Resistant Turfgrasses for Improved Chinch Bug Management on Golf Courses

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Objectives:

1. Evaluate selected cool- and warm-season turfgrasses for resistance to chinch bugs in the *Blissus* complex.
2. Investigate the biochemical and physiological responses of buffalograss to chinch bug feeding.
3. Identify genes conferring resistance to chinch bugs.

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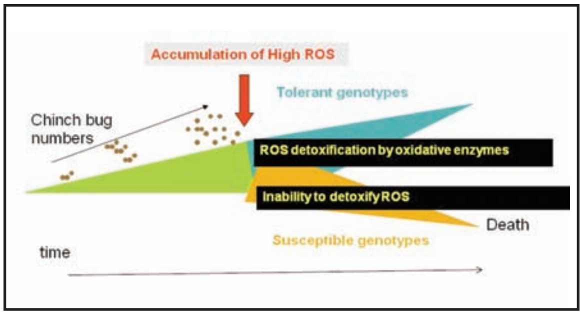
The overall goal of this research is to identify chinch bug-resistant turfgrasses, investigate the mechanisms of this resistance, and identify specific genes contributing to the resistance. Knowledge of specific resistance mechanisms is valuable for identifying biochemical and physiological markers for use in germplasm enhancement programs, and for characterizing plant defense strategies to insect feeding.

We continue to evaluate selected warm-season turfgrasses for resistance to chinch bugs. Of the 100 buffalograss genotypes evaluated in greenhouse and field studies, four have been categorized as highly resistant ('Prestige', NE 184, NE 196, and NE PX 3-5-1) and 24 as moderately resistant. Of the resistant buffalograsses studied, 'Prestige' exhibited the highest level of resistance even though it often became heavily infested with chinch bugs. Subsequent choice and no-choice studies characterized 'Prestige' as tolerant.

A second component of this research investigated the underlying biochemical and physiological mechanisms responsible for chinch bug resistance. The impact of chinch bug feeding on the physiological responses of resistant and susceptible buffalograss has been evaluated through gas exchange and chlorophyll fluorescence measurements at specific time intervals using established procedures. These studies have demonstrated that resistant plants can generate energy for recovery from chinch bug feeding. Susceptible plants appear unable to maintain compensatory photosynthesis and, as a consequence, suffer substantially more tissue damage from chinch bug feeding.

Our research also focused on characterizing protein changes, specifically oxidative enzymes, in resistant and susceptible turfgrasses challenged by chinch bugs and explored the value of these changes as protein-mediated markers to screen for insect-resistant turfgrasses. Reactive oxygen species (ROS), such as hydrogen peroxide, are known to be important early signals for altering gene expression patterns in plant cells in response to abiotic and biotic stressors.



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Despite the benefits gained from reactive oxygen species molecules like hydrogen peroxide as defense signals, accumulation of these molecules can be toxic to cells. To protect themselves from the effects of ROS accumulation, plants have developed oxidative enzymes that break down ROS. Peroxidase, catalase, and superoxide dismutase have all been documented as ROS scavengers in plants stressed by insects and pathogens.

Research by our group has documented increased levels of peroxidases following chinch bug feeding in the resistant buffalograss, 'Prestige', and a loss of catalase activity in the susceptible buffalograss, '378'. These findings support our working hypothesis that an initial plant defense response to chinch bug feeding is to elevate the levels of specific oxidative enzymes, such as peroxidase, to help detoxify peroxides that accumulate as a result of plant stress (see figure).

Native gels stained for peroxidase have identified differences in the isozyme profiles of resistant and susceptible buffalograsses. Studies are currently underway to identify these specific peroxidases and measure their expression over time in buffalograsses challenged by chinch bugs using qRT-PCR.

Our group has successfully constructed and characterized two subtracted cDNA libraries. These libraries were prepared from the resistant buffalograss 'Prestige' and the susceptible '378' buffalograss 5 days after initiation of chinch bug feeding. Several transcripts showed significant levels of change in 'Prestige' (resistant) when compared to the chinch bug susceptible buffalograss '378'.

These transcripts were cloned, sequenced, and categorized according to putative function. These assays indicated up-regulation of three defense-related transcripts in the resistant 'Prestige' buffalograss, but not in the susceptible buffalograss '378'.

Summary Points

- Warm-season grasses with resistance to chinch bugs in the *Blissus* complex have been identified.
- Commercial production of 'Prestige' provides consumers with a high quality buffalograss with improved chinch bug resistance.
- We hypothesize that peroxidases and other oxidative stress enzymes are playing multiple roles in the resistant plant's defense response, including the downstream signaling of plant defense reactions to chinch bug injury and/or efficient removal of reactive oxygen species.
- This research identified genes differentially expressed in response to chinch bug feeding and will serve to increase the genomic resources available for buffalograss and facilitate development of improved turfgrasses with resistance to chinch bugs.