Buffalograss as a low-maintenance turf

Turf from selected female buffalograss clones (left) remained under 4 inches tall without mowing. Nonselected buffalograss containing a large proportion of relatively tall male flower heads (right) produced undesirable turf.

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Buffalograss, an ancient range species, has potential as a drought-tolerant, low-maintenance, short-stature turf, if defects can be overcome. Studies suggest improvements are possible in characteristics affecting seed production and persistence of winter green color. Vegetatively propagated cultivars may be available in 3 to 4 years.

Buffalograss is one of the most promising grass species for water conservation and minimum maintenance turf. It is the oldest grass of the American Great Plains and still flourishes on rangelands in the midwestern states. Fossilized seed found in Kansas prairies by Dr. Joe Thomason of Fort Hays State University showed that it existed 5 to 7 million years ago. In the early American West, it sustained immense buffalo herds and supplied raw material for the sod homes of early pioneers.

In the last 100 years, buffalograss, *Buchloe dactyloides* (Nutt.), has been used primarily for forage. Because of its drought tolerance, low nutritional requirements, and short stature, it is drawing increasing attention for its potential as a low-maintenance turfgrass.

Buffalograss is usually dioecious (separate male and female plants), with striking structural differences between the flowers of male and female plants. Although it is grown commercially for seed production, the seed supply is limited because its short female flower stem and seed shattering make it difficult to harvest. In addition, seed burs contain an oil that inhibits germination. Sex expression of the plant is not clear or consistent, and both hermaphroditic flowers and monoecious plants (male and female flowers on the same plant) are not uncommon, making selection and breeding difficult. Extended winter dormancy and relatively open turf structure, which encourage weed invasion, are also inferior characteristics.

Our research at Davis is aimed at identifying which of the above characteristics are most amenable to buffalograss turf improvement. Selection of vegetatively propagated varieties is also in progress, with the goal of making this species available to the public in the near future. This report reviews current research in these areas.

Seed production

For buffalograss cultivar development and seed production, the emphasis is on selection for populations with predominantly female monoecious plants, in which most plants have more female than male flowers. This characteristic not only enhances seed production, but also improves turf quality, since male flowers are borne on stalks relatively high above the ground, while female flowers remain below the turf canopy. Complicating matters for buffalograss breeders, however, sex expression of individual plants in this species often varies between years and locations. In our work at Davis, we examined the nature of sex expression in buffalograss, hoping to discover a predictable pattern.

A commercial cultivar, Colorado Common, and buffalograss seeds collected from natural habitats in Colorado, Texas, Kansas, and Mexico were used for the study. When the Colorado Common and the Texas native populations were compared, the frequency of monoecious plants was much higher (about 38%) in the commercial cultivar than in the Texas native population (about 17%) (fig. 1). Among the natural buffalograss populations, the frequency of monoecious plants was lower in denser stands. For example, in populations collected from Guymon, Oklahoma, and Wilderado, Texas, where plant density is high and buffalograss may extend over hundreds of acres, the number of monoecious plants was less than 10%. In contrast, in populations from low-density areas in Chillicothe, Texas, and Apache Springs, New Mexico, monoecious plants made up as much as 38% of the stands.

This relationship between population density and frequency of monoecious plants may be a result of ecological adaptation. Under high-density conditions, inbreeding depression of monoecious plants could reduce their vigor and competitiveness in comparison to outcrossed progeny produced by the dioecious plants. Under low-density conditions, plants may be isolated as individual clones. The dioecious pollination mechanism may be less efficient, whereas monoecious plants are able to produce seeds through self-pollination. This finding suggests that buffalograss populations with a high frequency of seed-bearing plants may be predictable and can be obtained from natural stands.

Sex expression of buffalograss was studied under different environmental conditions. Plants of four sex forms, including male, female, predominantly male with 1% to 5% female flowers, and predominantly female with 85% to 95% female flowers, were grown either in a warm (95°F day, 80°F night) greenhouse or in a cool (75°F day, 59°F night) greenhouse. Within each greenhouse, there were two levels of light and two levels of nitrogen fertilization.

We found that the sex expression of male and female plants remained constant over all

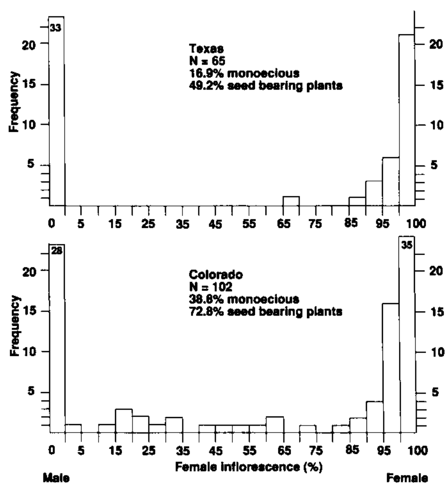

Fig. 1. Frequency of monoecious plants was much higher in the commercial Colorado cultivar than in the Texas native buffalograss population.

Male and female buffalograss flowers have striking structural differences. The female flowers (left) have short stems and bear seeds with burs that contain a germination-inhibiting oil. Male flowers (right) grow on much taller stalks than those of female flowers. Both flowers occur on the same plant (monoecious) or on separate plants (dioecious), or plants may produce hermaphroditic flowers bearing both stamens and pistils.

environmental treatments. The nitrogen treatment produced a significant effect on sex expression for the predominantly female monoecious form. The trends of sex expression for monoecious forms showed that warm temperature, high light, and low nitrogen were favorable for female sex expression. Cool temperature, low light, and high nitrogen were favorable for male sex expression. Sex expression was different between genotypes among monoecious sex forms, suggesting that the stability of sex expression in buffalograss is a genetic character and is genotype-dependent.

The extremely short female flower stem is a critical limitation in buffalograss seed production. We found that the height of flower stems varied considerably in both male and female flowers in Colorado Common buffalograss and showed a positive correlation between flower stem height produced in the greenhouse and in the field. It thus appears that selection for this trait is possible under both greenhouse and field conditions. Some monoecious plants with flowers containing both male and female organs were found. Hermaphroditic flowers are borne on inflorescences high above the ground, as are male flowers, and can set seed by selfing or reciprocal pollination among flowers on the same plant. Seeds produced by hermaphroditic flowers lack the bur structure and seed dormancy, and they stay on the inflorescence after ripening. In contrast, seeds produced by female flowers are enclosed in bur structures and cannot germinate without pre-treatment.

Winter characteristics

Although buffalograss is a warm-season grass, it can survive cold temperatures through winter dormancy. For a warm-season turfgrass, extended winter color, early dormancy break, and survival under subfreezing temperatures are important traits. We examined buffalograss collected from Mexico and the United States for these characteristics, establishing field plots at Davis in June 1986.

The Texas native and Colorado Common populations began winter dormancy and lost green color in the first week of November, before exposure to frost. The buffalograss collected from Mexico did not lose green color until the last week of December, after exposure to frost. Colorado Common buffalograss, however, showed the earliest spring green-up and resumed growth in the first week of March. The Texas native buffalograss began greening up in the second week of March, and the Mexican variety resumed growth by the end of March (table 1).

To test for resistance to cold and freezing, we collected 1-inch-diameter buffalograss plugs from the field in November 1985 and January 1986. The plugs were kept for 4 days at 35° to 41°F as an additional low-temperature treatment for winter dormancy enhancement. Buffalograss tillers were then separated from the plugs and stored either under 24-inch-deep ice at 32° to 36°F for 8 or 14 weeks, or in a deep freezer (10°F) for 2 weeks. After the cold or freezing treatment, tillers were transplanted into potting soil and kept in the greenhouse at 70°F night

TABLE1. Winter color ratings of American and Mexican buffalograss collections

	Turf winter color ratings*					
Collection	Nov	Dec	Jan	Feb	Mar	Apr
Texoka	2 c	1 d	1 d	1 d	5 a	5 a
Texas native	2 c	1 d	1 d	1 d	5 a	5 a
Mexico #2	5 a	5 a	3 b	2 c	3 b	5 a
Mexico #4	5 a	5 a	3 b	2 c	3 b	5 a

*Ratings on scale of 1 to 5: 1, the least green; 5, the greenest. Means followed by the same letter are not significantly different at 1% level, Duncan's new multiple range test.

TABLE 2. Growth recovery from cold and freezing treatment of American and Mexican buffalograsses

	Recovery after indicated weeks*			
	Cold		Freezing	
Collection	8 wk	14 wk	2 wk	4 wk
	%	%	%	%
Texoka	97 a	95 a	95 a	86 b
Texas native	97 a	97 a	97 a	77 c
Mexico #2	97 a	86 b	0	0
Mexico #4	95 a	88 ab	0	0

* Ratio of % stolons that resumed growth after cold or freezing treatment to % stolons that resumed growth in control treatment (93%-100% stolons of four collections resumed growth in the control). Means followed by same letter within cold and freezing treatments are not significantly different at 1% level, Duncan's new multiple range test.

and 81°F day. They were irrigated with 1/4 concentration Hoagland nutrient solution three times a week. After 3 weeks, growth recovery was measured as a percentage of the control treatment in which tillers were collected from the field and not given a cold or freezing treatment.

After 8 weeks of cold treatment, all the buffalograsses resumed growth. The Mexican collections showed only a slight reduction in growth recovery after 14 weeks' cold treatment. The Texas native and Colorado Common buffalograsses showed no reduced growth recovery, even after 14 weeks of cold treatment (table 2).

The Texas native and Colorado Common buffalograsses fully resumed growth after 2 weeks of freezing treatment and had 80% growth recovery after 4 weeks of treatment. Plants of the two Mexican buffalograsses did not resume their growth after 2 weeks of freezing (table 2). These studies indicate a substantial genetic variation in both winter color retention and cold resistance among buffalograss collections. Plants used in the test may be used for buffalograss turf improvement.

Vegetative propagation

Most commercial warm-season turfgrass cultivars are vegetatively propagated, but no vegetatively propagated buffalograss is available commercially. At both UC Davis and the UC Deciduous Fruit Field Station in Santa Clara, vegetatively propagated clones are being observed for differences in rate of spreading and turf quality under reduced mowing, irrigation, and fertilization.

Buffalograss clones have shown considerable differences in rate of turf establishment through vegetative propagation. Some clones selected from the natural buffalograss populations have formed a solid turf within 6 weeks, starting from 1-inch plugs planted 12 inches apart. Turf established from selected female clones remains under 4 inches in height without mowing. Flower heads of female clones are inconspicuous, because they are short and under the turf canopy. Reasonable turf color and density are being maintained with 1 pound nitrogen per 1,000 square feet per year and irrigation once a week during the summer.

Selected clones have been planted in the field in Davis, Santa Clara, and southern California. Vegetatively propagated cultivars from these trials may be available to the public within the next 3 to 4 years.

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Field-drying rice using modified swath harvesting

Bryan M. Jenkins

A technique for drying rice in windrows by covering them with stubble has been developed and field-tested. Modified swath harvesting reduces drying costs, and it protects the crop from dew, improving yield of head rice.

In the last 50 years, combine harvesting has completely replaced swath harvesting in California. To achieve the potential of combines for better quality and higher yields, however, growers of the rice varieties used in California have had to harvest at fairly high moisture. Because field-drying couldn't be used to reduce moisture to safe levels for storage, the grain had to be dried at a high cost after harvest. Rising energy costs over the last two decades have caused some growers to take another look at swath harvesting as a way to cut drying costs. Complete drying by traditional swathing doesn't work, because rice left for more than a day in a windrow loses quality rapidly.