Efficient Irrigation of Golf Turf in the Cool-Humid New England Region: Evapotranspiration and Crop Coefficients

Scott Ebdon and Michelle DaCosta
University of Massachusetts

Objectives:

Develop research-based crop coefficients (K_c) for efficient irrigation practices in recreational turf (golf and sports) under maintenance and climatic conditions typical of the New England region.

Start Date: 2011
Project Duration: 3 years
Total Funding: $57,304

Scheduling irrigation according to actual turfgrass evapotranspiration rates (ET_a) reduces waste and increases irrigation efficiency. Landscape and crop coefficients (K_c values) are used in association with weather station reference ET (ET_0) to accurately predict ET_a. Experimentally derived K_c values need to be developed at the local level to ensure optimum turf function and effective irrigation efficiency specific to the region. Specifications developed by the US EPA have been drafted to restrict irrigation to only 60 to 80% of ET_0. These EPA guidelines may severely impact turf function in the cool-humid New England region because EPA K_c recommendations are based on California data.

Compared ET_a and K_c values for a golf turf species (creeping bentgrass, CBG) maintained as green and fairway, and 2 sports grass species (Kentucky bluegrass, KBG, and perennial ryegrass, PRG) using the standard reference ET_0 values computed using the UN Food and Agricultural Organization report 56 (FAO 56 equation). Studies were initiated in 2011 at the Joseph Troll Turf Research Facility, South Deerfield, MA. Pure stands measuring 5 by 10 ft of "Exacta" PRG and "Touchdown" KBG were established to represent sports grass while 'Memorial' CBG was used as green and fairway turf. Sports grass height of cut was maintained at 1.25 and 2.5 inches while CBG plots were maintained at 0.125 and 0.375 inches. All treatment plots received either 2 or 4 lbs N 1,000 ft^{-2} yr^{-1}.

Twenty-four daily ET_a (using weighing lysimeters) and ET_0 (using FAO 56 equation) measurements were used to derive K_c values (calculated as ET_a/ET_0) during the summer months beginning June 21 and ending August 31, 2011. Reference ET values derived using the FAO 56 equation were correlated with ET_a ($r= 0.78$, $P\leq0.001$) and therefore ET_0 was effective in predicting actual daily ET rates.

Within a species, height of cut and N fertilization rate had no significant effect on ET_a and K_c values. However, taller grass species typical of sports turf exhibited significantly higher ET_a and K_c values than short grass fairway and putting green turf. Biweekly K_c values during the summer irrigation season for KBG ranged from 1.15 to 1.30. Perennial ryegrass biweekly K_c values ranged from 1.05 to 1.20. Creeping bentgrass ranged from 0.90 to 1.05 in biweekly K_c values in 2011. Averages for the 2011 irrigation season showed that KBG exhibited the highest seasonal K_c (1.28) and CBG the lowest seasonal K_c (0.98), with PRG statistically intermediate in seasonal K_c (1.13).

First-year results indicate that a lower K_c value may be more appropriate for golf fairway and green turf compared to taller grass. Short-cut golf turf offers potential water savings and, in turn, K_c values that are 25 to 30% lower compared to sports turf. Short-cut CBG exhibited significantly slower leaf growth rates and lower leaf area components, which contributed to this species lower ET_a and K_c. Implementation of specifications of 60 to 80% of reference ET may severely under estimate actual cool-season turf water use for the cool-humid New England region.

Twenty-four daily ET_a (using weighing lysimeters) and ET_0 (using FAO 56 equation) measurements were used to derive K_c values (calculated as ET_a/ET_0) during the summer months beginning June 21 and ending August 31, 2011.

Summary Points

- Species such as KBG and PRG maintained under tall HOC as sports turf used 25 to 30% more water as ET_a than short grass CBG maintained as putting green and fairway turfs.
- K_c values derived as the ratio of ET_a to ET_0 were significantly lower for golf turf compared to sports grass. CBG exhibited 15% lower K_c values than PRG, and 30% lower K_c values than KBG turf.
- Seasonal K_c values during the 2011 summer irrigation season ranged from 0.98 for CBG to as high as 1.28 for KBG, with biweekly K_c values for CBG ranging from 0.90 to 1.05.
- Effects of N and HOC within the species on ET_a and K_c values were not statistically significant.
- US EPA WaterSense proposed K_c values of 60 to 80% of reference ET_0 may severely under estimate irrigation requirements for cool-season turfgrass species in the cool-humid New England region.