DR. JAMES B. BEARD

TURFGRASS RESEARCH REVIEW

WARM WATER: MILD EFFECT ON SOIL TEMPERATURE

***Effects of irrigation water temperature on soil temperature.** P.J. Wierenga, R.M. Hagan and E.J. Gregory. 1971. Agronomy Journal. 63(1):33-36. (from the Department of Water Science and Engineering, University of California at Davis, Calif. 95616).*

The objective of this study was to compare the effects on soil temperature from irrigating with water of different temperatures. The experiments were conducted at two field sites in the Central Valley of California. The water temperature treatments utilized included 52, 58 and 81 degrees F. Soil temperature measurements were taken at 30-minute intervals following irrigations made between 8 a.m. and 11 a.m. and between 7 p.m. and 10 p.m. Soil temperature measurements were taken at depths of 4, 12, 18 and 24 inches. Soil temperatures were also monitored on a comparable, unirrigated site. The air temperature was also monitored at two feet above the soil surface in a shaded, ventilated shelter.

Results of this study reveal that irrigation water temperatures ranging from 50 to 80 degrees F had a relatively small influence on the soil temperature, the effect lasting for a very short duration. For example, differences in soil temperatures resulting from irrigations with water of 80 degrees F versus water of 58 degrees F applied to a soil having a surface temperature of 58 degrees caused a temperature increase that lasted less than 24 hours at the two and four-inch soil depths and for 60 hours at the 12-inch soil depth. There was little effect on soil depths over 18 inches.

Although the effects of the irrigation water temperature on the soil temperature were small and of short duration, irrigation did cause a significant decrease in the soil temperature. For example, maximum soil temperature comparisons between unirrigated and irrigated soils four days after irrigation revealed that the irrigated plots were 12 degrees F cooler at two inches below the soil surface, eight degrees F cooler at the four-inch depth and four degrees F cooler at the 12-inch depth.

Comments: The question is often raised whether the source of irrigation water, such as wells, ponds, rivers or water impoundments which may be warmed as a result of industrial activity, has any effect on the soil temperature and growth of turfgrasses. Data reported in this paper confirm two earlier investigations that show that the temperature of irrigation water has a relatively small effect on soil temperature. These conclusions are valid for temperatures in the 45 to 85 degree F range, which would be the most typical.

Actually, overhead sprinkler irrigation in which the water is broken up into fine droplets, will have essentially no effect, because the temperature of the droplets reaching the ground will be approximately the same or slightly cooler than the air temperature, if the droplets have traveled through the air 15 feet or more. Thus, applications of water by surface or sprinkler methods will not increase soil temperatures significantly above that for soils irrigated with water of a comparable temperature. The authors suggest that the only way to significantly alter soil temperatures through irrigation with water of a specific temperature is by a subsurface system.

Although the application of water having a substantially cooler temperature than the atmosphere does not cause any significant decrease in the soil temperature, it does have an indirect effect on turfgrass cooling. This occurs through the evaporative cooling process in which water remaining on the leaf surface after irrigation evaporates to the gaseous state, causing a cooling of the leaf. An additional benefit from this process is the delay in the normal diurnal warming of the soil and tissues, which is initiated shortly after daylight and reaches a peak between 1 and 2 p.m.

These data also show that irrigation significantly changes the soil temperature through increased evaporation and improved heat transfer. The soil temperature of irrigated sites will be significantly cooler as will the adjacent atmospheric microenvironment. The magnitude and duration of the cooling effect on the soil varies with the time of year and location.

In summary, these data show that the use of cooler water from deep wells will have no long term effect on cooling of the turf in comparison to irrigating with water of warmer temperatures. It also answers some questions arising from contemporary activities of urban and industrial sites; for example, irrigation water warmed through industrial cooling or electrical generation uses may not be as great a concern in turfgrass culture as some individuals have suggested.

***Retardation by carboxin of low temperature induced discoloration in zoysia and bermudagrass.** R.M. Sachs, R.W. Kingsbury and J. DeBie. 1971. Crop Science. 11:585-*

continued on page 20

BEARD *from page 17*
586. (from the Department of Environmental Horticulture, University of California at Davis, Calif. 95616).

The objective of this investigation was to study methods of chemically retarding the low temperature induced discoloration of warm season turfgrasses, such as zoysiagrass and bermudagrass. The three species utilized in this study were *Zoysia japonica* var. Meyer, *Zoysia matrella* var. Flawn. and *Cynodon dactylon*. Plugs of each species were grown in quart containers under greenhouse conditions at a minimum temperature of 65 degrees F. After establishment, the four-inch plugs had adequate turf density, with no visual deficiency symptoms.

The replicated treatments included in the study were an untreated check and an application of carboxin (5, 6-dihydro-2 methyl-1, 4-3 carboxanilide) at a 0.3 per cent concentration. Earlier preliminary studies indicated that concentrations of 1 per cent or more cause phytotoxicity. After treatment, the containers were placed in a greenhouse for three days, then transferred to a controlled environment chamber under chilling conditions. The turf plugs were held at this cold treatment temperature until almost complete foliar discoloration occurred on the untreated plants. Leaf samples were taken at periodic intervals during discoloration and after complete discoloration. These tissues were analyzed for chlorophyll content.

Results of this study reveal that the application of carboxin, a systemic fungicide, retarded the low temperature induced discoloration of zoysiagrass and bermudagrass. For example, zoysiagrass plants sprayed with carboxin solutions retained their green color under chilling conditions of 36 to 40 degrees F four to six weeks longer than the untreated plants. The color of the treated turfs was comparable to unchilled plugs growing at temperatures above 65 degrees F, whereas the untreated plants growing under chilled conditions became distinctly yellowish-brown. These observations were supported by the chlorophyll analyses. The carboxin treated plants contained three times as much chlorophyll as the untreated plants after four weeks of chilling. Also, regrowth of the plants when placed under favorable growing conditions was substantially greater for those treated compared to the untreated plants.

These results suggest that the carboxin treated plants were able to continue photosynthesis and the production of carbohydrates, because the plants were capable of retaining chlorophyll in a functioning condition. This in turn resulted in superior recovery and regrowth after chilling treatments.

These results indicate that it is possible to delay the low temperature induced discoloration of turfgrasses. In more moderate climates, such as southern Florida, where discoloration may last for only a few weeks, the possibility exists for practical utilization of this concept. However, further studies under field conditions are needed to confirm these results. □