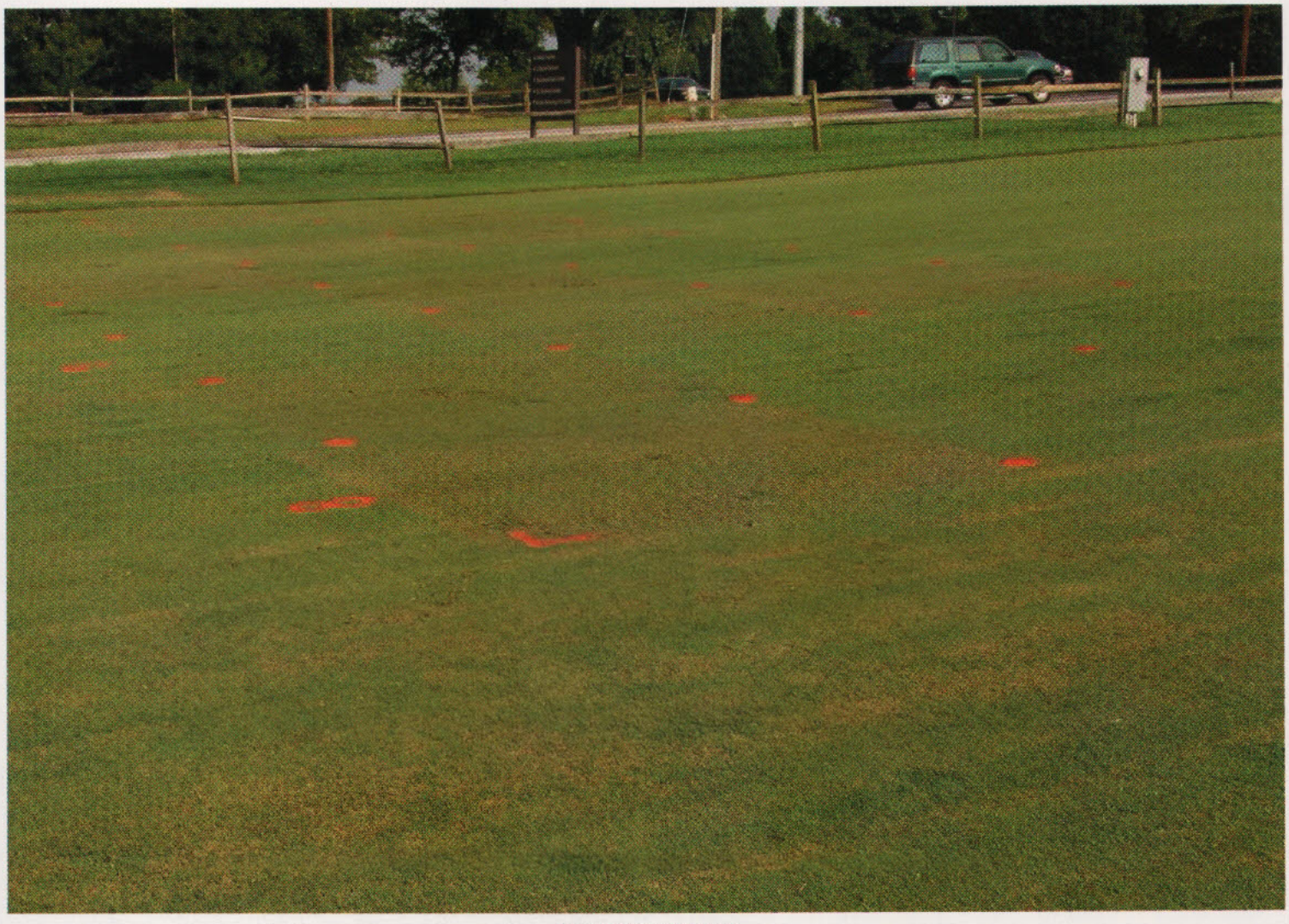
Plant growth regulators' effect on bermudagrass

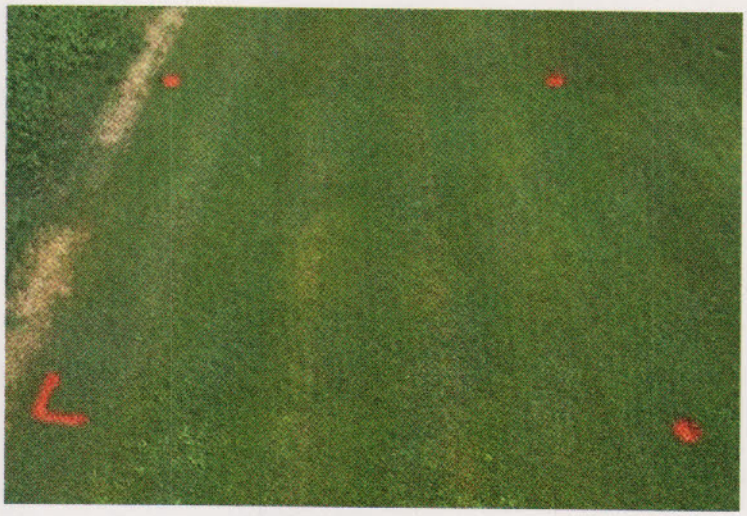
By F.W. Totten and L.B. McCarty

Bermudagrass is a popular turfgrass used on athletic fields due to its aggressive summer growth habit, fine leaf texture, and dark green color. However, if mowed infrequently, excessive scalping and clipping production combine to decrease its aesthetic quality. Plant growth regulators (PGRs) were introduced into the turf industry in the 1950's and since have been used in part to reduce mowing requirements and enhance color of bermudagrass.

PGRs are classified as Type I or Type II based on their mode of action. Type I PGRs, maleic hydrazide, mefluidide, and amidochlor, for example, inhibit cell division. Since being introduced, their use has become limited due to high potential for phytotoxicity and reductions

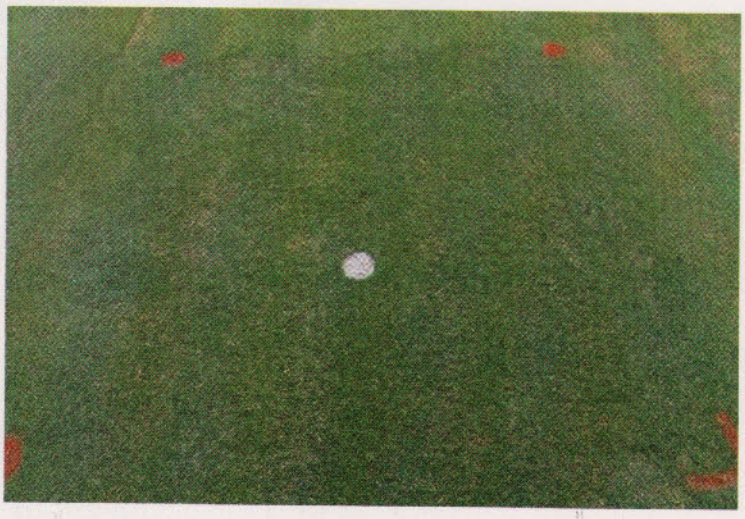


Overview of trial plots.



Untreated areas.

Plot with paclobutrazol at 16 ounces annually.



Plot with TE + paclobutrazol at 12 and 32 ounces annually.

in rooting. Type II PGRs inhibit the biosynthesis of gibberellic acid (GA), the hormone responsible for cell elongation. Alternatively, Type II PGRs can be classified as Class A or Class B based on their route of entry into the plant and the location in which they inhibit the GA biosynthesis pathway.

Flurprimidol interrupts GA biosynthesis early in the pathway via the cytochrome p450 monooxygenase enzyme. The result is shorter internode length, caused by reduced size of plant cells. Flurprimidol is predominantly root absorbed and exhibits excellent soil residual, extending growth regulation over time (www.SePRO.com/documents/cutless-bunnell.pdf). Flurprimidol use on warm season turfgrasses can potentially increase turf color and density, reduce mowing up to 50%, and reduce water use by the plant. The typical rate of flurprimidol on Tifway bermudagrass maintained at 0.5 to 0.75 in. ranges from 4 to 8 oz/A with repeat applications generally every 3 to 6 weeks. Flurprimidol at 8 oz wt/A, based on six applications per season, costs approximately $287/annually.

Paclobutrazol is similar to flurprimidol in that it interrupts GA biosynthesis early pathway via the cytochrome p450 monooxygenase enzyme and is root absorbed. Potential advantages to using paclobutrazol include turfgrass quality enhancement, reduction in mowing frequency, and Poa annua L. suppression. The typical rate of paclobutrazol on Tifway maintained at 0.5 to 0.75 in. ranges from 32 to 48 fl oz/A (depending on soil type), and a repeat application can be no sooner than 8 weeks after the initial application. Paclobutrazol at 32 fl oz/A, based on two applications per season, costs approximately $170/annually.

Trinexapac-ethyl is foliar absorbed and inhibits GA biosynthesis late in the pathway via the 3_-hydroxylase enzyme preventing active GA formation. Trinexapac-ethyl can potentially increase turf color, promote lateral stem and root mass development, and reduce vertical growth (www.syngenta.com/en/products_services/turf_page.aspx). The rate of trinexapac-ethyl typically used on Tifway bermudagrass maintained 0.5 to 0.75 in. is approximately 12 fl oz/A. Trinexapac-ethyl at 12.8 fl oz/A, based on seven applications per season, is approximately $245/annually (www.SePRO.com/documents/cutless_primo.pdf).

Tank-mix more effective?

"Is a flurprimidol + trinexapac-ethyl tank mix more effective in terms of growth regulation and cost?" is a question being asked by many turfgrass managers. Cooper (www.sepro.com/documents/cutlesscooper.pdf) found that a flurprimidol + trinexapac-ethyl tank mix applied at 4 oz wt/A + 6 fl oz/A, respectively, caused less injury and greater turfgrass quality on Tifway, compared to trinexapac-ethyl alone at 12 fl oz/A and flurprimidol alone at 8 oz/A.

Bunnell et al. (2005) reported a flurprimidol + trinexapac-ethyl combination at 4 oz wt/A + 6 fl oz/A provided Tifway bermudagrass turf quality and growth regulation comparable to trinexapac-ethyl used exclusively at 12 fl oz/A. However, our research indicated no advantage in growth regulation by using a flurprimidol + trinexapac-ethyl combination compared to using the products alone.

A flurprimidol or paclobutrazol + trinexapac-ethyl tank mix provides several potential benefits. The combination, or tank mix, provides growth regulation in early and late stages of GA synthesis, and provides both foliar and root absorption of PGRs. This potentially

Treatments included:

Product(s)	Rate
1. Untreated	
2. Trinexapac-ethyl	12 fl oz/A
3. Flurprimidol	8 oz wt/A
4. Trinexapac-ethyl + Flurprimidol	12 fl oz/A + 8 oz wt/A
5. Paclobutrazol	16 fl oz/A
6. Paclobutrazol	32 fl oz/A
7. Paclobutrazol + Trinexapac-ethyl	16 + 12 fl oz/A
8. Paclobutrazol + Trinexapac-ethyl	32 + 12 fl oz/A

provides longer residual growth regulation, and could subsequently reduce the number of annual applications. Also, from a cost-effective standpoint, approximately half the rate of either PGR is needed compared to when either product is used alone. The objective of this research was to evaluate Tifway's phytotoxicity, regrowth, and growth regulation in response to various rates of flurprimidol, trinexapac-ethyl, and paclobutrazol alone and in combination.

Our study was conducted during the summer of 2005 and 2006, at the registered Tifway bermudagrass research site at Clemson University. Experimental design was a randomized complete block with three replications, and treatments were arranged as a 3 by 3 factorial design. Plot size was 36 square feet.

During both summers, turf was mowed six days a week at 0.56 in., and irrigated to maintain a well-watered status. Treatments were applied with a CO2 backpack sprayer calibrated at 20 GPA. After the initial treatment, three sequential applications were made at 21-day intervals.

During both years, turf injury was measured weekly on a scale of 0 to 100% with >30% being unacceptable. Turfgrass quality was rated visually every 14d on a scale from 0 to 9 where 0 = brown turfgrass and 9 = dark green turfgrass. Percent lateral regrowth was measured using methods described by Bunnell (2003). A 4-inch Tifway plug was removed at the initiation of the study from each replicate. The holes were backfilled with an 85:15 sand/peat mix. A wire mesh grid containing 230 uniform squares was constructed in equal dimension to the original hole. A green shoot present in one 0.062 in2 square denoted one point. Percent lateral regrowth was calculated by:

Number of squares green shoot points divided by total points (230) times 100. Clippings were harvested from all treatments for all three replicates at 4, 8, and 12 weeks after the initial (WAIT) application and analyzed for dry weight.

Results

All injury observed during the 2005 and 2006 seasons was acceptable, thus not exceeding the 30% threshold. Injury was greatest, 2 WAIT, for all tank mix combinations containing trinexapac-ethyl and injury ranged from 10 to 25%. No injury was observed 3 WAIT for both years. Turfgrass visual quality was unacceptable, 2 and 4 WAIT, by all trinexapac-ethyl tank mix combinations. However, turfgrass quality was ≥ 7 for all treatments at all other rating dates.

Exceptional turfgrass quality was observed with flurprimidol during both years of the study and consistently provided turfgrass quality ratings around 8. Primo alone and tank mix combinations with paclobutrazol also provided consistent turfgrass quality ratings around 7.5.

Lateral regrowth was reduced 2 WAIT with flurprimidol + trinexapac-ethyl, paclobutrazol (16 fl oz/A/21d) + trinexapac-ethyl, and paclobutrazol (32 fl oz/A/21d) + trinexapac-ethyl combinations. Reductions were approximately 18% from the untreated check. Reductions in lateral regrowth by the tank mix combinations were not surprising and somewhat expected as the rates that comprised these tank mixes were providing a high amount of active ingredient.

Paclobutrazol applied alone at 16 fl oz/A/21 days did not significantly reduce clipping yield, compared to the untreated check, at 4 or

8 WAIT. Paclobutrazol applied alone at 32 fl oz/A/21 days reduced clipping yield 36% 8 WAIT. Flurprimidol applied alone at 8 oz wt/A/21 days reduced clipping yield 21 and 44% at 4 and 8 WAIT, respectively, while trinexapac-ethyl applied alone at 12 fl oz/A/21 days reduced clipping yield 43 and 67% at 4 and 8 WAIT, respectively.

Clipping yield reductions peaked, 8 WAIT, ranging from 67% to 80% with trinexapac-ethyl alone, flurprimidol + trinexapac-ethyl, and paclobutrazol (32 fl oz/A/21 days) + trinexapac-ethyl tank mix combinations. Also of importance, clipping yield was reduced 33%, 12 WAIT, from the untreated check by flurprimidol + trinexapac-ethyl. This tank mix combination showed good residual with respect to reducing clipping yield up to three weeks after the final application.

The tank-mix combination rates in this study, while not necessarily economically feasible, were chosen based of their performance in previous research by the author. Results from this research indicate no apparent advantage to a trinexapac-ethyl + paclobutrazol tank-mix compared to using trinexapac-ethyl alone at 12 fl oz/A/21 days. The flurprimidol + trinexapac-ethyl tank-mix combination produced the greatest reduction in clipping yield while causing acceptable injury to Tifway; however, lateral regrowth was reduced 18% 2 WAIT by this combination.

The flurprimidol + trinexapac-ethyl tank-mix combination exhibited great efficacy in both years with respect to reducing clipping yield. Yield reductions 12 WAIT, or 3 weeks after the final application, exceeded 30% with this treatment. Exceptional turfgrass quality and minimal injury (less than 10%) was observed with flurprimidol applied alone at 8 oz wt/ A/21 days during both years of the study and consistently provided turfgrass quality ratings around 8.

Future research should continue to vary rates and timings of flurprimidol, trinexapac-ethyl, and paclobutrazol tank-mix combinations on hybrid bermudagrass and other cool and warm-season turfgrasses. Residual clipping control of tank mix combinations should continue to be evaluated and better understood. Also, other PGR chemistries should be evaluated for potential use in the area of turfgrass management. ■

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John Mascaro's Photo Quiz

Can you identify this sports turf problem?

Problem: Black spots on turf
Turfgrass Area: Practice field
Location: Blacksburg, Virginia
Grass Variety: Bluegrass

Answer to John Mascaro's Photo Quiz on Page 43

John Mascaro is President of Turf-Tec International