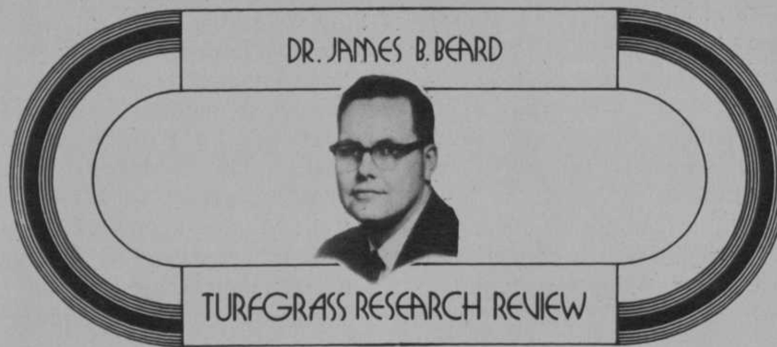

EFFECTS OF TEMPERATURES ON PENNCROSS GROWTH

Growth characteristics of Penncross creeping bentgrass* (Agrostis palustris Huds.) *at four soil temperatures and five fertility regimes. *D.T. Hawes. 1972. Ph.D. Thesis, University of Maryland. 124 pp. (from the Department of Agronomy, University of Maryland, College Park, Md.).*

The influence of three soil temperatures (50, 70 and 90° F) on shoot growth, root growth, carbohydrate reserves, recuperative rate, turfgrass, color, tillering and thatch accumulation rate were evaluated on a Penncross creeping bentgrass turf moved at one-half inch. Evaluations were made during the summer of 1969 and the spring and summer of 1970. The three soil temperature levels were maintained by local, thermostatically controlled, constant temperature heat exchangers positioned at a soil depth of 3.5 inches. Thus, the exchangers established three distinct planes of nearly constant temperature in the zone where most root, crown and stolon growth occur.

Results of this investigation showed root growth to be most active at 50° with a decline at the higher 70 and 90° F soil temperature treatments. The carbohydrate reserves were also highest at 50° F soil temperatures. Both the shoot growth and recuperative rates were highest at 70° F soil temperatures and declined as the temperature was either raised or lowered. The visual turfgrass appearance in terms of color also ranked highest at 70° F. Tillering and stolon growth were not affected by the three distinctly different soil temperature treatments, but responded to seasonal variations in the environment other than temperature.

Comparisons among several nitrogen levels showed that nitrogen increased turfgrass color, but decreased the shoot growth and recuperative rates of the turf. The effect of reduced recuperative rate and associated low carbohydrate reserves at higher nitrogen levels was most notable at the highest temperature treatment.

Comments: Temperature is a component of the turfgrass environment that affects most facets of turfgrass growth as well as disease development, thatch accumulation and seed germination of both weedy and desirable species. The temperature effect on shoot growth affects the mowing frequency, fertilization requirements and over-all turfgrass health. Temperature also affects the rooting depth and evapotranspiration rate, which are primary controls in the amount and frequency of water that must be applied by irrigation. Thus, temperatures are intimately related to the many day-to-day cultural practices on a golf course.

Temperatures vary on a seasonal cycle with the highest stress periods occurring in midsummer. Individual cultural practices must be adjusted in relation to temperature changes in order to maintain the desired level of turfgrass quality on the golf course. If adjustments are not made in relation to temperature changes, serious loss of turf may occur due to direct temperature effects or by the indirect effects of other related environmental components such as drought stress. The importance of adjusting turfgrass cultural practices is illustrated in this paper where high nitrogen levels drastically decreased the recuperative rate at the highest temperature treatment. A

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high nitrogen nutritional level also results in reduced heat stress tolerance and proneness to loss of turf. Thus, nitrogen fertilization, which stimulates shoot growth, should not be applied during heat stress periods.

It should be noted that these three temperature treatment differentials were based on soil temperatures. Soil temperature has much more influence on turfgrass growth and development than air temperature. It is possible to maintain turfs at extremely high air temperatures as long as the soil temperature is maintained at a more moderate temperature. This is also the reason why night temperatures are so important in controlling turfgrass responses. As long as the night temperature drops to lower levels that will maintain a cooler soil temperature, the turf can be maintained rather easily at normal growth rates. However, when the night temperatures rise to higher levels comparable to daytime temperatures, the soil is warmed considerably, resulting in restricted root and shoot growth and a decrease in turfgrass quality, health and vigor.

Because of the significant effects of soil temperature on heat stress, it is important for the golf course superintendent to periodically monitor soil temperatures under selected turfgrass areas on the golf course. In this way, he can more adequately interpret the turfgrass responses being observed and also make appropriate adjustments in his turfgrass cultural program. While these adjustments may appear to be relatively minor, they can be very important in determining whether an adequate or inferior quality surface is maintained for golf play.

So far as specific temperature responses are concerned, optimum root growth of Penncross creeping bentgrass occurs at lower soil temperatures than shoot growth. Specifically, the bentgrasses as well as Kentucky bluegrass, tend to maintain maximum root growth in the soil temperature range of 50 to 60° F. In contrast, optimum shoot growth and recuperative rates occur at somewhat higher temperatures in the range of 65 to 75° F. The over-all turfgrass appearance and color are also very good in this temperature range. Specific temperature stresses become evident as soil temperatures are raised into the 90° F range. Bermudagrass responds to temperature comparable to that for bentgrass and Kentucky bluegrass except in a higher temperature range. For example, optimum shoot growth for bermudagrass occurs in the range of 85 to 95° F.

Above the optimum temperature range there is a decline in most turfgrass growth response characteristics. Initially, this is expressed in reduced root growth. Not only is senescence of the existing roots progressing more rapidly to a brown, spindly, weak appearance, but initiation of new roots from meristematic areas on the crown is also blocked. This results in a very restricted root system for cool season turfgrasses at soil temperatures above 80° F. Other responses observed under temperature stress conditions included a decline in shoot growth as well as a reduction in (a) leaf length, width, and area, (b) rate of new leaf appearance and (c) succulence of the above ground tissues. The turfgrass appearance becomes dark green to blue green in color under heat stress. A decline in shoot density will also appear if the heat stress persists.

This brief article is a simplified introduction to the many effects of temperature on turfgrass growth and culture. It is a very complex aspect of turfgrass management, which is interrelated with many other cultural practices including mowing, fertilization and most important, irrigation. □

CORRECTION

GOLFDOM inadvertently misquoted Vaughn E. Border, director of marketing, Outboard Marine Corp., in the article entitled "The Japanese in the U.S. Golf Market: Where are They Now and Where are They Going?" published in the May issue, page 21. The correct quote should read: "The fact is that there are still only about *51,000* or *52,000*, I would guess, new golf cars being sold every year."