Turf Irrigation Management Using Time Domain Reflectometry

C. E. Kome, P. E. Rieke, and Jason Nigl
Department of Crop and Soil Sciences

Repeated volummetric soil moisture content (VMC) measurements provide useful information on soil hydrologic processes as such as infiltration, leaching, evapotranspiration (ET), as well as irrigation scheduling. Conventionally, weather based ET models are used to schedule irrigation. ET in urban areas depends on the site and may vary considerably from regional predictions. Better estimates of actual ET will provide an environmentally sound basis for efficient irrigation management.

The process of sending signals and analyzing the reflected wave forms is called time domain reflectometry (TDR). The TDR setup consists of a set of stainless steel probes embedded in the soil and crimped to cable wires connected to an oscilloscope and a computer. A signal traveling along the coaxial cable or wave guide is influenced by the dielectric properties of the surrounding material. The higher the dielectric constant, the slower the propagation velocity. TDR is a relatively new method of VMC determination. However, the use of TDR in irrigation scheduling has been limited to laboratory and field research. A soil based method of irrigation programming is expected to provide better estimates of soil moisture depletion and irrigation need. This study evaluated TDR as a tool for repeated and rapid VMC determination and turf irrigation scheduling on annual bluegrass and creeping bentgrass fairway turf.

Soil moisture depletion patterns by annual bluegrass (*Poa annua* L.) and Penncross creeping bentgrass (*Agrostis palustris* Huds.) were evaluated under three irrigation regimes: maintain at field capacity, application of 2.5 mm daily and application of 2.5 cm only upon the appearance of stress. Horizontally installed TDR probes at 0-5, 5-10, 10-15, 15-25 cm depths were used to monitor VMC daily with the exception of rainy days. The soil type is an Owosso sandy loam. The turf was mowed at 1.27 cm (5/8") height and maintained according to standard turf management practices for cool season grasses. The turfgrass species were evaluated for turf quality, clipping weight and rootmass and interspecific competition. Gravimetric moisture measurements converted to VMC were taken as a basis for comparison. Irrigation was scheduled based on soil moisture depletion only.

Water use was significantly different by irrigation treatment but not by species. The field capacity treatment used more water during dry periods while the 2.5 mm daily treatment used more water during wet periods. The 0-5 cm depth showed the highest variation in VMC for all treatments due to its proximity to the atmosphere, the high organic matter content and high root density. Soil moisture variation by depth as measured by TDR were in close agreement with the standard gravimetric method (Table 1). VMC during very dry periods was in the order 15-25 > 10-15 > 5-10 > 0-5 cm. The reverse order was true during wet periods. The field capacity and 2.54 mm daily irrigation treatments yielded significantly higher clipping weights during dry cycles but not during wet periods. Root mass means of creeping bentgrass were higher than for annual bluegrass for all treatments although water use by both species was not significantly different. Bentgrass encroachment was superior to that of annual bluegrass regardless of irrigation treatment. Because both 1992 and 1993 were wet years, the stress treatment did not receive any irrigation. However, the stress plots had the lowest quality ratings.

The irrigation treatments had VMC significantly greater than field capacity more than 28 days for the field capacity treatment and even higher for the 2.5 mm daily treatment. Under such conditions, there is a greater potential for pesticides and fertilizers to leach into ground water. The leaching

frequency was in the order 2.5 mm daily > field capacity > > stress. Monitoring soil moisture in the rooting zone will help reduce over-watering, maintain adequate aeration, promote adequate root growth, minimize reducing conditions, and limit leaching of agricultural chemicals into groundwater contamination .

Table 1. Means of Measured Parameters by Irrigation Treatment.

IRRIGATION TREATMENT Date	Root Mass (Kg/m2)	Clipping Weight (Kg/m2)	Quality Ratings	VMC-TDR (%)	VMC-GMC (%)
Field Capacity	2.52	12.59a	8.3	29.4b	28.6b
2.5 mm Daily	3.73a	15.56a	8.6	30.9a	30.4a
Stress	3.17	5.98a	6.9	23.4c	20.9c

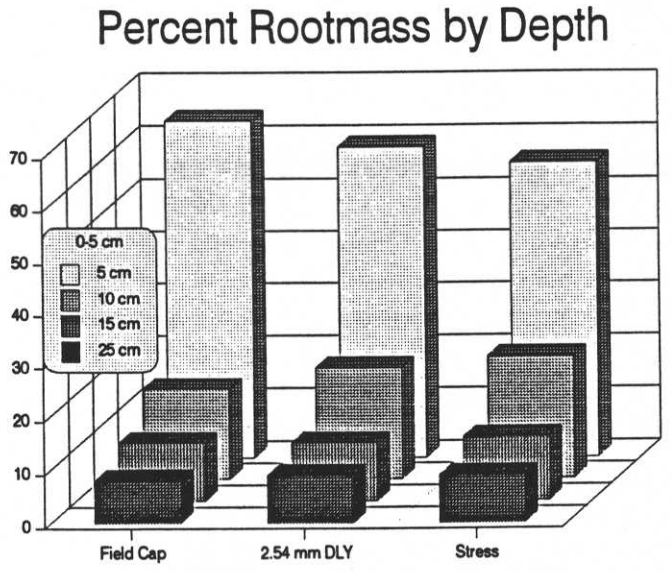

Figure 1.