Irrigation Program Effects on Six Cool-Season Lawn Grasses in a Cool-Humid Climate

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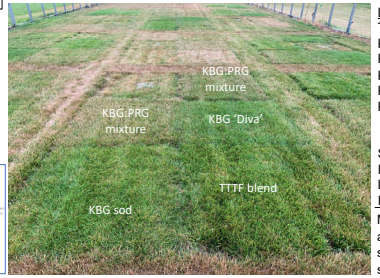
ABSTRACT

Water scarcity concerns, even in cool-humid climates, have increased interest in superior lawn water conservation strategies. Historically, guidelines for supplemental lawn watering in the absence of rainfall suggest providing 25-38 mm wk^{-1}, applied programmatically across three days per week (M-W-F). Information regarding the effects of varying lawn irrigation frequency on cool-season lawn grasses is limited. Policymakers may limit water application during drought to only once or twice wk^{-1} and it is unclear what effects this may have. A two-year field study compared natural rainfall only to three supplemental irrigation programs: 33 mm wk^{-1} applied two (M-Th) or three times (M-W-F) wk^{-1} and 80% of accumulated evapotranspiration (ET_o) for 70 days. These programs were applied to six lawn grasses: a turf-type tall fescue (*Schedonorus arundinaceus* (Schreb.) Durmort.: TTTF) blend, a drought sensitive and tolerant seeded Kentucky bluegrass (*Poa pratensis*: L.:KBG), a sodded KBG blend, and two KBG/perennial ryegrass (*Lolium perenne* L:PRG) mixtures. Visual turf quality (TQ), digital green color (DGC) and volumetric soil water content (0-7.6 cm: VWC) were measured, and the areas under the curve (AUC) for each response variable calculated. Rainfall measured 118.5 mm and 342.8 mm, in year one and two, respectively, which affected all data. Irrigation program and lawn grass responses were highly significant $p < .001$ in each year. AUTQC was lowest for the rainfall control (339 and 425) and highest for the 33 mm wk^{-1} applied three times (507 and 526) and 80% ET_o programs (508 and 535) in year one and two respectively. Responses for DGC and VWC generally followed annual TQ trends. In summary, supplemental irrigation aided all grasses. Under natural rainfall only the TTTF, and KBGs were generally superior to the KBG:PRG mixtures, thus emphasizing the importance of species selection where limited supplemental irrigation is intended.

Cool-season lawns in cool-humid environments may require supplemental irrigation during the summer months to maintain consistent seasonal green color and density. Unfortunately, many lawns are often receive excess supplemental irrigation to meet these goals.

Fig. 1. Overview of the research study area showing differences in the whole plot factors (irrigation program) and the differential responses of six cool-season lawn grasses to irrigation programs on 25 July, 2022 (Year 1).



Summary of Results

Natural rainfall differences (119 vs. 343 mm) between the two study years strongly affected visual quality and green color in each study year.

Irrigation programs:

- There were few differences among supplemental irrigation programs. The rainfall only program resulted in the lowest quality and green color in both study years.

Lawn grass species:

- In year 1 the TTTF blend, KBG 'Diva', and KBG sod had the best overall quality and green color.
- In year 2 the TTTF blend, KBG 'Desert Moon', and KBG sod had the best overall quality and green color.
- The KBG:PRG mixtures performed the worst for quality and green color.

Table 1. Summary of the area under the curve for turf (TQ), digital green color curve (DGC) and volumetric water content (VWC) data for two growing seasons.

Main effects	2022			2023		
	TQ	DGC	VWC	TQ	DGC	VWC
Irrigation pgm (IR)						
33 mm wk^{-1} M-W-F	507 A	6427 A	2561 A	526 A	6797 AB	2818 A
33 mm wk^{-1} M-TH	505 A	6291 A	2553 A	513 B	6647 B	2711 B
80% ET [c]	508 A	6247 A	2508 A	535 A	6841 A	2829 A
Rainfall only	384 B	3600 B	1617 B	480 C	5899 C	2465 C
Lawn grass (LG)						
Tall fescue blend	494 a	6000 a	2476 a	534 a	6665 b	2894 a
KBG 'Diva'	487 a	6274 a	2271 b	491 c	6507 bc	2627 c
KBG 'Desert Moon'	ND	ND	ND	529 a	7004 a	2721 b
KBG:PRG pro mix	442 b	4614 c	2264 b	491 c	6140 d	2675 bc
KBG:PRG retail mx	454 b	5144 b	2279 b	508 b	6363 c	2652 c
KBG sod	502 a	6173 a	2259 b	527 a	6597 b	2668 c
	ANOVA					
Source of variation						
IR	***	***	***	***	***	***
LG	***	***	***	***	***	***
IR x LG	NS	NS	NS	NS	NS	NS

Means in the same column for irrigation program followed by a common capital letter and means for lawn grass followed by a common lowercase letter are not significantly different according to Fisher's protected LSD (p<.05). ND=no data, *** significant at the p<.001 level and non-significant (NS), respectively.

Objective: Determine lawn species response to four supplemental irrigation programs for a 70 day summer period.

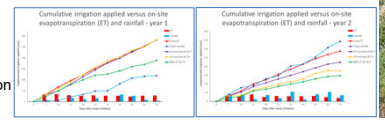
Hypotheses:

a. Decreasing irrigation frequency from the traditional programmatic approach of 3x wk^{-1} (Mon.-Wed.-Fri.) to a less frequent schedule of 2x wk^{-1} or reducing overall supplemental irrigation using a 80% ET_o approach, will not result in a significant reduction in turf quality and/or green color.
b. We anticipate that there will be program differences among drought-sensitive and tolerant species/cultivars.

Overview of Experimental Methods:

Four Irrigation programs (Whole plot factor)

1. 33 mm wk^{-1} applied M-W-F (3 times)
2. 33 mm wk^{-1} applied M-Th. (2 times)
3. 80% ET_o (2 or 3 times wk^{-1}) – using an on-site weather station
4. Natural rainfall only



Six cool-season lawn grasses* (Sub-plot factor):

1. Retail KBG:PRG mixture
2. KBG 'Desert Moon' (drought tolerant)**
3. Turf-type tall fescue blend
4. KBG 'Diva' (drought sensitive)
5. Professional KBG:PRG mixture
6. KBG sod

*all grasses were planted in Sept. 2021.
**not evaluated in Year 1 due to slow establishment

Program	Quantity	Weekly application frequency*	Total Irrigation (Year 1)	Total Irrigation (Year 2)
			---------- mm ----------	
1	33 mm wk^{-1}	3 (Mon.-Wed.-Fri.)	282.8	223.8
2	33 mm wk^{-1}	2 (Mon. and Thu.)	283.0	176.0
3	80% ET	2 or 3	188.9	147.5
4	Natural rainfall only	0	118.5	342.8

* No supplemental irrigation was applied if natural precipitation was over 12 mm between any two applications. In year two the 80% ET treatments were adjusted to a 3 time per week application frequency.

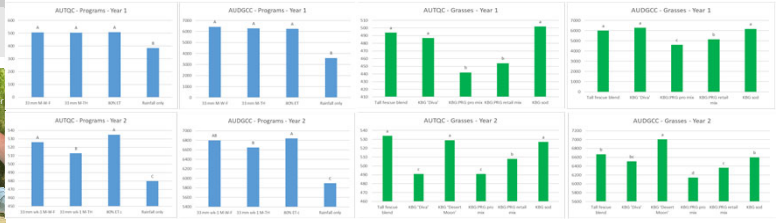
Study overview: A field study was conducted for two summers at the W. H. Daniel Turfgrass Research and Diagnostic Center, West Lafayette IN on a silt-loam soil. Plots were maintained a 7.6 cm height, fertilized with 150 kg N ha^{-1} yr^{-1} and pests controlled preventatively. Irrigation whole plots were rearranged in Year 2 to avoid any chronic drought bias.

Data Collected:

- Visual turf quality (TQ): Ratings every 7d on a 0-10 scale where 0 = dead turf; 6=minimum acceptable lawn quality; and 10 = optimum density, uniformity, and greenness.
- Digital Green Color (DGC): Plots were imaged weekly using a light box and green coverage was determined using Turf Analyzer software.
- Volumetric Water Content (VWC): Weekly measurements using a FieldScout TDR-350 Soil Moisture Meter at 7.6 cm depth in five locations per plot averaged for a single plot value.
- The area under the curve was calculated for all measurements and data were subject to analysis of variance (ANOVA) utilizing the general linear model (GLM) procedure. Treatment means were separated using Fisher's protected least significant difference (LSD) test (p<.05).

Irrigation Program Summary Means for Area Under the Turf Quality (TQ) and Digital Green Color (DGC) Curves for Two Growing Seasons

Lawn Grass Summary Means for Area Under the Turf Quality (TQ) and Digital Green Color (DGC) Curves for Two Growing Seasons



Means for irrigation program within each figure followed by a common capital letter and means for lawn grass within each figure followed by a common lowercase letter are not significantly different according to Fisher's protected LSD (p<.05).