Two Season Comparison of Nine Smart Controllers

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Abstract. *During the 2011 and 2012 seasons, nine different 'smart' irrigation controllers from various manufacturers were utilized to irrigated 18 similar plots of cool season turfgrass. Each controller serviced two plots, each 30-ft by 30-ft. Four of the controllers were soil moisture based controllers (with a separate sensor installed in each zone) and five were weather based. Each proved successful in maintaining adequate soil moisture for the turfgrass during both seasons, though not without some needed monitoring and adjustment.*

All the controllers were considered appropriate for the small residential or home-owner market. Four of the five soil moisture based controllers were add-on modules, often paired with a basic timer/clock from a different manufacturer. None of the weather based controllers utilized a subscription service for obtaining weather data. Three utilized only on-site temperature sensors to calculate needed irrigation time. Two utilized both air temperature and solar radiation sensors for this purpose.

Every controller had unique strengths and user appeal. The diversity of irrigation strategies and approaches by the various manufacturers ranged from fairly simple and straight forward to more 'black box'. Because the targeted application was for small residential, provided functionality was expectedly not all encompassing. Simple, transparent operation was favored over 'hidden' processes or algorithms that attempted to 'magically' but generically correct for most conditions.

Key functionality and features of the nine controllers are summarized in more detail below, providing basic guidance to consumers in matching their needs and expectations to products currently available in the irrigation industry.

Keywords. Smart irrigation controller, weather based controller, soil moisture based controller, soil moisture sensor.

Procedures

During the 2012 season, nine different 'smart' irrigation controllers from various manufacturers were utilized to irrigated 18 similar plots of cool season turfgrass. Seven of these were also utilized during the 2011 season. Each controller serviced a 30-ft by 30-ft plot of tall fescue (zone 1) and a 30-ft by 30-ft plot of Kentucky bluegrass (zone 2). Four of the controllers were soil moisture based controllers (with a separate sensor installed in each zone) and five were weather based. Tables 1 and 2 provide general information about the plots and controllers.

Plot	Turfgrass	'Smart' controller	Basis of control	Configuration	Sensors
B1-1	Tall fescue	MorpH2O AguaMiser	Soil moisture based	Add-on modules	Wireless soil moisture sensor in plots
B2-1	Kentucky bluegrass				
B1-2	Tall fescue	BaseLine WaterTec S100	Soil moisture based	Add-on modules	Soil moisture sensor in plots
B2-2	Kentucky bluegrass				
B1-3	Tall fescue	Rainbird SMRT-Y	Soil moisture based	Add-on modules	Soil moisture sensor in plots
B2-3	Kentucky bluegrass				
B1-4	Tall fescue	Acclima SC6	Soil moisture based	Sensors connect directly	Soil moisture sensor in plots
B2-4	Kentucky bluegrass				
B1-6	Tall fescue	Aqua Conserve ET-6	Weather based	Plug-in sensor	Air temperature sensor
B2-6	Kentucky bluegrass				
B1-7	Tall fescue	Rainbird ESP-SMT	Weather based	Sensor module incorporated	Air temperature sensor
B2-7	Kentucky bluegrass				
B1-8	Tall fescue	Weather matic SmartLine SL800	Weather based	Plug-in sensor	Air temperature sensor
B2-8	Kentucky bluegrass				
B1-9	Tall fescue	Irritrol Climate Logic	Weather based	Wireless plug-in module	Air temperature & solar sensors
B2-9	Kentucky bluegrass				
B1-10	Tall fescue	Hunter Pro-C Solar-Sync	Weather based	Add-on module	Air temperature & solar sensors
B2-10	Kentucky bluegrass				

Table 1. Summary of 'smart' controllers included in demonstration.

Plot	'Smart' controller			
B1-1 B2-1	MorpH2O AguaMiser	Wireless	Shuts off irrigation at specified threshold.	New in 2012
B1-2 B2-2	BaseLine WaterTec S100	Utilize existing wires to zone valve to connect sensor to interface at controller.	Allows irrigation at specified threshold.	
B1-3 B2-3	Rainbird SMRT-Y	Utilize existing wires to zone valve to connect sensor to interface at controller.	Allows irrigation at specified threshold.	Currently off market
B1-4 B2-4	Acclima SC6	Utilize existing wires to zone valve to connect sensors directly to controller. Sensors can be assigned to control one or more zones. Large display.	Allows irrigation at specified threshold.	
B1-6 B2-6	Aqua Conserve ET-6	Adjusts historical ET based on temperature sensor. Determines needed run-time minutes for specified irrigation days weekly. Accumulates minutes until at least 50% of peak need.	Varies run-time minutes.	Wireless sensor available
B1-7 B2-7	Rainbird ESP-SMT	Adjusts historical ET based on temperature sensor. Abundant operational data available. Includes auto shutoff for rain & low temperature. Estimates next irrigation.	Varies watering days or run-time minutes.	Measure rain w/ tipping bucket gauge
B1-8 B2-8	Weather matic SmartLine SL800	Adjusts historical ET based on temperature sensor. Calculates deficit & accumulates at midnight. Includes auto shutoff for rain.	Varies run-time minutes.	
B1-9 B2-9	Irritrol Climate Logic CL100	Adjusts historical ET based on temperature & solar sensors. Includes auto shutoff for rain & low temperature.	Varies run-time minutes.	New in 2012
B1-10 B2-10	Hunter Pro-C Solar-Sync	Adjusts historical ET based on temperature & solar sensors. Easy to install and setup.	Varies run-time minutes.	

Table 2. Summary of key functionality of 'smart' controllers included in demonstration.

Irrigation

All 18 plots were on a deep silty clay soil, with minimal slope. Irrigation flow to each plot was measured automatically by a dedicated DLJ water meter with pulse output (1 count per gallon) connected to a Campbell Scientific data logger (15-minute intervals). An adjacent weather station provided data for calculating reference ET or ETos using the ASCE standardized Penman-Montieth combination equation.

Although all plots were cool season turfgrass, the tall fescue had an effective root zone of 24 inches while the Kentucky bluegrass was only 12 inches. Flat surface grades, modest sprinkler precipitation rates, and reasonable soil intake rates routinely allowed runtimes where 0.75 inches could be applied per cycle with no significant surface runoff.

All tall fescue zones were irrigated with sprinkler rotors on 30 feet square spacing. All Kentucky blue grass zones were irrigated with Toro Precision spray nozzles on 15-feet square spacing. Annual maintenance and service provided distribution uniformities for all zones in the 0.65 to 0.70 range.

Although initial sprinkler precipitation rates were calculated from sprinkler audits, these were adjusted slightly based on the measured gallon through the flow meter and the runtime minutes set on the corresponding controller. This adjustment was expected as water pressures during early morning watering times can vary with additional zones running. The intent was to apply the design or target depth of irrigation as accurately as possible.

Conclusion

Each of the nine 'smart' controllers included in this demonstration proved functional for maintaining adequate soil moisture for cool season turfgrass. All required installation and setup by personnel having a basic understanding of irrigation principles and systems. None were free of the need for nominal monitoring and service.

No controller was expected to perform *optimally* 'out of box', relying solely on general configuration and setup per the instructions provided by the manufacturer (though some were easier than others). From the beginning, it was recognized that the controller was only one component of the irrigation system and its performance would be impacted by other components and operational constraints. Consequently, the ready ability of a controller to be adjusted or fine tuned was considered an essential feature.

References