Rooting and Carbohydrate Metabolism in Creeping Bentgrass Putting Greens in Response to Summer Irrigation and Aeration

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Objectives:

1. Evaluate physiological processes and rooting of putting green-height creeping bentgrass in response to two irrigation management and three aeration regimes.
2. Determine the influence of aeration and irrigation frequency on creeping bentgrass summer performance and root longevity during periods of supraoptimal temperature stress.
3. Provide information on the effects of soil temperature and soil water content on carbohydrate metabolism and its relationship to summer bentgrass decline.

Start Date: 2006
Project Duration: three years
Total Funding: $90,000

There has been little study on the impact of irrigation and aeration management on rooting in creeping bentgrass grown in a sand-based rootzone under field conditions.

'Providence' creeping bentgrass was grown on a sand-based rootzone meeting USGA recommendations. Plots were subjected to two irrigation programs: light and frequent versus deep and infrequent. Light, frequent plots were irrigated daily on rain-free days to maintain a moist condition in the upper 4-6 cm (1.6-2.4"); whereas, deep, infrequent irrigated plots were irrigated at leaf wilt to a depth > 24 cm (>9.5").

A majority of roots (55%) were found in the upper 2.4" (6 cm) of soil at the end of the summer, regardless of irrigation regime. Deep, infrequent irrigated bentgrass produced a greater number of roots, longer roots, and a larger root surface area and a smaller root diameter (2007) vs. light, frequent irrigated bentgrass.

Soil temperatures were on average < 0.7 C (< 1.4 F) greater in light, frequent irrigated bentgrass. Deep, infrequent irrigated bentgrass had lower canopy photosynthetic rates, but respiration was similar to light, frequent irrigated bentgrass. Canopy temperatures were 2.2 C (4.0 F) higher in deep, infrequent vs. light, frequent irrigated bentgrass.

Deep, infrequent irrigated bentgrass had lower color and quality and lower chlorophyll levels in 2006 and most of 2007. By late summer, however, color and quality and higher chlorophyll levels were detected in deep, infrequent vs. light, frequent irrigated bentgrass. Deep, infrequent irrigated bentgrass developed a less thick thatch-mat layer, which contained less organic matter versus light, frequent irrigated bentgrass.

Soil temperature was measured by installing temperature sensors about 0.8 inches below the soil surface.

Deep, infrequent irrigated bentgrass leaves had higher water soluble carbohydrate and total non-structural carbohydrate levels in 2006, but higher storage carbohydrate levels in both years. Deep, infrequent irrigated bentgrass had higher storage carbohydrate and non-structural root carbohydrate levels than light, frequent irrigated bentgrass in both years. Deep, infrequent irrigated bentgrass accumulated proportionately more non-structural carbohydrate in roots versus leaves. Nearly twice as much water was applied to light, frequent versus deep, infrequent plots in both years.

Regarding aeration, three regimes were assessed: spring only, spring plus three summer corings, and a non-cored check. Spring core aeration holes were filled to the surface with topdressing, but in summer, aerated plots cores were brushed to re-incorporate soil and no additional topdressing was applied.

In 2005, total root counts and total root length were increased by summer coring vs. spring coring. Total root counts and total root length generally were greater in the entire profile in spring plus summer-cored versus spring or non-cored bentgrass in 2007.

Data indicated that summer core aeration should be avoided the first summer of establishment. If necessary, only core aerate to the depth of the thatch-mat layer. The % total root counts in the 0-6 cm (0-2.4") of soil ranged 61to 74%, 58 to 59%, and 62 to 77% among all three coring treatments in late summer of 2005, 2006, and 2007, respectively.

Spring and spring plus summer-cored plots developed a thicker thatch layer than non-cored bentgrass. The amount of organic matter (loss on ignition) in the thatch-mat layer increased in all three regimes, but the levels remained the same among regimes. However, the organic matter concentration (gravimetric organic: dry wt. of cores) was lower in cored plots. Organic matter concentration less that 110 g kg^{-1} was associated with better turf performance.

Spring and spring plus summer coring reduced quality for about two weeks, but generally had higher color ratings than non-cored bentgrass. Late summer quality was better in cored plots. Chlorophyll a and a+b levels were higher for spring and spring plus summer cored bentgrass in both years.

Summary Points

- Deep, infrequent irrigation produced a greater number of roots, longer roots, a larger root surface, lower soil temperature, less thatch, higher water soluble and total non-structural carbohydrates than light, frequent irrigation.
- Data indicated that summer core aeration should be avoided the first summer of establishment.
- Spring and spring plus summer-cored plots exhibited reduced quality for about two weeks, but generally had higher color ratings and chlorophyll a and b levels than non-cored plots.