APPLYING SUGARS TO ENHANCE SHADE TOLERANCE IN TURFGRASS

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How can we ensure peak performance of turfgrass? The logical first step is to select the correct grass for the environment in which it will be established. We look to the turfgrass breeders to give us cultivars that can tolerate the environment and management systems to which the turf will be subjected. Even with all the diversity that we have available, the conditions under which we manage turfgrass can be extreme. Turfgrass is sometimes pushed to its physiological limits to provide a uniform surface.

Uptake of carbon, through the photochemical reactions of photosynthesis and the subsequent synthesis of sugars, is required for all of the building blocks necessary for turfgrass growth. These processes are totally dependent on light. Decreased photosynthesis under lower light gives less production of sugars. Thus with fewer resources, the negative impact of stresses like wear, water, or disease and pest pressures cannot be overcome because re-growth cannot be supported. Improving shade tolerance is a top priority for turfgrass management: on golf courses; for sports turf; in the landscape; and for utility turfgrass. Is it possible to reduce demand for limited resources and thereby improve turfgrass performance by supplementing photosynthesis (via sugar foliar applications) or by slowing down growth with plant growth regulators (Primo® - trinexapac-ethyl)? The objective of the work presented here is to investigate these questions.

MATERIALS & METHODS

Experiments were initiated at the Hancock Turfgrass Research Center, Michigan State University, East Lansing, Michigan. Cultivars commonly managed for sports turf use included: Supina, Kentucky Bluegrass, Bermudagrass and Zoysiagrass. All turfgrasses were established in GreenTech ITM modules in full sun summer during 2002 and then the entire experiment was repeated in 2003. After establishment, modules were moved into the simulated sports dome facility in late August of both years. Turfgrasses were maintained under ambient light, with temperature and RH monitoring through December. Athletic field standards for mowing, fertility, and irrigation were followed. Treatments consisted of 1.25% fructose dissolved in water + organo-silicone adjuvant (Break Thru, 0.1% w/v) applied 0, 1X/week, and 2X/week. Primo® was applied at a rate of 0 or 0.3 oz/module applied Aug 26, Oct 7, & Nov 18, 2002. Controls did not receive fructose or Primo® applications. Traffic was applied bi-weekly to each module with Cady Traffic Simulator-CTS, for an 8 game NFL schedule. Turfgrasses were evaluated based on: 1) turf quality (turf density, shear tolerance, and surface hardness) and 2) physiological status (chlorophyll content, carbohydrate metabolism, and overall plant stress measured by leaf reflectance).

RESULTS

Visually all turf grasses except Bermudagrass respond most favorably to weekly application of fructose and Primo® through Oct. Chlorophyll concentrations varied dramatically among cool and warm season turfgrasses when grown in full sun. Total extracted chlorophyll concentrations were 32, 25, 23, and 6 mg/ml for Kentucky Bluegrass, Bermudagrass, Supina, and Zoysiagrass, respectively. After the turfgrasses were moved to the shaded conditions of the dome, both chlorophyll-a (responsible for photosynthetic reactions) and chlorophyll-b (responsible for harvesting light energy) declined(from August to December) under shaded conditions. However, the magnitude of the decrease for chlorophyll-b was nearly twice that of chlorophyll-a for the same turfgrass species and time intervals. Thus when the ratio of chlorophyll-a and -b are compared, the ratio of chlorophyll a/b *increased* for both warm and cool season turfgrasses over the same time intervals Such a decline has been associated with decreased leaf nitrogen in previous studies. Leaf reflectance measurements indicated that all turfgrasses exhibited a loss of photosynthetic efficiency and vigor under extended shade conditions (December), irrespective of fructose and/or Primo® applications. This loss of efficiency would be expected to occur given the decline in chlorophyll-b.

Conclusions

Applications of fructose and Primo® extend turf shade tolerance for Supina and Kentucky Bluegrass past mid-fall ambient light conditions, with some benefit to Zoysiagrass. However, chlorophyll concentrations decline irrespective of fructose and/or Primo® applications. Previous studies have shown that the chlorophyll which constitutes the light-harvesting complex (chlorophyll-b) will normally increase under shaded conditions to increase the amount of light that is used for photosynthesis. However, when the ratio chlorophyll-a and -b are compared in this study, the ratio of chlorophyll a/b *increased* for both warm and cool season turfgrass over the same time intervals. These turfgrass species were unable to allocate the necessary resources to maintain or increase chlorophyll-b content in leaf tissue. So, application of fructose and/or Primo cannot indefinitely replace sunlight. Loss of chlorophyll under extended shade may be exacerbated by a decrease in leaf N. Thus, a better understanding of the interaction between exogenous sugar application and how we manage turfgrass under insufficient light is needed.

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