TURFAX™

of the International Sports Turf Institute, Inc.

The International Newsletter about Current Developments in Turfgrass

Volume V Number 2 March-April 1997

CONTENTS:

J B Comments: Ducks and Moles

To the right are comments on discouraging excessive populations of geese. At our northern Michigan summer place I have had a similar experience. In this case the problem is ducks on boat docks and the excrement problem. My desk is an office with a glass overlooking the dock area 100 feet away. Each time ducks appear on the dock, I immediately go out and chase them off. If this is done repeatedly for about two days the problems is solved. The ducks remain in the area but stay off of the dock. Again, they do not seem to like the disturbance.

On another wild life issue, a severe mole problem developed on my turfed lawn. The numbers were such that trapping is erratic. For years I have given the recommendation of killing off the food source, specifically the soil insects. Following my own advice, I found the majority of the mole problem has been solved. The exception is occasional short tunnel probes into the area for food. Now my neighbor has the mole problem. Failure to provide timely control of the insect food source results in a distinct rise in the mole damage.

The next step is to get the rabbits under control.

THE GEESE PROBLEM:

A few geese are a nice wildlife feature on turfed golf courses and parks. These few may attract more geese, until the numbers exceed the capacity of the site. Defoliation of the grass cover and coverage of the soil with excrement become serious problems. Practical experience in the field is now accumulating concerning relative successes and failures of various methods to discourage excessive numbers of geese on turfed areas such as golf courses and parks.

The irritant sprayers that have been developed require frequent reapplication, and are quite expensive. To date they have not been used to any significant extent. The method of using trip wires along the waters edge is quite costly and has some limitations.

The method that seems to be achieving the most success is the use of a dog to herd the geese off the turfed area onto adjacent water areas. Using this approach at 30 minute intervals continuously throughout consecutive days eventually results in significant success. The geese eventually get tired of the disturbance and move on to more quiet sites. It may take from 8 to 14 days of continuous disruption of their feeding pattern on the turfgrass areas until the geese depart. The procedure may need to be repeated occasionally as visiting geese test a potential new habitat site. The key to success is a properly trained dog and a persistent effort.

NOTE: As of May 10, 1997, the ISTI will operate from the summer office:

International Sports Turf Institute, Inc.
6900 E. Kelenski Drive
Cedar, MI 49621
Phone: 616-228-6328; Fax: 616-228-2848

WINTERKILL CAUSES:

In many areas in the northern portion of the cool-humid region of North America, extensive ice sheets were laid down early before the first snow fall for the 1996-97 winter. The depth of this ice was 2 to 3 inches (50-75 mm) in a number of areas. As a result my phone has been busy with incoming calls this winter. A number of articles written by certain turfgrass agronomic consultants have appeared relative to low-temperature kill particularly in relation to ice sheets. Some of these articles list one of the causes of winterkill as crown hydration. This is a totally incorrect concept. The term crown hydration is just now becoming widely used, but was introduced in 1973 in Turfgrass: Science and Culture.

The basic cause of direct low temperature kill in this case is a temperature sufficient low to cause lethal ice crystal formation within the meristematic plant tissues, which in many species are the crowns. The higher the water content in sensitive tissues like the protoplasm of cells the greater the potential for direct low-temperature kill. Thus, a high crown hydration level predisposes the plant to the potential for kill should sufficiently low temperatures occur, but it is <u>not</u> a cause of winterkill.

During the autumn hardening of grass plants, some species have an ability to lower the crown hydration level substantially, and these species typically have the greatest tolerance to direct low temperature kill. For example, normal tissue water contents are in the +85% range. During the autumn hardening period prior to entering winter dormancy, certain turfgrass species such as the bentgrass (*Agrostis*) species can lower their meristematic crown water contents to the 65 to 70% range. This contrasts with normal growing conditions wherein a tissue water content of 60% could result in death by desiccation. In contrast, other species such as the ryegrass (*Lolium*) species can barely lower their meristematic-crown water content to 80% during hardening, and accordingly tend to be very prone to direct low temperature kill.

Turfgrass and soil cultural practices that (1) cause higher tissue water contents or (2) impair surface and internal soil water drainage will result in higher crown hydration levels and increase the potential for direct low temperature kill. Cultural practices such as excessive nitrogen fertilization tend to increase the crown hydration level, while high potassium levels reduce the potential for direct low temperature kill.

UPCOMING JB VISITATIONS:

Provided for Institute Affiliates who might wish to request a visitation when I'm nearby:

- May 7 to 9 - Columbus, Ohio.
- May 21 to June 6 - England, Netherlands, Belgium, and Germany.
- June 7 to 14 - Torino and Rome, Italy.
- June 18 to 19 - Sea Island, Georgia.
- July 8 to 10, Woodstock, Vermont.
- July 17 to August 4 - Australia.

ISTI Chief Scientist: James B Beard
TURFAX™ Production Editor: Harriet J. Beard

The goal of the six issue per year TURFAX™ newsletter is to provide international turf specialists with a network for current information about turf. This newsletter is faxed to all Institute Affiliates that use the ISTI technical assistance services on an annual basis. Faxing is more costly, but ensures quick delivery to those outside the United States.

For non-affiliates, a TURFAX™ subscription is **available by annual payment of U.S. $60.00.** Payment may be made by sending a check to the address given below. Foreign orders please send a check or money order on a U.S. bank.

Direct inquiries to:
International Sports Turf Institute, Inc.
1812 Shadowood Drive
College Station, Texas 77840 USA
Telephone: (409) 693-4066
Fax: (409) 693-4878

JB VISITATIONS:

February - Las Vegas, Nevada.

Participated in the GCSAA Annual International Turfgrass Conference and Show. Another attendance record was set. This was the first showing of the book **Color Atlas of Turfgrass Diseases** authored by Dr's T. Tani and J.B Beard and published by Ann Arbor Press. The initial response and demand for this book has been outstanding, with a second printing scheduled shortly. The book is listed on page 2 of the December-November 1996 Turfax, including a description and procedures for purchase.

March - Montreal, Quebec, Canada.

Participated as a speaker in the Annual Canadian National Turfgrass Conference, plus was involved in an author autograph session for the **Color Atlas of Turfgrass Diseases.**

Direct low temperature kill of turfgrasses either prior to the first freeze or following the thaw of ice sheets was discussed at length. A number of golf courses in Canada in locations where this is a reoccurring problem are now using solid plastic covers placed upon problem putting greens prior to the occurrence of ice sheets. The approach has been quite successful except for one small problem, and that is leakage of water onto the turf through the factory manufactured seams. The main objective in this approach is to minimize standing water on the turf which results in increased crown hydration. If this situation is followed by a rapid freeze to below 20°F (-7°C) there is a greatly increased potential for turf loss due to direct low temperature kill.

Terminology:

Scald - grass shoots standing in very shallow water are exposed to lethal temperatures caused by exposure to solar radiation that rapidly heats the water. The shoots collapse and turn white.

SPRING CULTURAL PRACTICES:

The spring of 1997 has been a very cool one in many locations. While the timing spring greenup of turfgrasses has been reasonably normal, subsequent initiation of significant shoot growth has been greatly delayed by as much as a month, specially in the southern United States on warm-season turfgrasses.

In this situation, it is important to make the correct decisions relative to nitrogen fertilization. In the past there have been turfgrass managers who would make a nitrogen application in the spring, and obtained no response. After 14 days they would make a second nitrogen application with no response, and in some cases would even make a third application. What these individuals failed to realize was that the soil temperatures had not achieved sufficiently warm levels to permit significant shoot growth to occur. No amount of applied nitrogen was going to change the situation. As a result, when the soil temperature finally did warm up to adequate levels for shoot growth, the explosion in leaf production associated with the excessive nitrogen levels created serious problems.

For C_4, warm-season perennial turfgrasses spring greenup occurs when soil temperatures at a 4-inch (100 mm) depth reach 64°F (18°C). However, significant amounts of shoot growth do not occur with these species until soil temperatures are above 70°F (21°C).

In the case of C_3, cool-season turfgrasses significant amounts of shoot growth do not occur until soil temperature rise to above 50°F (10°C) with substantial rates of shoot growth occurring above 55°F (13°C).

There are several other factors that affect the rate of soil warming. For example, closely mowed turfs warm up more rapidly than high cut turfs due to the relative differential in shoot biomass insolation. Also, poorly drained, wet soils warm up much more slowly than well-drained .drier soils due to the high specific heat of water. Finally, dark colored surfaces will warm up more quickly than light colored areas.

MODERATING HEAT STRESS ON TURFGRASSES

by

Dr. James B Beard
International Sports Turf Institute, Inc.

Introduction

Unfortunately, too many turfgrass managers attempted to solve summer turf problems by just removing pest protection chemicals from the shelf and applying them at intervals as close as two days. This is done without having properly diagnosed that a disease problem exists.

Apparently some turfgrass manager have difficulty accepting the possibility that the loss of turf is occurring as a result of an environmental stress such as heat. Perhaps this is due to a lack of understanding of plant stress resulting from super-optimal temperatures. Thus, the thrust of this article will be to provide an understanding of the heat stress kill mechanism and heat stress resistance, plus the cultural approaches for minimizing heat stress.

UNDERSTANDING HEAT STRESS

Heat stress is most commonly a problem with C_3, cool-season turfgrasses, especially when attempts are made to extend them into the transitional and warm climatic regions. For example, creeping bentgrass (*Agrostis stolonifera*) for putting greens is being extended well beyond its normal adaptation limits in terms of heat stress. Heat stress typically is most severe on turfgrasses under conditions characterized by extraordinarily high temperatures and high humidities, that are sustained for several months. Also, periods with an absence of wind movement further accentuate the high heat and humidity levels near the surface of the turfgrass. Early summer high air temperatures with cool soil temperatures are not nearly as stressful as late summer periods when both the air and soil temperatures are at heat stress levels. This is because a high soil temperature is the most critical heat pool affecting the turfgrass plant.

Lethal heat stress results from the destruction of the critical protoplasm proteins in living cells. The heat stress injury may be direct and acute, or indirect and more chronic in nature. Visual injury is first observed via cross sections of grass shoots at the junction of the leaf blade and leaf sheath of the second and third youngest leaves. Plant death occurs at temperatures of 106°F (41°C) and higher, depending on the particular turfgrass species and cultivar.

Heat resistance is the ability to survive an externally imposed high temperature stress. When you assess research reports of heat stress resistance of turfgrass cultivars, it is important to understand there are two types of heat resistance: (a) heat avoidance and (b) heat tolerance. **Heat avoidance** is the ability to sustain internal temperatures below lethal heat stress levels via transpirational cooling. The higher the evapotranspiration rate of a cultivar, the greater the heat avoidance, assuming adequate rooting can be sustained for water uptake. In contrast, **heat tolerance** is the internal physiological ability of the plant to survive high internal tissue temperatures, which is attributed to better thermal stability of heat sensitive enzymes and membrane integrity. The heat resistance of turfgrasses is reduced (a) when grown under shaded environments, (b) by excessive nitrogen (N) levels, (c) by deficiencies of potassium (K), and (d) in older plant tissues.

Turfgrass cultivars that exhibit improved heat resistance in low humidity environments, such as Arizona, California, or Kansas, may fail to exhibit comparable heat resistance in humid areas such as Mississippi, Georgia and New Jersey, if the resistance is of a heat avoidance type. In contrast, turfgrass cultivars with good internal heat tolerance will exhibit this trait in both humid and arid climatic regions. This is an important distinction to understand in interpreting heat resistance data among cultivars.

MODERATING POTENTIAL HEAT STRESS PROBLEMS

The approaches to minimizing the adverse effects of heat stress on turfgrasses are multi-dimensional. The first principle in any stress environment is to select those cultural practices that produce the most healthy plant shoot and root systems possible. Some key cultural approaches to heat stress moderation include the following:

I. Proper Root Zone Modification. Water has the highest heat accumulation ability of any material. Wet or water-saturated soils require more energy to warm up and a longer time to cool down. Thus, the construction of high-sand root zones with USGA Method specifications to ensure maximum drainage of excess water also reduces the level of soil heat accumulation, when compared to poorly drained, clayey root zones. Also, a high-sand root zone of the proper particle size distribution is sufficiently aerated to allow deeper, more extensive root growth, thus allowing greater water uptake to support the high rates of evapotranspiration needed for heat avoidance.

II. Use of Heat Resistant Cultivars. The C_4, warm-season turfgrasses, such as bermudagrasses (*Cynodon* spp.) and tropical carpetgrass (*Axonopus compressus*), are physiologically adapted in terms of optimum growth at temperatures of 80 to 95°F (27-35°C). In contrast, the C_3, cool-season turfgrasses, such as bentgrasses (*Agrostis* spp.) and annual bluegrass (*Poa annua),* are physiologically adapted to optimum growth at temperatures of 60 to 75°F (16-24°C). The use of cool-season grasses beyond their adaptation zone may exceed their limit for survival. Please note that for most species the intraspecies heat resistance among cultivars is quite variable, such that a few cultivars would rank well above the mean ranking shown, while a few would rank well below.

Unfortunately, a number of turfgrass cultivars are being promoted as heat tolerant when in fact they are only heat avoiding in terms of their heat resistance mechanism. Thus, it is important when selecting heat tolerant turfgrass cultivars for humid climatic regions to obtain the supportive replicated research data that the cultivar has demonstrated true heat tolerance rather than only heat avoidance. It is best to obtain independent, comparative, replicated assessment data that have been conducted for a minimum of 3 to 4-years duration under similar humid conditions that demonstrate significant improvements in inherent heat tolerance when exposed to high internal tissue temperatures.

III. Cultural Practices To Maximize Heat Stress Resistance. There are a number of turfgrass cultural practices that enhance heat stress resistance. Individually each may not have a major impact, but collectively they can have a significant effect. Cultural factors of benefit in maximizing heat stress resistance include:

- **High potassium level.** Potassium (K) enhances rooting, which contributes to improved heat avoidance and also improves physiological heat tolerance of grass tissues. Chemical tests will provide the basis for selecting the appropriate potassium levels needed in the leaf tissue and the soil.
- **Modest to minimal nitrogen level.** Sufficient tissue nitrogen (N) levels should be maintained to ensure a healthy turfgrass plant, but it is advisable to avoid excessive nitrogen levels that force leaf growth and cause internal physiological reductions in heat tolerance.
- **Minimal thatch or mat.** Preventive thatch and mat depth control encourages deeper rooting, thereby facilitating water uptake from a greater portion of the root-zone profile. The thatch control aspects may include vertical cutting, core cultivation, and/or topdressing.

- **Cutting height elevation.** A slight cutting height elevation, especially on putting greens, during severe heat stress periods may prove beneficial and has minimal effect on putting speed as the grass growth has been slowed. For example, raise the height from 5/32 to 3/16 inch (4.0-4.8 mm), being sure to lower the cutting height to the original level once the heat stress has subsided.
- **Mower selection.** On putting greens, switch to a walking greensmower from a triplex unit during the severe heat stress period and/or change to a solid roller to lesser wear stress when shoot growth recovery is impaired by heat stress.

IV. Syringing For Heat Stress Avoidance. Syringing is the application of a very light amount of water in which only the leaves are wetted. It can be used for the purpose of cooling the turf canopy. It has the potential of reducing temperatures in the order of 10°F (5.5°C), if applied 1.5 to 2 hours before maximum mid-day temperatures that typically occur around 2:00 p.m. A low atmospheric humidity adjacent to the turf canopy maximizes evapotranspirational cooling. In hot, arid portions of the country, such as Arizona, syringing during mid-day heat stress has been used to maximize heat avoidance through high evapotranspiration rates. Unfortunately, this method of heat avoidance is of limited benefit in humid climatic regions during periods of high humidity.

V. Air Movement Enhancement. Air stagnation on putting green sites, especially when surrounded by trees in the direction of the prevailing wind, accentuates the stratification of higher temperatures and higher humidities near the turf canopy. This in turn accentuates heat build-up in both the turfgrass canopy and root zone, plus the environment for disease pathogens is more favorable.

If a tree-shrub barrier is the primary problem, then cutting an opening in the direction of the prevailing wind usually proves beneficial. Air stagnation also can be significantly reduced through the mixing action achieved by mechanical fans, especially in hotter climates. This author conducted the first research in the late 1950's that demonstrating the value of fans in reducing heat levels on bentgrass putting green turfs. A 14°F (7.8°C) cooler turf temperature was achieved by the use of a fan that produced a 4 mph (6.4 km hr^{-1}) air movement, under the conditions in West Lafayette, Indiana.

Fans are now becoming more commonly used around selected putting greens, where the surrounding trees and shrubs and/or low site placement with higher surrounding hills causes a serious restriction in air movement. The development of the best possible mechanical fan design is still evolving. Some criteria to consider in selecting fans include:

- noise level generated - a 54-inch (137 cm) diameter fan is 50% more quiet than a 48-inch (122 cm) unit, due to a lower blade velocity.
- effective distance - a longer effective distance allows placement of the fans from 40 to 50 feet (12-15 m) away from the perimeter of the putting green.
- effective pattern - the wider and longer the better, up to an associated air velocity of 4.5 mph (7.2 km hr^{-1}).
- relative obtrusiveness - color, distance from green, height above turf, and bulk size all influence just how harmoniously the fans blend with the surrounding environment.

Fans also will become more frequently used in sport stadia constructed with an erect, tall, fully-surrounded, seating design.