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FINAL STUDY REPORT
James E. "Bud" Smith Plant Materials Center
Knox City, Texas

Assembly and Evaluation of Blue Grama Germplasm for Rangeland Restoration

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ABSTRACT


USDA-NRCS James E. "Bud" Smith PMC

Blue grama [*Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths] is a native, warm season, perennial bunch grass occurring in Texas rangeland that provides good grazing value for livestock. Although several cultivars are available from commercial sources, a cultivar adapted to the lower elevations of Texas and Oklahoma has not been selected for rangeland restoration. The objective of this study is to assemble, evaluate, and identify elite blue grama germplasm for use in a cultivar or pre-varietal development program. Forty-six collections were received from the field but only twenty-two were transplanted into a common nursery at the James E. "Bud" Smith Plant Materials Center, Knox City, Texas on a Miles fine sandy loam soil and evaluated for plant growth and seed attributes. Accessions 9093076, 9093151, 9093120, 9093123, 9093126, 9093128, 9093132, 9093135, 9093137, 9107767, and 9107789 exhibited desirable qualities for plant growth and seed production potential, but failed to initiate germination in a controlled environment. Due to poor seed quality, a decision was made to discontinue further development of Texas collections for release consideration from the James E. "Bud" Smith Plant Materials Center.

INTRODUCTION

Blue grama is a native, warm season, perennial bunch grass occurring in Texas vegetational areas including the Cross Timbers and Prairies, Edwards Plateau, Rolling Plains, High Plains and Trans-Pecos (Hatch and Pluhar, 1993; Gould, 1978). Blue grama begins growth in late May or early June in areas with adequate moisture and matures 60 to 70 days later. It will become dormant during summer dry periods, but will begin growing again as soon as moisture is available (Leithead et al., 1971). These authors report that growth continues in the fall if moisture is available. Blue grama is choice forage for all classes of livestock and is occasionally harvested for hay (Gould, 1978; Leithead et al., 1971). Although it can withstand close grazing (Gould, 1978); a controlled grazing system should be

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part of the management for sustainable production. Blue grama has also shown to have a moderate salinity tolerance (Leithead et al., 1971).

Although there are several releases recommended for use, there are no cultivars or native seed sources of blue grama developed exclusively for the Cross Timbers and Prairies, Edwards Plateau, High Plains, Rolling Plains, and Trans-Pecos vegetational areas. Therefore, the objective of this study is to assemble and evaluate blue grama germplasm and identify superior ecotypes for range restoration in the southern plains. This is accomplished by contributions of blue grama collections made by field office staff from known populations in the aforementioned vegetational areas of Texas and evaluating them in a common nursery for superior plant characteristics.

MATERIALS AND METHODS

Forty-six accessions of blue grama were assembled at the USDA-Natural Resources Conservation Service (NRCS), James E. "Bud" Smith Plant Materials Center (PMC), Knox City, TX from 2011 to 2013. Seed collections were made by NRCS field office staff and provided to the PMC (Table 1). The assembly of collections were initially planted in the greenhouse in 22 February 2011 and seedlings transplanted to the evaluation nursery 5 May 2011. 'Hachita' blue grama, which was released from the Los Lunas Plant Materials Center in Los Lunas, New Mexico, was included for comparison purposes. A smooth, firm seedbed was prepared prior to transplanting. Plots consisted of ten plants from each accession spaced at twelve inches with 40 inch row spacing in non-replicated plots. Soil type was a Miles fine sandy loam. Weeds were controlled by hand weeding and cultivation. Irrigation was applied the first year to ensure establishment. Accessions were rated annually in late June and early September for survival, plant height (inches), seed maturity (mid to late spring, early to mid-summer, and late summer to early fall), plant growth characteristics (erect/prostrate growth and lodging), and seed production (1 = worst, 9 = best). Measurements taken in June and September were averaged for each year for comparison.

Seed was hand harvested from the surviving accessions in August 2012-2013 from the evaluation nursery and 100 seed were placed on a Petri dish and moistened with 15 ml distilled water. Non replicated seed samples were placed in a germination chamber (Seedburo Equipment Co., Chicago, IL) with alternating day/night temperature (20/30 °C) and (12 h/12 h). Germination counts were taken on day 7 and day 14.

RESULTS AND DISCUSSION

Twenty-four accessions failed to germinate under a greenhouse controlled environment the initial year of planting (data not shown). Of the forty-six planted in 2011, only twenty-two accessions were established in the field (Table 2). Several factors may have contributed to poor germination (i.e. immature seed, poor storage prior to shipment to PMC, or damaged during shipping and processing). A summary of the evaluations made in 2011-2013 are presented in Table 2. Accessions 9093076, 9093151, 9093120, 9093123, 9093126, 9093128, 9093132, 9093135, 9093137, 9107767, and 9107789 showed the highest visual ratings for uniformity and seed production potential and compared almost identically to the ratings collected for Hachita. All the accessions were similar in survival, growth habit, and lodging with some variability in seed maturity and plant height. This variability from year to

year could be contributed to below average precipitation during the growing season. Precipitation amounts from March to October for 2011, 2012, and 2013 were 4.8, 15.59, and 17.97 inches respectively. The forty-four year average for this same period is 20.38 inches.

Seed production potential of accessions 9093076, 9093151, 9093120, 9093123, 9093126, 9093128, 9093132, 9093135, 9093137, 9107767, and 9107789 rated satisfactory. Four accessions, 9093076, 9093123, 9107767, and 9107789, showed the same seed production potential as Hachita; however, hand collected seed from the evaluation nursery in August of 2012 and 2013 failed to germinate in the germination chamber (data not shown). None of the other seed harvested from the surviving accessions and other grass species germinated either. It is anticipated above average temperatures and below average precipitation during pollination may have attributed to poor seed quality. Adverse heat and moisture stress during the reproductive phase significantly reduces grain and pod yields and decreases seed quality of some agricultural crops (Vara Prasad et al., 1999; Fougereux et al., 1997; Schoper et al., 1987).

CONCLUSION

The twenty-three accessions of blue grama were similar in survival, growth habit, and lodging with minimal differences observed in plant height and seed maturity from year to year. Accessions 9093076, 9093151, 9093120, 9093123, 9093126, 9093128, 9093132, 9093135, 9093137, 9107767, and 9107789 had the highest seed production potential and uniformity compared to the other eleven accessions of blue grama. Subjective data collected showed similarities between these accessions and the commercially available Hachita. Due to poor seed quality exhibited by these accessions, a decision was made to discontinue the evaluation and close the study. Seed collections of blue grama accessions will be stored in a controlled environment for future germplasm screening by interested entities.

LITERATURE CITED

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Table 1. Blue grama collections evaluated at the USDA-NRCS James E. "Bud" Smith Plant Materials Center, Knox City, TX 2011-2013.

Accn. No	Origin
436803	Presidio
436804	Hudspeth
436805	Swisher
'Hachita'	New Mexico
477959	Stonewall
477960	Oklahoma
9064949	Brewster
9085788	Willbarger
9093076	Hale
9093078	Foard
9093083	Cottle
9093086	Gray
9093088	Baylor
9093090	Hockley
9093092	Kent
9093093	Dickens
9093100	Moore
9093102	Parmer
9093104	Crockett
9093107	Cochran
9093109	Sherman
9093112	Randall
9093113	Hall
9093114	Collingsworth
9093116	Hardeman
9093120	Gaines
9093122	Dawson
9093123	Carson
9093126	Hutchinson
9093128	Bailey
9093130	Lipscomb
9093132	Donley
9093133	Motley
9093135	Ellis
9093136	Hemphill
9093137	Ochiltree
9093146	Lubbock
9093148	Floyd
9093150	Collingsworth
9093151	Terry
9093153	Lynn
9093155	Roberts
9107763	Wheeler
9107764	Briscoe
9107767	Armstrong
9107770	Hartley
9107789	Presidio

*RED indicates collections that were not successful outside of the greenhouse

Table 2. Summary of blue grama collections evaluated at the USDA-NRCS James E. "Bud" Smith Plant Materials Center, Knox City, TX 2011-2013.

	Survival (%)[1/]				Height (in)[2/]				Seed Maturity[3/]			Uniformity[4/]				Growth Habit[5/]			Lodging[6/]			Seed Production[7/]			
Accn. No	2011	2012	2013	Ave.	2011	2012	2013	Ave.	2011	2012	2013	2011	2012	2013	Ave.	2011	2012	2013	2011	2012	2013	2011	2012	2013	Ave.
Hachita	100	100	100	100	11	16	21	16	Early	Early	Mid	7	8	7	7	Erect	Erect	Erect	0	0	0	8	6	8	7
9085788	100	90	90	93	14	17	16	16	Mid	Mid	Early	3	5	2	3	Erect	Erect	Erect	0	0	0	4	5	3	4
9093076	100	80	80	87	10	17	22	16	Early	Early	Mid	6	6	7	6	Erect	Erect	Erect	0	0	0	6	8	7	7
9093102	60	60	50	57	7	17	17	14	Mid	Mid	Mid	6	5	6	6	Erect	Erect	Erect	0	0	0	1	4	3	3
9093107	50	40	40	43	9	14	18	14	Early	Mid	Early	5	6	4	5	Erect	Erect	Erect	0	0	0	4	4	3	4
9093112	40	40	30	37	7	15	16	13	Early	Mid	Mid	6	5	5	5	Erect	Erect	Erect	0	0	0	3	5	4	4
9093116	60	60	60	60	9	14	16	13	Mid	Mid	Mid	4	6	5	5	Erect	Erect	Erect	0	0	0	4	4	4	4
9093120	80	70	70	73	6	19	23	16	Mid	Early	Early	6	8	8	7	Erect	Erect	Erect	0	0	0	6	7	6	6
9093123	100	90	90	93	5	16	23	15	Mid	Mid	Early	5	6	7	6	Erect	Erect	Erect	0	0	0	7	8	6	7
9093126	90	90	90	90	6	16	22	15	Mid	Late	Mid	6	6	8	7	Erect	Erect	Erect	0	0	0	6	6	6	6
9093128	100	100	100	100	10	20	21	17	Mid	Early	Mid	7	6	7	7	Erect	Erect	Erect	0	0	0	6	5	6	6
9093130	40	40	40	40	7	12	25	15	Mid	Late	Mid	4	5	3	4	Erect	Erect	Erect	0	0	0	1	2	2	2
9093132	100	100	100	100	11	19	28	19	Early	Early	Early	6	8	6	7	Erect	Erect	Erect	0	0	0	4	6	8	6
9093135	100	100	100	100	7	17	19	14	Mid	Early	Early	7	7	7	7	Erect	Erect	Erect	0	0	0	6	5	7	6
9093136	100	100	70	90	7	14	21	14	Mid	Early	Mid	4	3	4	4	Erect	Erect	Erect	0	0	0	1	2	4	2
9093137	100	100	100	100	8	15	21	15	Early	Early	Early	6	5	6	6	Erect	Erect	Erect	0	0	0	7	6	6	6
9093150	20	20	20	20	8	10	17	12	Early	Early	Early	4	6	7	6	Erect	Erect	Erect	0	0	0	1	2	1	1
9093151	60	60	50	57	9	15	21	15	Mid	Mid	Mid	6	5	8	6	Erect	Erect	Erect	0	0	0	6	7	6	6
9093153	70	70	60	67	11	15	21	16	mid	Late	Late	3	5	2	3	Erect	Erect	Erect	0	0	0	3	2	4	3
9093155	90	50	50	63	8	11	15	11	Early	Mid	Mid	4	5	2	4	Erect	Erect	Erect	0	0	0	3	5	4	4
9107767	70	70	70	70	7	13	19	13	Early	Mid	Mid	6	6	7	6	Erect	Erect	Erect	0	0	0	6	6	8	7
9107770	20	20	20	20	10	14	16	13	Mid	Mid	Early	4	4	5	4	Erect	Erect	Erect	0	0	0	1	2	1	1
9107789	90	90	90	90	15	24	28	22	Mid	Mid	Mid	7	6	8	7	Erect	Erect	Erect	0	0	0	8	7	5	7

1/ Percent of plants survived taken in June and September
2/ Maximum plant height in inches taken in September
3/ Seed Maturity ratings (Early: late spring to early summer--- Mid: mid to late summer--- Late: early to mid-fall)
4/ Uniformity rating compares the visual comparison between all plants in the plot (1=differences in plant appearance, 10=no difference in plant appearance). Taken in June and September
5/ Growth Habit (Erect grows at 90° angle; prostrate grows flat at 0° angle). Taken in June and September
6/ Lodging rated on scale 0-5 (0=none; 5= completely lodged). Taken in June and September
7/ Seed production is visual for potential yield on a scale 1-9 (1=poor, 9=good) Taken in late July