

EXECUTIVE SUMMARY

Work at Colorado State University in Fort Collins, CO to evaluate 3 western turfgrass species (alkaligrass, blue grama, fairway crested wheatgrass) for turf-type traits, as well as turf performance, continues.

Alkaligrass continues to perform poorly in spaced plant nurseries after seed production, but does well in turf evaluation plantings. The seed production capabilities of this species is being evaluated in the Pacific Northwest by Dr. Virginia Lehman (Great Western Seed, Lebanon, OR). Seed from the 4 best alkaligrass families was sent for testing. Seed production in Fort Collins will be augmented by establishing a large spaced plant nursery from greenhouse transplants (of the 10 best families) in early 1992. The turf trials were overseeded with extra seed in 1991 to fill in open areas. This will provide a more uniform surface on which to conduct mowing height evaluations in 1992 (0.75 and 1.5 inches). High and low fertility regimes will also be imposed on the 2 current alkaligrass turf trials. Rust incidence was not as severe in 1991 as in 1990, probably due to the higher N rates applied to stimulate growth of existing and seeded alkaligrass. Interestingly, Dr. Lehman noted that accessions resistant to rust in Colorado were infected in Oregon, while those sensitive in Colorado were free of rust in the Oregon trials. This points to the need for more wide-spread, testing of these cultivars. Seed of four experimental materials was sent to University of Illinois and Iowa State University for evaluation.

Blue grama continues to provide an attractive turf under conditions of limited water in our studies. Efforts were made, through the use of isolated recombination blocks of 4 subgroups ("elite", "nice", "plus", and "narrow"), to produce more seed of this species. A small amount of seed was produced by the "elite" nursery, with full seed production expected to occur in 1992. This is the most promising advanced population, and will enter a cycle of vigorous multiplication for foundation seed. Future efforts with this species should probably be concentrated on the "elite" group because it displays better seed production characteristics than the other groups, as well as desirable turf characteristics. Seed of experimentals was sent to University of Arizona and University of Nebraska for planting and evaluation.

The Fairway crested wheatgrass cycle 2 evaluation nursery performed well in 1991, with seed harvest being much better than in 1990. The seed harvested from individual plants displaying a rhizomatous growth habit will be used in bulking of seed for spring 1992 turf evaluation plantings. Plants with characteristics of interest were taken from this nursery, cloned, and replanted into 4 isolated recombination blocks. Two spring-established blocks contain material that exhibited good disease resistance and narrow leaves in the nursery. The two fall-established blocks contain more rhizomatous, broader-bladed plants. Full seed production from all four blocks is expected in 1992. This seed will be used for turf evaluation plots, as well as for the possible start of another selection cycle. The most extensive turf trial for this species was planted in September, and will be examined closely for performance under differential mowing and fertility regimes in 1992. A trial was also started at South Dakota State University.

We continue to evaluate experimental and released buffalograsses from Nebraska and Texas A&M, finding them to be greatly improved over Texoka and Sharp's Improved with respect to density, summer color, and dormant color. Those of southern origin green up slowly in the spring and are slow to establish from plugs, but retain color approximately 2 weeks longer in the fall than those of northern origin. Winterkill seems not to be a problem with any of them. The bermudagrasses from Oklahoma State University displayed excellent establishment characteristics, vigorous summer growth, excellent summer color, and surprisingly good low temperature tolerance. Their spring green-up rate is similar to that of buffalograss.

1991 USGA Annual Report

A. Breeding Plots

1. Alkaligrass (Puccinellia distans)

The Eurasian progeny trial nursery completed its third growing season this year. As observed in prior nurseries, the plants do not do well after they have been allowed to produce a seed crop. This nursery has behaved in this manner and is almost entirely moribund due to seed production in 1989 and 1990 (detail in the 1990 report), although a small quantity of seed has been harvested from it in 1991. The other seed production nursery in Fort Collins is the Western American Collection. This nursery of 49 plants of each of 14 accessions (686 total) was allowed to establish in 1990 but was prevented from producing a seed crop in that year in order to prevent the plants from dying. The plants were quite healthy in 1991 in spite of an infestation of mites, and did produce a respectable seed crop. However, as soon as seed was produced, they exhibited the typical early senescence of this species, and by fall many of the plants appear dead, although some have green leaves at the base.

In order to test the adaptability and seed production ability of these alkaligrasses in the grass seed production region of the Pacific Northwest, seed from the 4 best families was sent to Virginia Lehman of the Great Western Seed Co. in Lebanon, Oregon. The seed was used to plant some rows of grass by direct seeding and also some rows by transplant from greenhouse-reared seedlings. Dr. Lehman noted their rust reaction was different from what we observe in Ft. Collins.

Seed production in Fort Collins will be provided next by establishing a large spaced plant nursery from greenhouse transplants of our best 10 (approximately) families in the spring of 1992, which will be rogued for color variants. The colors and identity of these better families are indicated in Table 1.

2. Blue grama (Bouteloua gracilis)

This grass continues to impress us with its ability to provide good summer green color with minimal irrigation. Based upon spikelet fertility and seed performance data of previous years, plants in the Cycle 2 field evaluation nursery were assigned to one of four subgroups. As explained in the 1990 report, these groups were designated as "elite", "plus", "nice", and "narrow". Efforts were made to produce seed in 1991 from all these subgroups, in individual isolated recombination blocks.

The 25 best plants from Cycle 2, ("Elite"), were cloned in the greenhouse last winter and were transplanted at the CSU Horticulture Department Research Center in June 1991. That isolated recombination nursery of 1550 plants (62 replications of the 25 elite plants)

Table 1. Density^{1/} and color^{2/} ratings on alkaligrass 90/91.

No.	Accession and family	27 July Density	14 Aug Color	6 Oct Color	Remarks
1	2 1-1-5	9	14	14	
2	2 2-3-3	9	15	14	* † Not as good as 3
3	2 3-11-1	14	17	16	† Good
4	2 4-3-3	12	14	13	
5	2 5-3-1	10	15	14	
6	14 1-4-2	12	15	13	
7	14 3-12-3	11	14	14	
8	14 3-12-5	11	16	15	†
9	14 5-11-1	13	18	17	* † Best all round
10	14 8-8-3	8	13	14	
11	14 9-11-3	11	15	16	
12	15 3-8-1	11	18	15	† Best color Aug
13	15 6-4-2	10	16	15	
14	17 3-9-4	12	16	17	* † Good
15	17 4-10-3	12	16	15	†
16	18 1-9-4	12	15	15	†
17	18 3-1-5	7	13	14	
18	18 4-5-5	12	15	15	†
19	18 6-2-2	12	16	16	† Best of this acc.
20	18 7-1-2	10	12	15	
21	20 10-11-4	11	14	15	
22	Prostrate bulk	11	15	16	
23	Compact bulk	13	14	16	
24	Compact 14	13	14	14	
25	16 2-11-5	10	9	9	Poor, used for contrast
26	16 10-13-4	8	7	7	Poor, used for contrast
27	69	6	9	9	Poor, used for contrast
28	70	5	9	9	Poor, used for contrast
29	114	10	9	13	Fine leaf, yellowish; green Oct.
30	Fults	13	12	16	Better in Oct than Aug
Ave.		10.6	13.8	14.0	

^{1/} Sum of 3 replications each rated 1-9. Planted 4 Oct 90 but did not emerge until late April and stands poor - was thickened by reseeding 2 Aug but will not be scored till '92.

^{2/} Sum of 3 replications rated 1-9. Duller than Kentucky bluegrass and some brownish cast brought scores down from 8 to 6 or 5. Mowed at 2" with rotary mower. Not much rust in '91, compared with fall of '90.

* Sent to V. Lehman in Oregon for adaptation and seed production trials.

† Ten families which are scheduled for a large spaced plant nursery for intensive color roguing during final advance.

established well and has produced a small amount of seed which was harvested in mid-October. Full seed production is expected next year, as transplants always produce only a minimal amount in their establishment year. That seed will be tested as the most promising advanced population we have developed, and could if desired be used to start a third cycle of selection to further advance the turf characteristics. It will in any case enter a cycle of vigorous multiplication for Foundation Seed.

The group designated as "plus" consists of 24 clones of plants (selected from 37 of this class) similar to the "elites" but with slightly lower caryopses weights and slightly less fertility. Their spikelet fertility in 1990 was 9.6% compared to 8.0% for the larger group of 37. The 24 clones are represented in 4 replicates at the U.S. Department of Agriculture's South Research Farm for a total of 96 plants which were harvested in October 1991.

Two other small recombination blocks, each consisting of three replications, were established in the fall of 1990 at the CSU Agronomy Research Center. The plants in these two, known as "nice" and "narrow", have not increased as much in size as we had hoped for this year. The seed harvest from them was therefore quite small but they may produce a more satisfactory quantity in 1992. A separate progeny test nursery which consists of 24 plants of each of 9 families from the "nice" and "narrow" populations was evaluated this year after spring 1991 transplanting from the greenhouse. About 50% of these progenies have very low seed productivity and some are dwarfed plants. These observed characters may indicate that those subgroups are not really suitable for turfgrass use and that future efforts should be concentrated on the "elite" group.

Total weights of crude seed available from 1990 crop for turf tests (some used in 1991 as explained later) and further breeding were:

Elite	440 g	(17.7 g per plant)
Plus	669 g	(18.1 g)
Grade 6	997 g	(15.8 g)

Since the Elite had greater fertility, the processed seed was more per plant than that of "plus", though we were able by combining 1989 and 1990 seed of "plus" to have enough for two test sites.

3. Fairway crested wheatgrass (Agropyron cristatum)

The cycle 2 field evaluation nursery has performed well in 1991. The seed harvest from this nursery was much better than that of the previous year which was severely reduced by hail damage. The 1991 seed harvest was made individually from 122 plants designated as the "gray" group (rhizomatous plants with wider leaves) which were the only FCWG plants allowed to flower. That harvest will provide a breeding reserve for the individual plants as well as allow a bulking of seed for turf evaluation plantings in April 1992. This evaluation nursery was reexamined for the individual characteristics of interest prior to the establishment of four isolated recombination blocks this year, by digging up

selected groups of plants, cloning them into 3 or 4 pieces and replanting them in isolated locations.

Two such blocks established in the spring were the diploid and tetraploid blocks of narrow-leaved and disease resistant plants (the "red" and "pink" groups from the evaluation nursery. These two were planted at the CSU Agronomy Research Center in three replicates each (63 plants in the diploid block and 81 plants in the tetraploid block - 21 and 27 clones, respectively). In the fall, two more of these isolated recombinations were established in four replications at the USDA's South Research Farm with plants from the "gray" groups of rhizomatous wider leaved plants. There are 30 parent clones (120 plants) in the diploid block, and 60 parents (240 plants) in the tetraploid block. These 90 plants were selected from the original 129 in the "gray" group. All four of the blocks have successfully established and will provide seed (a) for turf evaluation of the subpopulations and (b) which could serve to start another selection cycle. The two spring established blocks provided a limited quantity of seed this fall but full production should be available from all four in 1992.

B. Turf Plots

1. Alkaligrass

The June 1990 planted alkaligrass turf test was thickened up by overseeding with some additional seed and is doing quite well except for some invasion by Kentucky bluegrass. This study was mowed at 2.5 inches throughout 1991. Differential mowing heights of 0.75 and 1.5 inches will be imposed beginning in spring 1992. The density of alkaligrass increases as mowing height is lowered, but the stand was not uniform enough to allow close mowing in 1991. Topdressing will be used to smooth this area in preparation for the closer mowing. This study will be controlled by an individual irrigation station in 1992 (new irrigation heads are also being installed), thus allowing better control of irrigation on this water-loving species. This experiment received 0.5 to 1.75 inches of water per week, depending upon conditions. Nitrogen applications totalled 6 lbs. N per 1000 square feet for the season. This high N application rate was used to stimulate filling-in of existing plants, as well as to "push" the overseeded grass. The area was core-cultivated at overseeding.

This experiment did not exhibit as much rust in the fall of 1991 as was observed in the fall of 1990. Rust incidence can be decreased by higher N rates; the high N rates described above probably were responsible for the lesser rust incidence seen this year. There is still a seasonal interaction which causes the healthiest accessions in the fall to be the least green and active during summer, and the poorest accessions in the fall appear better in the summer (see Table 2 for ratings summary).

The turf test planted 4 October 1990 with 9 g seed per 5' x 5' plot was not watered in fall, remained dormant until late April, and even in July its density was much below desirable levels (Table 1). This area was core cultivated in late July and 6 g more seed was

Table 2. Alkaligrass colors in 1990 experiment from 4 Eurasian selections, 3 western distans types, and 5 other Western collections.

Strain	Color rating ^{1/}		
	21 Sept 90	29 July 91	6 Oct 91
EURASIAN			
2	g	bg	g
14	g	bg	g
17	g	bg	g
20	g	bg	g
WESTERN			
6	R	g	br
26	R	g	br
57	g	bg	g
71	R-	bg-g	br
74	R-	g	br
81	R	g	br
87	R	g	br
93	R	g	br
Fults	R	g-	br to g-

^{1/} Colors agree among 3 replications: R = rusted, g = green, bg = bluegreen (some summer dormancy), br = brown with some rust but not as bad as 1990.

overseeded into each plot. Color ratings in August and October are given in Table 1; there was not much change between 22 Sept. and 6 Oct. so only the latter scores are shown. This experiment will be maintained much like the June 1990 seeding (described above). This plot will be watched carefully in 1992 but the 10 best-color families are scheduled for starting a new spaced-plant nursery and multiplication block on the most suitable land in spring 1992.

An adjacent area was seeded to 'Fults' alkaligrass in May 1990, and has been maintained under fairway conditions since that time (frequent irrigation, mowed at 0.75 inches). This area has been slow to fill in, despite 3 overseedings. From experiences gained at the research facility, and observations of alkaligrass performance in Colorado and Wyoming, it becomes obvious that this grass performs best under conditions of high salinity and moisture (even when there is no competition from other grass species). The current trials at CSU display poor resistance to weed invasion, requiring frequent applications of pre- and postemergent herbicides for both grassy and broadleaf weeds. We should consider imposing additional salinity stress on the existing trials to test this observation (current salinity levels are 6-8 mmhos/cm, a level tolerated by even Kentucky bluegrass), as well as to ensure that we have not lost salinity tolerance during the breeding and selection process.

2. Blue grama

The 1987 and 1988 plots still have a fine stand without weed invasion, and tolerate mowing at 1 1/2-2" well. They and the 1990 plot show that southern types Hachita and Alma stay greenish longer, with a few green leaves still among the brown "verdure" in mid-October, as compared with the "Elite" and "bulk 67", or the mid-latitude buffalograsses. The newest plot seeded July 3, 1991 has established well except for one entry of naked caryopses (seed) of Hachita. Alma and Hachita have quite lanky yellow-green growth in mid-September when "elite", "plus", and "Grade 6" were already ceasing leaf extension and beginning to lose their dark green intensity. Bare spots near plot edges will need a little replanting in May 92, for which we have seed. Other than color notes we have not yet rated turf quality. The 1991 plot will be mowed at 2 heights (0.75 and 1.5 inches), and will be fertilized differentially (1 or 2 lbs. N/year).

3. Fairway crested wheatgrass

Recovery of the 1988 plot from its intensive mowing treatment of 1989 has been partial, and it is not yet clear how much thickening value is derived from the rhizomatous habit, for filling in spaces. Apparently the lower amount of leaf area per plant in a turf stand does not give extra reserves for stimulating rhizome growth, and it is obvious that a turf would not be grown to 5 or 6" just to allow for rhizome development! On the other hand, we now have a new generation which was more positively selected toward rhizomatous habit (as spaced plants). The first test of this from 1990 seed salvaged from the hailed nursery was seeded in September 1991 and has come up to a good stand with irrigation, so 1992 will tell us more about the potentials of our "gray" rhizomatous non-narrow and

our "red/pink" partly rhizomatous narrow leaf in the turf mode, with checks 'Ephraim', 'Ruff', and 'Hycrest'. These plots will be mowed at 1.5 and 3 inches, since it has become obvious that (at least under Colorado conditions) this wheatgrass will not tolerate lower mowing heights.

It was not feasible to process August seed of fairway wheatgrass for September planting, so the latest seed harvest of "gray" and "red" material will be planted in April 92, with checks, in 10' x 10' plots for greater utility in multiple cultural practices. The September 91 plot has only the checks in 10' x 10' plots and the experimentals in 5' x 5' plots, all in 3 replications.

C. Out-state Trials

Alkaligrass has been sent to Tom Voigt in Champaign IL and Nick Christians in Ames, IA. Five materials - 4 experimental and Fults as check - were sent to each station, and some delays were experienced in planting or achieving good stands so comment will be deferred to 1992.

Blue grama experimentals were sent to Charles Mancino in Tucson AZ (a mid-November planting which was too late even for Arizona) and to Terry Riordan in Lincoln NE. At report time we have no details on the Nebraska performance.

Fairway crested wheatgrass: "gray", "blue 2x", 'green 2x', "green 4x" were sent to David Graper in Brookings SD along with Ephraim and Hycrest as checks. All established well in 3 replications of 5' x 5' plots and show more or less equal behavior except that Ephraim was more invaded by broadleaf weeds. Low-maintenance plots including other grasses are mowed twice weekly at 2" with inputs and encouragement from the SD Turfgrass Foundation and the SD Golf Course Superintendents Association.

We hope to add one or two locations for testing in 1992, with a NJ location already seeded to plots of alkaligrass through cooperation with Loft's.

D. Cooperative Trials

1. Buffalograss

The buffalograsses planted in June 1990 continue to perform well. Those of southern origin ('609' and 'Prairie') were quite slow to establish (as were 304 and 409), and only completely covered their respective plots in late July of this year. The Nebraska cultivars '315' and '378' performed quite well and are aggressive growers in Fort Collins. These 2 cultivars (and Texoka) green up earlier in the spring than Prairie, 609, 304, and 409; they also lose color approximately 2 weeks earlier in the fall. The Prairie and 609 retained good color late into the fall, possessing some apparent resistance to frosts which normally cause quick dormancy of buffalograss native to this area. The 378 and 315

cultivars appear to be more decumbant in their growth habits, a characteristic that might adapt them to a fairway situation.

2. Bermudagrass

The bermudagrasses from Oklahoma State (seeded in June 1990) survived winter low temperatures of -28 F. Some die-back did occur if the stolons had not pegged down to the soil. The Sahara bermudagrass planted at the same time did not survive (100% mortality).

These cultivars performed similarly for the most part during 1991. They came out of dormancy at the same rate as most of the buffalograsses (similar to Texoka) and grew aggressively during the summer. All four cultivars were quite decumbant in growth habit, but 90-3 and 90-4 appeared to be lower growing than the other two cultivars. All responded well to fertilization (color and growth); 0.75 pound of N was applied approximately every 4 weeks.