1987 ANNUAL RESEARCH REPORT

DEVELOPMENT OF DRYLAND WESTERN TURFGRASS CULTIVARS

Submitted by

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EXECUTIVE SUMMARY

Breeding research has continued on four western grass species which would be extremely useful in minimum maintenance turf plantings and for areas with special soil or moisture problems. The species in this turf performance improvement program are alkaligrass (*Puccinellia* spp.), blue grama (*Bouteloua gracilis*), fairway wheatgrass (*Agropyron cristatum*) and inland saltgrass (*Distichlis spicata*).

Alkaligrass is highly tolerant of saline, sodic and waterlogged soils and can therefore provide cover in such problem areas which are usually found in low areas of a turf. Its appearance and performance is approximately equal to Kentucky bluegrass in our turf test plantings which are progeny tests of accessions from 6 western states and 5 foreign countries. An advanced generation will be produced next year from the best performance disease resistant parents we have selected.

Blue grama, the dominant native grass in many western grasslands, produces a dense stand with a minimum amount of water and is tolerant of alkaline soils. Accessions from 3 western states have been screened and 27 elite selections produced seed this year in an isolated polycross nursery. The seedlings will be evaluated and serve as the basis of the second cycle of selection.

Fairway wheatgrass tolerates drought by going dormant and recovers rapidly after receiving moisture. We produced seed from 78 selected parent plants this year in an isolated crossing block and will field test their seedlings in cycle 2 next year as well as testing the turf performance of those selected parents.

Inland saltgrass forms a dense system of robust rhizomes which allow it to rapidly spread and create a serviceable turf. It is highly tolerant of salt and waterlogged soils, and deep roots and rhizomes help to withstand droughts. Many accessions being tested grow less than 6 inches high under irrigation so require only infrequent mowing. Selected elite parents will produce advanced generation seed next year.

Introduction

The Colorado State University turfgrass breeding program achieved some exciting progress during 1987 in the continuing effort to develop new turfgrass cultivars of the following four native grasses: alkaligrass (*Puccinellia* spp.), blue grama (*Bouteloua gracilis*), fairway wheatgrass (*Agropyron cristatum*) and inland saltgrass (*Distichlis spicata*). All four species continue in the program because each shows promise in filling a need for speciality turfgrass for various problem soils or special conditions. All are hardy species that will survive with minimum care on poor soil. Blue grama and fairway wheatgrass are drought tolerant, and alkaligrass and inland saltgrass will thrive in salty or poorly drained soils.

This year we continued maintenance and evaluation of the starting accession nurseries for the four species as well as expanding several other phases of the research work: The two cycle 1 isolated crossing blocks were evaluated and advanced generation seed was harvested this fall. The turf maintenance progeny test program was expanded by the addition of three more test plots in 1987. Three laboratory experiments were started last winter to study methods of breaking dormancy of inland saltgrass seed. Our work was shared with interested professionals and the public through the Agronomy Research Center Field Day and the Rocky Mountain Regional Turfgrass Field Day at the Horticulture Research Center. Detailed progress reports for each of the four species follow.

<u>**Alkaligrass**</u> The alkaligrass turf maintenance progeny test planted in September 1986 was evaluated this year for performance of 45 different accessions. We maintained this test with mowing at 3" and normal watering until the turf field day in June and its overall appearance was as good as Kentucky bluegrass. Irrigation was withheld from June 10 until August 4, and the plot received only a negligible amount of natural precipitation (1.32" in 8 weeks). The grass went dormant and we were then able to evaluate drought survival when irrigation brought the plots back to greenness. Some accessions stayed green longer into July, but in general they were the ones which did not recover as well once watering resumed. The accessions 2, 15, and 20 are about the best from most points of view, and have survived the 1987 treatments very well in addition to being good seed producers. On the other hand, not many of the plots from seed of native collections tolerated the lack of water, though they were in general darker green and looked healthier in early July. There are a few promising numbers (and some attractive survivors) that will have to be propagated from seed in a re-established breeding nursery before we can make new turf tests. Please refer to Table 1 and 2 for a summary of this turf test data.

A new turf maintenance progeny test was seeded in September 1987 with the 1987 crop of some of the best performing accessions, the seed coming from mite-resistant parent plants. This test is now becoming established and will serve for evaluations in 1988 of the turf performance

Table 1. Puccinellia turf quality mid-June, drought response when not watered from 10 June to 4 August and recovery by mid-September 1987. Rating scale is 0 to 9 = best.

Accession	Origin	Turf Quality 16 June	and notes	Turf Quality 2 July	Drought Response 25 July	Recovery 26 Sept
6	Sterling, CO	8.5		8.0	1.0	4.0
22	Alamosa, CO	8.0	dark gr.	7.0	2.0	3.0
23	Alamosa, CO	8.0		6.5	1.5	3.0
24	Alamosa, CO	8.0		7.0	1.5	3.0
25	Monte Vista, CO	6.5	Brownish	6.5	1.5	2.5
26	Arriola, CO	8.5	Dense Dark gr.	7.5	2.0	3.0
27	Cortez, CO	8.0		6.0	1.0	1.0
28	Mancos, CO	7.5		7.5	1.0	3.0
50	Rock Springs, WY	7.0		7.0	2.0	2.5
52	Bear River, UT	8.0	dark gr.	6.5	2.0	2.0
57	Aberdeen, ID	7.5		6.5	2.5	6.0
69	Humbolt Sink, NV	6.5		6.0	2.0	3.5
70	Humbolt Sink, NV	5.5	Tall, lt. gr	5.5	1.5	2.5
71	Sparks, NV	8.5		7.5	2.0	3.0
73	Bridgeport, CA	-	(no seed)	-	-	-
74	Bridgeport, CA	8.0		7.0	2.0	4.0
77	Mono Lake, CA	5.0		5.0	1.5	2.0
79	Warm Springs, NV	7.5		7.0	1.5	3.5
81	Cedar City, UT	9.0		7.5	1.0	3.5
82	Henrieville, UT	6.5		6.5	1.0	3.5
83	Henrieville, UT	6.0	Long, lt. gr.	6.0	2.0	2.0
85	Mack, CO	-	Sparse	-	-	4.5
86	Mack, CO	7.0	Dense <u>Poa</u>	6.0	1.0	4.0
87	Grand Jct., CO	7.0		7.5	2.0	4.0
89	Collbran, CO	6.0	Brownish	6.5	1.0	3.0
93	DeBeque. CO	8.5	Dark gr.	7.5	1.5	4.0
96	Walden, CO	8.0	Dark gr.	7.5	2.0	3.5
97	Walden, CO	7.0		7.0	2.5	6.0
101	Laramie, WY	7.0		6.5	2.0	2.0
106	Jeffrey City, WY	-	(no seed)	-	-	-
107	Frannie, WY	7.0	Lt. green	6.0	1.0	1.0
111	Goldeneye, WY	6.5		6.0	2.0	2.0
112	Medicine Bow, WY	6.5	Lt. brown	6.5	1.5	3.0
114	Rock River, WY	6.0	Very fine leaf	5.5	1.5	5.0

Table 2. Puccinellia: Some spaced plant ratings and suitability for turf of several accessions from overseas, rated in 1987.

Accession		4/28/87 Mite rating 1/	Spaced plant traits: Summer 86: Leaf 2/	Culm 2/	Julian flower. date	No. of parent plants with seed in 1987	Density 3/ 3/6/87	Turf quality 4/ 6/16/87	Turf quality 4/ 7/2/87	Drought resp. 5/ 7/25/87	Recovery 5/ 9/10/87	Turf quality 4/ 9/26/87
1	U.S.	1.24	P	P	149	0	1.7	7.3	6.7	2.3	1.0	4.0
3	Fra	1.46	P	P	142	0	1.0	7.3	6.0	2.3	1.0	5.0
4	'Fults'	1.30	P	P	143	0	2.7	7.0	7.0	3.3	1.7	5.3
21	Ger	1.42	P-E	P-E	165	0	1.0	7.3	7.3	3.3	1.0	5.3
16	Iran	2.24	(P)-B	(P)-B	154	4	3.3	6.0	5.7	1.7	2.7	7.0
13	Iran	2.76	B-E	B-E	174	10	2.0	5.3	5.3	3.3	3.0	6.3
2	USSR	3.56	B-(E)	B-(E)	159	17	3.0	7.0	6.3	3.0	3.7	8.0
14	Iran	3.54	(P)-B	(P)-B	159	29	3.3	6.0	6.0	3.0	3.0	7.7
15	Afg	3.02	(P)-B-(E)	(P)-B-(E)	156	7	4.7	6.3	6.3	3.0	4.0	8.0
17	Iran	3.44	P-B	P-B	156	22	3.0	7.0	6.3	2.7	3.7	7.7
18	Iran	3.66	P-B	P-B	158	31	3.3	6.3	6.0	2.7	3.3	7.7
19	Iran	3.36	(P)-B	(P)-B	155	18	3.3	5.0	5.3	3.3	2.3	6.7
20	USSR	3.26	(B)-E	(B)-E	161	16	3.7	6.7	6.3	2.7	3.3	8.0

1/ Rated 1 (very susceptible) to 5 (very resistant) for mite damage.
2/ Leaves and culms rated for growth form. P = prostrate, E = erect, B = both prostrate and erect.
3/ Density rated on a 0 to 5 (best) scale.
4/ Rated on a 0 to 9 (best) scale.
5/ Rated on a 1 to 4 (best) scale.

characters of those selected accessions. The 1985 test of alkaligrass seeding rates has shown that a sparse alkaligrass turf does not fill itself in to an appreciable degree, and that the best seeding rate is about 576 pure live seeds per square foot (about 1/4 pound PLS per 1000 square feet).

The starting accessions evaluation nursery was maintained and evaluated this year. After a dry fall and spring, many plants which had yielded seed in 1986 did not show good spring recovery, suggesting that some moisture may be needed after harvest. This tendency toward post-harvest death was more marked in the western U.S. collections, and may be related to poor recovery from drought in mowed turf plots. The live plants were severely attacked by mites in the spring which afforded us an opportunity to evaluate resistance to combined fall drought and mite damage (Table 2). Based upon the 1986 and 1987 ratings of the accessions evaluation nursery, and upon the progeny turf maintenance tests, we have made selections of some elite plants representing various accessions. Those plants will be cloned in the spring and moved from the evaluation nursery to an isolated area (subject to winterhardiness performance) to produce advanced generation seed in 1988.

Blue grama The blue grama starting accession individual spaced plants were maintained in three locations and seed for progeny and turf tests was again harvested this year. With some 1986 and earlier years' seed, a replicated turf

Our turf test plot of 'Ruff' and 'Ephraim' fairway wheatgrass has shown that both these cultivars produce an acceptable turf when watered and mowed (without adding fertilizer). Their ratings show 'Ruff' to be significantly better in turf quality, having more erect leaf growth, better recovery from drought and a greener color rather than the grey-green of 'Ephraim'. When not watered the turf went dormant but was restored quickly with irrigation after two months without any significant precipitation ('Ruff' being quicker to recover). The best seeding rate was found to be approximately 2 1/4 pounds per 1000 ft^2. The seed harvest of 1987 was insufficient to start any new turf plots in 1987, but the flowering abnormalities should not recur and 1988 seed should be available for a late summer planting.

Although some of the 17 parental accessions were better performers than others, we did not yet have turf adaptability information, so we decided to keep our options open and sampled all accessions. The isolated crossing block established in 1986 contains the six best plants of some, and three best of other accessions, using as criteria: tillering to increase basal area (BA), good rhizome-spreading growth habit (RH), narrow leaf width, good color, disease resistance, suitable flowering date, and good seedhead production without lodging. Accessions 3, 4, 6, 7, and 8 (all from Turkey) show a greater proportion of good plants for BA and RH, being definitely better than Ephraim or Ruff in these or other traits (Table 3). The 78 individual plants established well, exhibiting their

Table 3. Desirable plants for several traits[1/] from 1984 and 1985 observations in source nursery.

Acc. No.	Cultivar or origin[2/]	Desirable plants	Plants saved for rec.	Total plants	% of plants of grade 3 for '85 BA	'85 RH	'87 FL
1	Ephraim	5	6	50	26	32	17
2	E24 TU	3	6	50	16	14	33
3	E20 TU	12	6	50	18	30	17
4	E31 TU	13	6	49	44	22	17
5	E1 TU	8	6	49	61	8	50
6	E7 TU	14	6	49	22	35	0
7	E9 TU	13	6	50	34	48	67
8	E9 TU	13	6	49	27	61	17
9	R16-1 IR	5	6	25	4	12	67
10	R18-1 IR	0	3	25	20	0	100
11	R32-1 IR	0	3	25	8	0	67
12	R43-1 IR	1	3	25	8	4	100
13	R51-1 IR	3	3	24	8	21	67
14	R71-1 IR	1	3	25	24	0	67
15	R72-1 IR	1	3	25	12	0	67
16	R84-1 IR	1	3	25	16	4	67
17	Ruff	1	3	50	10	0	67
	Total	94	78	645			

1/ BA = basal area score 1-3 most in accession nursery
RH = rhizome spread 0-3 most in accession nursery
FL = flowered by June 15 (% of plants in recombination block)

2/ TU = Turkey, from crossing block at Blue Creek, UT (1983 seed)
IR = Iran, from CWG crossing block at Blue Creek, UT (1983 seed)

spreading characters, but were accidentally sprayed with herbicide in May 1987 which damaged their seed-setting. We obtained a small amount of seed from them in 1987 and will run a progeny test to evaluate selected advanced generation individuals in a spaced-plant cycle 2 field test in 1988. We will obtain sufficient seed next year to perform turf progeny tests on the elite families.

Both types of progeny test are necessary to secure worthwhile performance as seed parents and as quality turf. Since the turf appearance of Ruff (less rhizomatous) is better than that of Ephraim, we do not yet know the value of RH relative to turf quality, but it should make turf damage, as from divots, easier to heal.

Inland saltgrass This species has some of the most promising turf characteristics but also one drawback. The plants form a nice sod by extremely vigorous spreading rhizome growth; and many of our accessions grow to a natural height of less than 6 inches, so could remain unmowed in some applications. The natural seed dormancy however would be a problem in establishing turf plantings in most locations because good germination requires about 100°F temperatures during the day, and the young seedlings lack vigor.

We performed several laboratory experiments attempting to discover if various experimental seed treatments would promote germination at more moderate temperatures. The first experiment was a germination pretreatment test in which moistened or dry seeds were given ideal germination temperatures (104°F days and 50°F nights) for 0, 3, 6, or 9 days, or lab. temperatures (70°F) for the same test periods. The seeds could start the germination process but did not actually germinate and were then entered into germination tests at lab temperatures (70°F) at various time intervals following the pretreatment period to determine if any of the treatments enhanced germination ability, and if so, for how long the effect would last. Results showed small nonsignificant differences among the various treatments. Since the treatments did not affect the low 70°F germination, we tested a set of pretreated seeds after 44 days at the ideal germination temperatures (104 and 50°F) and discovered that germination ability was actually depressed by the warm moistened treatments i.e. "pre-germination" is not an effective method.

Another test employed high temperatures (140°F) on dry seeds for 0, 1, 3 or 9 weeks prior to germination testing. This type of dry heat does stimulate some dormant grass seeds (Digitaria spp. and Cenchrus spp.), but in the inland saltgrass it produced no effect when seed was germinated at 70°F. When germinated at the alternating 104 and 50°F temperatures, one seed source showed slightly depressed germination while the other seed source tested showed germination to be elevated by 56, 83, and 94%, leading us to conclude that dry heat is not a reliable treatment for inland saltgrass.

Potassium nitrate was tested as a germination enhancer in a cold stratification experiment. Two seed lots were stratified for 31 or 61 days at 32 or 42°F with plain water or with a 0.5% KNO_3 solution. The seeds were then germinated at the ideal day and night temperatures of 104 and 50°F (Table 4). Stratification significantly boosted germination rates over that of control seeds receiving no stratification. The KNO_3 solution was always much better than plain water as the stratification medium, and the 32°F temperature was generally better than the 42°F treatment. These results were obtained by testing the seeds immediately after completion of the stratification, and we have a second set of seeds stratified at the same time, then dried, which will be germination tested this winter to see if the enhancement persists after storage. This experiment should also be repeated with germination at a more moderate temperature (70°F) to see if the stratification could be a means of boosting germination in turf plantings in soils at normal summer temperatures, on the analogy of the treatment effective in buffalograss.

The turf test of several inland saltgrass accessions was maintained with a moderate level of irrigation and mowing but no fertilization, and it produced a more-or-less attractive turf throughout the season; by late October it is dormant. We have been able to remove unwanted cool season grasses growing among this warm season species by spraying the turf with a 1.6% solution of glyphosate in spring or fall while the saltgrass was dormant. The stand is now

Table 4. Germination of inland saltgrass seed stratified at 32 or 42°F for 31 or 61 days in water or 0.5% KNO_3 solution.

Seed Source[1]	Temp (°F)	Days	Treatment	% Germination
E	32	31	Water	77.5
E	32	31	KNO_3 solution	90.0
E	32	61	Water	72.5
E	32	61	KNO_3 solution	86.2
E	42	31	Water	71.2
E	42	31	KNO_3 solution	86.2
E	42	61	Water	60.0
E	42	61	KNO_3 solution	83.8
E	Control with no stratification			23.8
W	32	31	Water	25.9
W	32	31	KNO_3 solution	47.5
W	32	61	Water	26.2
W	32	61	KNO_3 solution	72.5
W	42	31	Water	12.5
W	42	31	KNO_3 solution	75.0
W	42	61	Water	10.0
W	42	61	KNO_3 solution	62.5
W	Control with no stratification			0.0

1/ Seed source was E = Eastern Colorado accessions or W = Western Colorado collection near Delta by Jess Fults.

Table 5. Density of stand after first full year of establishment of inland saltgrass turf planting. Scale is 0 to 3 = best.

Accession Number	Source	September 1985 Density
3	Sunnyside, WA	2.80[a]
2	Othello, WA	2.40[a,b]
1	Sunnyside, WA	2.14[b,c]
7	Delta, CO	2.00[b,c]
6	Whitewater, CO	1.94[b,c]
5	Fruita, CO	1.54[c]
4	Peers Landing, NV	1.54[c]

Means with same letter not significantly different (p = 0.05) by Duncan's Multiple Range Test.

equally dense, although there were differences in density of the various accessions during the first stages of establishment (Table 5).

The accession evaluation nursery of three different series of collected plants was observed and harvested this year and the seed will be used for laboratory germination experiments and a turf progeny test planting next year. A preliminary trial with two entries was started in August.

Turf propagation possibilities need to be tested with rhizome sections from the nursery as an alternative to the difficult seed propagation. Since many of our vegetative accessions were grown from rhizomes, we expect it to be a workable method, but must discover what minimum size rhizome piece is required. We have also been able to select some elite male and female plants from the accession nurseries for propagation next spring as parents in an isolated block to produce improved generation seed.

Status of germplasm or cultivar release

When we reach a suitable endpoint in each species, we intend to seek the appropriate method of germplasm release or varietal release. In concert with many turfgrass and forage crop breedres we may be better able to serve the public need with some form of exclusive release where a seed company will perform development work on seed production in return for a license to promote and market the product. The Colorado State University procedure will probably include a

Request-for-Proposal procedure to be sent to a number of potential seed-company licensees.

The first item likely to come to the commercialization stage is a selection among the introduced alkaligrass (or a bulk of several selections) shown in Table 2, and this is expected to materialize during 1988. The next item may be one of the blue grama materials which have been developed cooperatively with the Forage and Range Branch of USDA-ARS (and therefore have to be publicly released). We need turf information on this blue grama along with potential turfgrass types currently in our program, which could and perhaps should be the subject of a separate release.

At such time as we know how to efficiently propagate inland saltgrass, we could be in a position to make application for a patent as a vegetative plant material, or to look at a germplasm release for a seeded strain. This may be earlier than we are ready to decide on a varietal release for a synthetic derived from the fairway wheatgrass progenies.

<u>Coordination with other researchers</u>

The value of the Salt Lake City meeting with many of the research group and the USGA/GCSAA Joint Research Committee is fully appreciated. In addition, Robin Cuany is glad to note that he took the opportunity in October 1987 to visit both Riordan in Lincoln, NE, and Kenna in Stillwater, OK. In those places we discussed their progress, with buffalograss and bermudagrass, respectively. We laid plans for cooperative testing of their materials and ours as they get nearer to the point of test-worthiness, or where we need data on genotype adaptability to guide the selection program. Cooperative arrangements are also possible with other colleagues in the USGA/GCSAA network.

STATEMENT OF EXPENDITURES
U. S. Golf Association

Funding of 2/25/87 - 2/24/88

	Expenses 9/30/87	Encumbered	TOTAL
PERSONNEL			
G. Thor - Salary	6,555	8,135	14,690
G. Thor - PERA, 16.8%	1,101	1,366	2,467
TOTAL PERSONNEL	**7,656**	**9,501**	**17,157**
MATERIALS AND SUPPLIES	78	5	83
TRAVEL	1	-0-	1
INDIRECT COST, 16%	1,238	1,521	2,759
TOTAL EXPENDITURES	**$8,973**	**$11,027**	**$20,000**