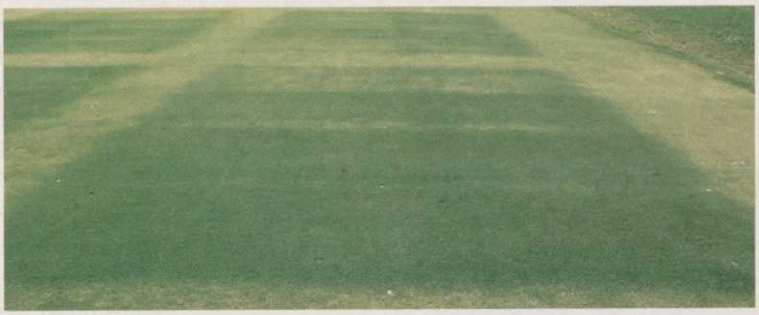
Routine Nitrogen Fertility, PGRs Influence Ball Roll on Bermuda

By Patrick McCullough, Haibo Liu and Bert McCarty



Picture 1. TifEagle bermudagrass plots treated with four nitrogen rates with and without trinexapac-ethyl in field experiments (2003-04, Clemson, S.C.).

While everyone seems interested in ball roll on bentgrass greens, ball roll on bermudagrass greens has received no prior research.

Hybrid bermudagrass (*Cynodon dactylon* Pers. x C. *transvaalensis* Burtt-Davy) putting greens require intensive management practices to promote surface uniformity and ball roll consistency. Turfgrass professionals traditionally consider bermudagrass putting green surfaces inferior to finer-textured creeping bentgrass (*Agrostis palustris* Huds.) from inabilities of previous cultivars to withstand routine mowing heights lower than three-sixteenths of an inch (Beard, 1973).

Recently introduced dwarf-type bermudagrasses have lower growth habits with the capability of withstanding long-term mowing heights of one-eighth of an inch (McCarty and Miller, 2002). Compared to traditional bermudagrass putting green cultivars, dwarf-type bermudagrasses have finer leaf textures and higher per area shoot densities (Beard, 2002). These morphological characteristics provide bermudagrass putting green quality once exclusive to creeping bentgrass greens (McCarty and Miller, 2002).

One of the greatest differences in routine management of bermudagrass and bentgrass putting greens are fertility requirements. Bermudagrass putting greens generally require two to three times as much annual nitrogen (N) inputs, ranging from 8 pounds to 24 pounds of N per 1,000 square feet, to meet growth requirements and compensate for nutrient loss through daily clipping removal (McCarty, 2005). Consequently, active shoot growth resulting from heavy fertilizations may disrupt surface uniformity and decrease putting green ball roll distances.

A practice commonly implemented to enhance putting green ball roll distances are the applications of plant growth regulators (PGRs). Suppressing leaf growth with PGRs may produce smoother putting surfaces by promoting lateral growth instead of undesirable top growth (Murphy et al., 2005). A gibberellic acid inhibitor, trinexapac-ethyl (TE), is safe for routine applications on dwarf-type bermudagrass putting greens to promote ball roll distances and surface uniformity (McCullough et al., 2005a). Turf managers also routinely apply TE to creeping bentgrass putting greens and other fine turfgrass areas.

Ball roll distances of dwarf bermudagrass putting green as influenced by N or TE have not been reported. However, research with TE on creeping bentgrass putting greens has been reported. Fagerness et al. (2000) evaluated monthly applications of TE on Penncross creeping bentgrass ball roll when maintained at one-eighth, five-thirty-seconds and three-sixteenths-of-an-inch mowing heights.

Long-term ball roll improvements were more consistent from reducing mowing height, while TE enhanced ball roll distances over the course of a given day. L-93 creeping bentgrass putting green ball roll distances have shown to be greater or equivalent to turf receiving supplemental and subsequent mowing operations following TE applications (McCullough et al., 2005b).

Turf managers may be able to reduce bentgrass putting green mowing frequencies without compromising ball roll distances following applications of TE.

Since bermudagrass putting greens may require a broad range of routine N fertilizations, evaluating the effects of N input with TE would advance the potential for practitioners to promote longer ball roll distances. A two-year field experiment investigated effects of routine N fertility and TE applications on TifEagle bermudagrass putting green ball roll distances.

Materials and methods

Field experiments were conducted over 12 weeks

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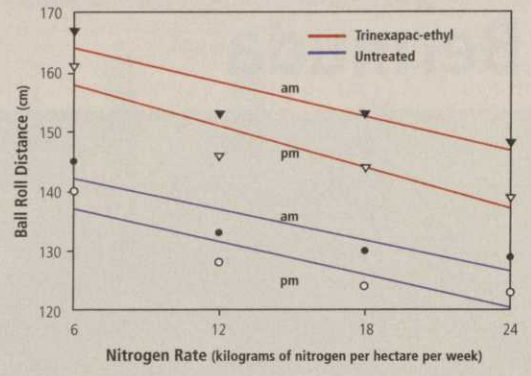
FIGURE 1



Pooled ball roll distances from 11 weekly samples taken with a 36-centimeter Stimpmeter on a TifEagle bermudagrass putting green in field experiments. Initial nitrogen treatments were April 26, 2003, and April 24, 2004. Trinexapac-ethyl was applied at 0.05 kilograms per hectare every three weeks beginning May 8, 2003, and May 4, 2004. Weekly ball roll measurements began one week after initial trinexapac-ethyl applications.

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from April to August in 2003 and 2004 on a TifEagle bermudagrass putting green at the Turf Service Center, Clemson (S.C.) University. The bermudagrass green was established in July 2002 and built approximately to USGA specifications (USGA Green Section Staff, 1993). The experimental design was a split block with four replications of 5-foot by 7-foot plots (Picture 1).

Beginning the first week in May, turf was mowed daily at one-eighth of an inch and irrigated as needed to prevent plant stress. Bermudagrass was aerified with half-inch-diameter hollow tines with 1-inch spacing and 4-inch lengths on May 20 and July 28 in 2003 and May 27 and July 28 in 2004. Potash was applied at 1 pound of potassium (K) per 1,000 square feet a week before initial treatments in 2003 to help correct deficiencies. Ammonium nitrate solution was applied weekly beginning April 26, 2003, and April 24, 2004.

TE (Primo Maxx) was applied every three weeks beginning 10 days after initial fertilization treatments. Applications were made with a CO_2 sprayer at 30 gallons per acre and rates are presented in Table 1. On June 21, 2003, and June 18, 2004, 0.25 pounds of N per 1,000 square feet was applied to all plots with an 18-3-18 ($N:P_2O_5:K_2O$) greens-grade granular fertilizer.

Weekly ball roll measurements were made approximately two hours after morning mowing (9 a.m. to 11a.m.) and in the evening (4 p.m.). Six ball roll measurements (three rolls in opposite directions) were made with a 14-inch Stimpmeter. The Stimpmeter was raised off of the ground until gravity caused ball roll off the cleft located on the opposite end. Ball roll distances were obtained with tape measurers running parallel with the plots. The six rolls were pooled per treatment for data analyses. Weekly ball roll distances were measured eleven times in both years beginning one week after initial TE application. Data analyses were made using the analysis of variance with SAS General Linear Model procedure (SAS Institute, Cary, N.C.).

Results and discussion

Since treatment effects were consistent on every sampling date, ball roll results were pooled and presented in Figure 1. Daily bermudagrass leaf growth reduced evening ball roll distances 5 percent from morning distances.

Similar diurnal differences have been reported on Penncross and L-93 creeping bentgrass putting green ball roll distances (Fagerness et al., 2000; McCullough et al., 2005b). Increased N rate linearly decreased both a.m. and p.m. ball roll distances. Reduced ball roll distances with increased N fertility generally results from greater shoot growth and wider leaf blades that increase ball roll resistance (McCarty, 2005a). Effects of N fertility on dwarf bermudagrass ball roll have not been reported. However, increasing N fertility appears to significantly reduce a.m. and p.m. ball roll distances.

TifEagle bermudagrass treated with TE had a.m. and p.m. ball roll distances increased about 15 percent from untreated turf. Enhanced ball roll distances from TE results from decreased leaf surface area and the inhibition of uneven shoot growth. TifEagle bermudagrass treated with TE had p.m. ball roll distances reduced 5 percent from a.m. distances. However, bermudagrass treated with TE had p.m. ball roll distances 10 percent longer than a.m. distances of the untreated. In the presence of TE, ball roll distances decreased with N rate, but TE-treated plots had longer ball roll distances compared to respective N inputs in the a.m. and p.m.

Although TE did not mask the influence of daily leaf growth, p.m. ball roll distances were longer for TE-treated turf relative to the untreated over the two-year experiment.

Turf managers who incorporate TE into dwarf bermudagrass management will have an effective tool for enhancing putting green ball roll. Inhibiting dwarf bermudagrass shoot growth with TE also enhances chlorophyll concentrations, inhibits seedhead formation, improves

TABLE 1

Treatment combinations of trinexapac-ethyl and nitrogen applied to a TifEagle bermudagrass putting green in field experiments (2003-04, Clemson, S.C.).

Trinexapac-ethyl (1EC)	Nitrogen[a]
fl. oz. of product/acre/3 wks.	lbs. N/1,000 ft2/wk.
0	0.125
	0.25
	0.375
	0.5
6	0.125
	0.25
	0.375
	0.5

[a]Nitrogen was applied with 34-0-0 ammonium nitrate solution.

nutrient-use efficiency and delays winter dormancy (Bunnell, 2003; McCullough, 2004). Applying TE at 6 ounces per acre every three weeks to TifEagle bermudagrass may initially cause discoloration in late spring and early summer. TifEagle bermudagrass has shown to recover within one or two weeks with enhanced color and quality relative to non-TE-treated turf. In field experiments at Clemson, turf discoloration was significantly minimized by reducing TE application rates in May and June.

Finally, this experiment was conducted on TifEagle bermudagrass. Ball roll distances of Champion, MiniVerde, FloraDwarf and other dwarf-type bermudagrasses may differ following N and TE treatments. Bermudagrass putting green ball roll distances may also vary when maintained with various cultivation techniques, watering regimens and mowing heights.

Patrick McCullough is a research program associate at Rutgers University. Haibo Liu and Bert McCarty are professors in the department of horticulture at Clemson University.

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