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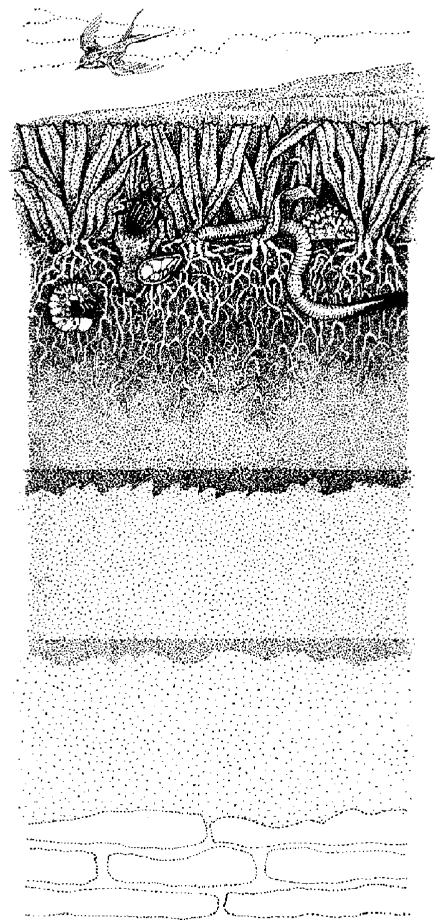

Water Conservation Techniques in Turfgrass

Turfgrass is considered by some as a major water consuming landscape feature. For example, Kentucky bluegrass is often singled out as a grass requiring high irrigation in arid and semi-arid regions of the U.S. In recent years there has been a shift towards less water demanding landscapes by utilizing such techniques as low water requiring turfgrass species and/or cultivars and alternative landscape features like xeriscapes. Although these techniques are useful in new landscape installations and some retrofitting of existing sites, it remains that many landscapes in cool-season turfgrass regions are mainly composed of traditional turfgrasses such as Kentucky bluegrass, perennial ryegrass, and fine and tall fescue. Thus, it is important to develop and use simple turfgrass management strategies that will conserve water on existing sites with traditional turfgrasses by reducing plant water use. ■

Two of the most common maintenance practices used in turfgrass management are mowing and fertilization. Mowing has a pronounced influence on the physiology and growth habit of the turfgrass plant. Mowing influences such properties as leaf area, root system depth and distribution, and shoot density which can influence plant water use. Fertilization, especially with nitrogen, can also influence plant water use by altering the physiology and morphology of the plant. The impact of variation in seasonal mowing heights and fertilization (nitrogen and potassium) on the water use, growth, visual quality, and water use efficiency of Kentucky bluegrass was studied in several experiments.

Mowing

One of the basics of mowing is selecting the height at which to mow. Conventional wisdom suggests mowing as high as possible in order to produce a more stress tolerant plant by encouraging a deeper root system. High cut turf will have a greater leaf area and lower resistance to water leaving the canopy (referred to as canopy

continued on page 4

This Times

Water Conservation

continued from front cover

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resistance), thus will use more water on a relative basis. Having a deeper root system allows the plant to obtain water deeper in the soil, thus becoming more drought tolerant and requiring less irrigation. Conversely, shorter cut turf will use less water but will be susceptible to greater stress due to a shallower root system.

One complicating factor in this discussion is the seasonal nature of both the root system development of cool season turfgrasses and plant water deficits that relate to the need for irrigation. The root system of most cool season turfgrasses are not perennial and follow a growth pattern of: extensive new root initiation and elongation in the spring; a summer decline period; and a slight resurgence of growth in the fall. Soil water deficits occur when precipitation is less than evapotranspiration (ET) for a long enough period of time to deplete the reserves of water stored in the soil, thus irrigation is needed. In cool season areas of the U.S. this most often occurs from late spring, through summer and into early fall.

Typically, turf is mowed at one cutting height during the year or in some situations allowed to grow higher in the summer months in order to reduce stress. The hypotheses tested in this study were: (1) Kentucky bluegrass will use more water if mowed at 3 inches than at 1 inch, (2) mowing higher in the spring will result in a deeper root system (more stress tolerant plant) and shorter in the summer will result in less water use, thus conserve water.

The following experiment was conducted to test these hypotheses: typical bucket weighing lysimeters (10" ID by 12" deep, PVC filled with a sandy loam soil for the Ithaca study or a silt loam for the Plainview study) were sodded with Kentucky bluegrass. Following a several months establishment period, the lysimeters were placed in field plots to simulate typical microclimatic conditions of a lawn. Two sites were used, one at the Cornell University Turfgrass Field Research Laboratory in Ithaca, NY and the other at the Cornell Cooperative Extension of Nassau County office complex in Plainview, NY. There were eight different mowing treatments (see Table 1) applied to the test area, each replicated three times. It should be noted that there was a four week transition period from one cutting height to another. During this time the turf was allowed to grow a half inch or was cut one half inch shorter so as to reduce the potential for stressing the turf (scalping especially). The field plots were 5' x 10' in size with one lysimeter placed in each of the plots. Mowing was done on a weekly basis. Each lysimeter was weighed three times per week to determine the water use rate. Root samples were periodically harvested and clipping yields collected from the lysimeters. On a biweekly basis a visual quality assessment was made. All other maintenance practices followed a typical lawn program.

Table 1. Seasonal mowing height variation effects on the average evapotranspiration rate (ET) and visual quality of Kentucky bluegrass, Ithaca, NY.

Mowing height (inches)			ET (mm/day)	Visual Quality†
Spring	Summer	Fall		
1	1	1	6.0	4.8
1	1	3	4.8	5.3
1	3	1	6.0	5.6
1	3	3	5.5	5.7
3	1	1	5.7	5.4
3	1	3	5.2	5.4
3	3	1	4.5	5.1
3	3	3	6.4	5.1

† Visual quality based on a scale of 1=dead grass and 9=ideal turf.

Table 2. Seasonal mowing height variation effects on the average clipping yield and root growth of Kentucky bluegrass, Ithaca, NY.

Mowing Height (inches)			Shoot Growth (g)	Root Growth (g/cm^3)		
Spring	Summer	Fall		Spring	Summer	Fall
1	1	1	1.4	14.0	14.4	6.8
1	1	3	1.0	12.4	11.2	9.1
1	3	1	1.1	14.5	15.7	8.1
1	3	3	1.0	14.8	13.3	8.3
3	1	1	1.3	13.2	12.3	7.4
3	1	3	1.1	11.7	11.6	9.3
3	3	1	1.1	13.7	13.0	10.2
3	3	3	1.1	13.6	12.3	8.3

Due to the wet nature of the study years (1989, 1990 and 1991) only limited data was obtained for water use measurements. Thus, the only reliable data to be presented was from the Ithaca site in 1990. As seen in Table 1, turf mowed at a constant height (1" or 3") had significantly higher average ET rates, thus would have required more irrigation water, than any of the mowing treatments that varied the height up or down. This difference was as much as 30% which could be a significant water savings. As expected, the higher cut turf used on average slightly more water (6%) than the lower cut turf. In addition, the average visual quality was higher on plots where mowing height was varied during the year (Table 1). Clipping yields (important if clippings are disposed of in landfills) and root growth (Table 2) were not significantly affected by the various mowing treatments. It should be noted that these studies were conducted during wet years and it is uncertain as to the results under drier conditions.

Fertilization

Fertilizers can influence water use in many ways. It has been long contended that faster growing grass will use more water. Therefore, if nitrogen (N) stimulates shoot growth then N may also stimulate water use. However, nutrients like N also influence other properties that may affect water use. High N has been shown to reduce the root system as shoot growth increases. At some point the stunted root system may not be able to supply the necessary water needed by the plant. Increasing the amount of N applied to turf also increases the number of shoots which increases the canopy resistance, possibly lowering water use. Potassium (K) has less influence on plant growth but improves plant stress tolerance (especially drought tolerance). Nutrients are seldom applied individually, thus the interaction of nutrients on water use should be evaluated. The hypotheses tested were: (1) even though N stimulates shoot growth it has a minimal affect on turfgrass water use, and (2) K will reduce turfgrass water use while increasing drought resistance.

Several experiments were conducted to study the effect of N, K and phosphorus (P) on the growth, water use and water use efficiency of either Kentucky bluegrass, or in the case of N, creeping bentgrass. The studies were conduced in a similar manner as described earlier. The same soil and bucket lysimeter set was used for Kentucky bluegrass. The study with creeping bentgrass, a grass primarily used on golf courses, utilized a sand root zone 12" deep (30 cm) unlined with 4" (10 cm) of gravel to simulate a putting green. N, P and K were applied to Kentucky bluegrass as urea, 0-46-0 and potassium chloride at the rates shown in Table 3. Ammonium sulfate was applied to creeping bentgrass at rates shown in Table 4. The amounts of nutrient applied range from no fertilization to excessive levels.

As expected, when more N is applied the clipping yields of either Kentucky bluegrass (Table 3) or creeping bentgrass (Table 4) increased dramatically. However, the affect of N on water use (ET) is far less apparent. Clipping

continued on page 6

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Table 3. Nitrogen effects on the shoot growth, water use (evapotranspiration (ET)) and the water use efficiency (WUE) of Kentucky bluegrass.

Nitrogen Rate lbs/1,000 ft^2	Clipping Yield	% Change ET	WUE
0	0	0	0
1	+138	-5	205
3	+152	+3	181
6	+132	+14	159
9	+152	+2	122
12	+285	+38	237

Table 4. Nitrogen effects on the shoot growth, water use (evapotranspiration (ET)) and the water use efficiency (WUE) of creeping bentgrass.

Nitrogen Rate lbs/1,000 ft^2	Clipping Yield	% Change ET	WUE
0	0	0	0
2	+138	+13	83
4	+666	+13	88
6	+866	+8	89

Water Conservation

continued from page 5

Common turf maintenance practices like mowing and fertilization can have a dramatic effect on the water use of common grasses like Kentucky bluegrass and creeping bentgrass. Altering the height of cut during the year resulted in as much as a 30% lower plant water use figure which could relate to a substantial saving in water used for irrigation.

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yields were increased by 150% with less than a 14% increase in water use (Kentucky bluegrass). This is most apparent in the normal range of N fertilization of 1 to 6 lbs N/1000 sq.ft. Unfertilized turf is very inefficient in utilizing water to produce growth (dry clippings) and that even the smallest amount of N substantially increased water use efficiency (WUE). In the study where K was also evaluated (Table 5), as before, when the amount of N applied increased, shoot growth increased with only a slight increase in water use. Potassium additions resulted in lower water use values, which appears to be related to less shoot growth. Evaluated alone, K applied at moderate rates (2 to 4 lbs K2O/1000 sq.ft.) resulted in lower water use.

Summary

Common turf maintenance practices like mowing and fertilization can have a dramatic effect on the water use of common grasses like Kentucky bluegrass and creeping bentgrass. Altering the height of cut during the year resulted in as much as a 30% lower plant water use figure which could relate to a substantial saving in water used for irrigation. Banning fertilization as a means of reducing the need for irrigation was found to be ineffective. In fact, unless extremely excessive levels of N are applied (9 to 12 lbs N/1000 sq.ft./yr.), water use is not affected. Potassium application accompanying N is a way to also help reduce water use.

A. Martin Petrovic and Beatrice Beth Baikan,
Dept. of Floriculture and Ornamental Horticulture

Table 5. Effects of nitrogen (N) and potassium (K) on the shoot growth, water use (evapotranspiration (ET)) and the water use efficiency (WUE) of Kentucky bluegrass.

Interaction Rate (lbs/1,000 ft²)			% Change	
N	K	Clipping Yield	ET	WUE
1	4	0	0	0
3	2	+6	-3	+8
3	6	-16	-3	-16
6	0	+43	+10	+22
6	4	+18	+3	+19
6	8	+14	+5	+9
9	2	+90	+5	+45
9	6	+63	+16	+28
12	4	+96	+6	+45
Simple Effects				
1		0	0	0
3		-6	-3	-5
6		+28	+6	+16
9		+77	+10	+36
12		+96	+6	+45
	0	0	0	0
	2	+3	-8	+11
	4	-2	-7	+5
	6	-14	-7	-9
	8	-20	-5	-19

Welcome to Scott Ebdon

Filling in for Norm Hummel will be Scott Ebdon. He will be joining the rest of the Turfgrass Work Group (Rod Ferrentino, Joann Gruttadaurio, Joe Neal, Eric Nelson and Marty Petrovic) and will be assuming some turfgrass extension responsibilities. Scott obtained his Masters degree from the University of Rhode Island where he concentrated on turfgrass management. He worked for 9 years in the turfgrass industry and came to Cornell in 1991 to work with Marty Petrovic. Scott received his doctorate in August this year. His research emphasized Kentucky bluegrass water use.

Scott is no stranger to turfgrass research and extension activities. He has been a speaker at the New York State Turfgrass Association Conference and an instructor at the Cornell Turfgrass Management Short Course. He will serve as the primary resource person for questions involving cultural aspects of turfgrass establishment and maintenance for professional turfgrass managers. Of course, your first line of defense is your local county Cooperative Extension agent (with turfgrass responsibilities). If they are not able to help you, you may contact Scott at (607) 255-1629. Joann Gruttadaurio will continue to coordinate the Cornell Turfgrass Management Short Course and the Field Diagnostic Summer Course. For questions regarding these educational programs, call her at (607) 255-1792.