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TURFGRASS TRENDS

TALL FESCUE AND IRRIGATION

Tall Fescue Rooting in Response to Irrigation Management

By Jack Fry

Tall fescue has become a popular turfgrass in the Midwest transition zone because of its deep rooting and capacity for drought tolerance. Under well-watered conditions, however, tall fescue's ET (evapotranspiration) rate is higher than most cool-season turfgrasses (Fry and Huang, 2004).

A deep, infrequent approach to irrigation reportedly increases rooting in some turfgrasses, and tall fescue is no different. Drying the soil from 0 centimeters (cm) to 20 cm under tall fescue in the greenhouse resulted in greater root mass at 0-cm to 20-cm and 20-cm to 40-cm depths compared to turf where the entire 0 cm to 40 cm soil profile was consistently maintained near field capacity (Huang and Fu, 2001). The authors of the study also reported greater carbon allocation to roots when the surface-to-20-cm range was allowed to dry, which may have resulted from a reduction in vertical shoot growth rate.

Soil quality is one limitation to enhancing rooting with deeper, more infrequent irrigation. In many cases, tall fescue may be growing on shallow, fine-textured soils where its genetic potential for rooting cannot be realized. On such soils, tall fescue may not be a desirable choice for water conservation, since it rapidly uses the relatively shallow pool of available water. This creates a need for more frequent application.

Deficit irrigation, or returning water in amounts less than typically required by well-watered turf, is one process used to conserve water. Ultimately, the goal is to use less water while maintaining an acceptable level of turf quality. In Kansas, for example, tall fescue quality can be maintained with deficit irrigation levels of 40 percent or 60 percent ET between June and September, assuming a turf manager can tolerate a week or two in which quality is just below a visually acceptable level (Fu et al., 2004).

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The study explored the impact of deficit irrigation on tall fescue rooting. Evapotranspiration of well-watered turf was measured using small weighing lysimeters. The shelter in this photo was moved to cover plots with the onset of precipitation.

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Because smaller amounts of water are applied with deficit irrigation, soil is wetted to a more shallow depth than with traditional deep, infrequent irrigation. Periodically wetting the surface few centimeters of soil, but not deeper soil, could influence growth and distribution of roots. Therefore, surface roots may experience little drought effect since they receive periodic moisture. Roots deeper in the soil profile might be exposed to drying soil, which may influence their development. Despite the positive water-saving benefits of deficit irrigation, effects of this practice on tall fescue root development were only recently evaluated.

In 2001 and 2002, a study at Kansas State University explored the impact of deficit irrigation on tall fescue rooting. Water was applied on Monday and Friday between June and September to Falcon II tall fescue growing on a silt loam soil. Evapotranspiration of well-watered turf was measured using small weighing lysimeters, and based on these values, was returned at 20 percent, 60 percent or 100 percent to 1.2 meter x 1.8 meter plots that were located underneath an automated rainout shelter. The shelter moved to cover plots with the onset of precipitation. Turf was mowed twice weekly at 5 cm using a walk-behind rotary mower, and clippings were collected. Nitrogen was applied at 49 kilograms per square hectare (kg ha-1) on May 3, Sept. 19, and Nov. 8, 2001, and May 3, Sept. 18, and Nov. 15, 2002.

Soil water content from a depth of 0 cm to 25 cm was measured using a time domain reflectometer. Root growth and production were measured using a mini-rhizotron imaging technique, which allows roots to be monitored as they grow without destructive sampling. Before the study began, two soil cores (5 cm in diameter by 90 cm long) were removed from each plot at a 45-degree angle from the soil surface. Clear butyrate tubes the size of the remaining voids were plugged with a black rubber stopper at the bottom end and manually forced into holes. On the upper side of each tube were etched frames (1.3 cm long by 1.8 cm wide) that extended along the length of the tube, allowing a camera to return to the exact location when repeated measurements were taken.

Video images of roots visible against the surface of the tubes were recorded using a high-magnification minirhizotron camera and a camcorder. Root images were taken every two weeks through 43 days of irrigation treatments, and then every four weeks each year until the end of the experiment. Video root images were recorded beginning at nearly 1-cm increments from a 4-cm soil depth to a 51-cm depth. Tall fescue irrigated at 20 percent ET had higher root numbers than well-watered turf at a 17.9-cm depth in 2001, and at 8.7-cm, 13.3-cm, and 17.9-cm depths in 2002. Root surface areas and lengths were also higher at the 20 percent ET irrigation regime at 8.7-cm, 13.3-cm, and 17.9-cm depths in 2002.

One of the concerns regarding deficit irrigation is the potential to restrict deep rooting

Research done by Huang and Fu in 2001 demonstrated that allowing the surface 0 to 20 cm of soil to dry down resulted in more extensive rooting at 20 to 40 cm (center). Treatment represented on the left is tall fescue that was watered to maintain soil at field capacity. Treatment on the right shows roots exposed to excessive drying.

because the surface is periodically wetted, but deep irrigation does not occur. However, we observed that soil water content from the surface to a depth of 25 cm was lower under tall fescue receiving 20 percent ET than under well-watered turf beginning after eight days of irrigation in 2001 and after seven days in 2002. At 20 percent ET, average irrigation ranged from 3 mm to 4.5 mm, and we observed that this typically served to wet the soil to a depth of less than 3 cm. Soil drying under the 20 percent ET regime enhanced tall fescue root development between 8.7 cm and 17.9 cm. The TDR probe measures average water content over its entire 25 cm length; as such, there were periods when the surface few centimeters were likely more wet than the rest of the profile for a short period after irrigation, but this was not detected by the TDR measurement.

Irrigation at 60 percent ET had no effect on tall fescue rooting or soil water content in either year compared to turf irrigated at 100 percent ET. Irrigation at this level was, on average, 13 mm and resulted in soil wetting to a depth of about 10 cm. The lack of effect by 60 percent ET irrigation level on soil water level likely resulted because ET rates were lower in this treatment than in turf receiving 100 percent ET. Also important to note is that rooting did not proliferate at 4.7 mm or 8.1 mm depths under a 60 percent ET irrigation regime, depths to which the soil wetting front reached twice weekly.

Irrigation at 20 percent reduced visual quality below a level that was considered acceptable after 60 days in 2001 and about 35 days after treatments were initiated in 2002. Irrigation at 60 percent ET was sufficient to maintain quality equivalent to turf receiving 100 percent ET throughout each summer of the experiment. Despite the reduction in visual quality at 20 percent ET, we found that tall fescue rooting was concomitantly enhanced under this irrigation regime

Tall fescue evaluated in this study and subjected to 20 percent ET irrigation had a vertical growth rate approximately 40 percent lower than that of turf irrigated at 100 percent ET (Fu et al., 2006). A similar re-allocation of carbohydrates from shoot to roots resulting from slower shoot development, as described by Huang and Fu, (2001), may have contributed to root growth enhancement in turf receiving irrigation at 20 percent ET. However, unlike the results reported in Fu et al. (2004), a drier soil between a depth of 0 cm and 25 cm in this field study did not promote tall fescue rooting at depths greater than 17.9 cm.

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Of greatest importance to the turfgrass manager is that there are no detrimental effects on rooting of irrigating tall fescue at 20 percent or 60 percent ET from June to September, when irrigation requirements are highest and restrictions are most common. Despite a drier soil in the surface 20 cm under the 20 percent ET irrigation regime, an increase in tall fescue root number, length and surface area occurred.

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