Automatic irrigation control to increase water efficiency

Turfgrass irrigation research at the University of California. *A. W. Marsh. 1970. California Turfgrass Culture. 20(1): 1-2. (Agricultural Extension Service, University of California at Riverside, Riverside, Calif. 92507).*

The objective of this investigation was to evaluate five different methods of assessing the irrigation water requirement of a turf. The experiment was initiated in 1966 at the University of California at Riverside, South Coast Field Station. Two turfgrasses, bermudagrass and St. Augustinegrass, were included in a randomized block design of four replications. The five irrigation treatments were as follows: (1) automatic irrigation when a tensiometer at either the six- or 12-inch soil depth reaches 15 centibars; (2) automatic irrigation when a tensiometer at either the six- or 12-inch soil depth reaches 40 centibars; (3) automatic irrigation when a tensiometer at either the six- or 12-inch soil depth reaches 65 centibars; (4) manual irrigation at rates based on actual evaporation measurements, and (5) manual irrigation to simulate the irrigation practices utilized by professional turfmen in the local area.

The first three treatments received water automatically when either tensiometer dried to the levels indicated. The controller was set to allow irrigations only at night and for repeated, short intervals. The irrigation ceases whenever enough irrigation cycles apply sufficient water to lower the reading.

The evaporation measurements for treatment four are obtained from a sunken evaporation pan. Irrigations were applied to treatment area four whenever the measured evaporation totaled one inch or more. The amount of water applied was 87 per cent of the measured evaporation during the peak summer months and 75 per cent of the measured evaporation minus rainfall during the fall, winter and spring months.

Treatment five was established as a standard practice equivalent, in terms of timing and amount of water applied, to that typically utilized by professional turfmen on adjacent turfgrass areas. Both treatments four and five were irrigated manually through the controller within the guidelines described. This experiment has been conducted for a three-year period.

The author summarized the results to date as follows. Less water was applied with the automatic tensiometer controlled irrigations than with the manually controlled irrigations, even with the rather wet 15 centibar treatment. The automatic tensiometer controlled 40 centibar irrigation level provided a substantial savings in water compared to the standard treatment five with no visible difference in terms of turfgrass response from that obtained with the 15 centibar treatment.

During the 1968 growing season the bermudagrass turf received the following total inches of water from irrigation treatments: (a) automatic tensiometer controlled 40 centibar level—31 inches; (b) automatic tensiometer controlled 15 centibar level—38 inches; (c) manual irrigation based on pan evaporation measurements—39 inches, and (d) manual irrigation typical of that commonly practiced—42 inches. This represents a considerable difference among treatments in terms of total water applied over the 12-month period.

Some interesting seasonal variations in the monthly water use rate were also evident among the five treatments. The manual water application plot representative of standard practices received more water during early and late spring and again in the fall compared to the irrigation treatments based on automatic irrigation controlled by tensiometers. In addition, the manually controlled standard practice received less water during the peak water use rate period of midsummer compared to the automatic tensiometer controlled treatments.

As would be expected there were considerable variations between months in terms of the water use rate and correlated irrigation rate. During the midsummer period of June, July and August, the monthly water application rate among the five treatments ranged from four to over six inches. This contrasted to the winter months of January and February when less than two inches of water was applied per month.

Comments: The author presents some very striking data showing how tensiometers can be used to automatically control irrigation practices and in turn achieve a significant improvement in water use efficiency. Two tensiometers are used, one placed at a six-inch soil depth and a second at a 12-inch soil depth. The reaction time of the six-inch depth tensiometer was quick enough to terminate an irrigation before all the soil was wet. On the other hand, the reaction time of the 12-inch depth tensiometer to a water application was slower and permitted enough extra irrigation periodically to rewet the profile to a greater depth. This technique is then used to apply an amount of water which comes very close to meeting the actual needs of the turf under the environmental and soil conditions of Southern California.

The decision regarding the timing and amounts of water to apply to turfgrass areas is one of the most difficult cultural practices which the professional turfman must make. It is usually made every day. Quite frequently the turf is over irrigated to insure that wilt or loss of turf does not occur. In some cases too much water is applied to certain areas in an attempt to provide an adequate amount of moisture in other loca-

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tions where the soil type, slope or rate of drying is different. In these cases the original design of the irrigation system does not offer the flexibility of selectively watering certain areas. Applications of excessive quantities of water over a period of time will result in increased soil compaction, reduced soil aeration and increased encroachment of annual bluegrass.

The use of automatic sensing devices for better control and efficiency of irrigation practices has great possibilities. Unfortunately, much is yet to be known in terms of developing the specific techniques for using these sensing devices in the varied environmental and soil conditions occurring throughout the United States. The turfmen in Southern California have taken the leadership in this approach. Their success in future years will be followed closely by turfmen throughout the United States.

Influences of fertility ratios on winter hardiness of bermudagrass. *W.B. Gilbert and D.L. Davis. 1971. Agronomy Journal. 63:591-593. (from the Department of Crop Science, North Carolina State University, Raleigh, N.C. 27607).*

The objective of this study was to determine the effect of various ratios of nitrogen, phosphorus and potassium on the low temperature hardiness of two bermudagrass varieties. The two varieties used were Tifgreen and Tifdwarf bermudagrass (*Cynodon* spp.). Vegetative plugs of the two varieties were taken from mature sods and transplanted into pots containing sand. The turfgrass plugs were grown under these conditions for four months at day temperatures of 86 degrees F and night temperatures of 68 degrees F. The turfs were not fertilized during this period in order to exhaust the existing fertility level in the transplanted sod to a minimal level. The plugs were watered daily with distilled water and clipped three times a week at 0.3 inch.

At this point eight nutrient ratio treatments were applied using a modified Hoagland's solution. The plugs were returned to the greenhouse for three weeks under the environmental and cultural system previously described. The plugs were then placed in a cold chamber at 38 degrees F and an eight hour period at 3,000-foot candles. The treated grass plugs were permitted to harden for four weeks prior to exposing them to a series of low temperature treatments utilizing a programmed low temperature chamber. The specific low temperature treatments were 28, 23 and 19 degrees F. Four replications of each variety were subjected to each of the three low temperature treatments.

Subsequently the plugs were allowed to thaw for 48 hours in a darkened cold chamber maintained at 35 degrees F. After this the plugs were placed in the greenhouse at an 86-degree F day temperature and an 68-degree F night temperature with a 14-hour day length. The quantity of shoot growth produced after four weeks regrowth was measured by clipping to a height of 0.3 inch. The eight nutrient ratios compared were 4-1-6, 4-1-3, 4-0-3, 4-0-0, 2-1-3, 4-1-0, 4-5-1 and 1-1-3.

Based on the quantity of shoot re-

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growth the following results were obtained. Both Tifgreen and Tifdwarf responded similarly to the eight nutritional ratios. Ratios in which the levels of nitrogen and potassium were approximately equal and about four to five times greater than the phosphorus level gave the highest quantities of shoot regrowth. Specifically, the 4-1-6 and 4-1-3 ratios resulted in a much larger shoot regrowth response. The 4-0-0 ratio was least tolerant of low temperature stress. The amount of low temperature kill was also quite high with the 1-1-3 ratio. At a given nitrogen level, the addition of either phosphorus or potassium alone improved the cold tolerance slightly whereas the application of both resulted in a substantial improvement.

Comments: The low temperature tolerance of the bermudagrasses is the limiting factor in how far north a bermudagrass turf can be maintained successfully over a period of years. A number of cultural factors can be manipulated to provide more favorable conditions for low temperature survival of bermudagrasses. Included are the (a) proper subsurface and surface drainage of excess water, (b) nitrogen and potassium nutritional levels, (c) quantity of thatch, (d) cutting height and (e) control of traffic during wet, cold conditions. Of these, proper surface and subsurface drainage is most important. However, the nutritional level is also a factor which, under certain conditions, can determine whether the bermudagrass turf lives or survives.

This study shows that the proper nutritional ratio can make a difference of 3 to 5 degrees F in the severity of low temperature stress that a bermudagrass turf can tolerate. The most important conclusions in this study are (a) that all three nutrients, nitrogen, phosphorus and potassium, are required for maximum low temperature hardiness and (b) they must be provided in the proper ratio to ensure maximum low temperature hardiness. In comparing the research reports between warm season and cool season species, it is evident that the preferred ratio varies depending on the particular turfgrass species that is involved. □