Determination of Critical Thresholds of Soil Temperature and Heat Accumulation Capacity Controlling Summer Bentgrass Decline for Various Creeping Bentgrass Cultivars

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Objectives:

1. Determine critical (maximum and minimum) thresholds of soil temperature influencing shoot and root growth of bentgrass cultivars differing in heat tolerance.
2. Compare the effectiveness of lowering daytime vs. nighttime soil temperature in improving shoot and root growth under high air temperatures.
3. Develop heat accumulation models to predict the timing and severity of summer bentgrass decline for various creeping bentgrass cultivars under USGA-recommended putting green conditions.

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Project Duration: 3 years
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High soil temperature is a major factor leading to summer bentgrass decline. An experiment was conducted to determine the critical thresholds of creeping bentgrass decline. Roots of nine creeping bentgrass cultivars were exposed to a range of soil temperatures (20–35 C).

Turfgrass quality rating did not decline throughout the entire study at 20 C. At 25, 31, and 35 C, turfgrass quality declined at 47, 40, and 33 days, respectively. Chlorophyll content and canopy growth were not effective at determining timing of decline probably due to sampling.

Photosynthesis rate declined at 23 C. Leaf cytokinin content and root number declined at 27 C after 30 and 26 days, respectively. Turfgrass quality rating decreased at 35 C after 25 days. Photosynthesis rate was the most sensitive parameter, while leaf cytokinin and root number were intermediate. Turfgrass quality was the least sensitive parameter presented. Root harvest after 54 days provided additional information on the sensitivity of root characteristics to elevated soil temperature. Root dry weight declined at 23 C. Root activity, as measured by dehydrogenase activity, declined at 22 C.

Lowering soil temperature during the night helped maintain bigger and healthier root systems than lowering soil temperature during the day when air temperature was supraoptimal.

Photosynthesis rate was the most sensitive parameter with respect to increasing soil temperature. Of the weekly measurements, root number declined earliest and at the lowest soil temperature. Photosynthesis rate and root number may be useful for prediction of bentgrass decline. Also if turfgrass managers wait to see visual turfgrass quality rating decline before changing cultural practices, they will be about 2–3 weeks late.

An experiment was conducted to examine the differential effects of lowering day and night soil temperatures on shoot and root growth of creeping bentgrass. Lowering soil temperature was an effective means of improving turf quality, leaf chlorophyll content, shoot extension rate, and root number when air temperature was high. The effectiveness increased as soil temperature is reduced to a lower level, especially during the day. Night temperature reduction was more effective than day temperature reduction.

An experiment was initiated to construct and test heat accumulation models from field data. Secondary objectives were to compare summer stress tolerance of bentgrass cultivars and species and further examine parameter sensitivity to increasing soil temperature. Turfgrass quality declined after 18 AHU (cumulative sum of mean daily temperature minus base temperture , 23 C) for both mowing treatments (0.125 and 0.157 inches). Penncross had the lowest quality during summer stress periods. Turfgrass quality began to recover in late September and October. Photosynthesis rate declined after two AHU for both mowing treatments. Significant cultivar differences were observed. Visual declines in root quality occurred after as low as three AHU. These data indicate that phtosynthesis declines after the least heat accumulation, followed by root quality, chlorophyll content, and turfgrass quality.

Summary Points

- Lowering soil temperature was an effective means of improving turf and root growth when air temperature was high.
- The effectiveness increased as soil temperature is reduced to a lower level, especially during the day.
- Night temperature reduction was more effective than day temperature reduction in alleviating heat stress injury.
- Root number declined earliest and at the lowest elevated soil temperature.
- Photosynthesis rate and root number may be useful for prediction of bentgrass decline. Also if turfgrass managers wait to see visual turfgrass quality rating decline before changing cultural practices, they will be about 2–3 weeks late.
- These data indicate that phtosynthesis declines after the least accumulated heat units, followed by root quality, chlorophyll content, and turfgrass quality, respectively.