Top view of the rhizotron and grasses growing in observation boxes.

Spring Root Dieback of Warm-Season Turfgrasses

by J.M. DiPAOLA and J.B. BEARD

TURFGRASS MANAGERS seek to establish and maintain healthy and actively growing turfgrass plants. The health and vigor of the entire plant is essential for superior turf performance under such conditions as heavy traffic, environment stress (heat, cold, water, etc.), and pest infestations. While the turfgrass shoot is the visible portion of the turf, both the shoot and root must be properly managed for optimum turfgrass utility.

The turfgrass root system serves several key functions in the life processes of the plant. Water intake and transfer, nutrient absorption and transfer, and soil anchorage are important functions of the turf's roots. Turfgrass management directed towards the development of deep, vigorous root systems is contingent on an understanding of the seasonal behavior of the turfgrass root.

Investigations concerning the seasonal rooting behavior of Tifgreen

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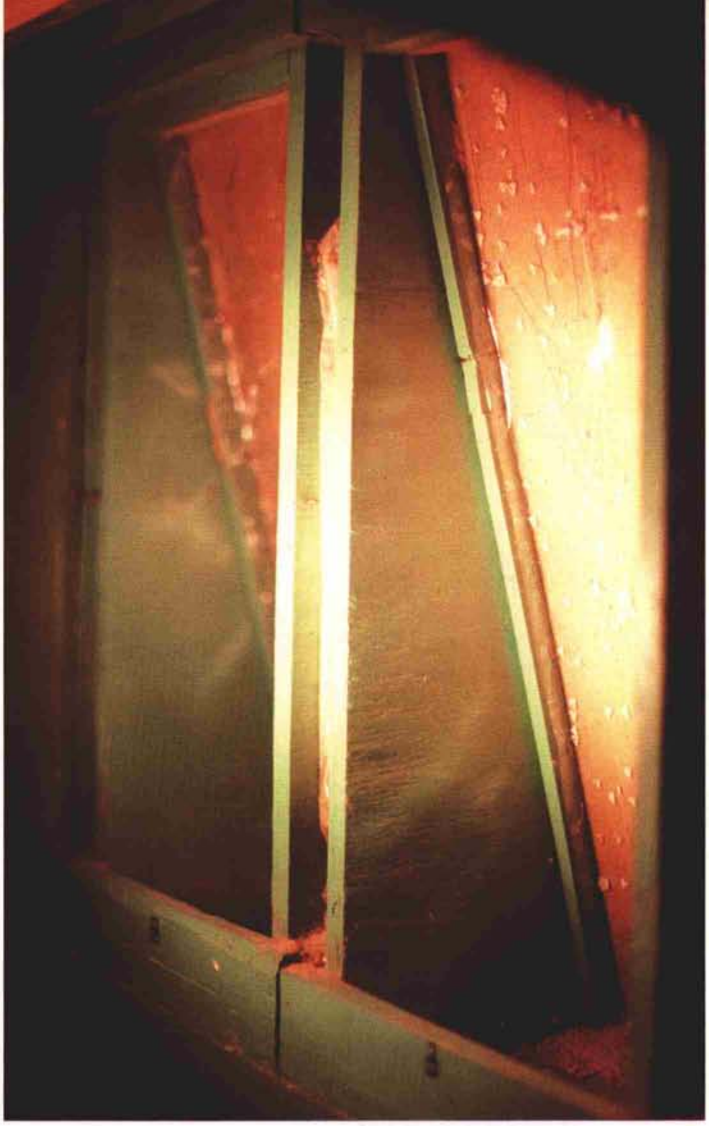
bermudagrass and Floratam St. Augustinegrass were initiated in the Texas A&M turfgrass rhizotron* in August, 1976. Turfs were established from sod in washed sand and received annual applications of phosphorous at a rate of three pounds per 1,000 square feet. Weekly applications of nitrogen and potassium were made at a rate of one pound of actual nutrient per 1,000 square feet per growing month.

Distinct seasonal patterns in root growth and activity were evident after the first three years of investigation. Summer root growth rates averaged one inch per day. This rate is some five

**Editor's note:* A rhizotron is a walk-in subterranean chamber that permits the researcher to observe, study and record root growth of grasses grown above in specially constructed observation boxes.



(Right) Subterranean view of the root observation boxes of the rhizotron. The doors and insulation of the root observation boxes are removed for root data collection . . . but are only partially removed above.

(Below) Appearance of St. Augustinegrass roots during the fall of 1978, showing their white to light tan color. Roots have a similar appearance during the winter. Bermudagrass roots are similar in color at this time, but have a smaller diameter.

(Below, right) St. Augustinegrass roots after root dieback showing the brown color of the entire root system (spring 1979).

times the growth rate reported for cool season turfs, such as creeping bentgrass. Declining soil temperature during the fall was accompanied by equivalent reductions in the turfgrass root growth rate. Continued reductions in the soil temperature during the fall to 50 degrees Fahrenheit or below resulted in shoot dormancy. Limited root growth was observed for approximately two to four weeks following shoot dormancy (loss of shoot green color).

During the winter dormancy period, the roots of these two warm season turfgrasses maintained the white-light tan color present during the summer and fall, and thus appeared alive. However, the root systems of these turfs turned brown about one week after the appearance of new green leaves in the spring (spring green-up). This root browning was followed by a delay in new root initiation, growth and replacement. Delayed new root initiation and growth following spring green-up was accompanied by significant new shoot development. This imbalance shoot: root ratio predisposes these turfs to injury and possible death due to low temperature stress (late spring frosts), desiccating winds, excess traffic, disease, pesticide phytotoxicity, and insect pests. Loss of turf from such causes often results in expensive re-establishment procedures and increased weed problems from summer annuals such as crabgrass and goosegrass.

These research findings raise a host of new questions concerning turfgrass management, particularly during the early spring. The many cultural practices that are known to influence root growth and development markedly must now be more closely evaluated with respect to spring root dieback of the warm season turfgrasses. Cultural practices of particular importance include: a) mowing frequency and height; b) fertilization timing, rate, and nutrient ratio; c) verticutting timing, frequency and intensity; d) soil coring depth (and core diameter), frequency, and timing; e) pesticide applications, particularly pre-emergence herbicides; and f) irrigation.

Current turfgrass agronomics outline the general turf responses to these various cultural procedures. Mowing removes some of the green photosynthetic tissue of the turf and thus reduces the amount of leaf area present to intercept sunlight and produce food for the entire plant. When faced with limited carbohydrate production and reserves, the shoot will use available carbohydrates at the expense of the root system. Therefore, the typical result of increasing mowing frequency and/or decreasing the cutting height is a restriction in the depth of the turfgrass root system.

FERTILIZATION timing and rates of application dramatically influence the performance of a turf. Nitrogen is important for many plant functions, including photosynthesis, and must be present in adequate amounts. However, excess nitrogen fertilization promotes shoot growth at the expense of the roots. Such a response may be of critical importance in relation to root dieback during the early spring. Above adequate levels of nitrogen have also been demonstrated to increase the susceptibility of a turf to many diseases, low temperature stress, and water stress. Additional potassium fertilization has been shown to increase root dry matter production of many turfgrasses. A balance in the ratio of nitrogen to potassium of fertilizer sources is also of critical importance.

Pre-emergence-type herbicides are commonly used during the spring for control of goosegrass and crabgrass. Most of these herbicides also restrict root growth of many turfgrasses. Applications of such chemicals so as to avoid the spring root dieback period, yet provide adequate weed control, may be important for optimum spring turf quality. Many growth retardants will also restrict root growth. Typically, root growth is restricted long after shoot growth inhibition has passed.

Root growth and distribution within the soil is affected by irrigation practices. Frequent and light applications of water will result in a turf with a shallow root system. On the other hand, more infrequent and deep irrigation will help promote a more vigorous and deep root system.

Winter overseeding of warm season turfs is a cultural practice which may have dramatic impact on the root sys-

tems of these grasses. Many of the fall establishment procedures utilized in winter overseeding, such as verticutting, close mowing, and late nitrogen fertilization, can reduce the winter survival of these turfs. These procedures are essential however, for the adequate performance of the winter overseeded turfs. Cultural practices conducted during the spring transition for the removal of the overseeded grasses will also influence the root systems of the permanent warm season turfs. While soil coring during spring root dieback period may prove beneficial, verticutting during this period is likely to be placing an additional stress on the permanent turf. It is important to note that new spring growth of warm season turfs that have been over-seeded will typically occur two to four weeks later than those areas that have not been overseeded.

MANY QUESTIONS concerning spring root dieback of warm season turfgrasses remain to be answered. What is the cause of this root loss? Is it hormonal, and/or related to carbohydrate supply? Does spring root dieback occur on all warm-season turfgrasses? Is spring root dieback observed throughout all of the southern United States? How is root dieback influenced by the environment, particularly late frosts or early warm weather? Is there any variation in spring root dieback from year to year? What is the optimum timing of the various cultural practices which may help reduce root loss during the early spring? The answers to these and other questions concerning spring root dieback of warm season turfgrasses are currently being sought in research programs at both Texas A&M and North Carolina State University.

ACKNOWLEDGEMENT

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(Top) Stolon of St. Augustinegrass sampled after the beginning of spring root dieback in 1979. New leaf growth is evident, while the roots on either side of the pencil have turned brown.

(Left) Drs. James B. Beard (left) and Joseph M. DiPaola (right) with the soil and air temperature recording equipment used in the rhizotron. Both the continuous recording (in shelter) and thermocouple devices are shown.