The Importance of Carbon Balance and Root Activity in Creeping Bentgrass Tolerance to Summer Stresses

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Objectives:

1. Investigate the physiological factors that cause summer bentgrass decline and examine how carbohydrate metabolism influences the decline in creeping bentgrass root activity and turf quality under low mowing and high temperatures.

Start Date: 1998
Project Duration: 3 years
Total Funding: $75,000

Creeping bentgrass is the most widely used cool-season turfgrass on golf greens. Loss of bentgrass is observed on many golf courses every year during smmer months when golf greens receive maximum use. Attempts to extend bentgrass into transitional and warm climatic regions further accentuate the problem.

Some researchers have suggested turf quality decline of cool-season grasses could result from carbon imbalances due to reduced photosynthesis and increased respiration leading to carbohydrate starvation. This study focuses on the importance of carbon balance and root activity on summer bentgrass decline under high rootzone temperatures and close mowing.

Turf quality of all three cultivars was highest in May and declined to the lowest level in September and recovered in October. This growth pattern was true when mowed either at 1/8 inch or 5/32 inch. The difference in turf quality between the two mowing heights was not apparent. From June to late August, 'L-93' had the highest quality, 'Penncross' the lowest, and 'Crenshaw' was intermediate. Shoot clipping yield showed the same seasonal and cultivar variation as turf quality, but the decline in the summer was more severe than turf quality decline.

At Kansas State University, Dr. Bingru Huang demonstrates how bentgrass root systems are monitored in putting green field plots.

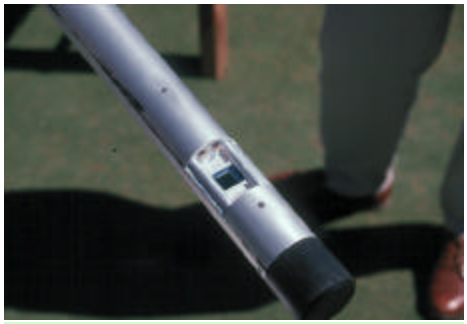
Electrolyte leakage of leaves for all three cultivars increased dramatically in August and September, suggesting that heat damage to leaves occurred in the summer months. Heat injury was more severe for grasses mowed at 1/8 inch than that mowed at 5/32 inch in September.

Seasonal changes in root dry weight followed a similar pattern as turf quality for all three cultivars. L-93 had higher root dry weight than 'Penncross' and 'Crenshaw'. Grasses mowed at 1/8 inch had lower root dry weight than those mowed at 5/32 inch for all three cultivars.

Root images were recorded monthly and will be analyzed for rooting depth, root mortality rate and root length. Nitrogen uptake capacity of roots was evaluated by ^{15}N tracing techniques. About 200 shoot and root samples were collected and stored for ^{15}N analysis.

The activities of antioxidant enzymes including superoxide dismutase, catalase , peroxidase, and ascorbate peroxidase, increased in the early summer and decreased dramatically in the middle of the summer. The activities of antioxidant enzymes recovered gradually when air temperature decreased in October. No significant difference in the activities of the antioxidant enzymes was found between 'L-93' and 'Penncross' under either mowing height. Raising mowing height from 1/8 inch to 5/32 inch increased enzyme activities only in early July.

Turf quality decline during high temperature periods in summer was associated with changes in the activities of antioxidant enzymes, indicating summer bentgrass decline could involve oxidative stress. Increasing antioxidant enzyme activities may help improve turf quality of creeping bentgrass during summer.



A video camera mounted in a tube is inserted into plexiglas tubes buried in putting green rootzones at Kansas State University.

Leaves and roots were collected monthly from May to October. Samples have been dried and stored for analysis. The content of total nonstructural carbohydrate, fructans, starch, glucose and sucrose are being analyzed. Seasonal changes in carbon allocation pattern was examined. About 400 shoot and root samples were collected during the entire growing season. Samples have been grounded and stored for ^{14}C analysis.

Summary Points

- Turf quality of all three cultivars ('L-93', 'Crenshaw', 'Penncross') declined over the summer as expected and recovered in October. 'Penncross' was the lowest throughout.
- Electrolyte leakage of leaves for all three cultivars increased dramatically in August and September and was more severe at the 1/8-inch cutting height than 5/32 inches.
- L-93 had higher root dry weights than 'Penncross' and 'Crenshaw'. Grasses mowed at the lower cutting heights had lower root weights.
- Antioxidant enzyme levels increased in early summer, decreased dramatically in the middle of summer, and gradually recovered in the October when temperature decreased.