CYTOLOGICAL, MORPHOLOGICAL, AND AGRONOMIC TRAITS OF EASTERN GAMAGRASS (*TRIPSACUM DACTYLOIDES* L.) ACCESSIONS

By

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CYTOLOGICAL, MORPHOLOGICAL, AND AGRONOMIC

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(TRIPSACUM DACTYLOIDES L.)

ACCESSIONS

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Cytological, Morphological, and Agronomic

Traits of Eastern Gamagrass

(Tripsacum dactyloides L.)

Accessions

ABSTRACT

Cytological, morphological, and agronomic traits of 51 eastern gamagrass (Tripsacum dactyloides L.) accessions were measured. The objectives of the study were to characterize the accessions for the respective traits and to estimate the magnitude of phenotypic variability in the species for these traits. The characters studied were: 1) chromosome number, 2) mode of reproduction, 3) vigor of early spring growth, 4) anthesis date, 5) leaf blade width, 6) plant height, 7) percent seed set, 8) seed stalk number, 9) vigor of summer regrowth, 10) in vitro dry matter digestibility and 11) dry matter content of forage.

Thirty-eight of the 51 accessions were diploids with 2n = 36 chromosomes. Eight of the accessions had more than 36 chromosomes and are probable tetraploids (2n = 72), but an exact count was not made due to stickiness of the chromosomes, or, the presence of multivalent associations, or both. In five of the accessions, no meiotic stages could be found in the collected floral material. Studies of reproductive mode indicate that all accessions produce a monosporic embryo-sac containing differentiated nuclei, usually identifiable as egg, synergids, polars or antipodals. This suggests normal sexual reproduction for all accessions but the possibility of apomictic reproduction in one or more

of them, via the diplosporic mechanism, cannot be precluded without a detailed study of megasporogenesis.

There were highly significant differences ($P < .01$) among the accessions for all morphological and agronomic traits. Percent *in vitro* dry matter digestibility (IVDMD) and percent dry matter (DM), measured at four sampling dates in 1979 (May 9, June 11, July 11 and August 22) showed highly significant differences ($P < .01$) due to accession and to sampling date. The first order accession by sampling date interaction was also highly significant ($P < .01$) for each of these traits. The first three sampling dates were measures of ontogenetic differences due to advancing age of forage. The last sampling (August 22) was of 5 week old regrowth. Mean percent IVDMD decreased with advancing plant maturity (67%-May 9, 62%-June 11, 53%-July 11) in a near linear fashion. Mean IVDMD percentage for the 5 week old regrowth forage was only slightly higher than that of the July sampling date (56% versus 53%) when most accessions were fully headed and at an advanced stage of maturity. The mean percent DM was lowest at the first sampling (39%-May 9) and differed only slightly at the second and third samplings (51% and 52%). Mean percent DM content of the 5 week old regrowth forage was 44.

Accession means and ranges for the other traits were: vigor of early spring growth-5.79, 1.25-8.75; anthesis date-144.59 (days from Jan. 1), 135.00-169.75; leaf blade width-22.43 (mm), 13.82-29.27; plant height-106.46 (cm), 71.80-136.00; percent seed set-54.82, 0.59-90.00; and vigor of summer regrowth-4.49, 2.00-8.00.

Simple correlation coefficients calculated for all possible pairings of the morphological and agronomic traits were not significantly

different from ($P > .05$) and, in nearly all cases, were numerically very low.

The magnitude of the differences found among the accessions for all the traits studied points to a tremendous storehouse of genetic variability within the species, and provides for further genetic and breeding studies.

Additional index words: Agronomic correlation, Genetic variability, *in vitro* dry matter digestibility, Monosporic embryo-sac, Morphological correlation.

INTRODUCTION

Agriculture may well be the most important industry that has developed during the urbanization of mankind. In fact, agriculture has been considered "a revolution that allows a small part of the population to feed the rest" (3). Agricultural research continues to promote this revolution in order to meet the needs of an ever growing population. For sustenance of the revolutionary changes, research investigates many agricultural disciplines, such as the development of higher quality forages. Through the development of quality forages comes increased quality among the livestock man utilizes.

Eastern gamagrass (*Tripsacum dactyloides* L.) is one species that is currently undergoing research to ascertain its agronomic value, since it has been credited as an excellent hay grass capable of yielding a tremendous volume of forage (9). Gamagrass, a native, perennial, warm-season, tall growing bunch grass, has the reputation of being highly palatable to all classes of livestock. Consequently, it has been termed an "ice cream" plant by range management specialists, and as a result of its exceptionally high palatability, has disappeared from most rangelands.

Gamagrass is best adapted to alluvial bottomland soils with favorable moisture conditions and is found throughout the eastern United States. Moreover, this forage has been represented by some as one of the most productive and palatable native grasses in the southeastern United States bottomlands (4).

A great quantity of scientific investigation has been conducted on the basic cytology of eastern gamagrass, however, virtually no work has been directed toward the characterization of its potential value as a forage. The problems associated with the successful use of gamagrass for either grazing or hay purposes relate basically to the successful establishment of stands and to the intensive management criteria that must be applied to sustain acceptable yields on a long term basis. Gamagrass seed production is relatively low, but such seed can be used for establishment of new stands (1). A mature gamagrass plant will also yield approximately 150 reproductive shoots which can be used as propagules for the vegetative reproduction of the species.

Consequently, the extremely high palatability of gamagrass and the resultant selective grazing by herbivores is expected to require tedious management to insure continued persistence and production of this grass. Under range conditions, the overutilization of this forage normally leads to its disappearance. Hence, if there is a use for gamagrass, it may be in an intensively managed system where plants are grown in a monoculture.

The purpose of this study was to characterize existing variability among 51 accessions of gamagrass that would aid in the determination of its value with regard to future breeding and selection. Specific objectives of this study were to determine the chromosome number and reproductive mode for each accession, and to characterize the range of variability among the accessions for selected morphological and agronomic characteristics.

The manuscript will be presented in the acceptable form for the Crop Science Society of America Journal, <u>Crop Science</u>. The same format is currently being adopted by many professional journals (6).

MATERIALS AND METHODS

Plant material used in this study consisted of 51 accessions supplied by the United States Department of Agriculture-Soil Conservation Service Plant Materials Center at Knox City, Texas, from a collection made by that agency throughout the southern Great Plains (Table 1). The accessions were planted at the Agronomy Research Station near Perkins, Oklahoma in June 1976 in Teller loam (Udic Arguistoll) soil. The field plot design was a randomized complete block with four replications. Individual plots contained eight clonal plants spaced 1.22 m apart in a row with 1.02 m between rows.

Cytological Studies

Inflorescence material for chromosome number determination was collected in the spring of 1978, with some additional material collected in the spring of 1979. The staminate portions of the spikes were collected at three stages in order to get a range of material with respect to meiotic activity: a) just prior to emergence from the boot: b) as the spikes began to "peak" out from the boot; and c) when spikes had emerged approximately one-third from the boot. The collected material was placed in Carnoy's fluid for killing and fixing. After about 24 hours in Carnoy's fluid, the material was placed in 70% ethyl alcohol and stored until chromosome squashes were made. To prepare slides, anthers containing pollen mother cells were squashed in an aceto-carmine dye solution. For permanent mounts, venetian turpentine was used as a mounting medium, and for temporary slides, the cover slips were sealed with paraffin (7).

Chromosome counts were normally made at the diakensis stage of prophase I, however anaphase was used for verification of the count where possible (8).

Floral material for determination of reproductive mode was collected in the spring of 1978. The pistillate portions of the spikes were collected at four stages: a) as female spikelets emerged from the boot (stigmas not yet exerted); b) as stigmas began to emerge; c) when stigmas were fully emerged; and d) after stigmas received pollen and began to wither. The material was placed in a formaldehyde-acetic acid-alcohol (FAA) solution (19:1:1) that is specifically used for killing and fixing megasporocyte material. In the laboratory the pistils underwent vacuation of air to facilitate penetration of liquid chemical treatments. A dehydration and infiltration schedule was then used to remove water from the fixed material and to prepare it for paraffin embedment. Paraffin-infiltrated specimens were then embedded in liquified paraffin and allowed to cool. These paraffin blocks were trimmed and mounted upon the microtome pin for the sectioning process. Next the trimmed blocks were sectioned at a uniform thickness (12μ) and serially mounted on slides. Finally, the ovary sections were stained with a safranine-fast green schedule (7).

<u>Field Studies</u>

The field plots were burned off in mid March 1979 to rid them of refuse and to promote uniform growth among the plants. During the spring and summer in 1979, measurements were taken on the following agronomic and morphological characteristics: 1) vigor of early spring growth, 2) anthesis date, 3) leaf blade width, 4) plant height, 5) percent seed set, 6) seed stalk number, 7) vigor of summer regrowth, 8) *in vitro* dry matter digestibility and 9) dry matter content of forage.

A subjective rating system, based on observation of the plot as a whole (no subplot measurement of individual plants) with a scale of 1 to 10, was used to rate accessions for early spring growth and vigor of summer regrowth. One indicated very little growth or vigor and ten signified the opposite.

Staminate anthesis date of the accessions was recorded daily beginning about May 15 and ending June 19. This was recorded as the number of days from January 1, 1979. The inflorescence of eastern gamagrass is composed of racemes which are in turn composed of an upper staminate portion and a lower pistillate portion. The species is protogynous, i.e. stigmas are exerted from florets 3.6 days before anthers are exerted from staminate florets.

Leaf width was measured in mm for three randomly selected leaves on each plant in each plot. Plant height was measured in cm from ground level to a "visually assessed" average height of the pinnacle leaves. Height measurements were made for all plants in all plots. In mid July, after most accessions had matured seed, the number of seed stalks were counted for three randomly selected plants per plot in the first replication.

The percent seed set by each accession (except accession 2 which produced no seed heads) was estimated by collecting one or more mature heads from each plant. Heads from plants within individual plots were bulked. Individual florets were dissected using pliers, to ascertain the presence or absence of a caryopsis. The percent seed set was determined by the formula: no. of plump caryopses/total seed X 100. Shriveled caryopses were counted as empty florets.

Four samplings were taken for the measurement of percent *in vitro* dry matter digestibility (IVDMD) and percent dry matter (DM) during the summer of 1979: May 9, June 11, July 11 and August 22. Small samples were hand clipped from 3 to 5 randomly chosen plants per plot and bulked. Weights of the green forage samples were immediately recorded (gm), and the samples were later placed in a drying oven at a temperature of approximately 54° C. Dried samples were weighed and stored. Dry matter percent was calculated by dividing the oven dry weight by the green weight and multiplying by 100. The entire nursery was mowed at the approximate height of 20 cm on July 19 to remove old growth. Five weeks of regrowth was allowed before the final sampling in August.

In preparation for IVDMD analyses, the dried samples were initially ground through a 2 mm screen and subsequently ground to pass through a 40 mesh screen using Wiley mills. The IVDMD of each sample was determined, in duplicate, using the two-stage technique of Tilley and Terry (11). The work was conducted at the Southwestern Livestock and Forage Research Station, El Reno, Oklahoma.

Data for each of the agronomic and morphological characters studied were statistically analyzed using standard procedures. Simple correlation coefficients were calculated for all possible pairings of the morphological and agronomic traits. The accession designated as entry 2 was not included in the statistical analyses of the data for anthesis date and percent seed set since it produced no seed heads.

Table 1. Origin and Soil Conservation Service identification (PMT No.) of the 51 accessions studied.

Acc. No. [1]	PMT No.	Origin	Acc. No.	PMT No.	Origin
1	3197	Baird, TX	28	1604	Okmulgee, OK
2	3198	Brackettville, TX	29	1616	Mayes Co., OK
3	3199	La Grange, TX	30	1605	Okmulgee, OK
4	3200	San Antonio, TX	31	1616	Noble Co., OK
5	3201	Fannin, TX	32	1607	Mayes Co., OK
6	823	Clarksville, TX	33	1609	Chandler, OK
7	1213	PMC, GA	34	1610	Chandler, OK
8	826	Crosbyton, TX	35	1611	Chandler, OK
9	827	Lufkin, TX	36	1612	Ada, OK
10	828	Croesbeck, TX	37	1613	Ada, OK
11	829	Rosenberg, TX	38	1614	Rush Springs, OK
12	830	Liberty, TX	39	1615	Noble Co., OK
13	833	Waco, TX	40	1617	Grant Co., OK
14	832	San Marcos, TX	41	1618	Wagoner Co., OK
15	831	Waxahatchie, TX	42	1619	Wagoner Co., OK
16	1466	PMC, KS	43	1620	Wagoner Co., OK
17	1588	Nowata, OK	44	1621	Talihina, OK
18	1589	Nowata, OK	45	1622	Talihina, OK
19	1590	Nowata, OK	46	1623	Texas Co., OK
20	1591	Waco, TX	47	1624	Texas Co., OK
21	1594	Woodward, OK	49	1626	Miami, OK
22	1598	Bryan Co., OK	50	1627	Leflore Co., OK
23	1599	Bryan Co., OK	51	1805	PMC, MS
24	1600	Pawhuska, OK	52	1806	PMC, MS
26	1602	Blaine Co., OK	53	824	Clarksville, TX
27	1603	Okmulgee, OK			

[1] Accession Nos. 25 and 48 failed to establish at time of planting.

RESULTS AND DISCUSSION

Thirty-eight of the accessions were diploids with 2n = 36 chromosomes. Eight accessions had more than 36 chromosomes and are presumed to be tetraploids (2n = 72), but an exact count was not possible due to the stickiness of the chromosomes, or to the multivalent associations present, or both. The chromosome number for 5 of the accessions was not determined because no meiotic stages could be found in the collected floral material. Chromosome number determination for the 51 accessions are given in Table 2.

The study of the method of reproduction indicated that all accessions produced a monosporic embryo sac, containing eight differentiated nuclei. This suggests normal sexual reproduction for all accessions but the possibility of apomictic reproduction in one or more of them, via the diplosporic mechanism, cannot be precluded without a detailed study of megasporogenesis. Among the accessions, entry numbers 23, 37 and 42 had a low percentage of spikelets containing a double pistil. The cause of "twin" pistils is not known.

Highly significant differences ($P < .01$) existed among the 51 accessions for all traits studied (Table 3). Means, ranges, standard deviations and CV's for the morphological and agronomic characteristics are given in Table 4.

All accessions survived the two exceptionally severe winters (76-77 and 77-78) following their planting. While there were only minor differences in the time that they began active spring growth, there were large differences in growth during the first 6 weeks of spring (Table 4, Fig. 1) and in regrowth vigor (Table 4, Fig. 2). This does not appear to be related to the latitude of their origin.

Percent IVDMD and percent DM averages for the four sampling dates showed significant differences ($P < .01$) due to entry, sampling date and entry by sampling date interaction (Table 3). The May 9, June 11 and July 11 sampling dates measured ontogenetic differences resulting from advancing age of the plants. The August 22 sampling was of 5 week old regrowth. Mean percent IVDMD decreased with advancing age of forage (67, 62, and 53% for the May 9, June 11 and July 11 sampling dates, respectively) in near linearity (Table 7). Mean IVDMD percentage for the 5 week old regrowth forage was only slightly higher than that of the July sampling date (56% vs. 53%), when most accessions were fully headed and at an advanced stage of maturity. Although, the significant first order entry by sampling date interaction indicates that the relative magnitude of differences in IVDMD among the accessions changed with time, it is encouraging that some accessions, e.g. 45 and 46, had high IVDMD percentages at all sampling dates. The frequency distributions of the accessions for IVDMD by sampling date are given in Table 5.

Mean percent DM (Table 1) was lowest at the first sampling date (39%), increased significantly by the second sampling date (51%), and stayed essentially the same during the period between the second and third sampling dates (52%). The frequency distributions of the accessions for DM by sampling date are given in Table 8.

There were large differences among the accessions in anthesis date ranging from 135 to 170 days from January 1, and they were rather uniformly distributed over this period of time (Fig. 3). Some of the accessions that reached anthesis earliest continued producing seed heads over a relatively long period and headed most profusely in early June, approximately 145 days from January 1.

In growth habit, the accessions varied from narrow to broad leafed types (Table 4, Fig. 4) and from relatively short, somewhat decumbent types, to tall more erect types (Table 4, Fig. 5). There were also visual differences in leaf coloration, more evident in summer and fall than in the spring, that appeared to be somewhat related to leaf morphology. The wider leafed types tended to remain green throughout the season whereas the more narrow leafed types assumed a bluish-green color in the summer and fall, particularly during periods of heat or drought stress, or both.

Fertility of the accessions, as indicated by percent seed set, was perhaps the most variable character studied and appeared to be related, at least partially, to chromosome number and meotic stability (Table 4, Fig. 6). The top 19 ranked accessions for percent seed set were diploids. Accessions with more than 2n = 36 chromosomes, and having sticky chromosomes, or multivalent associations, or both, generally had relatively poorer seed set, however, accessions 4, 14, and 22 were exceptions. If the species is to be used for agronomic purposes particular attention will have to be given to the seed yield potential of varieties in order to provide adequate quantities of seed for planting purposes.

None of the simple correlations computed for all combinations of the morphological and agronomic characters were significantly different from 0 (Table 9).

The agronomic potential of eastern gamagrass is dependent on many factors including principally, general level of forage nutritive value, ease and cost of stand establishment, competitive land use and management criteria required to sustain good productivity. While this study does not elucidate the agronomic potential of the species, the great variation found among the accessions for all traits is indicative of tremendous genetic variability within the species which might be manipulated in a breeding-selection program to produce agronomically desirable varieties.

Table 2. Chromosome numbers for the accessions.

Accession Number	2n Chromosome Number	Accession Number	2n Chromosome Number
1	> 36 †	28	36
2	not determined	29	36
3	36	30	36
4	> 36 †	31	36
5	36	32	36
6	36	33	36
7	not determined	34	36
8	36	35	36
9	> 36 †	36	36
10	36	37	36
11	36	38	36
12	not determined	39	36
13	36	40	not determined
14	> 36 †	41	36
15	36	42	36
16	36	43	36
17	36	44	36
18	36	45	36
19	36	46	36
20	36	47	> 36 †
21	36	49	36
22	not determined	50	> 36 †
23	36	51	> 36 †
24	36	52	36
26	36	53	> 36 †
27	36		

† Probable tetraploid (2n = 72).

Table 3. Mean squares from respective analysis of variance of the 8 agronomic and morphological characters.

Character	df	Accession MS	df	Sampling Date MS	df	Accession-Sampling Date Interaction MS
% IVDMD	50	101.69**	3	7595.44**	150	18.25**
% DM	50	49.89**	3	7017.13**	150	31.74**
% Seed Set	49	9829.02**				
Spring Vigor	50	9.08**				
Anthesis Date	49	907.78**				
Regrowth Vigor	50	5.57**				
Leaf Blade Width	50	50.78**				
Plant Height	50	663.29**				

**Statistically significant at the 0.01 level of probability.

Table 4. Means, ranges, standard deviations and CVs for the agronomic and morphological characters.

Character	Mean	Range	Standard Deviation	CV
% IVDMD	59.52	51.88 - 64.74	6.82	11.45
% DM	46.25	43.73 - 51.23	4.92	10.63
% Seed Set	54.82	0.59 - 90.00	24.09	43.94
Spring Vigor (rating 1-10)	5.79	1.25 - 8.75	2.08	35.94
Anthesis Date (days from Jan. 1)	144.59	135.00 - 169.75	9.25	6.40
Regrowth Vigor (1-10)	4.49	2.00 - 8.00	2.13	47.40
Leaf Blade Width (mm)	22.43	13.82 - 29.27	3.14	14.01
Plant Height (cm)	106.46	71.80 - 136.00	12.48	11.72

Table 5. In vitro dry matter digestibility of forage of the 51 accessions by and over sampling date. [1/]

Accession No.	May 9	Rank	June 11	Rank	July 11	Rank	Aug. 22	Rank	Avg.
	% IVDMD								
45	72.1	2	63.3	1	58.9	2	59.7	6	64.7
46	71.8	3	68.0	2	58.7	3	56.6	29	63.8
28	69.8	5	64.6	9	56.5	11	62.1	1	63.2
29	69.0	11	65.4	6	56.7	9	61.3	3	63.1
47	72.3	1	67.1	3	56.3	10	54.8	36	62.7
44	70.3	4	65.7	5	57.3	8	56.8	24	62.5
17	68.5	14	62.4	20	57.3	7	61.6	2	62.5
2	64.3	41	66.4	4	60.3	1	57.8	18	62.2
43	69.6	7	63.3	12	57.8	5	57.1	23	62.0
42	67.8	22	62.7	17	57.9	4	59.0	9	61.8
18	66.8	34	62.3	21	57.7	6	58.9	12	61.4
52	68.4	16	62.3	23	54.5	17	60.1	5	61.3
51	69.8	6	65.1	7	53.7	22	56.7	28	61.3
16	67.6	26	61.0	32	55.3	13	59.6	7	60.9
49	69.3	9	62.0	25	53.6	24	58.4	15	60.8
3	68.1	19	62.7	16	53.6	25	58.5	14	60.7
1	68.6	13	63.0	14	54.9	16	56.3	31	60.7
15	69.1	10	62.6	18	54.1	19	56.3	32	60.5
53	67.7	24	63.8	10	52.2	37	57.4	21	60.3
38	68.1	18	61.7	27	54.5	18	56.6	30	60.2
30	68.4	15	60.7	36	51.4	40	60.3	4	60.2
27	67.5	27	60.8	34	53.9	20	58.4	16	60.1
5	67.5	29	62.4	19	53.1	29	57.4	22	60.1
20	66.7	35	60.8	35	53.7	21	59.1	8	60.1
13	67.8	23	62.3	22	55.4	12	54.8	37	60.1
50	67.4	30	59.9	41	53.2	28	58.9	10	59.9
41	67.0	32	61.5	29	53.4	27	56.7	26	59.7
19	65.2	39	60.5	37	54.9	15	58.1	17	59.7
22	66.6	36	62.2	24	52.8	33	56.8	25	59.6

Table 5. Continued

Accession No.	May 9	Rank	June 11	Rank	July 11	Rank	Aug. 22	Rank	Avg.
	% IVDMD								
39	67.0	33	58.4	44	53.7	23	58.9	11	59.5
36	67.5	28	59.7	43	52.8	31	57.5	20	59.4
40	69.3	8	61.4	30	52.7	34	53.2	41	59.2
26	68.0	20	63.1	13	52.6	35	51.9	47	58.9
4	67.8	21	61.2	31	53.6	26	53.1	42	58.9
37	64.1	45	61.9	26	51.9	38	56.7	27	58.6
21	68.2	17	60.5	38	51.7	39	53.0	43	58.4
7	68.9	12	65.0	8	45.7	49	53.7	40	58.3
35	64.2	42	60.9	33	52.8	32	55.5	33	58.3
34	66.1	37	51.2	45	41.2	41	57.7	19	58.3
31	63.7	47	57.2	47	52.3	36	58.6	13	57.9
24	67.3	31	59.7	42	49.8	43	57.7	38	57.9
6	67.6	25	61.7	28	48.7	45	52.7	45	57.7
10	63.9	46	60.4	39	50.4	42	55.1	35	57.4
33	61.7	50	57.4	46	55.1	14	55.4	34	57.4
14	64.1	44	60.2	40	53.0	30	50.9	49	57.0
9	63.1	48	62.9	15	47.0	48	52.8	44	56.4
8	65.6	38	63.4	11	49.0	44	47.7	51	56.4
23	65.0	40	55.8	49	47.7	47	54.1	39	55.6
11	64.1	43	55.4	50	47.8	46	50.7	50	54.5
12	63.1	49	56.1	48	45.1	50	51.7	48	54.0
32	57.5	51	53.0	51	45.0	51	52.0	46	51.9
Avg.	67.1		61.7		53.2		56.3		59.5
Prob. > F	<.01		<.01		<.01		<.01		<.01
5% LSD	5.3		54		7.5		5.9		4.8
C.V. (%)	5.6		6.3		10.1		7.5		11.4

Sampling date[1]

[1] May 9, June 11 and July 11 samplings were from progressively older forage. The August 22 sampling was from 5 week old regrowth forage.

Table 6. Number of accessions by frequency classes, means, standard deviations and CVs from the four sampling dates for percent IVDMD.

Sampling Date	% IVDMD 45-50	51-55	56-60	61-65	66-70	71-75	Mean	Standard Deviation	CV
	No. of Accessions								
May 9	0	0	1	13	34	3	67.13	3.80	5.66
June 11	0	3	16	28	4	0	61.57	3.91	6.35
July 11	10	30	11	0	0	0	53.06	5.42	10.21
August 22	3	16	29	3	0	0	56.31	4.23	7.51
Average	0	3	34	13	0	0	59.52	6.82	11.45

Table 7. Dry matter percentage of forage of the 51 accessions by and over sampling dates. [1/]

Accession No.	Sampling date								Avg.
	May 9	Rank	June 11	Rank	July 11	Rank	Aug. 22	Rank	
	% IVDMD								
45	53.8	1	54.1	8	52.2	20	44.8	16	51.2
31	42.6	6	54.9	3	52.1	22	51.0	1	50.2
15	44.2	3	51.0	26	56.4	4	47.1	3	49.7
7	39.0	20	59.7	1	53.1	12	44.6	17	49.1
11	39.1	18	52.0	16	62.1	1	42.8	41	49.0
33	38.2	26	53.5	9	59.0	2	45.2	10	49.0
22	38.2	27	57.8	2	52.8	16	45.0	13	48.5
28	36.4	43	54.1	7	58.4	3	48.8	27	48.2
18	42.5	7	49.5	32	54.5	7	44.8	15	47.8
38	40.2	11	51.2	23	55.2	6	44.4	20	47.8
37	41.3	10	54.6	4	48.8	42	46.2	7	47.7
32	41.6	9	51.4	22	52.6	17	44.9	14	47.6
2	46.1	2	52.2	13	48.3	45	42.9	40	47.4
24	38.6	24	51.1	24	52.8	13	45.7	9	47.1
34	40.2	12	51.6	20	51.9	24	44.3	23	47.0
41	36.3	45	51.7	19	55.7	5	43.0	37	46.7
16	40.0	14	50.5	27	51.7	25	44.2	22	46.7
14	38.6	23	52.3	12	51.6	26	43.8	30	46.6
36	39.3	15	48.2	38	54.3	9	44.4	21	46.6
44	43.5	4	50.2	29	49.6	36	42.9	39	46.5
17	37.1	37	51.8	17	52.8	15	44.2	24	46.5
42	37.4	34	51.5	21	49.7	35	46.6	5	46.3
23	38.6	21	50.3	28	51.2	29	45.1	12	46.3
20	35.8	46	51.0	25	51.5	28	46.4	6	46.2
27	37.9	33	48.9	35	54.3	10	43.8	29	46.2
19	37.9	32	51.7	18	52.5	18	42.5	43	46.2
39	36.5	41	52.2	15	52.1	21	43.8	28	46.2
13	38.2	28	49.0	33	53.4	11	43.6	33	46.1

Table 7. Continued

Accession No.	Sampling date May 9	Rank	June 11	Rank	July 11	Rank	Aug. 22	Rank	Avg.
				% IVDMD					
12	39.0	19	54.3	6	49.9	33	40.5	51	45.9
29	34.8	51	52.3	11	54.5	8	42.0	44	45.9
30	43.4	5	47.5	40	48.5	44	43.9	26	45.8
40	35.1	48	54.4	5	49.2	40	44.5	19	45.8
6	39.3	16	52.2	14	45.3	48	45.2	11	45.5
35	39.3	17	46.0	49	52.2	19	44.2	25	45.4
43	40.0	13	45.7	50	49.3	39	45.9	8	45.3
52	37.2	35	47.5	42	52.8	14	43.3	36	45.2
10	36.5	42	49.8	31	50.2	32	42.8	42	44.8
49	38.4	25	47.6	41	48.8	43	44.5	18	44.8
50	37.1	38	47.4	43	50.9	30	43.7	31	44.8
26	37.2	36	47.9	39	45.2	49	48.2	2	44.6
5	42.4	8	47.1	47	48.1	47	40.8	50	44.6
46	34.9	50	50.0	30	49.8	34	43.4	35	44.5
3	35.7	47	48.6	36	52.0	23	41.7	46	44.5
47	38.1	29	47.3	44	48.9	41	43.5	34	44.3
9	38.1	30	53.0	10	44.8	50	41.5	48	44.3
53	35.0	49	48.9	34	51.6	27	41.2	49	44.2
51	38.6	22	46.4	48	48.1	46	42.9	38	44.0
8	36.8	40	48.2	37	44.2	51	46.8	4	44.0
21	38.0	31	43.6	51	50.3	31	43.6	32	43.9
1	36.9	39	47.2	46	49.6	37	41.7	47	43.9
4	36.4	44	47.2	45	49.4	38	41.9	45	43.7
Avg.	39.0		50.6		51.5		44.1		46.2
Prob. > F	<.01		0.23		<.01		<.01		<.01
5% LSD	7.0		—		6.9		3.6		3.4
C.V. (%)	12.8		11.5		9.5		5.8		10.6

1/ May 9, June 11 and July 11 samplings were from progressively older forage. The August 22 sampling was from 5 week old regrowth forage.

Table 8. Number of accessions by frequency classes, means, standard deviations and CVs from the four sampling dates for percent DM.

Sampling Date	% DM 31-35	36-40	41-45	46-50	51-55	56-60	61-65	Mean	Standard Deviation	CV
	No. of Accessions									
May 9	6	35	8	1	1	0	0	38.83	4.65	11.98
June 11	0	0	3	23	23	2	0	50.53	5.73	11.34
July 11	0	0	4	18	25	3	1	51.52	4.94	9.59
August 22	0	2	43	5	1	0	0	44.13	2.50	5.67
Average	0	0	23	27	1	0	0	46.25	4.92	10.63

Table 9. Simple correlation coefficients for all pairings of the 8 morphological and agronomic characters.

	Character							
	IVDMD (%)	DM (%)	Seed Set (%)	Spring Vigor	Anthesis Date (days)	Regrowth Vigor	Leaf Blade Width (mm)	Plant Height (cm)
% IVDMD								
% DM	0.06							
% Seed Set	-0.02	-0.08						
Spring Vigor	-0.17	0.05	0.11					
Antehsis Date	-0.07	0.12	-0.07	-0.11				
Regrowth Vigor	-0.08	0.02	0.03	0.38	-0.10			
Leaf Blade Width	-0.01	0.00	-0.02	-0.11	0.05	0.04		
Plant Height	-0.04	-0.09	0.05	0.28	-0.13	0.03	0.10	

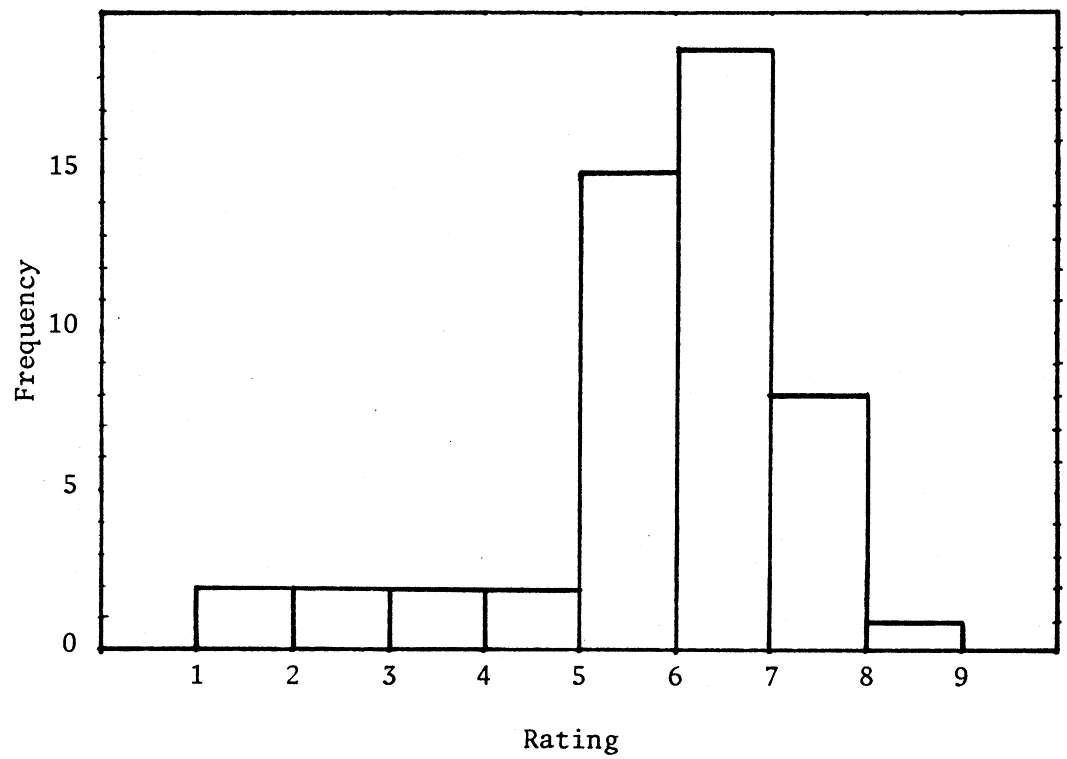

Figure 1. Frequency distribution observed in 51 accessions of eastern gamagrass for vigor of early spring growth using ratings of 1 (low) to 10 (high).

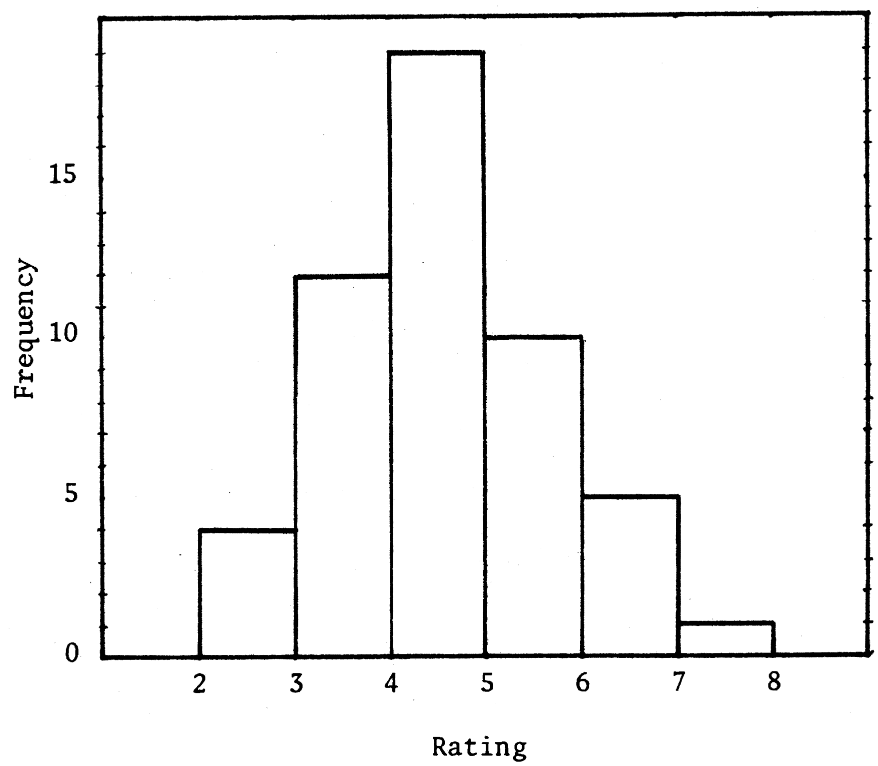

Figure 2. Frequency distribution observed in 51 accessions of eastern gamagrass for vigor of summer regrowth using ratings of 1 (low) to 10 (high).

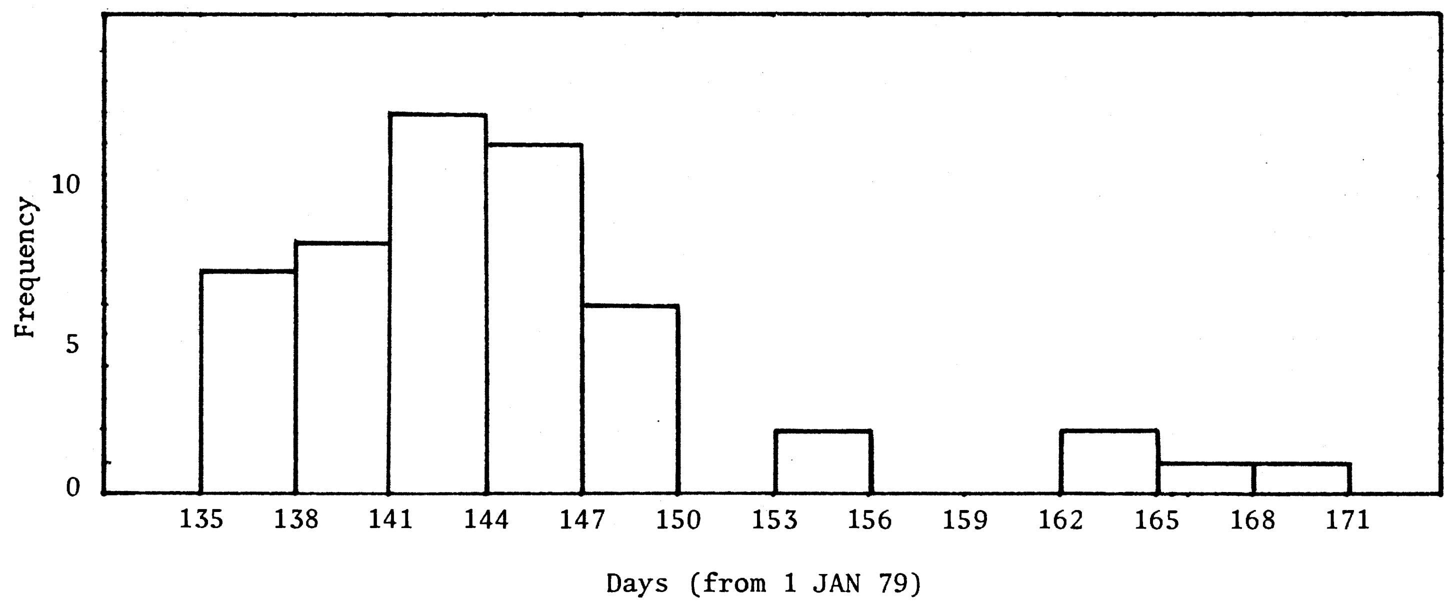

Figure 3. Frequency distribution observed in 50 accessions of eastern gamagrass for staminate anthesis date.

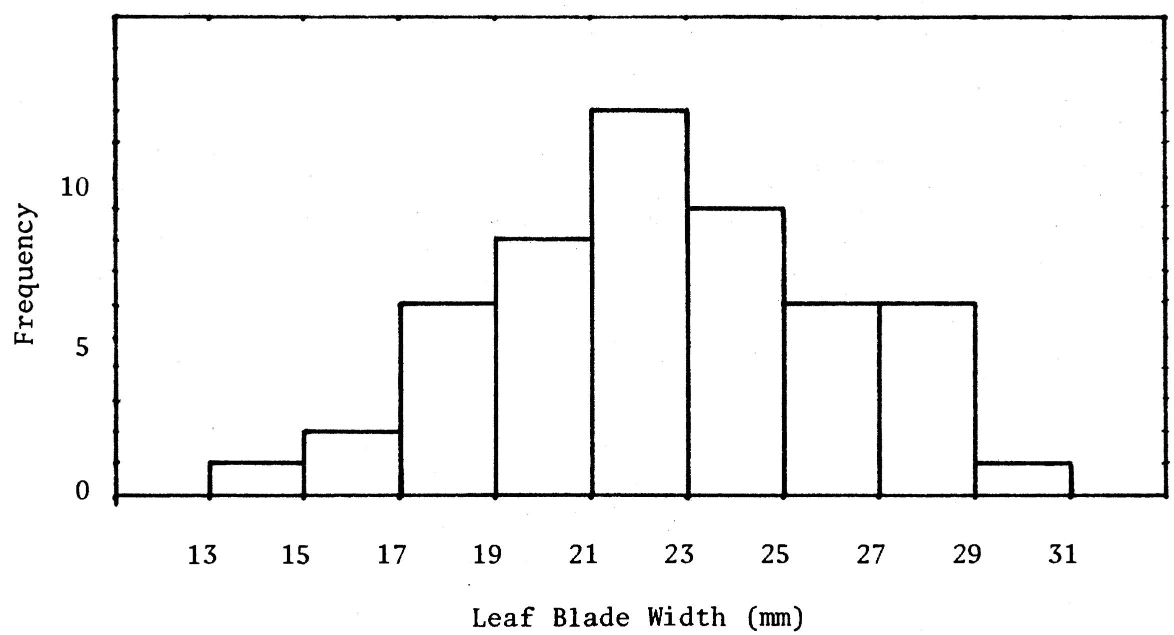

Figure 4. Frequency distribution observed in 51 accessions of eastern gamagrass for leaf blade width.

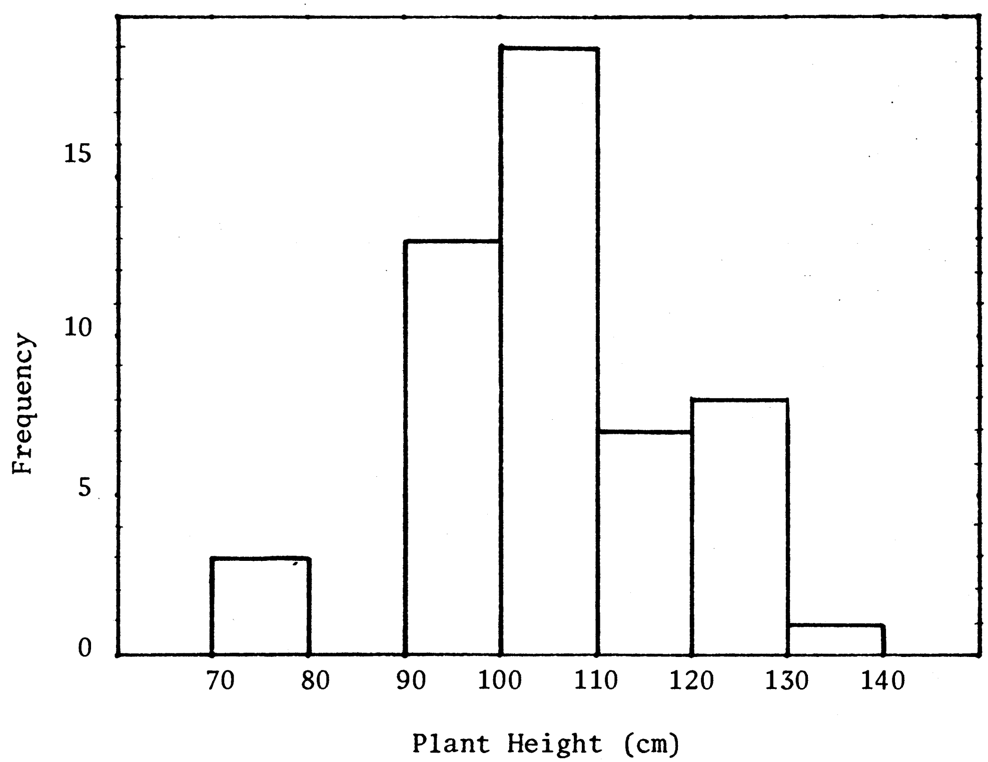

Figure 5. Frequency distribution observed in 51 accessions of eastern gamagrass for plant height.

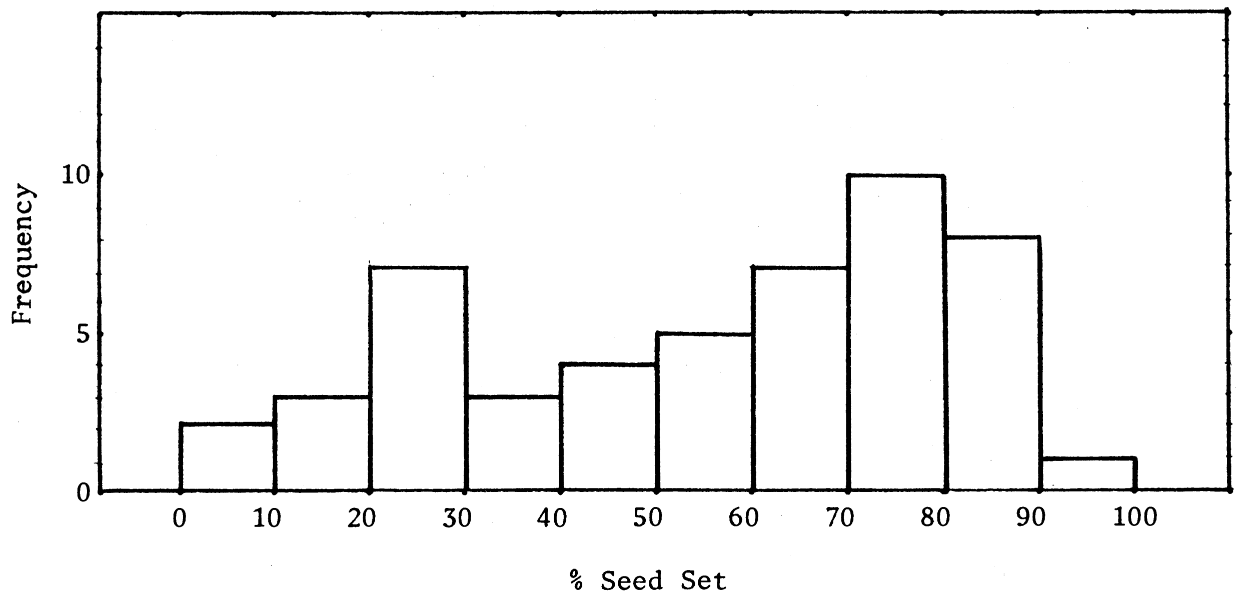

Figure 6. Frequency distribution observed in 50 accessions of eastern gamagrass for percent seed set.

REFERENCES

1. Ahring, R. M., and H. Frank. 1968. Establishment of eastern gamagrass from seed and vegetative propagation. J. Range Management 21:27-30.

2. Burton, G. W., J. C. Millot, and W. G. Monson. 1973. Breeding procedures for Panicum maximum Jacq. suggested by plant variability and mode of reproduction. Crop Sci. 13:717-720.

3. Day, B. E. 1978. The morality of agronomy. p. 19-27. In J. W. Pendleton (ed.) Agronomy in today's society. ASA Special Pub. No. 33.

4. Dewald, C. L. and V. H. Louthan. 1979. Sequential development of shoot system components in eastern gamagrass. J. Range Management 32:147-151.

5. Farquharson, L. I. 1955. Apomixis and polyembryony in Tripsacum dactyloides. Amer. J. Bot. 42:737-743.

6. Fucillo, D. A., and R. C. Dinauer (co-chairman). 1976. Handbook and style manual for ASA, CSSA and SSSA publications. Crop Sci. Soc. Amer., Madison, WI.

7. Mohamed, A. H. 1964. Plant cytological technique, a syllabus for genetics 685 (unpublished). Texas A & M University Plant Sciences Dept.

8. Newell, A. A., and J. M. de Wet. 1974. Morphological and cytological variability in Tripsacum dactyloides (Gramineae). Amer. J. of Bot. 61:652-664.

9. Phillips Petroleum Company. 1977. Pasture and range plants. Bartlesville, OK.

10. Polk, D. B., and W. L. Adcock. 1974. Eastern gamagrass. The cattleman. 50:83-85.

11. Tilley, J. M. A., and R. A. Terry. 1963. A two-stage technique for the *in vitro* digestion of forage crops. J. Brit. Grassl. Soc. 18:104-111.

A P P E N D I X

Table 10. Vigor of early spring growth means and ranges for the 51 accessions.

Accession	Mean	Range	Accession	Mean	Range
32	8.8	7-10	23	6.0	5- 7
1	7.5	7- 8	30	6.0	5- 7
29	7.5	6- 9	12	5.8	4- 8
6	7.3	7- 8	37	5.8	5- 6
10	7.3	6- 9	21	5.5	4- 7
20	7.3	6- 9	27	5.5	4- 6
3	7.0	5-10	31	5.5	5- 6
15	7.0	6- 8	40	5.5	4- 7
24	7.0	6- 8	41	5.5	4- 7
4	6.8	6- 7	11	5.3	3- 7
13	6.8	6- 7	33	5.3	4- 6
34	6.8	6- 9	38	5.3	4- 6
52	6.8	6- 7	46	5.3	4- 6
14	6.5	6- 7	47	5.3	4- 6
16	6.5	5- 9	8	5.0	5- 5
17	6.5	6- 8	26	5.0	4- 6
19	6.5	6- 7	35	5.0	4- 7
22	6.5	6- 7	43	4.8	3- 6
28	6.5	5- 8	5	4.5	4- 5
18	6.3	6- 7	9	3.8	2- 5
36	6.3	5- 7	51	3.3	3- 4
39	6.3	6- 7	2	2.8	1- 5
42	6.3	5- 8	7	2.3	1- 3
49	6.3	5- 7	44	1.3	1- 2
50	6.3	4- 8	45	1.3	1- 2
53	6.3	5- 7			
Avg.	4.49				
Prob > F	<0.01				
5% LSD	1.49				
CV (%)	47				

Table 11. Vigor of summer regrowth means and ranges for the 51 accessions.

Accession	Mean	Range	Accession	Mean	Range
5	8.0	6-10	19	4.5	3- 5
12	6.8	5-10	2	4.5	3- 6
1	6.3	5- 7	16	4.3	4- 5
29	6.3	5- 7	28	4.3	4- 5
3	6.3	5- 7	37	4.3	4- 5
11	6.0	4- 8	31	4.3	3- 5
32	5.8	5- 6	17	4.0	4- 4
13	5.8	5- 8	36	4.0	3- 5
6	5.5	4- 7	27	4.0	3- 5
10	5.5	5- 7	18	3.8	3- 4
15	5.3	4- 6	30	3.8	3- 5
39	5.3	4- 7	33	3.8	3- 4
7	5.3	4- 6	35	3.8	3- 4
4	5.0	4- 6	42	3.5	2- 4
50	5.0	4- 6	46	3.5	2- 4
23	5.0	4- 6	45	3.5	2- 4
20	4.8	4- 6	34	3.3	2- 4
24	4.8	3- 8	49	3.3	3- 4
14	4.8	4- 6	21	3.3	3- 4
22	4.8	3- 7	40	3.0	2- 4
53	4.8	4- 6	8	3.0	2- 4
41	4.8	4- 6	51	2.8	2- 3
43	4.8	4- 7	47	2.5	2- 3
9	4.8	4- 6	26	2.5	2- 3
44	4.8	3- 7	38	2.0	1- 3
52	4.5	4- 5			
Avg.	4.49				
Prob > F	<0.01				
5% LSD	1.50				
C.V. (%)	24				

Table 12. Staminate anthesis date means and ranges for 50 accessions. 1/

Accession	Mean	Range	Accession	Mean	Range
7	169.8	163-172	20	143.0	143-143
5	167.3	162-169	6	143.0	143-143
44	162.3	143-178	16	142.8	142-143
45	162.0	147-183	46	142.0	135-147
3	153.5	150-156	35	141.3	136-143
9	153.3	143-162	15	141.3	136-143
41	149.8	147-154	42	141.3	136-143
11	149.3	149-150	43	141.3	136-143
39	148.8	147-150	37	141.0	135-143
52	148.0	147-149	24	141.0	135-143
50	147.8	143-150	19	139.5	136-143
8	147.0	143-149	36	139.5	136-143
13	146.3	144-147	23	139.5	136-143
51	146.0	143-147	34	139.5	136-143
47	146.0	143-147	49	139.3	135-143
1	146.0	143-149	17	139.3	135-143
14	145.5	143-149	27	139.3	135-143
26	144.5	140-147	30	139.0	135-143
40	144.5	143-149	28	137.8	136-143
10	144.3	143-147	32	137.8	136-143
4	144.0	143-147	18	137.5	135-143
21	144.0	143-147	29	137.5	135-143
38	144.0	143-147	31	135.8	135-136
53	143.5	143-144	33	135.3	135-136
12	143.3	143-144	22	135.0	135-135
Avg.	145				
Prob. > F	<.01				
5% LSD	6.5				
CV (%)	6.4				

1/ Accession number two deleted from statistical analysis since it produced no seed heads.

Table 13. Leaf blade width means and ranges for the 51 accessions.

Accession	Mean	Range	Accession	Mean	Range
52	29.3	26.8-30.5	14	22.3	22.0-22.9
41	28.4	26.5-30.3	4	22.3	21.0-23.4
50	28.3	26.6-30.6	2	21.9	20.0-23.7
7	28.1	26.7-30.8	16	21.6	20.6-22.4
13	27.3	26.0-28.3	49	21.4	20.4-23.3
9	27.3	26.9-27.6	30	21.1	19.5-24.9
10	27.2	28.4-28.4	15	21.1	19.6-22.8
53	26.8	26.0-27.4	20	21.1	19.6-22.4
5	26.4	24.4-28.9	18	20.8	19.6-21.4
8	25.8	24.4-26.9	19	20.4	18.5-21.6
3	25.6	23.8-27.3	24	20.4	19.3-22.3
46	25.4	23.6-27.0	32	20.2	19.1-20.8
51	25.3	23.4-27.1	17	20.1	19.1-21.8
47	24.7	23.9-28.4	27	19.7	16.9-22.3
40	24.5	22.6-26.3	28	19.3	17.0-20.9
44	24.3	21.3-26.5	37	19.1	18.5-19.9
26	23.8	23.3-24.6	12	18.6	18.1-19.4
29	23.7	21.5-25.0	31	18.6	17.9-19.5
11	23.4	22.1-24.3	33	18.3	17.0-19.3
21	23.2	15.1-27.4	35	17.8	17.4-18.8
1	23.2	22.1-24.4	43	17.5	16.4-18.4
39	23.2	22.3-24.0	34	17.1	14.9-18.4
45	22.9	16.8 27.0	36	16.9	16.0-18.0
42	22.8	22.8-22.9	22	16.2	15.1-17.9
6	22.7	21.5-24.1	23	13.8	12.4-16.0
38	22.6	21.5-23.0			
Avg.	22.4				
Prob > F	<.01				
5% LSD	2.2				
CV (%)	7				

Table 14. Plant height means and ranges for the 51 accessions.

Accession	Mean	Range	Accession	Mean	Range
39	136.0	127.8-150.8	6	105.2	101.9-108.5
52	127.9	118.4-132.8	38	102.8	98.4-111.3
50	127.3	121.6-133.4	31	102.5	100.0-108.5
41	125.8	120.4-132.3	19	102.5	101.4-103.4
10	125.6	121.8-129.8	28	102.2	97.1-108.3
3	124.7	119.9-129.5	9	101.8	94.1-109.0
53	124.5	110.1-138.8	49	101.4	91.4-108.1
32	122.0	121.0-123.5	40	101.2	93.1-108.0
5	120.0	95.0-133.5	42	101.1	99.3-106.0
13	117.8	115.3-120.8	36	99.0	88.5-105.0
1	117.4	111.3-124.6	21	99.0	93.3-104.9
29	114.9	108.5-122.1	43	98.9	95.0-106.3
4	111.1	103.8-117.8	47	98.6	95.0-102.1
16	110.8	109.8-111.5	37	98.2	95.4-101.6
17	110.6	108.8-115.3	8	97.7	95.4-100.9
15	110.4	107.3-115.0	26	97.0	90.8-104.5
14	109.6	107.8-110.6	18	97.0	85.6-103.9
11	109.4	103.6-115.5	34	96.4	94.0- 98.8
24	108.7	102.5-113.0	33	96.0	80.1-105.0
23	107.4	99.1-110.4	22	93.3	89.5- 98.4
20	107.3	101.0-114.5	46	93.2	90.9- 93.9
7	105.9	95.4-111.8	51	90.2	88.3- 91.9
27	105.8	101.6-111.3	44	78.9	73.4- 84.3
35	105.8	98.4-115.9	2	78.6	63.0- 94.7
12	106.5	87.0-114.3	45	71.8	57.0-80.6
30	105.3	98.0-109.5			
Avg.	105.9				
Prob > F	<.01				
5% LSD	9.1				
CV (%)	6.14				

Table 15. Percent seed set means and ranges for 50 accessions. [1]

Accession	Mean	Range	Accession	Mean	Range
19	90.0	84.0- 94.0	11	60.5	50.0- 72.0
16	89.5	88.0- 92.0	32	59.5	32.0- 90.0
37	86.0	70.0-100.0	42	59.5	36.0- 88.0
29	85.5	78.0- 96.0	41	59.0	38.0- 74.0
24	84.0	68.0- 92.0	15	56.5	36.0- 80.0
36	83.0	72.0- 96.0	3	54.0	48.0- 66.0
17	82.0	76.0- 94.0	12	46.0	34.0- 56.0
27	80.3	75.0- 86.0	49	46.0	30.0- 66.0
31	80.0	72.0- 90.0	53	43.5	30.0- 56.0
23	78.5	70.0- 88.0	21	40.0	22.0- 74.0
39	75.5	74.0- 84.0	1	39.5	16.0- 52.0
20	75.0	66.0- 82.0	8	37.0	24.0- 50.0
18	74.5	84.0- 96.0	13	36.0	14.0- 54.0
30	72.5	62.0- 84.0	5	28.0	18.0- 38.0
35	72.5	56.0- 82.0	26	28.0	20.0- 38.0
33	72.0	56.0- 88.0	52	25.5	8.0- 56.0
34	71.0	54.0- 82.0	44	24.9	0.0- 41.7
28	70.0	54.0- 78.0	10	24.0	16.0- 30.0
50	70.0	62.0- 78.0	40	24.0	10.0- 40.0
22	69.0	60.0- 80.0	47	21.0	16.0- 28.0
14	64.5	52.0- 74.0	46	18.4	7.4- 22.0
4	64.0	56.0- 72.0	45	15.3	0.0- 32.0
6	62.0	48.0- 76.0	51	12.0	2.0- 24.0
38	62.0	44.0- 82.0	9	4.0	0.0- 10.0
43	62.0	50.0- 82.0	7	0.6	0.0- 2.4
Avg.	54.8				
Prob > F	<.01				
5% LSD	16.8				
CV (%)	44				

[1] Accession number two deleted from statistical analysis since it produced no seed heads.

Table 16. Number of seed stalks per plant for the 51 accessions. July 9-12, 1979. 1/

Accession	Rep.	Average no. of Stalks/plant	Accession	Rep.	Average no. of Stalks/plant
1	1	40.3	26	1	49.0
2	1	0.0	27	1	49.7
2	2	0.0	28	1	70.0
2	3	0.0	29	1	61.0
3	1	72.3	30	1	56.3
4	1	75.0	31	1	53.0
5	1	25.0	32	1	75.7
6	1	35.7	33	1	46.3
7	1	7.3	34	1	93.3
8	1	67.7	35	1	41.0
9	1	19.7	36	1	55.7
10	1	51.7	37	1	41.7
11	1	31.7	38	1	52.7
12	1	43.3	39	1	49.0
13	1	29.3	40	1	71.7
13	3	70.7	40	4	58.0
14	1	64.3	41	1	84.3
15	1	75.0	42	1	58.7
16	1	83.7	43	1	3.0
17	1	41.7	43	4	43.0
18	1	48.0	44	1	31.0
19	1	41.3	45	1	0.3
20	1	55.7	46	1	53.7
21	1	86.7	46	2	74.3
22	1	57.7	47	1	65.3
23	1	21.3	49	1	54.7
24	1	61.0	50	1	62.3
24	2	67.7	50	3	79.0

1/ Average of three plants. Only one replication counted.

VITA

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