GROWING KNOWLEDGE

Series content is coordinated by Dr. Lloyd Nackley, associate professor of nursery production and greenhouse management at Oregon State University in Corvallis, Oregon.

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Less-thirsty lawns

Study examines turf cultivars with improved drought tolerance, lower water requirements

BY ALEC KOWALEWSKI AND CHRISTIAN SANCHEZ

Turfgrass is known for requiring frequent irrigation during the summer months to sustain active growth and development, and an aesthetically pleasing appearance. Due to recent concerns associated with the availability of water, turfgrass irrigation is being scrutinized.

Turfgrass scientists have been exploring the use of genera, species and cultivars with improved drought tolerance and reduced water requirements.

In the northern parts of the United States, cool-season grasses like tall fescue and fine fescue have emerged as genera that require less water. Some landscape managers and homeowners have even decided to discontinue summer irrigation of drought-tolerant grasses such as these, as a method to further conserve water.

In this circumstance, cool-season turfgrass will go into a state of summer dormancy during periods of extended drought and heat stress, returning to active growth and development when rains return and temperatures decrease.

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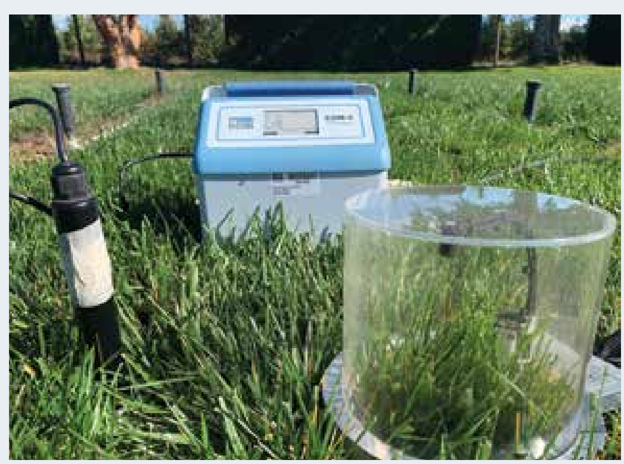

Images 1: Evaluating surface temperature (top), and a portable photosynthesis system chamber and portable gas analyzer used to evaluate the carbon flux (bottom). PHOTO COURESY OF OSU

Images 2: Sod removed to a 15.2 cm depth, pan lysimeter installed at a 25 cm depth, soil and sod returned and syphon used to extract leachate from pan. PHOTOS COURTESY OF OSU

Others have even removed their lawns in exchange for bare soil, mulch or hardscape.

Preliminary results from 2024

However, recent research conducted at Oregon State University in Corvallis, Oregon has shown that by not irrigating your lawn, you compromise several of the ecosystem services the turfgrass would otherwise provide. These ecosystem services include heat island effect and carbon sequestration.

Preliminary research findings determined that the average summer surface temperature of irrigated turfgrass in June, July and August in Western Oregon was 82 F, while the non-irrigated turfgrass summer temperature averaged 97 F, and bare soil averaged 109 F (Table 1, Page 28; Images 1, Page 25).

In fact, bare soil reached temperatures as high as 120 F in August, while turfgrass with irrigation peaked at 91 F. In fact, higher evapotranspiration (ET) replacement rates (80%) resulted in lower surface temperatures than lower ET replacement rates (45% ET replacement) (Table 2, Page 28).

In addition to changes in surface temperature, major differences in carbon sequestration have been observed between irrigated turfgrass, non-irrigated turfgrass and areas where the turfgrass was removed (Table 3, Page 28; Images 1, Page 25).

Preliminary results have found that cool-season turfgrass is a carbon sink during periods of cool, wet weather without irrigation, which is October to the subsequent June (9 months per year) in Western Oregon. Areas that had turfgrass removed became a carbon source, rather than sink, meaning the carbon sequestered in the soil by the turfgrass roots is now being lost to the atmosphere by decomposition because the turfgrass is no longer a living system.

During the summer months when irrigation is required in Western Oregon (July, August, and September), non-irrigated turfgrass transitioned from being a carbon sink to a carbon source. However, the irrigated turfgrass was able to continue sequestering carbon during the summer months due to the sustained active growth and development.

Broader implications of preliminary

findings and previous findings

For those that want to provide the benefits of reduced heat island effect and sustained summer carbon sequestration while reducing potable water use, the use of effluent water from kitchens, washing machines, dish washers, sinks, showers, etc. is an option.

The use of effluent water has been increasing in popularity and government mandates in arid areas of the country, which are typically dominated by warm-season turfgrass. Therefore, the effluent irrigation work conducted on cool-season turfgrass is minimal.

However, recent research on cool-season turfgrass at Oregon State University has determined that effluent water with high concentrations of the typical household byproducts and cleaning agents [boron (B), sodium (Na), and chlorine (Cl)] did not substantially reduce cool-season turfgrass quality, growth and development and can safely be used for irrigation.

This research did not see a substantial increase in soil levels of B, Na and Cl likely because the annual precipitation in cool, humid environments like Western Oregon is adequate to flush these elements during the fall, winter and spring months.

Another alternative water source is harvesting rainwater from roofs. Western Oregon enjoys prolific rainfall in the fall, winter and spring. Above- and below-ground containment systems are available for water harvesting and reuse in the landscape.

In the future, humans will have to continue to search for innovative methods to conserve water. Discontinuing summer irrigation of turfgrass is an option for conserving water, but this will compromise the ecosystem services that have made irrigated turfgrass a popular choice, aesthetic appeal, reduced heat island effects, and enhanced carbon sequestration.

As an alternative to discontinued irrigation, effluent water and rain harvesting are viable options for cool-season turfgrass.

If you want to maximize the cooling effects and carbon sequestration associated with turfgrass, frequent irrigation (four times per week) was found to be optimal. To conserve water when applying fre- »

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quent irrigation, reduced application rates are suggested. Considering this, 0.25" applied four times per week totaling 1" per week is suggested for cool-season turf in northern climates like Western Oregon.

Future research (2025):

Temperature and carbon sequestration data will continue to be collected from the irrigated and non-irrigated turfgrass plots, as well as the plots that have had turfgrass removed. In the spring of 2024, lysimeters were installed in the plots and are being used to collect leachate samples (Images 2, Page 26). The leachate samples will be evaluated for ammonium and nitrate leaching. We suspect the samples without irrigation, which enter summer dormancy and desiccation will produce more nitrogen leaching than the plots with irrigation.

Previous research on warm-season turfgrass in Florida has shown that

Table 1

Contrast comparing irrigated turfgrass to non-irrigated turfgrass and non-irrigated plots without turfgrass on surface temperature, irrigation applied July 1 to September 29, 2024, in Corvallis, Oregon.

	June	July	August	September
Irrigation	20.4 C	30.4 C	33.2 C	27.7 C
Non-irrigated turfgrass	19.7 C	40.8 C*	45.3 C*	39.4 C*
Non-irrigated, no turfgrass	35.2 C*	50.7 C*	49.4 C*	36.1 C*

*Significant at 0.05 level of probability.

Table 2

Main effects of reference evapotranspiration replacement (ET ref) rate on surface temperature when applied from July 1 to September 29, 2024, on surface temperature in, Corvallis, Oregon.

	June	July	August	September
45% ETref replacement	20.8 C	30.3 C	34.5 C*	27.7 C
80% ETref replacement	20.2 C	31.1 C	31.9 C	27.8 C

*Significant at 0.05 level of probability.

Table 3

Contrast comparing irrigated turfgrass to non-irrigated turfgrass and non-irrigated plots without turfgrass on carbon (CO_2) flux, irrigation applied July 1 to September 29, 2024, in Corvallis, Oregon.

	June	July	August	September
Irrigation	7.9	1.5	3.3	3.6
Non-irrigated turfgrass	7.4	-6.0*	-4.2*	-10.1*
Non-irrigated, no turfgrass	-3.0*	-2.2	-1.7*	-2.9*

*Significant at 0.05 level of probability. Positive numbers indicate the assimilation of atmospheric CO_2, negative numbers indicate the release of CO_2 into the atmosphere.

stressed turfgrass produced more nitrogen leaching than healthy turfgrass.

Conclusion

Research has shown that irrigating turfgrass reduces surface temperatures and promotes carbon sequestration, two ecosystem services important to an urban environment. For those interested in conserving water, viable alternatives to traditional irrigation sources include effluent water and rain harvesting. Efficient lawn water use in Western Oregon is around 0.25” applied 4 times per week, totaling 1” per week.

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