1990 ANNUAL RESEARCH REPORT

DEVELOPMENT OF DRYLAND WESTERN TURFGRASS CULTIVARS

Submitted by

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Submitted to:

The United States Golf Association - Green Section
and Golf Course Superintendents Association of America

November 14, 1990

EXECUTIVE SUMMARY

The Colorado State University project went a stage further in the developing of turfgrass varietal material of three western-adapted species: alkaligrass, blue grama, and fairway (crested) wheatgrass. In all these grasses we have been looking at plant type in the spaced-plant nurseries, seed productivity and other seed traits, and exercising our best efforts to produce enough seed for the multiplication stage and the early verification of turf behavior and quality. Since all these grasses are (purposely) different from Kentucky bluegrass or bermudagrass, they have different appearance and modified needs for cultural practices, in addition to being adapted to specialized uses such as saline soils, low water inputs, or reduced grooming. These grasses are not highly domesticated and they are not suitable for use on greens, but two of them are suitable for fairways and low-maintenance roughs, while the fairway crested wheatgrass is probably more suitable for roughs than the modern close-cut fairways on golf courses.

Alkaligrass nurseries produced less seed in their second full-season year than their first, some of the loss being from plants becoming senescent, i.e. not truly perennial. This could be solved by more frequent establishment of seed fields as is done for annual crops. Our selections have been for the best surviving plants of Eurasian and Western U.S. sources and several promising lines are in production and in turf tests. Alkaligrass is salt-tolerant, not very drought resistant, and exhibits summer dormancy from hot weather regardless of water status, but as a cool-season grass it greens up very early (late March, before bluegrass) and retains color well into winter. We have lines which are much more resistant to rust than cultivar Fults.

Blue grama is a warm-season grass, green from late April till frost, and shows an attractive apple-green color under 1-2" mowing and very limited water. In order to show sufficiently dense turf it needs to be seeded at 2 to 2.8 lb. per 1000 sq. ft. and the chief breeding objective is to increase the seed harvestable from a plant or a field. Blue grama has a low seed fertility (viable seed per spikelet are often less than 10%) so we have selected the best parents for seed traits and are preparing a large recombination block for 1991 seed production. Other blocks have been planted to explore the narrow-leaf trait shown by a few plants, and a June 1990 turf test shows Western material of the "Elite" type to have a darker green than the cultivar Hachita.

Fairway crested wheatgrass (the common name for Agropyron cristatum) has been surveyed in several nurseries totalling over 1,000 plants, which showed considerable variation in leaf width, tendency to put out one or two rhizomatous shoots, and incidence of a summer clump-disease causing lodging of seed-stalks. Selections were made for the narrower leaves and/or the more rhizomes, within the healthy group, and recombinations will set seed in 1991. Previous turf trials have shown this grass will not adapt to a 3-

cut per week regime at 3/4" when not irrigated, but will do so with some supplemental water. It is best at 1 1/2 - 2" mowing and probably fits best into roughs. Our seed harvest was damaged by hail but we hope we have enough seed for a small-plot turf test to be planted in April 1991.

Cooperative testing here continued with new plots of sprigged buffalograss and seeded bermudagrass in June 1990, materials from Nebraska and Oklahoma respectively, also Numex 'Sahara'.

A. Alkaligrass (Puccinellia distans, etc.)

1. Breeding nursery - Eurasian

This nursery, originally constructed to test whether progenies show variability due to segregation, or uniformity due to apomixis, was harvested as bulks or single plants in 1989. Since apomixis was essentially disproved, we are treating this as a cross-pollinated species, and reorganized the nursery to keep only the better-performing rows (up to 30 plants per single-parent progeny) as an open-pollinated nursery for seed production which was harvested in July 1990. The worst rows, corresponding to poor turf appearance lines seen in 1988 and 1989, or to unsatisfactory seed-bearing or unthrifty plants, were dug out in April 1990, or in two cases clipped in June so as not to shed inferior pollen. Each row of the 27 lines remaining was harvested as a separate bulk. The quantities of seed produced in 1989 and 1990, and the remainder after planting the large plot turf tests in June 90, and other seed used in September-October 1990, are shown in Table 1. In addition to amounts shown, we have a 15g breeding reserve of every line.

Average seed amounts collected in 1990 were only half to two-thirds of the harvests from the same plants in 1989, partly due to earlier shattering. Despite watering the plants immediately after harvest, it appears that alkaligrass plants allowed to bear seed are not fully perennial in productive life, meaning that seed fields would have to be re-established every 3 years if grown in Colorado Front-Range climate. The probable place for commercial seed production is Oregon, east of the Cascades, and a cooperator will undertake some seed production trials there under special arrangement in 1991. We expect to send one or two representative families from sources 2, 14, 15, 17, and 18. We will examine the nursery in Fort Collins carefully in April 1991 to see how many families are still vigorous enough to make a final seed harvest, at the same time as a new breeder's seed field is started, for major seed production in 1992. A 2,000-plant field should yield 15 kg of seed as an essential step in releasing an improved alkaligrass cultivar under USGA and Colorado State auspices.

2. Breeding nursery - Western American

The older 1988-established blocks of western collections, planted from 1986 seed, yielded enough 1989 seed for the June 1990 replacement turf plot which included 8 entries of this origin. Since it was apparent that these "Western" blocks would not yield any seed in 1990, having died in the fall of 1989, we established new multiplication plots in spring 1990 of all the possible numbers: 6, 22, 24, 26, 57, 69, 70, 71, 74, 81, 87, 93, 97, and 114. Those underlined are in the large June 1990 turf test, and 69, 70, and 114 are in the small Oct. 1990 turf plots. We want to have some fresh seed on hand for possible adaptation tests, or in case any look good enough in the 1990 tests to warrant a large multiplication for an alternative cultivar. The present plots have

Table 1. Alkaligrass clean seed yields 1989 and 1990 (g total) and remnant seed available for multiplication.

Source	Family	Seed yields[1/] 1989	1990	Remnant [2/]	Notes[3/]
2	1-1-5	243	104	268	
	2-3-3	231	108	170†	
	3-11-1	264	145	361	
	4-3-3	262	126	256†	
	5-3-1	218	137	199†	
	6-9-3	259	143		turf color?
14	1-4-2	278	252	482	
	2-7-2	193	98		turf color?
	2-7-3	200	98		turf color?
	3-12-3	226	94	164	
	3-12-5	292	163	295	
	5-11-1	299	175	420	
	7-5-3	267	154		turf color?
	8-8-3	239	138	143†	
	9-11-3	247	158	349	
15	3-8-1	151	122	236	
	6-4-2	169	104	230	
17	3-9-4	263	139	144†	
	4-10-3	249	176	349	
18	1-9-4	256	139	218	
	3-1-5	167	91	211	
	4-5-5	185	123	261	
	6-2-2	173	88	186	
	7-1-2	139	70	161	
	10-4-1	139	76		turf color?
20	5-2-1	169	52	20†	turf color?
	10-11-4	177	108	80†	
Mean per year		221	125		

1/ Yields in g per 30 spaced plants (can be multiplied by .854 to get lb/acre)

2/ † additional seed given out for thickening June 90 turf test in Sept., if not all used will increase remnant.

3/ Turf color? indicates families with bluish and/or coarser plants which either did or could show undesirable turf color. They would probably not be included in a multiplication for release. The other 21 types are to be finally screened as turf in 1991.

49 plants each, and a border of "Regreen" (wheat x wheatgrass sterile hybrid) has been seeded around each, to serve as a pollen barrier in the spring of 1991 when the alkaligrasses are flowering and setting seed. This nursery has established well, and was not damaged by hail in July 1990. The various blocks could yield from 150 to 650 g of seed in 1991. It takes 27 g of seed to plant 3 turf plots 5' x 5', but 4000 plants could be raised from 1 gram.

3. Turf tests

The older 1987 and 1988 tests have not been watched closely, as they got an unfavorable start in spring because of irrigation system difficulties. We have established two new tests with 1989 seed, one a 12-entry test in 10' x 10' plots at full turf density, containing 8 entries of western type (see above) and the Eurasian entries 2, 14, 17, and 20. It is interesting that the Eurasian "elite" materials are green and rust-free, also no. 57, while the "Fults" border is moderately rusted and the other Western types quite heavily rusted in October. Their spring and summer disease and quality under mowing will be very important in 1991.

The other plot seeded (on Oct. 4, 1990) contains 21 of the 27 families listed in Table 1, for final 5' x 5' turf appearance screening in 1991 to correct any undesirable inclusions in the final Eurasian cultivar. This plot also contains 3 Western entries, Fults as a check, and 5 plots to compare prostrate vs. erect or compact parent plants as a guide to the selectability of turf traits in spaced plants.

Arrangements have been made to test the entries 2, 14, and 18 (each of these as blend of 5 best lines out of the respective sources), 57, and a check of Fults, in Iowa and Illinois. These plots, 3 replications of 5' x 5' will be seeded in spring 1991 through the cooperators Nick Christians, Ames, IA, and Tom Voigt, Champaign, IL. The Eurasian types contributed 11g from each line to make up these test packets, and were already accounted for before the "Remnant" column of Table 1 was calculated.

B. Blue grama Bouteloua gracilis

1. Breeding nurseries

This is probably the most promising grass for low water use but still with good summer color, and survives winter in a dormant straw-colored state. We have the latest generation nursery of 300 plants which was harvested in 1989 and again in 1990. Seed from 1989 was processed during the winter to give information on seed fertility by separating the naked caryopses (seeds) out of 3g of harvested spikelets, which gave percentages of 0.9 to 13.1, not out of the ordinary range of this species. The top-ranking clones having > 4.5% fertility and hundred caryopsis weight (CW) over 43 mg were considered to have the most promise of use for turfgrass seed production, since they also had more seed-spike-bearing culms than average. This group named Elite contained 25 plants and yielded enough seed (entirely used) for the June 1990 turf plot of 3 replications of 5' x 5' plots. Another entry in the same test was Bulk-67 which consisted of the bulk of 67 plants of grade 6 heading, all 765 g of whose crude seed had to be used to plant the turf entry at 927 viable seed per sq. ft. This density is slightly better than Elite's 784 per sq. ft. but both less than turf experts' target of 1440. The latter, which is 10 viable seeds per sq. inch, corresponds to 2.5 lb/M.

Certainly, productivity of seed being an important trait, attention paid to it is justified, and 80 of the 300 plants, those having head-scores of 7, 8, or 9 (maximum) were put through the individual seed processing. Out of these 25 were elite, and 37 others were considered for a second-rank group titled Plus. Listing of sources (15 plants each) in the nursery and their traits (Table 2), along with the number of Elite and Plus plants derived from each shows that there were some desirable plants from most sources (19 excelled in fertility and CW). A few of the Nice group and several Narrow-leaf plants were chosen phenotypically in 1990 without having any seed processing data. Nice plants may have looked attractive because of leaf height and bushy dense verdure in the clump, possibly in contrast to fewer heads. Narrow plants were rated visually and were not allowed to produce seed in 1990.

The seed in 1990 and therefore also the pollen load, came only from the 25 Elite, 37 Plus, and 8 Nice plants, all of which were harvested individually, as well as from 63 grade 6 plants which were bulk-harvested. The 37 Plus plants will be processed for seed traits (fertility and CW) in addition to the few plants of sources 5, 14, 15, 26, and 27 which were not available in the main nursery. Threshing of these lots has just commenced.

The criteria and means for the traits leading to the make-up of Elite, Plus, and Bulk 67 (63) are given in Table 3. The 25 Elite plants are being propagated over winter in the greenhouse, first into 10 ramets, then each of these into 5 ramets in February so that a recombination block of 25 plants x 50 ramets will be 1250

Table 2. Blue grama sources and disposition to recombination blocks for seed production based on 1989 seed data and 1990 plant type.

Source	Plants processed as seed	Fertil. %	CW mg	Head grade	Number of plants selected as: Elite	Plus	Nice[1/]	Narrow[1/]
1	3	2.4-7.5	39-46	8	1	2		
2	9	1.6-6.5	38-54	6-9	2	4	1	
3	-[2/]					(1)		2
4	-							1
6	3	3.5-10.1	39-54	7-8	1	1	1	
7	7	0.9-10.7	38-54	7-8	1	4		1
8	3	2.5-7.1	38-47	7		2	1	
9	4	4.4-8.5	33-46	7-8	1	1		
10	2	5.1-7.1	37-46	7-8	1			
11	7	2.0-6.9	39-51	7-9	1	4	1	
12	1	2.7	40	8		1		
17	4	2.9-9.7	38-55	7-9	1	3		
18	8	2.3-6.2	36-46	7-8	2	5		1
19	6	4.6-13.1	48-60	7-8	6			
20	3	2.9-7.2	48-55	7	2	1		
21	3	1.3-9.0	37-43	6-7	1		2	
22	7	1.6-6.0	36-56	7	2	3		
23	2	3.0-5.4	46-67	8-9	1	1	1	4
24	6	2.3-8.4	48-60	7-9	2	3		
25	3	1.0-2.9	34-50	7		1	1	1
Total	80				25	37	8	10[3/]

1/ Nice and Narrow classes not necessarily tested for seed trait.
2/ Substandard seed amount and negligible fertility; an untested plant in Plus.
3/ Also two border plants were added to the Narrow group to make 12 in recombination.

Table 3. Blue grama trait averages for bulks for multiplication and/or turf testing.

Group	Head[1/] rating 1989	Clump[2/] size 1990	Seed traits[3/] Fertility %	Seed traits[3/] CW mg	Notes
Elite	7.5	3.4	6.8	51	> 4.5% fert. and > 43 mg CW
Plus	7.6	3.4	4.1	46	> 5.8% fert. or > 49 mg CW or at least 2.0 fert and 38 mg CW
Nice	6.1	3.4	4.0	41	not chosen by seed
Narrow	3.6	2.2.	-	-	not chosen by seed
Bulk 67	6.0	2.8	4.1	44	seed traits from a bulk sample

1/ Heads 1 sparse - 9 prolific as an index of seed potential
2/ Clump size on 1-4 scale (3 has 6"-8" diam., 4 > 8" diam. at base)
3/ See text

plants for bulk harvest as Breeder's Seed of Elite in 1991 and 1992.

The Plus group may be diminished from 37 plants by confirmatory data on the 1990 seed crop, and will be propagated in the field next spring, probably 4 ramets per plant to give a block of over 120 plants. The Nice and Narrow groups have alrady been planted into separate recombination blocks at the Rigden Farm, with 3 replications each, for 1991 harvest. All the groups should give enough seed then for further multiplication, as well as wider testing in 1992.

2. Turf plots

The blue grama turf tests, though small, have confirmed the attractive mid green (apple-green) color of unwatered but mowed plots (2") in the midsummer. The latest germplasm of Elite status (for seed-fertility) is more attractive than available cultivars Hachita or Alma, because of a darker green color. In mid-fall just before and after the first frost, Hachita shows more green leaves among the dormant ones so has a more greenish cast than the nearer-straw-color of the dormant Elite and other Northern Colorado types. This difference was not visible in earlier plots at spring green-up, but the June 1990 plot will be carefully watched next year, to monitor density as well as color. We suspect 1.5 to 2.0 lb/M of seed giving 800-900 plants per sq. ft. may be adequate with the tillering habit, to make a close-knit sward, particularly in the minimal-irrigation state.

Only after seed threshing and blowing is complete this winter will we know how much seed is available for May-June 1991 turf testing planting, but we hope to send test packets to at least two other locations, and to make a bigger test at Fort Collins with some commercial seed lots of Hachita, naked caryopses of Hachita, coated (prilled) caryopses of Hachita and spikelets of Alma. The damaging hailstorm at the Rigden Farm fortunately did not affect the South Farm at all, where the blue grama nursery is located.

C. Fairway crested wheatgrass (Agropyron cristatum)

1. Breeding nursery

The nursery planted in spring 1989 contained 77 single-plant progenies from 17 sources being recombined in the cycle-1 crossing block, plus four checks of released cultivars, and was arranged in a diploid (2x) portion and a tetraploid (4x) portion with the checks in between. There were 4 plants of each progeny in each of 3 replications, so the nursery comprised almost 972 plants (a few spaces were blank because seedlings died). Observation in the fall of 1989 covered out-of-season flowering, rhizome spread, and narrowness of leaves. About 50% of the plants had from 1 to 25

heads as reported last year, with a range among sources from 14 to 75%, and no obvious difference due to ploidy. Because of climatic factors such heading is not useful for seed production in the seedling year.

About half the plants in Nov. 1989 had at least one "rhizome" (rated +) reaching out as a short underground shoot at least 10 cm long, and one-sixth of the plants had two or more shoots, rated ++. All sources had at least some rhizomatous habit (Table 4) but it seems to be a trait with considerable environmental variability and uncertain heritability though the scores (possible maximum 8) range from 2.0 for check 'Fairway' to 6.2, which is marginally higher than Ephraim's 4.9. Although Ephraim is quoted as being a rhizomatous crested wheatgrass, we evidently have some germplasm which is better. On the other hand we do not know the value of the rhizomatous trait for turf behavior - it apparently does not result in any fill-in of bare spots, which is the desired effect. Nevertheless, considerable attention was placed on rhizomes in making selections in 1990, and this would facilitate a future experiment on the expression of rhizomes in a turf environment.

The third trait classified in November 1989 was the narrowness of leaves, also a useful trait in turfgrass for appearance. Plants were classified as N, (N), ordinary, or B (broad) with N being more definitely narrow than (N). With 65 narrow out of 324 diploid (20%) and 83 narrow out of 612 tetraploid (13.6%) there are more narrows in diploids than tetraploids, significant at $P < 0.05$. There is no clear distinction between 2x and 4x in the frequency of broadleaf types. In the probability that a rhizomatous narrow-leaf type might be our desired turf candidate, we laid most stress on identifying such types for individual harvest and inclusion as clones in a crossing block, without regard to their source other than to separate diploids from tetraploids. The highest incidence of narrows is in sources 3, 4, 5, 6, and 8 (all from Turkish origin), and they are markedly absent from the check cultivars (Table 4).

The 1990 season revealed two new events: one a disease infecting the center of the clump about the time of flowering and causing lodging away from the center; and the other a damaging July 28 hailstorm just as the seed was maturing, which shattered a lot of seed onto the ground. Ratings were made for disease, because it would be an unwanted trait in a seed-production field, yet it never killed the plants. All grades from the near-healthy grade 1 to the blackened-center grades 4 and 5 produced young regrowth from tillers in the center and periphery of the clump in August even before all seed culms had been harvested. In order to assess the influence of this clump-disease susceptibility upon turf quality and susceptibility, we harvested bulks from different disease grades, though we expect to make recombinations only from the healthy end of the scale. The quantities of seed were of course hurt considerably by the hail, and we are still at report-time processing seed to find out what we have, for multiplication or turf-testing in spring 1991. Table 5 shows what combinations of

Table 4. Traits scored on spaced-plant nursery of Fairway crested wheatgrass, Fort Collins Oct. 1989 to June 1990.

Source	Rhizome score[1] Mean	Rhizome score[1] Range[4]	Narrowness[2] mean score	Clump-disease score[3] Mean	Clump-disease score[3] Range[4]
Diploid (2x)					
5	3.7	2.3-4.7	1.8	3.15	2.8-3.8
6	5.2	3.7-6.3	1.5	2.76	2.5-3.1
7	3.9	2.7-5.7	1.0	2.58	2.2-2.9
8	3.9	3.3-4.3	1.4	2.82	2.3-3.2
17	3.7	3.3-4.3	0.4	2.39	2.0-2.8
Fairway	2.0		0.0	3.25	
Ruff	3.7		0.0	2.50	
Tetraploid (4x)					
Ephraim	4.9		0.7	3.17	
Hycrest	2.3		0.0	2.00	
1	4.1	2.3-7.0	0.5	2.92	2.6-3.4
2	3.1	0.5-4.7	0.3	2.50	2.2-2.7
3	3.6	1.3-5.0	1.6	2.81	1.8-4.0
4	2.4	0.8-3.7	1.3	3.04	2.8-3.2
9	3.9	1.7-6.0	0.8	2.44	2.0-2.7
10	3.0	2.3-4.0	0.8	2.64	2.3-3.2
11	6.2	6.0-6.3	0.8	2.42	2.1-2.8
12	3.8	3.3-4.7	0.2	2.47	2.3-2.8
13	4.3	2.7-6.7	0.3	2.78	2.2-3.3
14	4.3	3.7-5.3	0.9	2.81	2.4-3.1
15	2.9	2.0-4.4	0.9	2.58	2.4-2.8
16	3.4	1.0-6.3	1.1	2.81	2.3-3.4
Column Mean	3.73		0.78	2.73	

1/ Rhizome: 0, 1, or 2 per plant, plot score can be up to 8

2/ Narrow: 2 = N, 1 = (N) not many plots have narrows, plot score could theoretically total 8, but average plots are below 1.0.

3/ Clump-disease (June 1990): 1 almost healthy to 5 badly diseased, score is averaged on a per-plant basis.

4/ Range among the means of individual 12-plant progenies from the 3 or 6 parents of that source in the cycle-1 crossing block.

plants are represented in bulks (or individuals) and in recombination blocks. The selecting of parents regardless of source should help maintain vigor as well as genetic diversity, since most sources had some desirable plants. Recombination blocks will include a total of 178 plants or 18% of the nursery, while seed was gathered from 220 additional plants as shown in Table 5. All plants were mowed after harvest and the moving of plants for recombination will be done in early spring as the more favorable season for establishment compared to our dry fall soil conditions.

Despite the attractiveness of narrow-leaved plants as single plants, there is a slight tendency for them to exhibit more summer clump disease than the average of all plants in the replication. Plants were rated 1 (healthy) to 5 (blackened center, flattened and lodged clump), and narrows rated 2.85 compared to the overall 2.74. Narrow (N) were somewhat worse, and definite broad (B) plants were slightly better. Although there seems to be no carryover to fall foliage, a type of tip-burn of narrow-leaf plants is evident in October, which was rated only on the N and (N) plants, in case we want to restrict the selection only to those with minimum expression of tip-burn. In a continuously-mowed turf this symptom may be unimportant. In our nursery the tip-burn seemed worse on N plants than (N) and may have some relation to faster drying out in the narrower tips. Data on disease scores are presented in Table 6.

Table 5. Fairway wheatgrass seedstocks harvested in 1990, and recombinations planned.

Group Code	No. plants	Leaf width	Rhizome	Disease	Ploidy	Recombination Block?
Red	12*	N or (N)	+	1 or 2	diploid	Yes
	15*				tetraploid	Yes
Pink	9*	N or (N)	(no)	1 or 2	diploid	Yes
	13*				tetraploid	Yes
Blue	41	Narrow	any	3-4	diploid	
	43				tetraploid	
Gray	40	not nar.	++1/	1-2	diploid	Yes
	89				tetraploid	Yes
Gray	13	not nar.	(no)	1	(both)	
Green	43	not nar.	++	3	diploid	
	80				tetraploid	

* Seed lots individually harvested by plant, so progeny rows can be tested.
1/ This group is +1, ++1, ++2, only, for rhizome and disease

Table 6. Disease scores for FCWG in summer and fall 1990 (averages of 3 replications).

Disease and ploidy	Leaf width class N	(N)	B	Whole repl.
Clump disease				
2x	2.89	3.20	2.69	2.78
4x	2.81	3.14	2.54	2.70
Tip-burn				
2x	2.37	1.70		
4x	2.52	2.13		

1/ 1 (least disease, healthy) to 5 (blackened culms, clump lodged)

D. **Alkaligrass Turf Management Trials.**

A 12-entry alkaligrass management study was planted on 7 June 1990. Due to tremendous weed pressure (pigweed, kochia, spurge, dandelion, purslane), this new study was mowed at a 2 inch height. This allowed full development of the grass plants at a time when we did not wish to impose an added stress of low mowing height (in addition to the competitive stress of the weed population). Also, the last two weeks of June (when the alkaligrass was in the seedling stage) were the warmest on record for our area. This stimulated the growth of the weeds (all warm-season, except for dandelion) and reduced the vigor of the cool-season alkaligrass. Light (1/2 rate applications of 2,4-D, triclopyr, and dichlorprop were made in attempts to kill some of the weeds (without damaging the grass), but were mostly unsuccessful. We resorted to hand-weeding during this first year.

All entries germinated with a couple of days of each other, 8 to 10 days following seeding. The establishment ratings of the entries follow. Ratings are the averages of three replications, and over 3 rating dates (4, 6 and 8 weeks after seeding). No differences in establishment vigor were noted at any of the individual dates, so the three dates were combined for this report. A rating of 5 equates with excellent establishment vigor, and a rating of 1 designates poor establishment.

ESTABLISHMENT RATINGS OF ALKALIGRASS (1990)

ENTRY #	AVERAGE RATING
26	5.0
81	4.7
2	4.3
14	4.3
17	4.3
20	4.3
57	4.3
74	4.3
93	4.3
71	4.0
6	4.0
87	4.0

LSD (0.05) = N.S.

Beginning this spring, two mowing heights (3/4" and 1 1/2") will be imposed on this experiment. Also, 2 fertility regimes (high and low; details in research proposal) will be examined.

Beginning in early September, differential susceptibility to rust was noted in this experiment. While the symptoms appear severe on some of the entries, causing discoloration of the turf, the density of the severely infected plots did not appear to suffer. A rating of rust incidence on these entries follows. A rating number of 1 equates with no symptoms of disease, and a rating of 5 indicates severe infection. All ratings are averages of 3 replications.

RUST INCIDENCE ON ALKALIGRASS ENTRIES (2 October 1990)

ENTRY #	SEVERITY (5 = high)
93	5.0
74	4.7
81	4.7
87	4.7
6	4.3
26	4.3
71	4.0
2	1.0
14	1.0
17	1.0
20	1.0
57	1.0

LSD (0.05) = 2.3

It is interesting to note that the susceptible entries are of Western U.S. origin, and the resistant entries are Eurasian materials. One exception to this is #57, which is U.S. material. It should be noted that the Fults alkaligrass border was also heavily infected with the rust disease (rated at a level of 5). The effect of fertility regime on incidence of this disease will be interesting to observe next year, since rust tends to be more of a problem in low fertility management regimes.

E. **Blue Grama Turf Management Trials.**

A blue grama turf management test was planted on 29 June 1990. This test included the available cultivars Alma and Hachita, as well as 2 bulks (Elite and Bulk 67). These entries germinated quite quickly in the warm temperatures that were prevalent at time of seeding, and plants were visible 4 days after seeding. The color of the two bulks was better (i.e., darker green) than the color of either Alma or Hachita. The color of the Elite bulk was almost blue-green in color.

The growth habit of the two bulks tends to be a bit more decumbant, with a slower vertical growth rate, as compared to Alma and Hachita. This is encouraging, since grasses that display this characteristic are better able to tolerate mowing (and maintain density) than the more upright growing grasses.

With the advent of cool weather and frosts, this warm-season grass species begins to lose its green color. Hachita and Alma appeared to retain more green leaves, and for a longer period of time into the fall, than the two bulks. This difference is noticeable because the plots were adjacent to each other, but probably is not significant enough to detract from the improvements that have been made with this grass by Dr. Cuany.

More extensive turf management trials are planned for 1991, pending yields of seed from the blue grama nursery.