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

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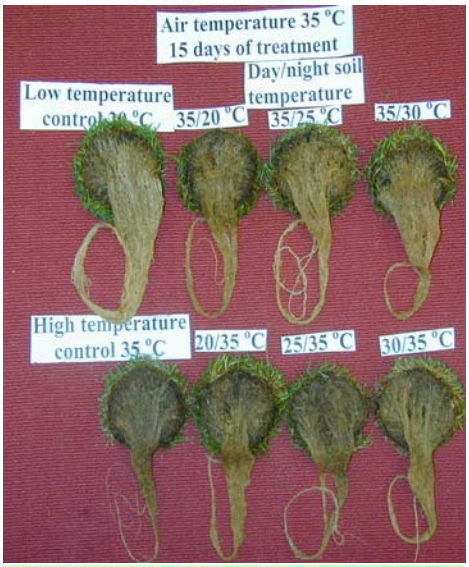
Objectives:

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 versus 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-specification putting green conditions.

Start Date: 2001
Project Duration: 3 years
Total Funding: $89,985

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).

This project involves three experiments. Each experiment addresses a specific objective. We have completed two studies in 2001 and 2002: 1) Determined critical (maximum and minimum) thresholds of soil temperature influencing shoot and root growth of bentgrass cultivars differing in heat tolerance; 2) Compared the effectiveness of lowering daytime versus nighttime soil temperature in improving shoot and root growth under high air temperatures.



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

The third study was designed to develop heat accumulation models to predict the timing and severity of summer bentgrass decline for various creeping bentgrass cultivars under USGA-specification putting green conditions. This requires data from field plots. Data were collected and analyzed for 2002. The 2003 trial is still in progress and will be completed at the end of October.

Results for the first two studies were reported last year. In 2003, we repeated the field study to evaluate cultivar variation in summer performance and determined the timing and the severity of summer bentgrass decline in association with accumulated heat units.

Nine creeping cultivars were planted in fall, 2000. Measurements were made from May to October in 2002 and June to October in 2003. Plots were mowed at two mowing heights (1/8 or 5/32 in.) in both years. Turf quality rating, photosynthesis rate, chlorophyll and water content, and root density (visual) decreased in summer months (to a greater extent at 1/8 in mowing height than at 5/32 in mowing). 'Penn A-4', 'L-93', and 'Century' performed best, while 'Putter' and 'Penncross' had the lowest performance in 2002.

Although similar trends in both years were observed, there was a two-to-three-week delay in turf quality decline in 2003 compared to 2002. Seasonal variation, cultivar difference, and mowing effects in all plant parameters evaluated were less dramatic in 2003 than in 2002. This is largely due to the difference in weather conditions between the two years. Summer 2002 was dry and hot while summer, 2003 was relatively cool and wet.

Soil temperatures at 2-, 4-, and 6-inch depths were monitored with thermocouples in both 2002 and 2003. Heat accumulation models will be developed using the data from the field and growth chamber studies when the data collection from the field plot is completed this fall.

The difference between environmental conditions in 2002 and 2003 will test the validity of the accumulated heat model. Other environmental factors, such as rainfall and humidity, may be necessary to construct a model. Conditions in 2002 consisted of a relatively warm spring with at hot, humid summer. A cool, wet spring in 2003 caused a delay in the decline of measured factors. These polar-opposite years will either validate or refute the soil accumulated heat theory.

Summary Points

- Nine creeping cultivars were planted in fall, 2000. Measurements were made from May to October in 2002 and June to October in 2003. Plots were mowed at two mowing heights (1/8 or 5/32 in.) in both years. Turf quality rating, photosynthesis rate, chlorophyll and water content, and root density (visual) decreased in summer months (to a greater extent at 1/8 in mowing height than at 5/32 in mowing).
- 'Penn A-4', 'L-93', and 'Century' performed best, while 'Putter' and 'Penncross' had the lowest performance in 2002.
- Heat accumulation models will be developed using the data from the field and growth chamber studies when the data collection from the field plot is completed this fall. The difference between environmental conditions in 2002 and 2003 will test the validity of the heat acumulation model.