



EFFICIENT IRRIGATION FOR RECREATIONAL TURF IN NEW ENGLAND: EVAPOTRANSPIRATION AND CROP COEFFICIENTS

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SUMMARY

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 (i.e., WaterSense) developed by the US EPA have been drafted restricting irrigation to only 60 to 80% of ET_0 . These EPA WaterSense guidelines may severely impact turf function since EPA K_c values are based on California data. The objective of this study was to compare ET_a and K_c values for golf species (creeping bentgrass) maintained as green and fairway with sports grass species (Kentucky bluegrass and perennial ryegrass) using the standard reference ET_0 values computed using the UN Food and Agricultural Organization report 56 (FAO 56 equation). Studies were initiated in 2010 at the Joseph Troll Turf Research Facility, South Deerfield, MA. Pure stands of "Exacta" perennial ryegrass and "Touchdown" Kentucky bluegrass were established to represent sports grass while 'Memorial' creeping bentgrass was used as green and fairway turf. Sports grass height of cut (HOC) was maintained at 1.25 and 2.5 inch while creeping bentgrass plots were maintained at 0.125 and 0.375 inch HOC. All treatment plots received either 2 or 4 lbs N 1000ft² yr⁻¹. Thirty daily ET_a (using weighing lysimeters), reference ET_0 (using FAO 56 equation) and K_c values (calculated as ET_a/ET_0) were made during the summer of 2012 beginning in late June and ending 31 August.

Reference ET_0 values derived using the FAO 56 equation was effective in predicting daily ET_a in short and tall grass turf accounting for 84% of the total variation in ET_a during the 2012 irrigation season. Results show that a lower K_c value may be more appropriate for short grass such as golf fairway and green turf requiring a K_c value approaching “0.90” (i.e., irrigating at 90% of FAO 56 reference ET_0) (Table 1). Higher K_c values ranging from 1.10 to 1.20 may be more appropriate for taller grass such as sports and lawn grass (Table 1). Our results indicate a crop coefficient of “1.0” (i.e., irrigating at 100% of FAO 56 reference ET_0) should not be used in weather station software using FAO 56 to estimate seasonal irrigation requirements because golf turf K_c is below “1.0” while tall grass lawn and sports turf K_c is greater than 1.0. Furthermore, golf turf offers a potential water savings of 15 to 30% compared to lawn and sports turf because of its closer HOC and slower leaf growth rates, which effectively lowers leaf area components and reduces turf ET_a . Higher N and taller HOC increased K_c values by increasing ET_a by as much as 5% over shorter HOC and lower N. Practices that promoted higher leaf growth rates increased K_c values (and ET_a) (Table 1, Figure 1). Implementation of WaterSense specifications of 60 to 80% of reference ET_0 as part of the irrigation systems software for calculating turf ET_a may significantly under estimate turf water use in summer for the cool-humid New England region.

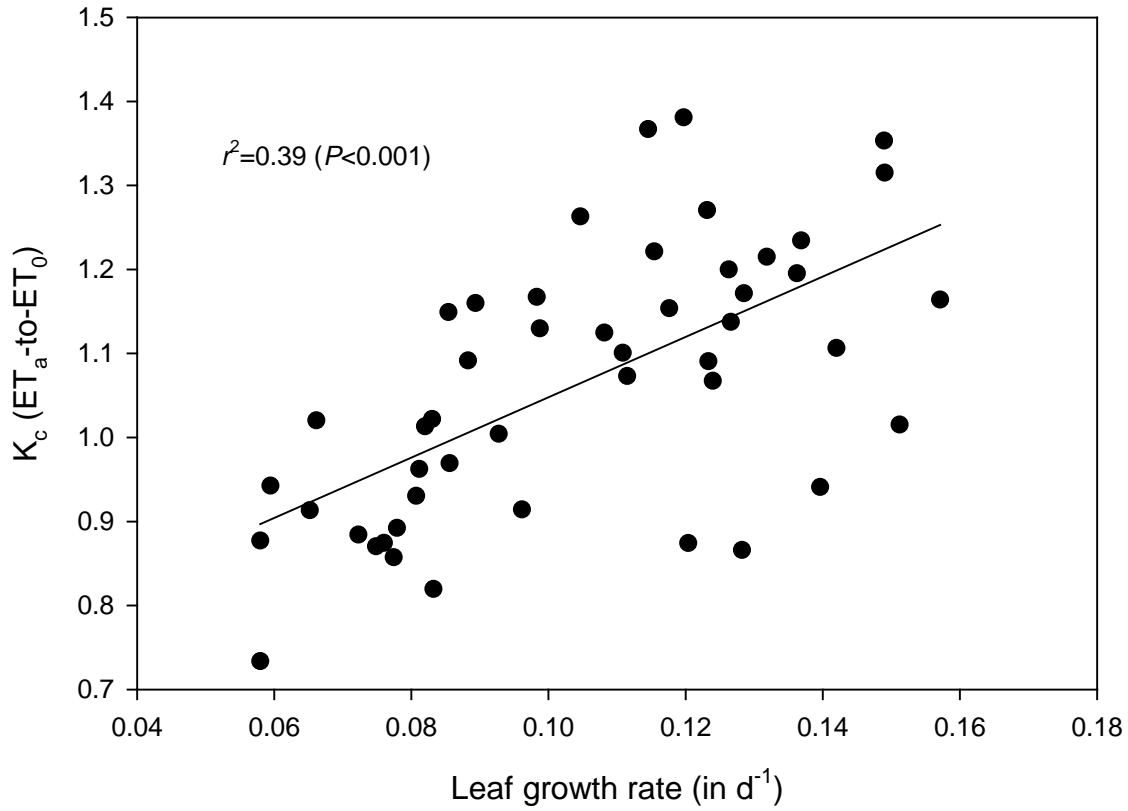
Table 1. Three year averages (2010-2013) for leaf growth rate and Kc values derived using the daily mean (ratio) method from daily ETa and ET0 measured over the growing season from late June to late August.

Factor	Kc value (ETa/ET0)	Leaf growth rate (in. d ⁻¹)
Species		
KBG, lawn and sports	1.19a†	0.13a†
PRG, lawn and sports	1.08b	0.11b
CBG, golf	0.92c	0.08c
N fertilization (lb 1000ft ⁻²)		
Low, 0	1.04b	0.10a
High, 1	1.09a	0.11a
HOC		
Low	1.04b	0.11a
High	1.09a	0.10b
Species by N		
KBG-Low N	1.17a§	0.12b§
KBG-High N	1.22a	0.14a
PRG-Low N	1.01b	0.10c
PRG-High N	1.16a	0.12b
CBG-Low N	0.94bc	0.08d
CBG-High N	0.89c	0.07d

† Numbers followed by the same letter within a factor are not significantly different.

§ Numbers followed by the same letter(s) for species by N combination are not significantly different.

Figure 1. Relationship between leaf growth rate and K_c values (2010-2012 average).



KC-ET STUDY PLOT PLAN

B L O C K 1	6 High HOC	2 Low HOC	1 High HOC	3 Low HOC	4 High HOC	5 Low HOC
	Low HOC	High HOC	Low HOC	High HOC	Low HOC	High HOC
	CBG 4 lbs N	KBG 2 lbs N	KBG 4 lbs N	PRG 4 lbs N	PRG 2 lbs N	CBG 4 lbs N
B L O C K 2	1 High HOC	5 High HOC	3 Low HOC	2 Low HOC	6 High HOC	4 High HOC
	Low HOC	Low HOC	High HOC	High HOC	Low HOC	Low HOC
	KBG 4 lbs N	CBG 4 lbs N	PRG 4 lbs N	KBG 2 lbs N	CBG 4 lbs N	PRG 2 lbs N
B L O C K 3	4 Low HOC	3 High HOC	6 Low HOC	2 Low HOC	5 High HOC	1 Low HOC
	High HOC	Low HOC	High HOC	High HOC	Low HOC	High HOC
	PRG 2 lbs N	PRG 4 lbs N	CBG 4 lbs N	KBG 2 lbs N	CBG 4 lbs N	KBG 4 lbs N
B L O C K 4	6 High HOC	4 High HOC	2 High HOC	1 High HOC	5 Low HOC	3 High HOC
	Low HOC	Low HOC	Low HOC	Low HOC	High HOC	Low HOC
	CBG 4 lbs N	PRG 2 lbs N	KBG 2 lbs N	KBG 4 lbs N	CBG 4 lbs N	PRG 4 lbs N

10ft

KC-ET TREATMENTS

1. 'Touchdown' Kentucky bluegrass 4 lbs N/1000ft²/yr
2. 'Touchdown' Kentucky bluegrass 2 lbs N/1000ft²/yr
3. 'Exacta' perennial ryegrass 4 lbs N/1000ft²/yr
4. 'Exacta' perennial ryegrass 2 lbs N/1000ft²/yr
5. 'Memorial' creeping bentgrass 4 lbs N/1000ft²/yr
6. 'Memorial' creeping bentgrass 2 lbs N/1000ft²/yr

All main plots are split according to height of cut (HOC)

KBG & PRG: Low HOC (1.25 in.) & High HOC (2.5 in.)

CBG: Low HOC (1/8 in.) & High HOC (3/8 in.)

TENNIS GRASS COURTS (PLOTS) AND REPLICATIONS (BLOCKS)

River Road

BLOCK A

Longwood Poa	Barbeta P. Ryegrass	6.75 ft
Capri Colonial bentgrass	3-Way K. Bluegrass	
2-Way P. Ryegrass	P-105 K. Bluegrass	
Villa Velvet Bentgrass	Pure Distinction Cr. Bentgrass	

← 44 ft →

← 88 ft →

BLOCK B

Villa Velvet bentgrass	P-105 K. Bluegrass
Longwood Poa	3-Way K. Bluegrass
Pure Distinction Cr. Bentgrass	Barbeta P. Ryegrass
2-Way P. Ryegrass	Capri Colonial Bentgrass

↑ 27 ft ↓

All Borders: 3-Way P. Ryegrass (Barenbrug)

BLOCK C

3-Way K. Bluegrass	Capri Colonial bentgrass
Pure Distinction Cr. Bentgrass	Longwood Poa
P-105 K. Bluegrass	Villa Velvet bentgrass
2-Way P. Ryegrass	Barbeta P. Ryegrass

BLOCK D

Pure Distinction Cr. Bentgrass	Barbeta P. Ryegrass
P-105 K. Bluegrass	Villa Velvet bentgrass
3-Way K. Bluegrass	Longwood Poa
Capri Colonial Bentgrass	2-Way P. Ryegrass

Drainage

