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The purpose of *USGA Turfgrass and Environmental Research Online* is to effectively communicate the results of research projects funded under USGA's Turfgrass and Environmental Research Program to all who can benefit from such knowledge. Since 1983, the USGA has funded more than 290 projects at a cost of \$25 million. The private, non-profit research program provides funding opportunities to university faculty interested in working on environmental and turf management problems affecting golf courses. The outstanding playing conditions of today's golf courses are a direct result of ***using science to benefit golf***.

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# Response of Three Bermudagrass Genotypes to Mowing Height and Nitrogen or Growth Regulators

Wayne W. Hanna

## SUMMARY

Scientists at the Tifton station of the University of Georgia initiated a study to see if nitrogen levels in combination with growth regulators would increase the lie at four different mowing heights x mowing frequency treatments of bermudagrass. The study found:

- Treatments with 1 or 1.5 lbs. N/1000 sq. ft. produced similar turf quality and color in 'TifSport', Tifton 11, and Tift No.4.
- Treatments with nitrogen + Primo or nitrogen + Primo + Cutless did not have major effects on improving turf quality or color.
- Application of Primo or Primo + Cutless produced a denser turf which gave a higher ball lie in 'TifSport'. Ball lie in Tifton 11 and Tift No. 4 were similar for all treatments.

'TifSport' bermudagrass, a high turf quality and fine-textured interspecific triploid ( $2n=3x=27$  chromosomes) bermudagrass hybrid, was released in 1995 (3). Its genetic purity, improved cold resistance, superior sod strength, pest resistance, turf density, and improved traffic tolerance has made it a popular choice to plant on golf courses, athletic fields, lawns, and landscape areas.

Cella et al. (2) found that golf ball lie varied among Kentucky bluegrass cultivars and that number of plant tillers showed the highest correlation to ball lie. It was brought to our attention that although 'TifSport' performed well on golf courses, high handicap golfers wanted to see the ball with a higher lie. Therefore, we initiated this study to see if nitrogen levels in combination with growth regulators would increase the lie at four different mowing heights/schedules. We used a modification of an instrument described by Cella et. al. (1) to measure ball lie.

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## Experimental Procedures

'TifSport' bermudagrass (established in 2004) and two experimental vegetatively propagated bermudagrasses (Tifton 11 and Tift #4 (ST-5) were established in 2005. Tifton 11 and Tift #4 were also selected for testing because both of these experimental cultivars show potential for golf course use. The design was a strip plot test with four replications. Treatments included three nitrogen (N) levels in combination with Primo (trinexpac-ethyl) and Cutless (flurprimidol) and four mowing heights. A treatment with 1.0 N per 1000 sq. ft. per month plus Primo was considered a general practice used by golf course superintendents.

## Nitrogen/Primo/Cutlass Treatments

- 0.5 lbs. N/Month/1000 sq. ft.
- 1.0 lbs. N/Month/1000 sq. ft.
- 1.5 lbs. N/Month/1000 sq. ft.
- 1.0 lbs. N/Month/1000 sq. ft. + Primo



Researchers used a modification of an instrument described by Cella et. al. (1) to measure ball lie.



Ball lie measurements were taken by dropping two golf balls into each plot from a height of six feet and then measuring the distance the ball sank into the turf.

- 1.5 lbs. N/Month/1000 sq. ft. + Primo
- 1.0 lbs. N/Month/1000 sq. ft. + Primo + Cutless
- 1.5 lbs. N/Month/1000 sq. ft. + Primo + Cutless

Primo was applied at 9 oz./acre in Primo-only treatments and at 4.0 oz./acre in Primo/Cutless treatments. Cutless was applied at 4.0 oz./acre. Treatments were applied once per month during the growing season (May to October).

### **Mowing Heights**

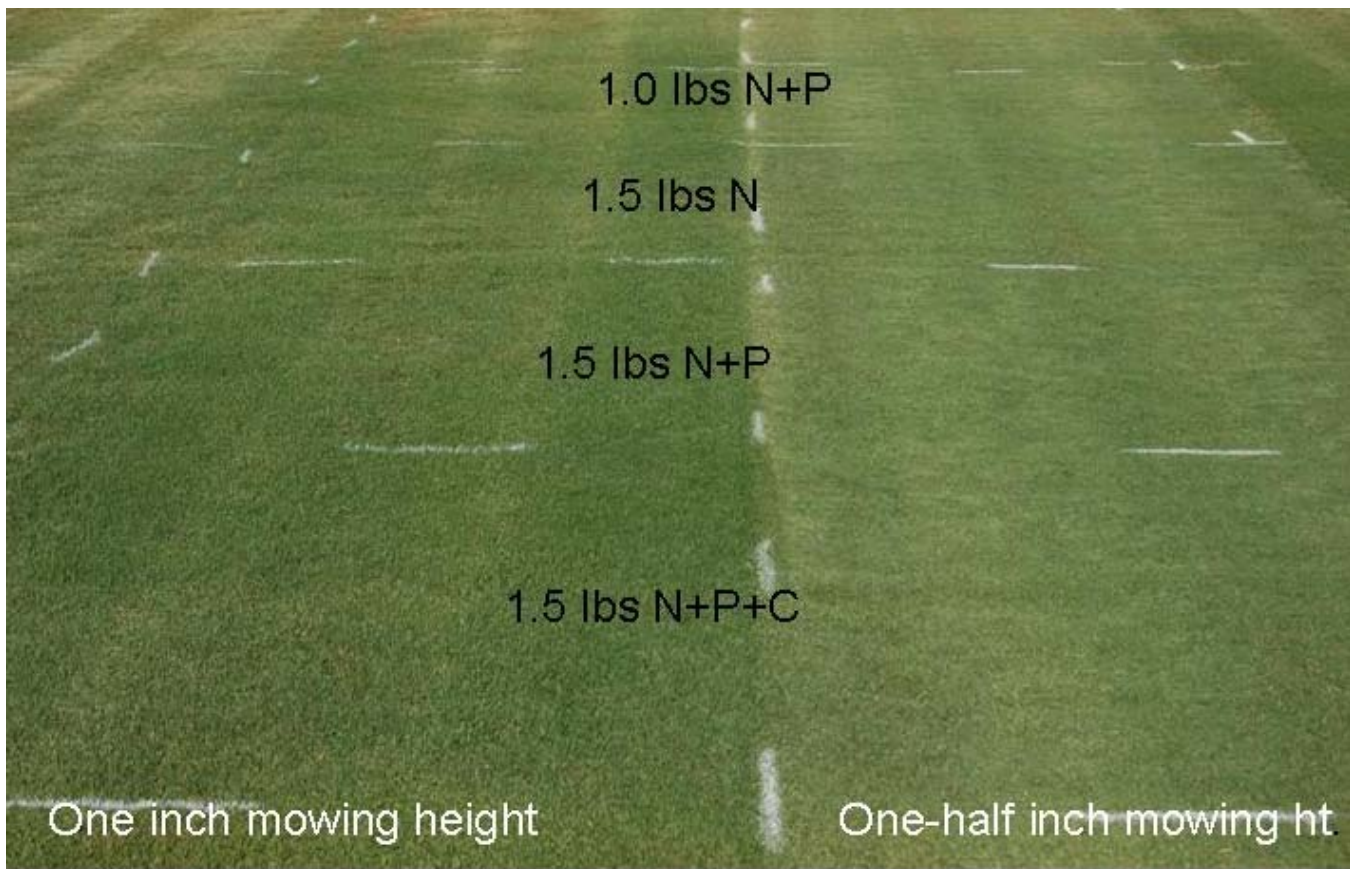
- 0.5 inch (12.5 mm)- 2x per week
- 1.0 inch (25 mm)- 2x per week
- 1.5 inches (37.5 mm)- 2x per week
- 1.5 inches (37.5 mm)- 1x per week

Mowing heights were selected to approximate practices used in various areas of the golf course. Quality and color ratings were usually taken at the end of the month before the new treatments were applied.

### **Ball Lie**

Ball lie measurements were taken by dropping two golf balls into each plot from a height of six feet and then measuring the distance the ball sank into the turf. Data on turf quality were collected in both 2005 and 2006. Data on ball lie were collected in both 2005 (three dates) and 2006 (three dates) for 'TifSport', but only in 2006 (one date) for Tifton 11, and Tift No. 4 (ST-5). Rating used ranged from 1 to 9 with 9 being the best turf quality. A rating of at least 7 is needed for acceptable turf quality.

A golf ball is 42 mm in diameter. The values listed in tables for ball height indicate the number of mm that the ball sank into the surface of the grass. Therefore, the smaller the number, the higher the ball lie. All ratings and ball lie measurements were rounded to the whole number because decimal values have little practical value. Analysis of variance was used to determine the effects of various treatments on turf quality and ball lie. Fisher's LSD test was used to determine differences between treatments.



**Figure 3.** One pound of N per 1000 sq. ft. per month appeared adequate for maintaining desirable turf quality in all three grasses.

## Results

### Turf Quality

There were only small differences in overall turf quality except for the 0.5 lb.N/1000 sq. ft. treatment where turf quality was reduced for ‘TifSport’ and in 2005 for Tifton 11. We also observed lighter green color (data not shown) for the 0.5 N treatment for ‘TifSport’ and Tifton 11, but not for Tift. No. 4. We observed a little discoloration in the Cutless treatments for a few days after treatment. Cutless appeared to discolor Tift 97-4 more than the other genotypes, probably because this cultivar is the most naturally dense grass of the three being tested. We observed the least discoloration in Tifton 11 and it is the most coarse grass of the three tested.

One pound of N per 1000 sq. ft. per month appeared adequate for maintaining desirable turf quality in all three grasses (Figure 3). However, 0.5 lb. N/1000 sq. ft. per month may be adequate

for Tift No. 4, a dense naturally dark green shade-resistant genotype. Neither Primo nor Cutless improved overall turf quality in this test. However, clipping removal (not measured in this test) would probably have been reduced by the growth regulators. Turf quality tended to improve for ‘TifSport’ from 2005 to 2006 as the turf matured. Treatments with Cutless caused browning and swirling of the turf at 25 and 37 mm mowing heights for about a week after treatment in ‘TifSport’ and Tift 97-4, which was especially pronounced at the October treatment. There were only small differences in turf quality due to mowing heights (Table 2).

### **Ball Height**

Nitrogen level had little effect on keeping the golf ball from sinking into the grass (Table 3). All combination of nitrogen, Primo, and Cutless were effective in improving ball lie in ‘TifSport’. As ‘TifSport’ matured (planted in 2004) from



**Figure 4.** As 'TifSport' matured (planted in 2004) from 2005 to 2006, the ball lie improved (above right). Treatments had almost no effect on ball lie in Tifton 11 (above left).

2005 to 2006, the ball lie improved. Treatments had almost no effect on ball lie in Tifton 11 and Tift No. 4. Tifton 11 is quite vigorous (producing a dense turf) so it apparently can mature soon after planting. Tift No. 4 is a naturally dense turf. The highest ball lie was achieved with 1.5 lbs. N combined with Primo and Cutless. It appears from these results that 1.0 lbs. N plus Primo can produce a good ball lie. Users would need to decide for themselves whether the slight improvements in ball lie are worth the extra costs of another 0.5 lb. of N and/or Cutless per month. A lower level of Cutlass may also prevent some of the discoloration that we observed in this study.

Mowing at 0.5 inch twice per week produced the best ball lie in all three bermudagrasses

(Table 4). The lowest mowing height produced the most dense turf. As mowing height increased and mowing frequency decreased, the ball sank further into the grass for 'TifSport' and Tifton 11 and for Tift No. 4 going from the 0.5 to 1.0 inch mowing height. There were no differences in ball lie at the 1.5 inch mowing heights for Tifton 11 and Tift No. 4. The ball lie improved in 'TifSport' from 2005 to 2006, probably due the production of a more mature turf.

Another consideration in this mowing height study is not only the ball lie, but how far is the bottom of the ball from the ground for the various mowing heights (numbers in parenthesis in Table 4). Although the ball sinks less into the grass at the 0.5 inch mowing height, the ball is farther

Treatment	Turf Quality					
	TifSport		Tifton 11		Tift No. 4	
	2005	2006	2005	2006	2005	2006
0.5 N	7	7	7	8	7	7
1.0 N	7	8	8	8	7	7
1.5 N	7	8	8	8	7	7
1.0 N + Primo	7	8	8	8	7	7
1.5 N+ Primo	7	8	8	8	7	7
1.0 N+ Primo + Cutless	7	7	8	8	7	7
1.5 N+ Primo + Cutless	7	8	8	8	7	7
LSD ( $p=0.05$ )	1	1	1	1	1	1

Turf Quality: 9=best; 7= acceptable quality

**Table 1.** Mean turf quality ratings for 'TifSport', Tifton 11, and Tift No.4 in 2005 and 2006

Mowing Height (inches)	Turf Quality					
	TifSport		Tifton 11		Tift No. 4	
	2005	2006	2005	2006	2005	2006
0.5 - 2x/wk	7	8	8	8	7	7
1.0 - 2x/wk	7	8	7	8	7	7
1.5 - 2x/wk	7	7	8	8	7	7
1.5 - 1x /wk	7	8	8	8	7	7
LSD <sub>(p=0.05)</sub>	1	1	1	1	1	1

**Table 2.** Mean turf quality ratings for 'TifSport', Tifton 11, and Tift No.4 in 2005 and 2006 for different mowing height and frequencies.

Treatment	Ball Height* (mm)			
	TifSport		Tifton 11	Tift No. 4
	2005	2006	2006	2006
0.5 N	24	14	5	5
1.0 N	21	14	5	5
1.5 N	20	13	5	5
1.0 N + Primo	14	10	5	4
1.5 N + Primo	16	9	5	5
1.0 N + Primo + Cutless	15	10	5	5
1.5 N + Primo + Cutless	11	8	5	5
LSD <sub>(p=0.05)</sub>	3	2	1	1

\* The smaller the number, the higher the ball lie.

**Table 3.** Mean ball height measurements (mm) for 'TifSport', Tifton 11, and Tift No.4 in 2005 and 2006 for different N, N+ Primo, and N + Primo + Cutless treatments.

Mowing Height (inches)	Ball Height <sup>†</sup> (mm)			
	TifSport	Tifton 11		Tift No. 4
	2005	2006	2006	2006
0.5 - 2x/wk	8(4) ‡	5(7)	3(9)	3(9)
1.0 - 2x/wk	10(15)	8(17)	5(20)	4(21)
1.5 - 2x/wk	24(13)	13(24)	6(31)	6(31)
1.5 - 1x /wk	28(9)	17(20)	6(31)	6(31)
LSD <sub>(p=0.05)</sub>	2	2	1	1

† Distance (mm) that the ball sank into the grass.

‡ Distance (mm) from ground to bottom of the golf ball in parentheses.

**Table 4.** Mean ball height measurements (mm) for 'TifSport', Tifton 11, and Tift No.4 in 2005 and 2006

from the ground at the 1.0 and 1.5 inches mowing heights.

Treatments with Primo or Primo + Cutless were the most effective for preventing the golf ball from sinking into the 'TifSport' turf. Nitrogen level by itself appeared to have little effect on ball lie. Tifton 11 was exceptional at all treatment levels and mowing heights for keeping the ball from sinking into the turf.

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