Examination of Cold Deacclimation Characteristics of Creeping Bentgrass and Annual Bluegrass

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Objective:

1. To determine the temperature degree and duration combinations that result in a loss in freezing tolerance of creeping bentgrass and annual bluegrass.

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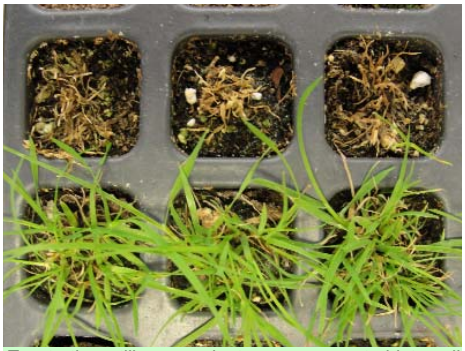
Project Duration: 1 year
Total Funding: $3,000

Fluctuations in soil temperatures during winter months can negatively impact turfgrass freezing tolerance levels and enhance susceptibility to freezing injury. Some limited research suggests that annual bluegrass (*Poa annua* L.) and creeping bentgrass (*Agrostis stolonifera* L.) may differ in their capacity to resist deacclimation, which can contribute to interspecific differences in winter injury potential. In order to understand the physiological basis of winter deacclimation, we needed to first quantify the critical temperature thresholds leading to deacclimation of annual bluegrass and creeping bentgrass.

Plant material consisted of one annual bluegrass ecotype obtained from researchers at Agriculture and Agri-Food Canada, Quebec, that was previously shown to exhibit sensitivity to freezing temperatures. For comparison, one creeping bentgrass cultivar ('L-93') was obtained from the Joseph Troll Research Center, University of Massachusetts. Two to three tillers per plant were propagated into cell trays (10 x 20 cm) and maintained in a greenhouse under optimal conditions for 3 weeks. Following establishment, plants were moved to a controlled environment growth chamber to initiate treatments.



Two to three tillers per plant were propagated into cell trays (10 x 20 cm) and maintained in a greenhouse under optimal conditions for three weeks.

Before plants were subjected to deacclimation treatments, they were cold acclimated at 2° C for 2 weeks, followed by -2° C for 2 weeks. The baseline freezing tolerance values for annual bluegrass and creeping bentgrass were determined following this cold acclimation period.

Next, plants were exposed to one of six deacclimation treatments which consisted of the following temperature degree and duration combinations: 4° C for 1 or 5 days, 8° C for 1 or 5 days, and 12° C for 1 or 5 days. Changes in freezing tolerance were determined based on controlled freeze tests from -6 to -21° C.

The lethal temperature at which 50% of plants were killed (LT_{50}) was determined by curve fitting percent survival to temperature using a four-parameter sigmoid model. In addition, leaf extension was measured to evaluate changes in growth associated with exposure to deacclimation treatments.

Following cold acclimation, the freezing tolerance of creeping bentgrass (LT_{50} of -19.2° C) was greater than that of annual bluegrass (LT_{50} of -14.3° C). There were no significant changes in freezing tolerance when creeping bentgrass was exposed to 4° C for either 1 or 5 days. However, the freezing tolerance of annual bluegrass declined when exposed to 4° C for either 1 day or 5 days.

For creeping bentgrass, deacclimation was not observed until plants were maintained at 8° C for 5 days. As expected, the greatest change in freezing tolerance occurred when plants were exposed to 12° C, where freezing tolerance of creeping bentgrass and annual bluegrass declined to approximately -8.5° C and -6.1° C, respectively.

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In addition to observed changes in freezing tolerance, the deacclimation temperature treatments also influenced leaf growth. In general, leaf growth did not change following exposure to 4° C, whereas increases in leaf growth were detected in response to both 8° C and 12° C. There were no significant differences in leaf extension among the two species, which suggested a lack of strong association between interspecific differences in deacclimation potential and leaf growth rate.

Summary Points

- Fluctuations in soil temperatures following cold acclimation can lead to a decrease or complete loss in freezing tolerance, and therefore predispose plants to freezing injury.
- Deacclimation of annual bluegrass and creeping bentgrass was observed in response to 4° C , 8° C , and 12° C whether exposed to 1 day or 5 days.
- Annual bluegrass deacclimated to a greater extent at a lower temperature, which may account for greater susceptibility to freezing injury for this species.