Seasonal environmental factors affecting Poa trivialis physiology

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Objective:

Evaluate physiological responses of rough bluegrass to naturally occurring heat stress during the summer stress period.

Rationale:

Rough bluegrass exhibits poor heat tolerance that often affects its summer performance. It becomes most apparent as a weed at this time in creeping bentgrass fairways. Better understanding how rough bluegrass responds physiologically to heat stress will lead to improved management and control strategies.

Hypotheses:

1) Turf physical attributes (turf quality and shoot mass) will decline as temperatures increases throughout the summer stress period.
2) Total nonstructural carbohydrates and proteins will decline proportionately with turf physical attributes for both species.
3) Heat shock protein concentrations will vary among heat sensitive and heat tolerant cultivars of rough bluegrass.

Treatments:

2 rough bluegrass cultivars: Laser (heat tolerant) Pulsar (heat sensitive) and L93 creeping bentgrass
9 Harvests (4/21, 5/19, 6/10, 6/30, 7/21, 8/4, 8/18, 9/8, 10/14 in 2008)
(6 replications)

Location:

Daniel Center

Materials and Methods:

Plots were established by seed in August of 2007 and 2008 and sampling began/will begin in April of 2008/2009. Samples were collected once monthly in April, May, and June. Sampling frequency increased in July and August to biweekly intervals during peak summer stress. Sampling frequency then ramped back down to once monthly in September and October. Sampling frequency and dates may vary during the year depending on turf performance. Percent cover and turf quality of both species were measured throughout the growing season. Shoot samples taken from the field were harvested using a standard 4” cup-cutter. Above-ground tissue was then removed followed by freeze drying. Some fresh shoot material was extracted to perform chlorophyll content analysis and electrolyte leakage. Stolon samples were also gathered from the field by removing a divot of turf from field plots from which stolons were excised. Whole stolons were separated and the nodes were counted and stolon length measured. Stolons were then weighted and frozen for lab analysis. Preserved samples were later used to analyze total soluble carbohydrates and protein content. Gels are planned to identify heat shock proteins present in tolerant species. The study will be repeated in 2009.

Data Collection:

Field observations:

- Percent cover for both species will be assessed prior to sampling.
- Turf quality will be assessed prior to sampling using a 1 to 9 scale with 1 equaling bare soil, 7 being acceptable, and 9 representing ideal turf.
- Soil and air temperatures

Lab observations:

- Stolon dry weights
- Stolon counts
- Shoot dry weights
- Electrolyte leakage
- Chlorophyll content
- Total soluble carbohydrates will be analyzed using Anthrone method
- Total soluble proteins will be analyzed using Bradford Assays
- Gels will be run to detect heat shock proteins

Summary of 2008 Observations:

This particular study contains large amounts of data that has not yet been fully analyzed. However, some of the more interesting observations to date relate to changes in stolon morphology over the course of the growing season. Rough bluegrass and creeping bentgrass produce stolons that provide a means of lateral spread, energy storage, and recuperative potential following stress. Relationships between rough bluegrass and creeping bentgrass stolons observed in the field in 2008 include:

- Mild summer temperatures in 2008 resulted in minimal turf loss. However, temperatures did reach levels of intensity to induce turf decline (Fig 1).
- Stolon dry weights (mg/cm^2) increased throughout the growing season. As rough bluegrass and creeping bentgrass matured, stolon mass per area of soil surface increased similarly for both species. This increase in mass could be a result of individual stolons growing in size and/or greater numbers of stolons being produced (Fig 2).
- Dry weights per stolon (mg/cm) diverged between the two species between 21 July and 4 August of 2008. This separation suggests that creeping bentgrass produced more stolons than rough bluegrass, while rough bluegrass increased individual stolon mass more efficiently than creeping bentgrass. This difference in survival strategy may play a significant role in stress survival (Fig 3).
- Fewer nodes per cm of stolon were observed for both species as stolons matured through mid-year. Creeping bentgrass then began to increase the number of nodes per cm of stolon toward the end of the growing season (Fig 4).

Future Plans:

The study will be repeated in 2009 and protein separation gels will be run to identify changes in concentration of individual proteins in response to heat stress.

Figure 1. 2008 maximum air and minimum daily soil temperatures in West Lafayette, IN.

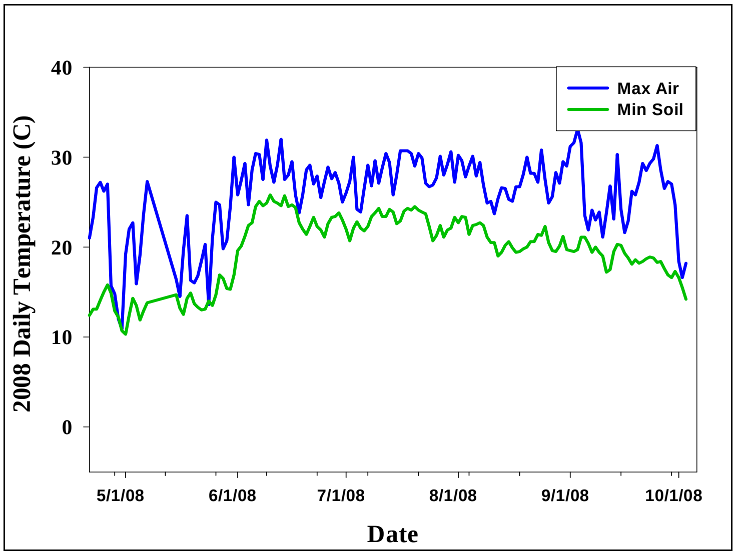

Figure 3. Mean dry weight per cm of stolon in 2008. Vertical bars represent standard deviations from the mean.

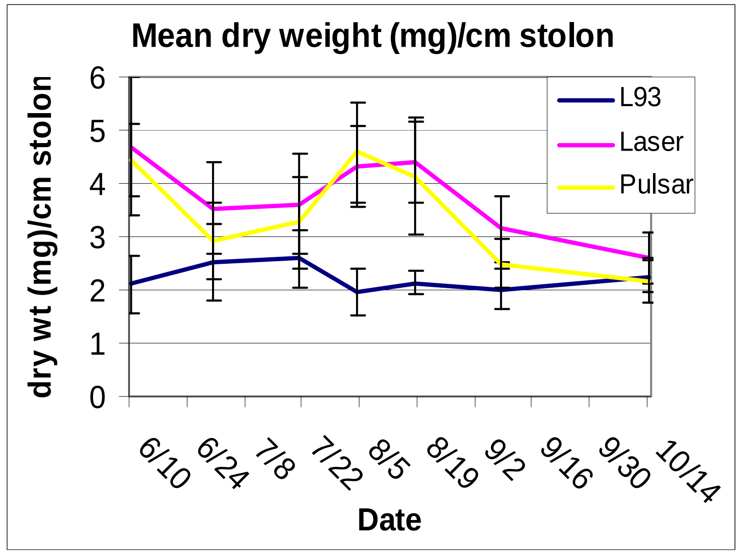

Figure 2. Mean dry weight of stolon per area of soil in 2008. Vertical bars represent standard deviations from the mean.

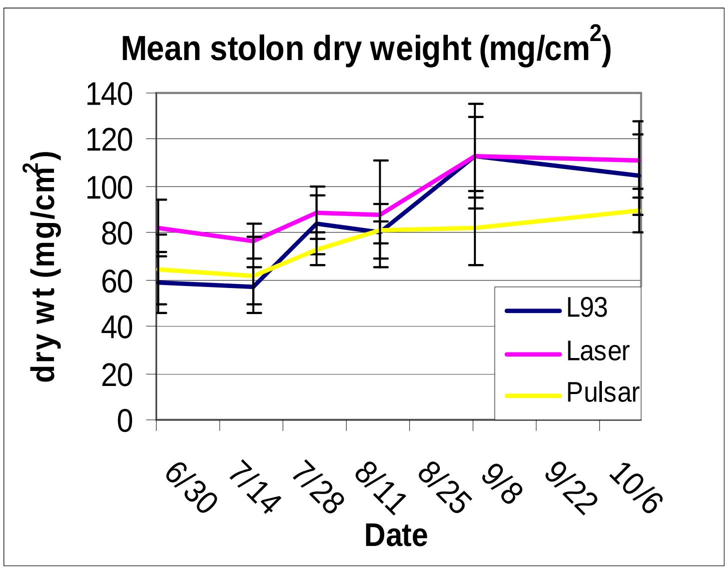

Figure 4. Mean nodes per cm of stolon in 2008. Vertical bars represent standard deviations from the mean.