USGA PROGRESS REPORT - 1985

Breeding, Evaluation and Culture of Buffalograss for Golf Course Turf

Terrance P. Riordan
Associate Professor of
Turfgrass Breeding

Edward J. Kinbacher
Professor of
Stress Physiology

Robert C. Shearman
Associate Professor of
Turfgrass Culture and Physiology

A USGA/University of Nebraska Research Project
Initiated July, 1984

EXECUTIVE SUMMARY-NOVEMBER 1, 1985
NEBRASKA PROJECT

Breeding, Evaluation and Culture of Buffalograss for Golf Course Turf

Buffalograss Collection

Since the initiation of the Buffalograss Development project at UN-L, 708 buffalograss plants have been collected throughout the Great Plains region. During the summer of 1985, 519 plants were collected and either have been planted in an evaluation area at the Agricultural Research and Development Center near Mead or are being held in the greenhouse to be planted next spring. Forty eight plants have been selected from the collection area for having qualities acceptable for turfgrass. Criteria for selection were density, horizontal growth, color, leaf height, seed production, inflorescence height (tall females, short males), breeding ability, extended fall color and overall aesthetic quality.

Buffalograss Plant Breeding

Three sources of commercial buffalograss seed, Texoka (Nebraska source), Texoka (Texas source) and Sharp's improved (Kansas source) were transplanted into the field for evaluation. Plants were rated for color, turf quality, leaf height and rate of cover. Sex was also determined when possible. The most outstanding plants are being vegetatively increased in the greenhouse and will be used as parents in the breeding program.

A breeding plan or strategy has been developed which will allow for both vegetative and seed production, hybridization and inbreeding, and development of either male and/or female plants. Experience will be necessary to select the best system.

The male and female plants selected for the breeding program have a superior color, turf quality, and better rate of cover than that of the base population. These plants also have a higher initial leaf height (better agronomic vigor) and a lower final unmowed leaf height. The percentage of female plants selected suggest that turf-type characteristics are sex linked. However, both good males and good females are required in the breeding program.

A test planting using three males and eight females was made during September. This planting was carried out to evaluate procedures and also to generate seed from the better female parents. In this planting eight outstanding female clones are surrounded by three outstanding male clones. This plan allows for random pollination by the males and seed collection from each female.

Buffalograss Seed Treatment Evaluation

Buffalograss seed is relatively expensive and is slow to germinate and establish. The major reason for this is that multiple seeds are enclosed by a very hard burr. The main objective of this evaluation was to determine if scarification in a Waring blender wouuld enhance germination and establishment.

Laboratory results showed the 2 second treatment germinating more rapidly and with higher numbers than the other five treatments. In the field study the 2 second treatment was superior to all treatments including the check, decreasing the initial germination time and producing more seedlings, providing an earlier developing and denser stand compared to the no treatment stand. This lends itself to greater ease in establishing a buffalograss turf. Plans are to work with Ag. Engineering to develop a method for similarly treating buffalograss seed in large quantities.

Buffalograss Establishment Study

The data collected from this study was used to determine whether there was a significant difference between plugs with an established root system (pre-rooted plugs, PRP) and regular plugs (non-pre-rooted plugs, NPRP). In general, the PRP treatment produced more stolons much sooner, established much more quickly, and had a better initial adaptation to transplanting (color measurement) than the NPRP treatment. These results could be very significant in a vegetatively propagated grass and open up a new way of marketing buffalograss.

Buffalograss Culture

Herbicide evaluation studies on buffalograss since 1983 have given the following results: 1). Buffalograss shows a decrease in tolerance to increased rates of 2,4-D and combinations of 2,4-D, MCPP and dicamba, and 2). Combination treatments had a synergistic effect when compared to 2,4-D, MCPP and dicamba treated individually.

STATUS REPORT-NOVEMBER 1, 1985
NEBRASKA PROJECT
Breeding, Evaluation and Culture of Buffalograss
for Golf Course Turf

Buffalograss Collection

Buffalograss collection was initiated during the summer of 1984. Turf-type buffalograss ecotypes were selected based on horizontal growth, density and uniformity of stand, adaption to mowing or close grazing, drought resistant, adaptation to compaction, short height and color. Buffalograss was selected in four Nebraska counties from golf course roughs and grazed range areas. Samples from a 20 year-old stand on the University of Arizona campus were collected by Dr. Kneebone and added to our collection. During September, buffalograss ecotypes were collected from over-grazed areas in Pawnee National grassland in Colorado and on non-irrigated golf course roughs in Fort Collins and Eaton, Colorado. Plant material was collected from ecotypes showing turf quality in Dallas, Texas with the cooperation of Dr. M. C. Engelke.

During the summer and fall of 1985, buffalograss ecotypes were collected in 13 Nebraska counties. Most of these counties were located in south central Nebraska where buffalograss is present in the grazed rangeland. Six of the collection sites were golf courses with buffalograss fairways. Collections were also made on High Plains Grassland Research Station, Cheyenne, Wyoming; Northern Great Plains Research Center, Mandan, North Dakota and Soil Conservation Service Plant Materials Center, Bismarck, North Dakota. Buffalograss was collected from other sites in North and South Dakota as well as Wyoming, Montana and Idaho.

Since the initiation of the Buffalograss Development project at UN-L, 708 buffalograss plants have been collected throughout the Great Plains region. During the summer of 1985, 519 plants were collected and either planted in an evaluation area at the Agricultural Research and Development Center near Mead or are being held in the greenhouse to be planted next spring. Forty eight plants have been selected from the collection area for having qualities acceptable for turfgrass. Selection was based on density, horizontal growth, color, leaf height, seed production, inflorescence height (tall females, short males), breeding ability, extended fall color and overall aesthetic quality.

The average leaf height of the selected plants was 6.4 inches at the end of the growing season under no mowing. The average percent cover of the selected plants was 80% (1 plant per 3.5 sq. feet plot). This cover was accomplished in four months of growth. Of the 48 plants selected, 12 are males, 30 are females, four are monecious (both male & female inflorescences on the same plant) and two which have shown no sexual characteristics. For breeding purposes and for seed production a ratio of 9 females to one male is suggested. Measurements and information on the base population is shown in Figures 1 and 2.

Vegetative material (stolons and plugs) have been brought into the greenhouse for overwintering. This material will be propagated, breeding ability and physical characteristics will be assessed and plants will be put into crossing blocks in the spring of 1986. These plants will also be planted in an area where a maintenance schedule can be applied to monitor their response to various cultural practices.

Buffalograss Plant Breeding

This phase of the USGA project involved four research areas during 1985. These areas were: evaluation of commercially available sources for potential parents, review of literature and development of a buffalograss breeding plan, selection of male and female parents, and the planting of a buffalograss breeding block. The following summarizes progress in these four areas.

1. Evaluation of Commercially Available Sources.

These sources of commercial buffalograss seed, Texoka (Nebraska source), Texoka (Texas source) and Sharp's improved (Kansas source) were germinated and transplanted into 2" pots to produce 1000 seedlings of each during March. In June approximately 700 seedlings of each source were transplanted into the field for evaluation. In July, nearly 30% of the seedlings died due to hot, desiccating conditions, even though the plants were under regular irrigation. It is believed that the seedlings lacked a sufficient root system under the summer stress, and in the future seedlings will be allowed to develop a larger root system either by using a larger container or by allowing more time for the root system to develop.

The remaining seedlings in the greenhouse were used to replace the dead plants and all plants were evaluated during the remainder of the 1985 growing season. Plants were rated for color, turf quality, leaf height and rate of cover. Sex was also determined when possible. The most outstanding plants are being vegetatively increased in the greenhouse and will be used as parents in the breeding program.

2. Literature and Breeding Plan

Various breeding publications on nativegrasses and on dioecious plant species were reviewed during 1985. One review paper on the dioecious plant asparagus was very helpful in developing a buffalograss breeding plan. This plan is given in Figure 3. This plan will allow for both vegetative and seed production, hybridization and inbreeding, and development of either male and/or female plants. Experience will be necessary to select the best system.

3. Selection of Male and Female Parents.

The male and female plants selected for the breeding program are listed in Table 1. Figures 1 and 2 show that these plants have a superior color, turf quality, and better rate of cover than that of the base population. These plants also have a higher initial leaf height (better agronomic vigor) and a lower final unmowed leaf height. The percentage of female plants selected suggest that turf-type characteristics are sex linked. However, both good males and good females are required in the breeding program.

The selected male and female plants have been brought back to the greenhouse for vegetative increases and use in the breeding program.

4. Buffalograss Breeding Block.

A test planting using three males and eight females was made during September. This planting was carried out to evaluate procedures and also to generate seed from the better female parents. Figure 4 provides a plot plan of this planting. In this planting eight outstanding female clones surround and are surrounded by three outstanding male clones. This plan allows for random pollination by the males and separate seed collection of the females.

Buffalograss Seed Treatment Evaluation

Buffalograss seed is relatively expensive and is slow to germinate and establish. tTe major reason for this is that multiple seeds are surrounded by a very hard burr. The main objectives of this evaluation were 1) to apply several levels of scarification treatment to the burrs, in order to enhance germination rate; 2) to determine the treatment which would give the highest germination and 3) to conduct the same evaluation under actual field conditions.

The treatments were applied by placing seed in a Waring blender for designated lengths of time, a method designed by Dr. E. J. Kinbacher. The treatments were as follows: one gram of burrs was treated for 2 seconds, 5 seconds, 10 seconds, 20 seconds, 30 seconds and a check (no treatment). The first test also included a manual hand separation treatment in order to count caryopses and determine total potential germination. Tests

1 and 2 were seed treatment tests set up in the laboratory. The seeds were germinated in petri dishes for two weeks and the seedlings were counted on the fourth, eighth and fourteenth days. The field test was carried out at the UNL Agricultural Research and Development Center near Mead. In the field study sixty grams of seed per treatment was processed one gram at a time to provide the same treatments used in the lab tests. The treatments were seeded into 8 X 5 foot plots. An 8 X 4 inch frame was randomly dropped in the plot three times to determine the number of seedlings per plot. The results for these three studies are given in Figures 5, 6 and 7.

Laboratory results showed the 2 second treatment started germinating sooner and with higher numbers than the other five treatments. The numbers continued to increase throughout the duration of the experiment, with total germination equalling that of the no treatment control. In the field study the 2 second treatment was superior to all treatments including the check, increasing the initial germination time and producing more seedlings, which lead to an earlier developing and denser stand compared to the no treatment stand. This lends itself to greater ease in establishing a buffalograss turf. Plans are to work with Ag. Engineering to develop a method for similarly treating buffalograss seed in large quantities.

Buffalograss Establishment Study

The data collected from this study was used to determine whether there was a significant difference between plugs taken from an established field, put in the greenhouse for two months and allowed to establish an extensive root system (pre-rooted plugs, PRP) and plugs taken from an established field and replanted directly into a plot area (non-pre-rooted plugs, NPRP). The percent cover was based on a qualitative rating from 1-10, with one indicating 0-10 percent of the plot area covered and 10 indicating near 100 percent coverage. The stolon number measurement was an actual count of the number of stolons longer than three inches. Color was based on qualitative ratings from 1-9 with 1 indicating a straw brown color and 9 indicating a dark green color.

The results of this study are summarized in Figures 8, 9 and 10. In general, the PRP treatment produced more stolons much sooner, established much more quickly, and had a better initial adaptation to transplanting (color measurement) than the NPRP treatment. These results could be very significant in a vegetatively propagated grass and open up a new way of marketing buffalograss. This information will be submitted for scientific publication as soon as possible.

Cultural Practices

Buffalograss Responses to 2,4-D, MCPP, and Dicamba

A study was conducted at the Turfgrass Research Facility, Agricultural Research and Development Center near Mead in 1983 and 1984 to evaluate the relationship between the rate of herbicides (2,4-D and dicamba) and time of application on potential buffalograss damage. In 1985, a study was initiated to expand on the previous study by examining the effect of 2,4-D, MCPP and dicamba alone and in combination on actively growing and dormant buffalograss turfs. Actively growing turf received treatment in June and dormant turfs in October, 1985. No results are available for the dormant study at this time. Data will be collected during and after spring green-up in 1986. Treatments were arranged to simulate label recommended rates of application, boom overlap (i.e. twice the recommended rate) and three times the recommended rate for a tolerance confidence level.

Three responses were evaluated: turf color based on a scale of 1 to 9 with 1 = straw brown and 9 = dark green; turf quality was comprised of six components; density, smoothness, uniformity, texture, color, and growth habit. Quality ratings were based on a 1 to 9 scale with 1 = poorest, and 9 = best turfgrass quality Phytotoxicity was based on a scale of 1 to 9 with 1 = no damage and 9 = 90-100% of the turf showing severe damage.

Results (Table 2).

1). Both 2,4-D and combinations of 2,4-D, MCPP and dicamba showed linear relationships between phytotoxicity and rate of herbicide. As herbicide rate increased, phytotoxicity increased.

2). Both 2,4-D and combination treatments had negative linear responses for turf color and herbicide rate. As herbicide rate increased, turfgrass color deteriorated.

Conclusions

1). Buffalograss shows a decrease in tolerance to increased rates of 2,4-D and combinations.

2). Combination treatments had a synergistic effect when compared to 2,4-D, MCPP and dicamba treated individually.

Literature Review

An extensive library search was conducted during the summer of 1985 for articles on buffalograss and other nativegrass research. Fifty nine articles were pulled from the acquired list and studied. Much of the research done on buffalograss was done previous to 1950. The articles selected range from sexual characteristics, to vegetative propagation, seed harvest, seed pretreatment, herbicide effects, diseases and pests. Review of this literature has given background material for present and future tests. Plans include a review article summarizing past research on buffalograss.

Table 1

BFG Breeding Selections

Plant #	Origin	Date Selected	TX Code	Reason for Selection	Sex	Present Location(s)
84-402	TX	8/6/85	1362.2	good spread, dense	M	B4-1213, BFGB5, GH
84-409	TX	8/6/85	1346.1	good spread, color, density, & low grow	F	B4-614, BFGB5, GH
84-402	TX	8/27/85	1362.2	low grow, good color	M	B4-1114, BFGB5, GH
84-205	TX	8/6/85	1276.4	good density	F	B4-1315, GH
84-205	TX	8/6/85	1276.4	good density, good grow	F	B4-316, GH
84-904	NE	8/27/85		good spread, bluegreen color	F	B4-817, BFGB5, GH
84-512	TX	8/27/85	1364.2	good spread, sparse	F	B4-217, GH
84-514	TX	8/6/85	1363.1	good spread, med. grow	F	B4-1418, GH
84-505	TX	8/6/85	1321.2	good spread, med-low grow	M	B4-1019, GH
84-108	TX	8/6/85	1314.2	good spread, tall female, dense	F	B4-419, GH
84-315	TX	8/6/85	1303.1	very dense, low grow	F	B4-119, BFGB5, GH
84-506	TX	8/6/85	1280.9	dwarfness, dk. green	F	B4-1520, GH
84-306	TX	8/6/85		very vigorous growth	F	B4-121, GH
84-45-3	CO	8/6/85		med. spread, very dense	M&F	B4-122, GH
84-63	NE	8/6/85		dense, spread with tight nodes	M&F	B4-1622, BFGB5, GH
84-903	NE	8/27/85		good spread, dense, bluer, hairy leaves	F	B4-324, BFGB5, GH
84-315	TX	8/6/85	1303.1	med. spread, very dense	F	B4-724, GH
84-401	TX	8/6/85	1360.1	good spread, med. grow, good density	F	B4-425, GH
84-606	TX	8/6/85	1319.2	good spread, med. grow,	F	B4-225, GH

Table 1 (cont.)

BFG Breeding Selections

Plant #	Origin	Date Selected	TX Code	Reason for Selection	Sex	Present Location(s)
84-800	AZ	8/6/85		low grow, good spread	F	B4-1301, GH
84-404	TX	8/6/85	1354.1	good spread, decumbant prostrate growth	F	B4-1102, GH
84-802	AZ	8/27/85		low grow, good spread	F	B4-1602, GH
84-304	TX	8/27/85	1336.2	good spread	F	B4-303, GH
84-608	TX	8/6/85	1280.8	good spread, low grow	F	B4-1204, GH
84-404	TX	8/6/85	1354.1	good spread	F	B4-506, GH
84-36-2	CO	8/6/85		good spread	M	B4-207, GH
84-412	TX	8/6/85	1327.2		M	B4-807, BFGB5, GH
84-104	TX	8/6/85	1408.1	med. leaf height, good spread, lt. green, lush	F	B4-1307, BfGB5, GH
84-25-2	CO	8/6/85		very dense, dk. green	F	B4-108, GH
84-204	TX	8/27/85	1286.1	good spread, good color	M&F	B4-708, GH
84-603	TX	8/6/85	1319.3	good spread, open growth	F	B4-908, BFGB5, GH
84-409	TX	8/6/85	1346.1	low grow, very good spread, good density	F	B4-110, BFGB5, GH
84-507	TX	8/6/85	1363.2	good spread, low grow	F	B4-112, GH
84-415	TX	8/6/85	1271.1	med. spread, dense, low grow	F	B4-412, GH
84-18-3	CO	8/6/85		very hairy leaf, dk. green		B4-1012, GH
84-612	TX	8/6/85	1321.1	excellent spread, low grow		B4-1512, BFGB5, GH
84-104	TX	8/27/85	1408.1	good spread, good color	M&F	B4-1112, GH
84-507	TX	8/6/85	1363.2	good spread, good density	F	B4-6.13, GH

Table 1 (cont.)

BF6 Breeding Selections

Plant #	Origin	Date Selected	TX Code	Reason for Selection	Sex	Present Location(s)
85-6	NE	8/27/85		dark green color	M	B4-126, GH
85-22	NE	8/27/85		dark green, good spread, sparse	F	B4-626, GH
85-3010	T2	8/27/85		Excellent spread, sparse, good color	F	B-10 150
85-4071	T	8/27/85		good spread, color sparse	M	B-10 460
85-4104	T	8/27/85		good spread, sparse bright green	F	B-10 637
85-3162	T2	8/27/85		excellent spread, dark green	M	B-10 1023
85-3335	T2	8/27/85		good spread, tall growth	M	B-10 2040
85-3428	T2	8/27/85		very sparse, med. growth, excellent spread, good color	M	B-10 2542
85-3434	T2	8/27/85		dense, low growth, good spread, dk. green color	M	B-10 2560
85-4509	T	8/27/85		good spread, bright green color	M	B-10 2760

Table 2. Buffalograss turf responses to 2,4-D, MCPP, and dicamba treatments applied alone and in combination to actively growing turfs.

Herbicide	Rate	Herbicide Phytotoxicity[z]					Turfgrass Color[y]		Turfgrass Quality[x]	
	(#a.i./A)	6/24	6/27	7/2	7/10	7/23	6/25	7/23	6/25	7/23
Control	--	1.0	1.0	1.0	1.0	1.0	5.3	4.3	4.9	4.6
2,4-D	1.0	2.0	1.8	1.5	1.3	1.0	4.5	4.1	3.8	3.3
	2.0	3.0	2.3	3.0	1.5	1.0	3.8	4.9	4.1	4.3
	3.0	4.0	3.6	3.8	3.0	1.0	3.3	4.5	3.3	3.5
MCPP	0.5	1.3	1.9	1.0	1.0	1.0	5.0	4.4	4.6	4.9
	1.0	1.4	1.1	1.3	1.0	1.0	5.1	4.3	4.8	4.8
	1.5	2.4	1.8	1.8	1.3	1.0	4.3	4.4	4.4	4.3
Dicamba	0.1	1.0	1.0	1.0	1.0	1.0	4.9	4.3	4.6	4.0
	0.2	1.9	1.3	1.3	1.0	1.0	4.6	4.3	3.5	4.1
	0.3	1.9	1.6	1.5	1.0	1.0	4.4	4.5	4.0	4.1
Combination[w]										
	1.0, 0.5, 0.1	2.6	2.0	2.0	1.5	1.0	4.1	4.2	3.9	3.3
	2.0, 1.0, 0.2	4.9	4.4	3.8	4.0	1.0	2.9	4.0	2.9	3.3
	3.0, 1.5, 0.3	5.8	5.1	5.8	4.8	1.0	2.5	4.8	2.6	3.5
LSD (0.05) =		1.0	0.7	0.8	0.6	ns	0.7	1.0	0.8	1.1
2,4-D rate (L) =		*	*	*	*	ns	*	ns	ns	ns
MCPP rate (L) =		*	*	ns	ns	ns	*		ns	
Dicamba rate (L) =		ns	ns	ns	ns	ns	ns		ns	
Combination rate (L) =		*	*	*	*	ns	*		*	

[z]Phytotoxicity based on a 1 to 9 scale with 1 = no injury and 9 = 90-100% of turf severely injured.

[y]Turfgrass color based on 1 to 9 scale with 1 = straw brown, 6 = light green and 9 = dark green.

[x]Turfgrass quality based on 1 to 9 scale with 1 = poorest, and 9 = best.

[w]Combinations were 2,4-D, MCPP, and dicamba, respectively.

Figure 1.

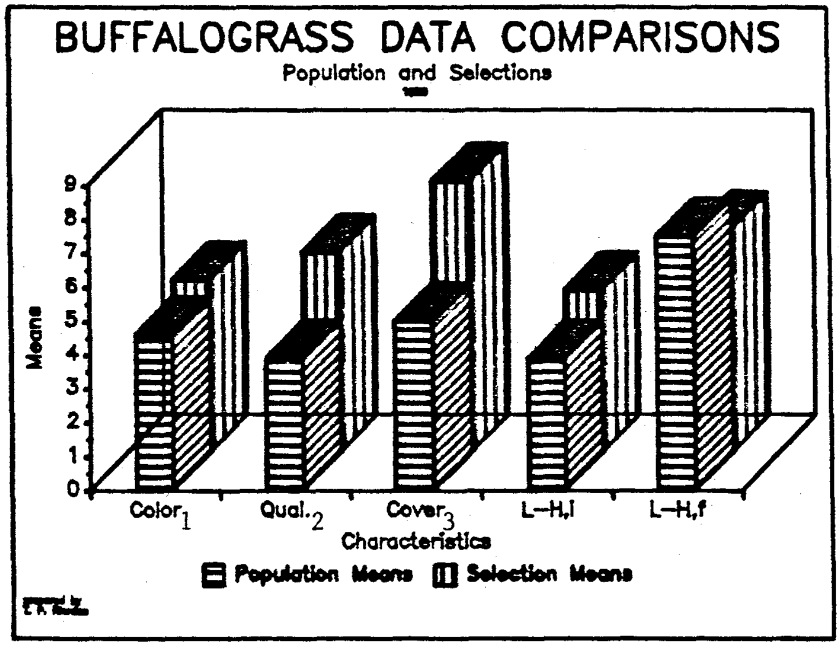
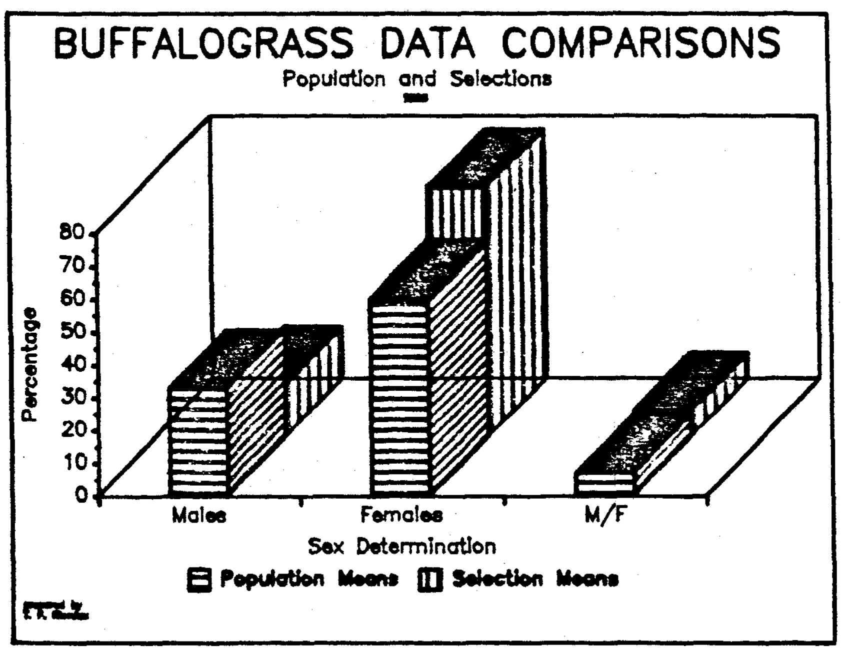
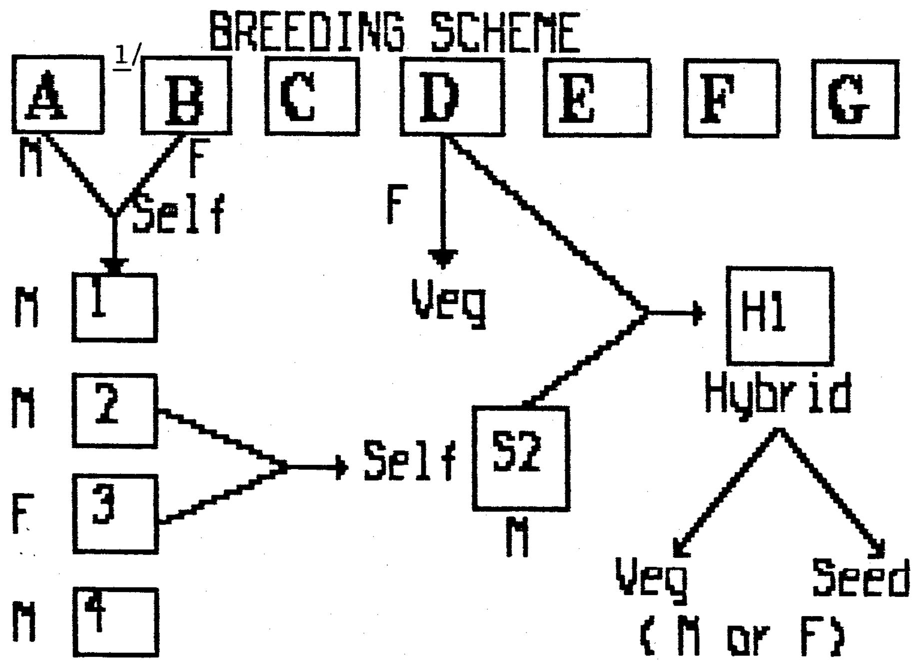


Figure 2.



1 Color is rated 1 to 9 with 1 = straw brown and 9 = dark green
2 Quality is rated 1 to 9 with 9 = best turf quality
3 Cover is rated 1 to 10 with 1 = 0 to 10%,cover and 10 = 100% cover

Figure 3.



1. Each box indicates a different genotype or clone

Figure 4.

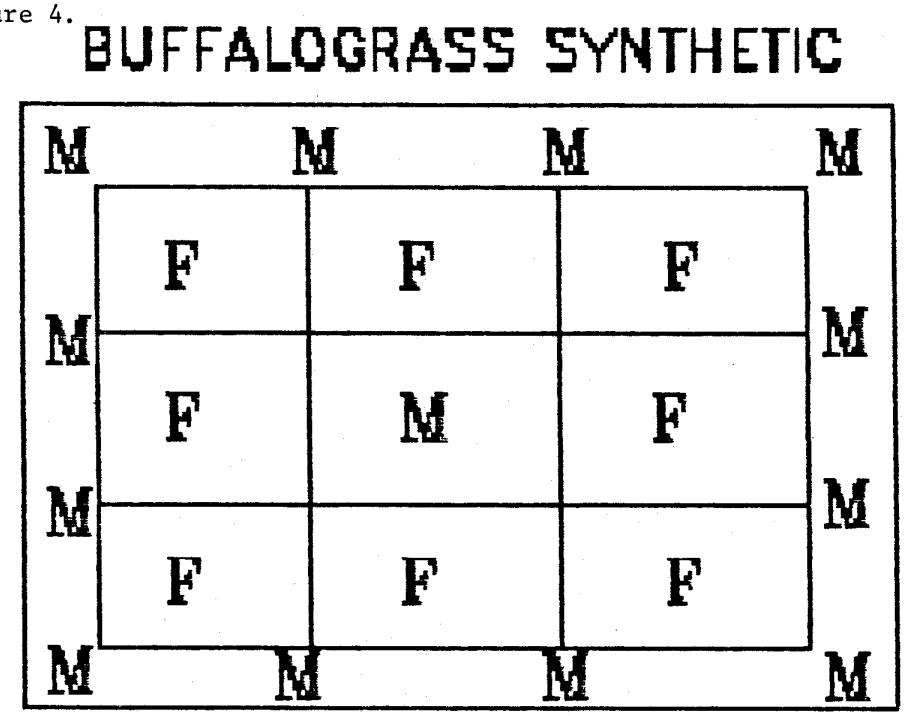


Figure 5.

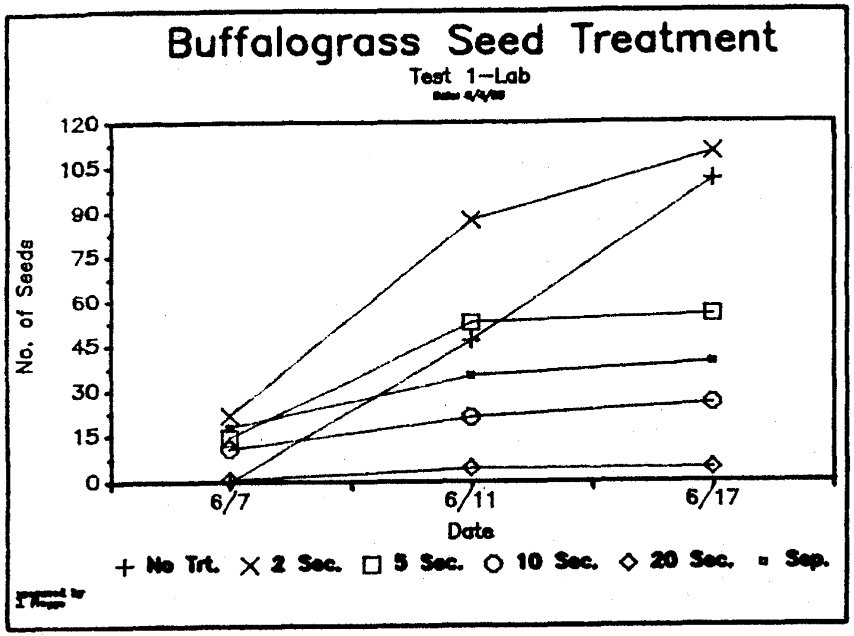


Figure 6.

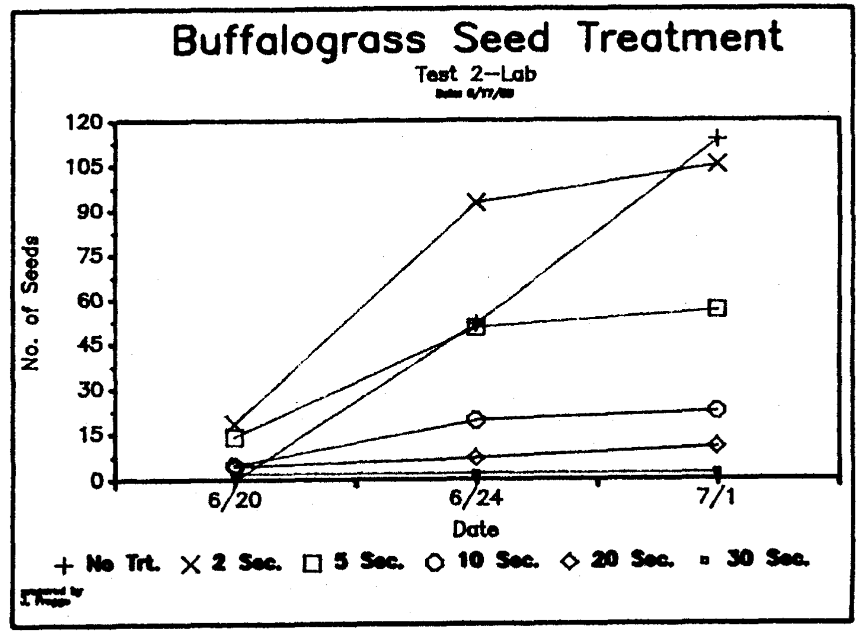
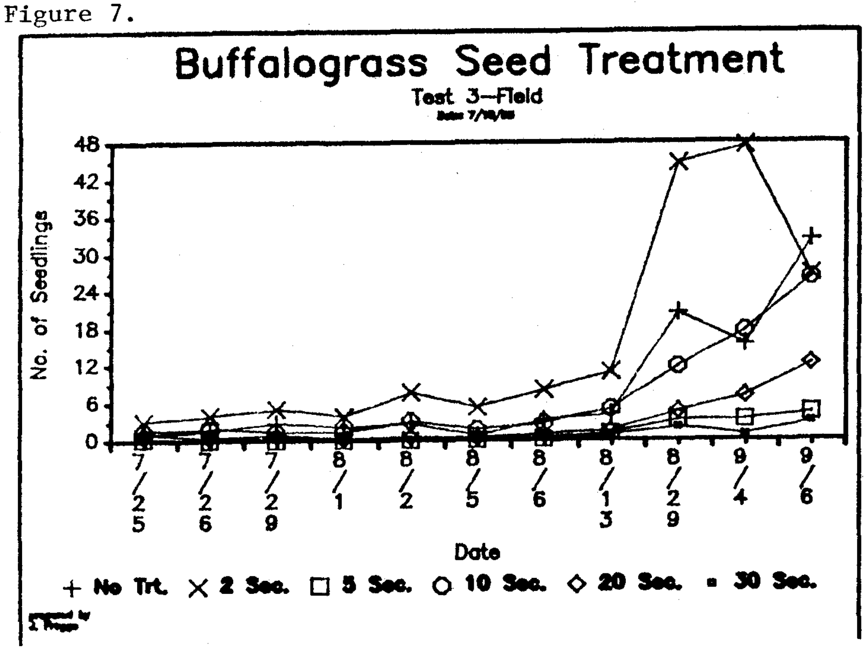


Figure 7.



All treatments were made on 1 gram of buffalograss burrs using a Waring blender. Measurements are number of actual caryopses germinating and surviving.

Figure 8.

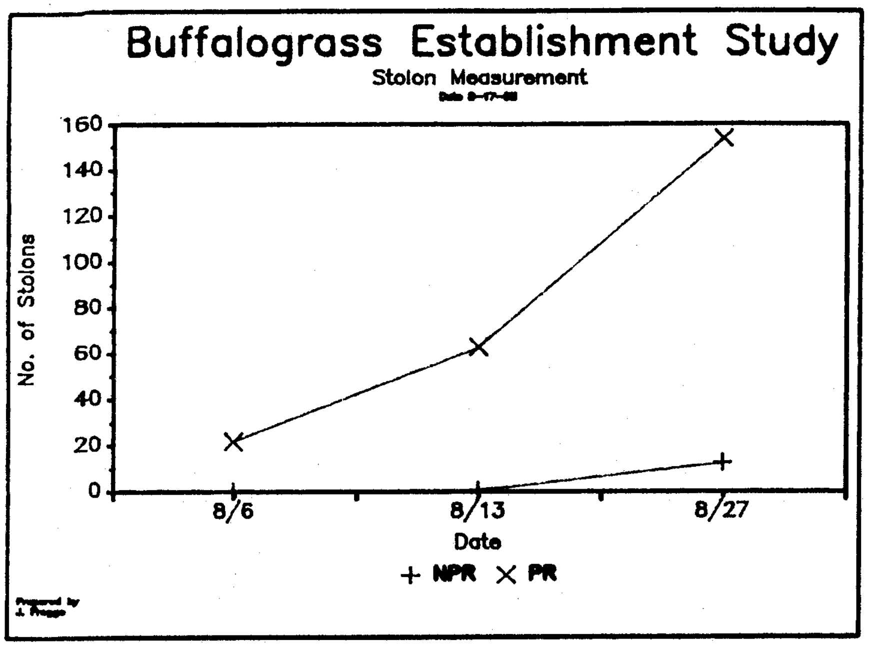


Figure 9.

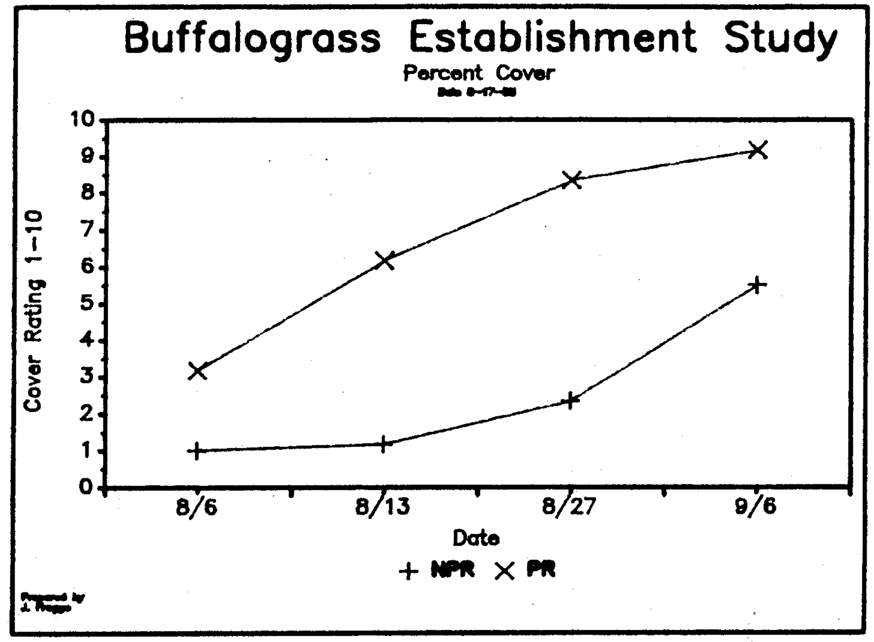


Figure 10.