Turfgrass alternatives with low water needs

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Of 27 turfgrasses and other plants evaluated for ability to provide ground cover under low irrigation, bermudagrasses and seashore Paspalum performed the best. Two species of saltbush, buffalograss, and two varieties of **Phalaris** ***also gave comparatively good cover and quality.***

Many recreational facilities require a uniform, well-maintained turf sward. Common examples include golf courses, bowling greens, picnic areas and parks, soccer, lacrosse, polo, baseball and football fields, and school grounds. Turfgrass provides the smooth surface needed, as well as a safety "cushion."

Turfgrass and other plants also improve urban environments, reducing glare and traffic noise. Turf also reduces or controls soil erosion. Chemical and particulate air pollution is decreased at the turfgrass surface. Because of transpirational cooling, turf modifies high temperature by heat dissipation.

Recreational facilities currently use warm-season and cool-season grasses because of their ability to withstand mowing, their desirable appearance, ability to recuperate from wear and injury, and adaptability to the California environment. Warm-season grasses include common and hybrid bermudagrass, zoysiagrass, St. Augustinegrass, seashore Paspalum, and kikuyugrass. The most commonly used cool-season turfgrasses are Kentucky bluegrass, perennial ryegrass, and tall fescue.

These species require significant amounts of irrigation water to sustain their growth, appearance, and usefulness. Warm-season grasses require less water than do cool-season turfgrasses under California test conditions (*California Agriculture*, July-August, 1986).

It has been estimated that up to one-half of the current acreage in recreational facilities does not receive wear or intensive use. These plantings are used for aesthetic purposes or soil erosion control, or are out of the play area. In such areas, there is no need for plants with recuperative ability following wear. They need only be green, withstand mowing, and have a uniform appearance. Plant materials other than the currently used warm- and cool-season turfgrasses might therefore be used. We conducted a study to evaluate the turf quality of low-water-requiring turfgrasses, other forage or range grasses, and ground covers when irrigated at low irrigation levels and maintained with regular mowing.

Methods

The study was established at the University of California South Coast Field Station, Irvine. The site has a maritime climate, and the soil is a San Emigido sandy loam with an almost neutral pH and a low salt level.

The field layout consisted of three blocks, one for each of the irrigation schedules, with 27 plant materials replicated three times within each block (table 1). The study area had a very uniform irrigation system (coefficient of uniformity [CU_{cv}] = 89.7; calculated extra water factor [EWF_{90}] = 1.2).

The research plot was seeded on April 11, 1984. Following establishment, the site was irrigated at 100% of calculated evapotranspiration (ET) for warm-season grass, fertilized at 0.5 pound nitrogen per 1,000 square feet per month with ammonium sulfate and mowed every week at 1.5 inches with a rotary mower.

Differential irrigation began on March 17, 1985, consisting of 20%, 40%, and 60% of calculated ET for warm-season turfgrass. Throughout the study, the calculations to determine the minutes of sprinkler system operation to result in 20%, 40% and 60% ET, were based on evaporation readings from a Class A Weather Bureau Evaporation Pan factored for warm-season turfgrasses. Irrigation was applied weekly.

Plant material characteristics for turf quality (a composite of color, texture, density, and uniformity) were rated visually at regular intervals, using a 1 to 9 rating system with 9 being the highest quality. Additionally, the percentage of live desired plant material was determined as percent cover. For purposes of analysis and data presentation, we used the square root of the product of cover and quality. By this method the data became approximately normally distributed so that treatment differences could be determined statistically (by Analysis of Variance).

The results are from 1986. At that time, all plant material was considered fully developed and had been irrigated with the three irrigation regimes since March 1985. Because of the vigorous growth habit of some species and the very slow growth of others, invasion became a problem during 1986, especially at the 60% ET regime. Our ratings of cover x quality accounted for the invasion of nondesired species.

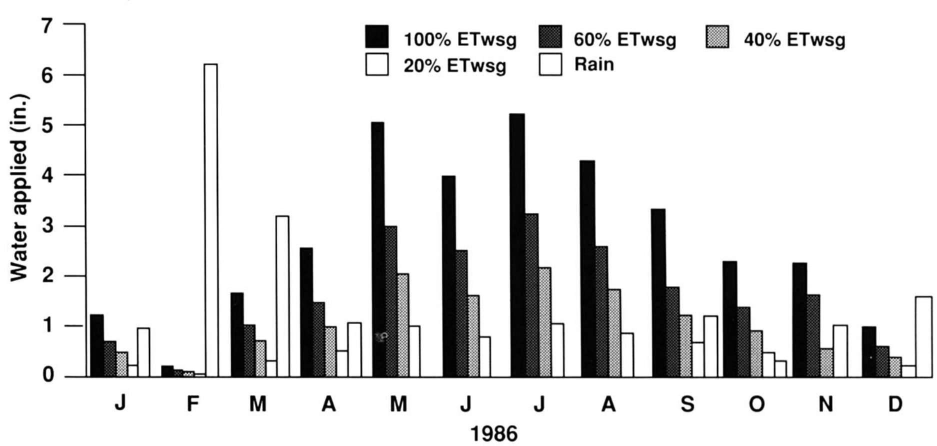

Fig. 1. Monthly calculated water required for warm-season turfgrasses, rainfall, and actual water applied for the three irrigation regimes (60%, 40%, and 20% of calculated evapotranspiration of warm-season turfgrasses).

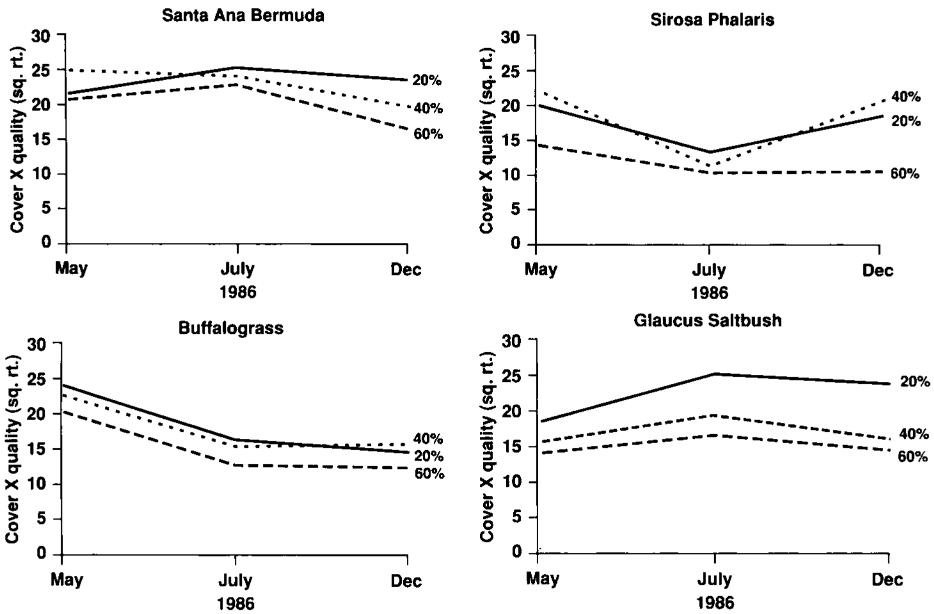

Fig. 2. Four of the species tested showed different responses (cover x quality rating) to the three irrigation regimes and to the season.

Water applied

The calculated water required for warm-season turfgrass species in 1986 was 33.2 inches, and the three irrigation regimes were 60%, 40%, and 20% of that amount. Actual amounts applied on an annual basis were: 60%, 20 inches; 40%, 13.2 inches; 20%, 6.6 inches. Figure 1 shows the monthly water applied for the three irrigation regimes. Rainfall for the year was 15.6 inches.

Plant performance

In table 1, the 27 plants tested are presented in ranked order for the 20% regime, the most severe irrigation treatment. The warm-season turfgrasses common and hybrid bermudagrass and seashore Paspalum and the Australian and glaucus saltbushes were best able to give good cover under the low irrigation regimes. The success of the bermudagrasses and seashore Paspalum was evidently due to the low water use rate, as documented elsewhere, and the deep root system that characterizes these grasses. Bermudagrass commonly has 6-foot-deep roots and seashore Paspalum 4.5-foot deep roots at this location.

The two saltbush (*Atriplex*) species performed better at the lower than the higher irrigation regimes. At 60% ET_{wsg}, they were invaded by other species, but at 20%, they gave a uniform, although stemmy, cover with quite good coverage. The surprising success of *Atriplex* points to the need for further study of this as a possible turfgrass alternative.

Two varieties of *Phalaris stenoptera*, Sirosa and Sirolan phalaris, were very coarse-textured grasses for turf purposes but responded in an interesting way to the low irrigation regimes. In early summer, the grasses went dormant, losing growth and color, and remained in that condition through the summer. By mid-September, their color quickly returned and growth resumed irrespective of irrigation regime. The uniform grass stand through the fall, winter, and spring resulted in the comparatively high annual cover and quality shown in table 1.

Buffalograss, a native warm-season plains grass with low water requirements, also retained turf cover under the low irrigation regime. In this study, it survived the low irrigation regimes by going dormant

TABLE 1. Cover x quality (square root) ratings of 27 plant materials irrigated at 20%, 40%, and 60% of calculated evapotranspiration for warm-season turfgrass, across May, July, and December 1986 evaluation dates

Common and botanical names	Seeding rate	Cover x quality ratings* Percent ET_{wsg} applied†§ 20%	40%	60%
	lb/1,000 sq ft			
Santa Ana bermuda, *Cynodon* sp.	4.0 bu	23.8 a	23.2 a	20.7 a
Common bermuda, *Cynodon dactylon*	1.0	23.7 a	20.9 ab	23.1 a
Glaucus saltbush, *Atriplex glaucus*	.7	22.1 ab	16.5 abcde	15.3 abcd
Seashore Paspalum, *Paspalum vaginatum*	4.0 bu	21.9 ab	17.7 abcd	22.0 a
Australian saltbush, *Atriplex semibaccata corta*	.7	20.2 abc	20.0 abc	15.0 abcd
Buffalograss, *Buchloe dactyloides*	1.25	18.4 abcd	18.3 abcd	15.7 abcd
Sirosa phalaris, *Phalaris stenoptera*	6.9	17.8 abcd	12.1 bcdef	17.8 abc
Blue grama, *Bouteloua gacilis*	1.0	17.4 abcd	16.3 abcde	16.0 abcd
Sirolan phalaris, *Phalaris stenoptera*	6.9	14.9 abcd	15.8 abcdef	19.4 ab
Alta tall fescue, *Festuca arundinacea*	10.0	14.4 abcd	14.8 abcdef	20.2 ab
Fresa strawberry clover, *Trifolium fragiferum* var. *Fresa*	.4	12.8 abcde	10.4 cdef	12.9 abcd
Perla koleagrass, *Phalaris tuberosa* var. *hirtiglumus*	6.9	12.5 abcde	13.9 abcdef	13.5 abcd
Brookston tall fescue, *Festuca arundinacea*	10.0	11.6 abcde	11.0 bcdef	14.6 abcd
Fairway wheatgrass, *Agropyron desertorum*	1.5	10.5 bcde	14.0 abcdef	6.7 abcd
Birdsfoot trefoil, *Lotus corniculata*	1.0	10.4 bcde	11.5 bcdef	8.8 abcd
El Toro zoysia, *Zoysia japonica*	4.0 bu	10.3 bcde	13.9 abcdef	14.9 abcd
Berber orchardgrass, *Dactylis glomerata*	3.4	9.9 cde	9.4 defg	7.5 abcd
O'Connor's legume, *Trifolium fragiferum*	.15	9.6 bcde	10.7 bcdef	8.3 abcd
Smooth brome, *Bromus inermis*	1.25	8.5 cde	9.5 defg	10.4 abcd
Crested wheatgrass, *Agropyron cristatum*	1.5	8.1 cde	11.2 bcdef	0.7 d
Palestine orchardgrass, *Dactylis glomerata*	3.4	8.0 cde	5.8 fg	9.7 abcd
Hard fescue, *Festuca ovina* var. *duriscula*	5.0	7.1 de	6.4 efg	7.7 abcd
Yarrow, *Archillea millefolium*	.06	6.6 de	7.0 efg	3.8 bcd
Tall wheatgrass, *Agropyron elongatum*	1.5	5.7 de	7.2 efg	3.1 cd
Indian ricegrass, *Oryzopsis hymenoides*	1.25	0.0 e	0.0 g	0.0 d
Fults weeping alkaligrass, *Puccinellia distans*	1.25	0.0 e	0.0 g	1.8 cd
Lemmon alkaligrass, *Puccinellia lemmoni*	1.25	0.0 e	0.0 g	0.0 d

* Turf quality (color, texture, density, and uniformity) rated visually on scale of 1 to 9 (9=highest quality). Percent live desired plant material determined as percent cover. Ratings given represent square root of product of quality x cover.

† Values followed by same letters are not significantly different at 5% level of probability.

§ ETwsg = evapotranspiration for warm-season turfgrass.

during the summer. Being a warm-season grass, it was also dormant in the winter, irrespective of irrigation regimes. Nevertheless, its spring and fall growth allowed it to persist and compete with all invading species.

Time of year

We collected data in May, July, and December to target plant responses at critical times. May readings reflected the response to the winter and early spring months; July readings, response under high temperatures; and December readings, response during the winter, which identified dormancy of warm-season species.

Figure 2 presents responses of four species, with quite different growth patterns, to the three irrigation regimes and three times of year. Santa Ana bermudagrass showed little difference in performance among the three irrigation regimes in May and July. In December, there was a downward trend in performance, reflecting the growth cessation and approaching winter dormancy of this warm-season turfgrass.

Conversely, the growth pattern of Sirosa phalaris showed its summer dormancy with higher cover and quality ratings before (May) and after (December) dormancy.

Buffalograss performed similarly at all irrigation regimes. It clearly showed the dormancy pattern that characterizes the species during summer and winter months, despite the irrigation regime.

Glaucus saltbush showed less of a seasonal response than an irrigation response. This species performed better as a turf cover when irrigated at the 20% regime than at the 40 and 60% regimes.

Conclusions

Of the 27 turfgrasses and ground covers tested in this study, bermudagrasses and seashore Paspalum were the best performing turfgrasses under very low irrigation regimes. Two species of saltbush, buffalograss, and two varieties of *Phalaris* also gave comparatively good cover and quality.

This work showed that there are existing turfgrasses, and other plant material maintained as turf, that are capable of surviving and giving cover under extremely low irrigation regimes. These materials apparently resist the stress of low water application by various mechanisms, including dormancy, deep roots, and low rates of water use.

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Russian wheat aphid (green insect) and birdcherry oat aphid.

Suction trap reveals 60 wheat aphid species, including Russian wheat aphid

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Effective aphid pest management strategies depend on a knowledge of the economically important species present in an area and their flight behavior. A suction trap at UC Davis collected 60 aphid species, most of which are economically important. The trap detected the first specimens of the Russian wheat aphid found in northern California.

Aphids occur throughout the world on a wide variety of cultivated and wild plants. Many aphids cause economic damage through direct feeding, injection of toxins, transmission of plant pathogenic viruses, contamination with honeydew, or their presence on edible plant parts. They may attack any portion of the plant including leaves, stems, fruit, and roots.

Because aphids have adverse effects on many crops, are widely distributed, and reproduce rapidly, aphid control has been under investigation for many years. The introduction of biological control agents, such as lady beetles and syrphids, has not been practical in large-scale crop production, but the natural occurrence of these insects and fungal diseases or parasites has reduced aphid populations in such crops as sugarbeets. Adjusting planting dates to avoid a damaging infestation can be effective in barley, wheat, sugarbeets, and some other crops. Control by insecticides is effective, but is costly when repeated applications are needed. Insecticides usually do not control diseases caused by aphid-transmitted viruses, because the viruses are transmitted from the aphid to the plant during a short feeding period before the insecticide kills the aphid.

Trapping aphids

Monitoring aphid populations is a first step in developing crop management practices to minimize losses. Methods of determining the aphid species and numbers present include ground-level collection of flying aphids in pan traps, vacuum or sweeping techniques to remove aphids directly from plants, and direct counts of insects on plants. Aphids can also be collected at various distances above the soil surface with suction traps. In the western United