by Dr. James B. Beard

TURFGRASS RESEARCH REVIEW

Chances for turfgrass survival during flooding

***Influence of water temperature on submersion tolerance of four grasses.** J.B. Beard and D.P. Martin. 1970. Agronomy Journal. 52(2):257-259. (from the Department of Crop and Soil Sciences, Michigan State University, East Lansing, Mich. 48823).*

The relative submersion tolerance of four turfgrasses to three water temperatures was investigated. Five year old, actively growing, disease free sods of Toronto creeping bentgrass, Merion Kentucky bluegrass and annual bluegrass were utilized. Four-inch diameter by three-inch deep plugs of each species were collected July 15, 1969. The intensity of culture of the four turfgrasses prior to sampling was typical for each species. The Toronto creeping bentgrass had been cut daily at 0.25 inch; the Merion Kentucky bluegrass and Pennlawn red fescue every four days at 1.5 inches and the annual bluegrass every three days at 0.5 inch.

Three replications of each species were completely submerged in separate constant temperature water tanks having water temperatures of 50, 68 and 86° F. The water tanks had thermostatically controlled heating and refrigeration units, an aerator and a circulating water pump for maintaining a uniform water temperature throughout the tank. The sods were maintained at a submersion depth at which the uppermost portion of the turfgrass leaves was two inches below the water surface.

Three replications of each turfgrass species from the 50 and 68° F. water treatments were removed at five day intervals and from the 86° F. water treatment at 24 hour intervals. The submersion experiment was terminated after 60 days. After removing the sod plugs from the water they were drained and placed in a 70° F. greenhouse for evaluation of survival.

No visual evidence of injury to the turfs was evident when removed from the flooding treatments. However, death generally occurred within 48 hours after removal. A brownish discoloration would first appear on the leaf sheath followed by death of the leaf blade which progressed from the tip toward the stem. The cells in submerged leaves and stems were generally larger than in nonsubmerged tissues with the protoplasm coagulating near the cell walls as injury developed. Submersion injury of turfgrasses would initially appear in the old leaves whereas the youngest leaves were generally the last to show visible symptoms of injury.

The relative submersion tolerance of turfgrasses was directly related to (a) water temperature, (b) duration of submersion, (c) turfgrass species and (d) depth of submersion. The duration of submersion tolerance decreased as the water temperature was increased. For example, a Merion Kentucky bluegrass turf was completely killed after eight days of submersion at 86° F. and after 41 days submersion at 68° F. but was not completely killed by 60 days submersion at 50° F.

In comparison of the submersion tolerance among turfgrass species, Toronto creeping bentgrass possessed superior tolerance and Pennlawn red fescue the least tolerance whereas Merion Kentucky bluegrass and annual bluegrass ranked intermediate. For example, approximately 18 days of continuous submersion at 86° F. was required to kill Toronto creeping bentgrass whereas Merion Kentucky bluegrass was killed after eight days, annual bluegrass after five days and Pennlawn red fescue after two days.

Several small associated studies were also conducted. The authors found that partial submersion in which some leaves extended above the surface resulted in substantially

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less injury than when the plants were completely submerged. In one case, elongated Penncross creeping bentgrass stolons survived for an entire growing season while floating in water with only the leaves extending above the surface.

Comments: It is not uncommon to establish golf courses, recreational areas and parks on low-lying flood plains adjacent to rivers. As a result, turfs on these areas are periodically subjected to flooding. These investigations indicate that the professional turfman can minimize flooding damage through the use of certain cultural practices.

It is evident from this study that a substantial range in submersion tolerance exists among the commonly used cool season turfgrasses. Bentgrass or Kentucky bluegrass are definitely preferred to red fescue or annual bluegrass. They also have a greater recuperative potential from surviving vegetative plant parts. In addition, it is obvious that certain creeping bentgrasses and Kentucky bluegrasses can survive submersion for a relatively long period of time provided that higher water temperatures are avoided. The occurrence of high water temperatures is less likely to occur where flooding involves a continuous flow of water across a turf area rather than shallow, stagnant pools. The latter problem can be avoided by insuring rapid removal of surface water accumulations by proper surface contouring or the use of slit trenches or surface drains connected to an adequate subsurface tile system. If shallow, stagnant pools of water develop on greens, the water should be removed by a squeegee-type device before the water temperature becomes excessively high.

The increase in water temperature to lethal levels is most likely to occur in small, shallow pools during periods of high light intensity and high air temperatures. Injury to turfs resulting from this condition is referred to as scald. This term may be somewhat misleading because scald injury can occur at water temperatures considerably below the boiling point of 212° F.

This paper is devoted to only one phase of flooding. That is, the direct effect of submersion on the turf. However, one must remember that turfgrass damage by flooding can

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also occur due to (a) actual displacement of sods and soils when subjected to flowing water of high velocity; (b) covering portions of the turf with wood, soil, and other debris which results in death of the turf by light exclusion and (c) deposition of a soil layer, particularly silt, which creates a soil layering problem and associated long term disruption of soil air and water movement. The latter problem is particularly difficult to correct.

A study of certain nutritional requirements for Tifgreen bermudagrass* (Cynodon dactylon x C. transvaalensis L.) *Utilizing a hydroponic system. *W.G. Menn and G.C. McBee. 1970. 62(2): 192-194. (from the Department of Soil and Crop Sciences, Texas A&M University, College Station, Tex. 77843).*

Tifgreen bermudagrass was grown under various levels of nitrogen, phosphorus and potassium for the purpose of correlating visual analyses of these elements. Six-inch diameter plugs were taken from a mature monostand of Tifgreen bermudagrass. The plugs were thoroughly washed to remove all soil and decayed plant material. Most of the root system was also eliminated. The plugs were placed in plexiglass frames over fiberglass screens. The frame containing a plug was then placed in a gallon, glazed, porcelain container.

Seven individual nutrient treatments of nitrogen, phosphorus and potassium were utilized in the study with four replications. The seven treatments were maintained by a modified hydroponic system where all other essential elements were provided. The culture solutions were aerated and maintained at a pH between 5.8 and 6.2. The nutrient levels maintained during the experiment include 0, 35 and 140 parts per million (ppm) of nitrogen; 0, 7.75 and 31 ppm of phosphorus; and 0, 58.5 and 234 ppm of potassium.

Visual ratings of turfgrass quality were made at weekly intervals for a month following development of the first visual nutrient deficiency symptoms. Leaf clippings were also collected weekly for analyses of the nitrogen, phosphorus and potassium content.

Specific relationships were established between the visual turfgrass quality of Tifgreen bermudagrass and the nutrient content in the leaf tissue. Nitrogen was the first nutrient to show a visual deficiency symptom. A reduction in shoot growth and loss of color occurred as the tissue nitrogen content declined below 22,500 ppm. Chlorosis of leaves and increased seedhead formation also occurred when the tissue nitrogen content dropped below 15,000 ppm.

Phosphorus deficiencies in Tifgreen bermudagrass first appeared as a dark purplish-green coloration of the shoots. Subsequently a pale green color and reduction in shoot growth occurred when the phosphorus content dropped below 2,000 ppm. In addition shoot growth suppression occurred at higher phosphorus levels in the range of 4,500 ppm.

Symptoms of potassium deficiency first appeared as a thinning of shoots and narrowing of the leaf blade. This occurred when the potassium level decreased below 18,000 ppm and was very distinctive at potassium tissue contents less than 10,000 ppm. The grass did appear somewhat pale green at this lower potassium level.

Comments: The primary analytical method of determining turfgrass

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fertilization practices has been through the use of a soil test. Sometimes this method can be inadequate because the nutrient level determined for the soil may not be available for uptake by the plant.

An alternate approach involves the use of tissue analysis which measures the actual nutrient status of the turfgrass plant. The laboratory analysis of tissue is very accurate. However, the primary problem involves proper tissue sampling procedures. and proper interpretation of the results. Representative uniform, tissues of the same age and type must be selected. A particularly difficult problem frequently associated with turfs is that minute quantities of dust or soil present on the shoots can adversely affect the tissue analysis. Another serious problem in effective utilization of turfgrass tissue analysis has been the lack of sound scientific data on which to base interpretation of the results. Studies of the type reported in this paper will assist in eliminating this latter problem.

Specific observations relating to this data include defining the nitrogen and potassium content of the tissue at which deficiency symptoms develop. In the case of these two nutrients, the severity of deficiency symptoms increases as the nutrient content of the tissue decreases. In the contrast, phosphorus appears to have a critical level in Tifgreen bermudagrass tissue rather than a range. In summary, continuing investigations of this type may eventually provide sufficient information so that tissue analysis of turfgrasses could be effectively used in diagnosing the turfgrass nutrient status and requirements. □

Other papers of interest:

*1. **Performance of crownvetch and selected cool season grasses on roadside backslopes as affected by slope exposure and nitrogen fertilization.** A.E. Dudeck and J.O. Young. 1970. Agronomy Journal. 62(3):397-399. (from the Department of Horticulture and Forestry, University of Nebraska, Lincoln, Neb. 68503).*

*2.**Sources of variation in Cynodon Dactylon** (L.) pers. J.R. Harland and J.M.J. deWet. 1969. Crop Science. 9(6):774-778. (from the Department of Agronomy, University of Illinois, Urbana, Ill. 61801).*