TURFGRASS TRENDS

CREEPING BENTGRASS DENSITY

Nitrogen Affects the Summer Density of Creeping Bentgrass

By Adam C. Moeller and Cale A. Bigelow

Creeping bentgrass (*Agrostis stolonifera* var. *palustris* Huds. Farw.) is the preferred turfgrass species for golf greens (Beard, 2002). Creeping bentgrass is a cool-season grass that forms an extremely dense, fine-textured, persistent turf that tolerates close (less than 0.125 inches), frequent mowing. During summer months, however, shoot density (SD) often declines, resulting in poor stand quality. Various cultural practices, such as mowing height, fertilization regime, topdressing and vertical mowing, can have an influence on SD. Golf course superintendents utilize several management practices to maintain turf vigor during the summer. One practice is light, frequent, nitrogen (N) fertilization. However, annual N rates vary widely.

Recently, high shoot density (HSD) bentgrasses bred to provide superior appearance and stress tolerance compared to the industry standard (Penncross) have been widely planted (Beard et al., 2001; Landry and Schlossberg, 2001). The effect of variable N rates on these cultivars and their seasonal changes in SD is unclear.

Tale of two fertilities

A field study was conducted at the W.H. Daniel Turfgrass Research and Diagnostic Center at Purdue University, West Lafayette, Ind., from 2006 to 2007 on a sand-based research green built to United States Golf Association (USGA) specifications. Three creeping bentgrass cultivars — A-4, L-93 and Penncross — were evaluated because of their commonality on golf greens and noted differences in SD.

The study site was maintained to emulate moderate golf course putting green conditions with modern cutting heights and cultural practices.

Two fertility regimes designated as "low" and "high" (2.3 pounds versus 4 pounds of N per 1,000 square feet annually) were used to assess the varying range of N applied to mature putting greens annually. Granular N was applied in the spring and fall to promote recovery from hollow-tine core cultivation (mid-April and mid-September) and to store carbohydrates in late fall (early November). Spoon feeding N was performed during the summer months (mid-May through September) with roughly half of the total N applied as a liquid.

Seasonal SD was measured by removing two intact cores per plot with a soil probe and counting individual shoots, which were then averaged and used for data analysis. Four SD measurements were taken in 2006 (June, July, August and October) and six times in 2007 (May through October).

Continued on page 48

IN THIS ISSUE

Pollutant-reducing Plants
California Bulrush improves wetland water quality 50

Burgeoning Biofuels
Our two-part series on using biodiesel and vegetable oils as fuels is now online at www.turfgrasstrends.com.

OUR SPONSORS

Continued from page 45

Seasonal density changes

Seasonal SD counts ranged from 760 to 2,160 shoots dm^2 (per square decimeter) throughout the study (Figure 1). The temporal changes in SD followed the cool-season growth pattern with the highest values measured during spring and autumn and a decline during the summer months. Among cultivars, A-4 generally possessed the highest SD (1,400 to 2,160 shoots dm^2) compared to Penncross (760 to 1,470 shoots dm^2) which had the least, while L-93 was intermediate (1,230 to 1,780 shoots dm^2). While each cultivar experienced reduced SD during the summer, the magnitude of the decline varied with cultivar and to a lesser extent N regime. The spring density of Penncross in both years was on average 37 percent less than A-4 at 4 lbs N/1,000 ft^2 yr^{-1} (square feet per year). By comparison, summer density of Penncross averaged over both years was 44 percent less than A-4 under 4 lbs N/1,000 ft^2 yr^{-1}. The higher SD of L-93 and A-4 is consistent with reports that have demonstrated the enhanced ability of HSD cultivars to provide superior turf conditions during the summer when compared to Penncross and many other earlier bentgrass generations (Landry and Schlossberg, 2001).

The SD values for HSD cultivars in this study were generally similar to some previously reported values (Ervin et al., 2000; Bruneau et al., 200) but lower than others (Beard et al., 2001; Sifers et al., 2001; Jordan et al., 2003). Sweeney et al. (2001) reported similar shoots dm^2 . They did not, however, report significant density reductions and in some instances measured an increase in SD from spring through summer. Some possible reasons for our lower values may be the slightly higher cutting height and the more intensive/abrasive light frequent sand topdressing program employed to reflect contemporary management practices.

In general, annual N regime did not significantly affect SD (Figure 1). In August of each year, however, when overall SD was lowest, the high N regime resulted in significantly more shoots than low N plots when averaged across cultivars, 1,170 versus 1,330 and 1,220 versus 1,310 shoots dm^2 for the low and high N regimes in the 2006 and 2007 study years, respectively. For example, SD reductions for A-4, L-93 and Penncross from June to August of each year averaged 23 percent, 23 percent and 37 percent at 2.3 lbs N/1,000 ft^2 yr^{-1}, respectively. By comparison, at the 4 lbs N/1,000 ft^2 yr^{-1} N rate, reductions were 17 percent, 15 percent and 23 percent, respectively.

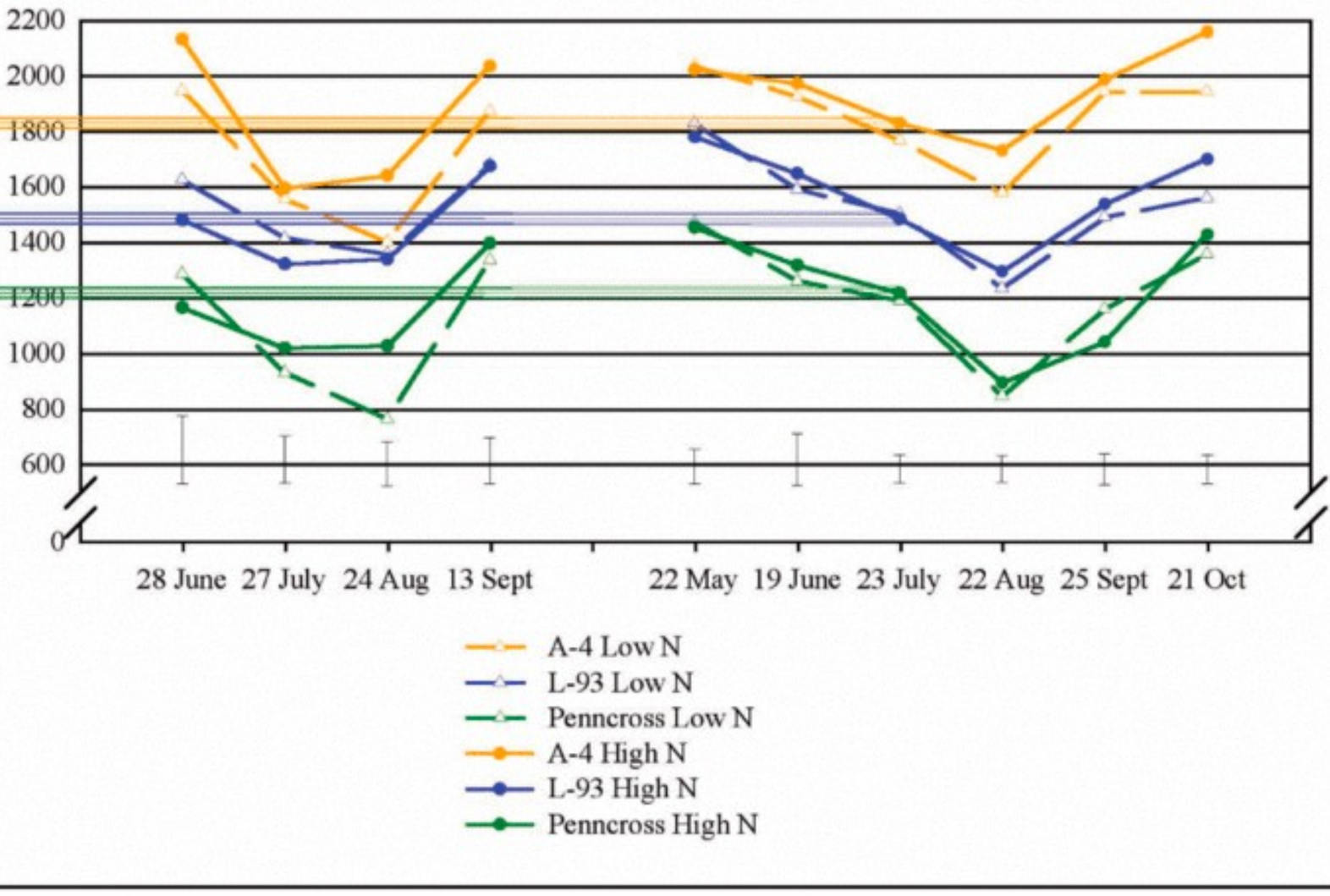
Summary and recommendations

As superintendents continue to strive to produce smooth, firm, consistent, putting green conditions, it is clear that several important factors affect bentgrass appearance and overall health. Of utmost importance is cultivar selection and N fertility level, particularly with respect to summer performance. The HSD cultivars are more reliable than Penncross because they maintain a dense turf canopy even with SD losses during the summer. Consider the following: When Penncross was most dense, during May or June, its SD was nearly equivalent to A-4 and L-93 at their lowest SD.

In response to golfers' desires for fast green speeds, many superintendents are applying low annual N, often < 2.5 lbs N/1,000 ft^2 yr^{-1}. This management approach is risky, and may compromise bentgrass health, especially on heavily trafficked greens grown in poor growing environments. These ultra-low N regimes result in malnourished turf, which is more prone to environmental stress, pest damage and *Poa annua* invasion. An alternative approach might be to apply 3 lbs to 4 lbs N/1,000 ft^2 yr^{-1} and manipulate other inputs such as applying plant growth regulators and using lightweight rollers to achieve a desired green speed.

In this field study, increasing the annual N level from 2.3 to 4 lbs N/1,000 square feet per hear had little effect on the overall seasonal SD of each cultivar. The exception, however, occurred in August when a beneficial response of the higher N level for SD was observed for both Penncross and A-4. Additionally, although increased N did not significantly enhance SD, it dramatically improved bentgrass visual appearance (data not shown). These data support the recommendation that moderate summer N (0.4 to 0.5 lbs N/1,000

FIGURE 1



Seasonal shoot density was measured by removing two intact cores per plot with a soil probe and counting individual shoots.

square feet per month) should be applied to minimize stand loss and ensure rapid recovery at the onset of favorable growing weather.

Due to the increased SD and organic matter accumulation associated with HSD cultivars, many golf course managers are on an aggressive sand topdressing program to maintain a firm, smooth surface. This normally involves the light application of sand topdressing every seven days to 10 days throughout the growing season. Although not directly evaluated in this study, we suggest that care should be exercised when attempting this management strategy for older bentgrass cultivars like Penncross, especially when maintained using a low N fertility program. Sand topdressing is a mechanically abrasive practice and may cause deleterious effects and, if improperly timed, further reduce Penncross SD and negatively affect overall putting green quality.

Where the densest, most aesthetically pleasing and persistent putting greens are desired, modern bentgrass cultivars should be planted and ample annual N should be applied. In the cool-humid region this will be about 3 to 4 lbs N/1,000 square feet per year for mature sand-based putting greens. In addition, a large proportion of the annual N should be supplied during the summer months using light, frequent liquid applications in order to promote recovery during the heavy-use seasons.

Adam Moeller is a United States Golf Association Northeast regional agronomist located in Easton, Pa. He can be contacted at amoeller@usga.org. Cale Bigelow is an assistant professor of agronomy/turfgrass science at Purdue University in West Lafayette, Ind. He can be reached at cbigelow@purdue.edu.

REFERENCE

Beard, J.B., P. Croce, M. Mocioni, A. DeLuca, and M. Volterrani. 2001. The comparative competitive ability of thirteen Agrostis stolonifera cultivars to Poa annua. Intl. Turfgrass Soc. Res. J. 9:828-831.

Beard, J.B. 2002. Turf management for golf courses. 2nd ed. Ann Arbor Press, Chelsea, MI.

Bruneau, A.H., C.A. Bigelow, R.J. Cooper, and D.C. Bowman. 2001. Performance of creeping bentgrass cultivars maintained at two mowing heights and under two fungicide regimes in North Carolina. Intl. Turfgrass Soc. Res. J. 9:835-842.

Ervin, Erik H.; Frame, Scott; Smith, Adam; Zelko, Alan. 2000. Turfgrass: 2000 Research & Information Report [Missouri]. p. 13-14. [Online]. http://agebb.missouri.edu/pdc/turf/report00.pdf (verified 13 Nov. 2007).

Jordan, J.E., R.H. White, D.M. Vietor, T.C. Hale, J.C. Thomas, and M.C. Engelke. 2003. Effect of irrigation frequency on turf quality, shoot density, and root length density of five bentgrass cultivars. Crop Sci. 43:282-287.

Landry, G., and M. Schlossberg. 2001. Bentgrass (Agrostis spp.) cultivar performance on a golf course putting green. Intl. Turfgrass Soc. Res. J. 9:886-897.

Schlossberg, M.J., and K.J. Karnok. 2001. Root and shoot performance of three creeping bentgrass cultivars as affected by nitrogen fertility. J. Plant Nutr. 24:535-548.

Sifers, S.I., J.B. Beard, and M.L. Fraser. 2001. Botanical comparisons of twelve Agrostis cultivars in a warm-humid climate. Intl. Turfgrass Soc. Res. J. 9:213-217.

Sweeney, P., K. Danneberger, and D. Wang. 2001. Root weight, nonstructural carbohydrate content, and shoot density of high-density creeping bentgrass cultivars. HortSci. 36(2):368-370.