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 for 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-recomendation putting green conditions.

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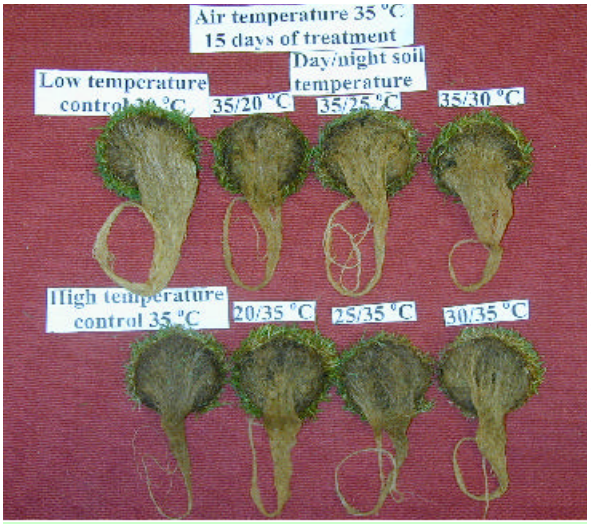
High soil temperature is a major factor leading to summer bentgrass decline. However, the critical thresholds of soil temperature that are high enough to cause the decline have never been documented, especially for creeping bentgrass cultivars differing in heat tolerance. No information is available on whether reducing daytime or nighttime soil temperature is more effective in improving shoot and root growth under high air temperature conditions. Furthermore, heat accumulation capacity that causes summer bentgrass decline for different cultivars is unknown. Such information is critical for the development of timely, effective management programs to prevent summer bentgrass decline.

An experiment was conducted in 2001 to examine the differential effects of lowering day and night soil temperatures on shoot and root growth of creeping bentgrass. The experiment was conducted in growth chambers using water baths to manipulate soil temperatures. Plants were exposed to the following temperature treatments: 1) optimal air and soil temperature during the day and night (20/20 C, day/night, control); 2) high air and soil temperature during the day and night (35/35 C, day/night); 3) lowering soil temperatures during the day (20/35, 25/35, and 30/35 C, day/night); and 4) lowering soil temperature during the night (35/20, 35/25, and 35/30 C) while air temperature was maintained at 35 ,C during the day and night.

Prolonged exposure of roots to lowering soil temperatures at 20 and 25 C during the day or night increased turf quality, chlorophyll content, shoot extension rate, and root growth in creeping bentgrass even though air temperature was supraoptimal. The effectiveness of heat injury alleviation increased as soil temperature was reduced to a lower level from 30 to 20 C.

Reducing soil temperature during the night to 20 C could maintain turf quality to the same level as the control. However, lowering soil temperature to 30 C during the day had almost no effects on turf quality and root growth. Reducing soil temperature to 20, 25, 30 C during the night generally was more effective than during the day in improving turf quality, chlorophyll content, shoot and root growth under high air temperature conditions. This suggests that night soil temperature is more important than day soil temperature in controlling shoot and root growth of creeping bentgrass. The physiological mechanisms of the differential effects of lowering day and night soil temperatures on creeping bentgrass are not clear, which deserves investigation.



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

Lowering soil temperature during the night was more effective than lowering soil temperature during the day to improve turf quality when air temperature was supraoptimal .

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.