Bermudagrass Sprig Heat Tolerance

High temperatures may be an unrecognized problem for many bermudagrass sprig shipments, and especially for putting greens.

by DR. EARL ELSNER and DOUG McWHORTER

Variable bermudagrass sprig establishment 40 days after planting.

THE NEW ultradwarf bermudagrass varieties are raising player and superintendent expectations for bermudagrass putting greens. Under ideal conditions it is possible to play the first round of golf within six weeks after sprigs are planted. Sprig planting rate and quality determine if that goal can be reached. Unfortunately, sprig quality will be severely compromised if they generate extreme heat in transit from the sprig farm to the golf course. Control of sprig temperature after harvest is vital for maintaining high quality sprigs for rapid and uniform grow-in.

This article will discuss temperature studies that we conducted in 1998 and 1999 in association with Ralph Hinz, golf course superintendent, as he renovated the Plantation Course at The Landings in Savannah, Georgia. It also will describe the characteristics of greens planted with heat-damaged sprigs and review some of the research conducted to assess the severity of the problem. Finally, suggestions for superintendents who are purchasing bermudagrass sprigs will be provided to assist in making the grow-in as rapid and problem-free as possible.

The Situation

TifEagle sprigs were harvested for the Plantation Course from the Seed Commission's foundation field in mid-afternoon on Friday in early July. They were delivered early Saturday morning, the next day. Typical Southeast procedures for harvesting, packaging, and transporting the sprigs were used. The grass foliage was dry, ambient temperature was in the mid-90s, and the soil was approximately at field capacity. Most of the greens were planted on Saturday (ca. 18-28 hours after harvest), and the remainder were planted Sunday morning (ca. 40-45 hours after harvest). Ralph indicated that when they opened the boxes the sprigs were "really hot and had a bad odor."

Twelve days after planting Ralph described the putting greens as follows:

- Regrowth had started, it was not uniform, there were large areas with only a few living plants, and some areas had more dead plant material than live plants.
- Of the living sprigs, many had only one or two growing points with a single green leaf.
- The first-planted greens had more and better growth than the last planted.
- There was no pattern except the first greens planted were better than the last planted.
- Dead sprigs planted at the proper depth were in the same row and adjacent to living sprigs that were planted at the proper depth or were on the surface.

A new shipment of sprigs was arranged. When the boxes were opened (18 hours after harvest), they also were hot and had a pungent odor. The temperature in the center of the sprig mass was 145°F. Near the top and edges of the 48" × 45" × 50" cardboard box, the temperature was about 100°F.

Cardboard boxes fitted with 4-mil plastic bags have been used effectively to limit the oxygen in the enclosed sprig mass.

During the next few days, we contacted several growers and were told that no one ever has a problem with sprig survival on putting greens if the superintendent does his job and keeps the sprigs watered. They indicated that the only time that high temperatures are a problem is when wet grass is harvested. I also checked with two courses that were planted about the same time as the Plantation Course. Neither thought they had a problem and described grow-in as normal. However, under close questioning, the appearance and growth of the sprigs were described as being very similar to the sprigs at the Plantation Course. Thus, it seems likely the sprig quality and resultant grow-in experience at the Plantation Course may reflect an unrecognized problem with many sprig shipments and newly planted putting greens.

Researching The Problem

We conducted several experiments during the next few months to:

- Reproduce the high temperatures,
- Determine the temperature response of different varieties,
- Quantify the effect of high temperatures on sprig viability, and
- Develop an economical way to maintain acceptable temperatures in harvested springs.

The results of these tests revealed some interesting conclusions:

- The temperatures inside a 48" × 45" × 48" cardboard box filled with either Tifdwarf or TifEagle sprigs rose as much as 2.5°F per hour.
- The highest temperature measured in a box of sprigs was 160°F, 40 hours after harvest.
- There was no difference in the rate of temperature rise in Tifdwarf or TifEagle sprig boxes.
- Tifway and TifSport averaged about 1°F temperature rise per hour in aluminum trailers.
- Temperatures increased more rapidly when sprigs were harvested during periods of active plant growth than in late fall and early spring.
- Removal of all soil and thatch appeared to limit the temperature buildup,
- Neither the harvest time of day nor moisture on the leaves affected the rate of temperature rise.
- The center of a 48" × 45" × 48" box was significantly hotter than the edges. When the sprigs in the center of the box reached 145°F, approximately 50% of the entire box of sprigs had a temperature greater than 120°F.
- Sprigs can tolerate 110°F for an extended period and 120°F for 8-10 hours. However, after six hours at 120°F, regrowth is delayed and after 10 hours the percent of surviving sprigs is significantly reduced.
- After four hours exposure to 130°F, only 30% and 60% of the sprigs developed new shoots in 8 and 14 days, respectively. The surviving sprigs had fewer growing points and leaves.
- Exposure to 140°F caused almost 100% sprig death within one hour.
- Tifdwarf and TifEagle had similar patterns of regrowth after exposure to high temperatures.

What Really Happened at the Plantation Course?

The sprigs simply got too hot before they were planted. Sprigs that were subjected to high, but not lethal temperatures were slower to initiate new growth and had fewer growing points.

When the greens at the Plantation Course were planted, baskets were filled directly from the sprig boxes and spread on the green's surface such that sprigs from the center of a box were planted in the same general area and sprigs from the top were planted in another area. The part of the green that was planted with baskets filled from near the center of the box (130°-140°F) had a lot of dead material and poor regrowth. Some of these sprigs did not develop a new leaf until day 13. In contrast, areas planted with sprigs from the edges of a box (100°F) grew normally. These healthy sprigs on day 13 had several active growing points, each with 2-3 new leaves. Thus, growth on the green was uneven and overall coverage was significantly delayed. This was due not only from slow sprig regrowth, but also because the areas with a high percentage of dead sprigs had larger voids that required more time to fill in.

If the sprigs from each box had been thoroughly mixed before planting, the growth response would have appeared quite different. Rather than having areas with good, fair, or poor growth, it would have appeared that the average sprig survival was about 50%, but uniform across the entire green. The greens planted on Sunday would still have had less survival than the greens planted on Saturday because more sprigs in each box would have been subjected to lethal high temperatures during the extra day.

Fixing the Bug

We have concluded that the temperature rise in the sprig mass was due to heat generated by plant and microbial respiration. Additional studies

determined that the temperature rise can be reduced by sealing the sprig mass from oxygen because much less heat is generated in an anaerobic environment.

Most important, bermudagrass sprigs grow quite well after being in an anaerobic environment for several days. We have demonstrated that sprig regrowth is excellent after five days without oxygen.

Avoiding High Temperatures During Shipment

Growers who harvest and plant the same day or who use refrigerated trucks to transport sprigs avoid overheating problems. Excessively high temperatures do not appear to be a problem in late fall or early spring shipments or with growers who harvest sprigs with very little soil or thatch.

When sprigs are at risk from potential high temperatures, they can be placed in an anaerobic environment (sealed from oxygen), and maintain high quality for at least five days.

The most effective method we have found for limiting the oxygen in the sprig mass is to place the sprigs inside large 4-mil plastic bags inside the normal cardboard boxes. The bags should be large enough so that the top can be folded and sealed.

The following example illustrates the effectiveness of creating an anaerobic environment for bermudagrass sprigs while in transit to a planting site. Seven 48" × 45" × 51" cardboard boxes of TifEagle sprigs were shipped from Adel, Georgia, to Phoenix, Arizona, during May 1999. In six of the boxes, the sprigs were enclosed in plastic bags to exclude oxygen. The sprigs in the seventh box were not in plastic bags and thus obtained oxygen for normal respiration through the sides and top of the cardboard box. The temperature in the center of the seventh box was 160°F, 40 hours after the harvest. The temperature in the center of the boxes with plastic bags was only 98°F, 64 hours after harvest. Most of the sprigs in the seventh box were dead or of very poor quality. The sprigs in the six anaerobic boxes were healthy and produced excellent, uniform regrowth even when planted 3½ days after harvest.

Evaluating a Shipment of Sprigs

Superintendents are understandably concerned about the potential for diminished sprig vigor and regrowth. The best way to determine if high temperature is a problem is to check the sprig temperature. It should be measured immediately upon opening a container, and the probe should be placed several inches below the surface.

Since an entire box does not reach the same high temperature and since the time of exposure is critical to assess the potential loss of vigor, it would be almost impossible to describe every situation that a superintendent might face and provide the appropriate guidance. A better alternative is for the superintendent to be aware of potential high temperatures and discuss the matter with the sprig supplier before harvest and shipment.

The question remains, however, at what temperatures should a superintendent reject bermudagrass sprigs?

- Short-term exposure (< 5 hours) at 120°F usually does not cause significant deterioration in sprig quality.
- If the temperature is measured in the 130°F range, there will be a reduction in the number of sprigs that are capable of regrowing, and the ones that regrow will be slower to produce new leaves and will have fewer growing points.
- Almost all sprigs that are exposed to temperatures exceeding 140°F will be dead. These also usually have a pungent odor.

Are There Other Concerns About High Temperatures?

Planting bermudagrass sprigs in hot, dry soil will give the same results as high temperature storage. Dry soil temperatures in direct sunlight can exceed 130°F when ambient temperatures are near 100°F. The soil temperature under the same conditions but with moist soil will be below 100°F. Thus, only one hour in excessively hot soil between planting and the first irrigation may result in near failure of otherwise high quality sprigs. It is best to plant in moist soil.

Conclusions

Although the best people and plans can be in place, the first requirement for a successful bermudagrass putting green is healthy sprigs. These studies have shown bermudagrass sprigs to lose vigor when exposed to 120°F for six hours. Furthermore, a high percentage of bermudagrass sprigs are incapable of producing new growth after one hour of exposure to 130°F. While it is possible to grow an excellent putting green with high temperature damaged sprigs, the grow-in time is significantly increased and the initial uniformity may be poor.

Tifdwarf and TifEagle have similar temperature responses and rates of temperature increase in sprig containers.

Reducing the oxygen supply to the sprig mass by enclosing sprigs in polyethylene bags will allow sprigs to be shipped at ambient temperatures and retain excellent quality.

DR. EARL ELSNER *and* DOUG McWHORTER *are with the Georgia Seed Development Commission at Athens, Georgia. They are responsible for genetic purity of Tifway, Tifdwarf, TifEagle, and TifSport, plus more than 65 varieties of other crops developed by the University of Georgia and USDA plant breeding programs.*