THE PRODUCTION OF SORGHUM-SUDANGRASS HYBRIDS THROUGH THE USE OF CYTOPLASMIC MALE STERILITY IN SORGHUM

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Experiments were designed to produce sorghum-sudangrass hybrid forage by utilizing male sterile lines of sorghum. Sorghum male sterile lines, Redland, 802, KS4 and Kafir and four varieties of Sudangrass, 9580, 4158, 58 and local were utilized for evaluation of the combining ability and heterotic studies. The parental lines showed distinct combining behaviour and the hybrid offered promise by exhibiting heterosis in forage yield components. The sorghum varieties, Redland, KS4 and 802 showed better combining ability with sudangrass types 4158, 58 and 9580. The hybrids between Redland and 4158 showed that they are the best combiners for forage yield.

INTRODUCTION

In West Pakistan, 10-12 per cent of the total cultivated area is put under fodder crops. However, the quantity of fodder falls short of the actual requirements especially in summer months. Sorghum is a popular summer fodder, which gives high yields of palatable, soft and leafy forage. Sudangrass another fodder crop, is a close relative of sorghum which gives profuse tillering and at least double the quantity of green fodder as compared to the sorghum. Some proliminary studies on the hybridization between sorghum and sudangrass gave encouraging results and attempts were made to combine the sorghum characters, sweet and juicy stalk, soft and leafy forage and resistance to bacterial diseases with the growth habit and production of common sudangrass. The possibility of commercial utilization of F_1 heterosis now seems practicable with the discovery of cytoplasmic male sterile lines of sorghum.

Lueschen (1968) observed that the sorghum-sudangrass hybrid SX 11, out-yielded sudangrass variety Piper, when harvested at a height exceeding 122 cm or at the heading stage. While working on sorghum-sudangrass hybrids, Bhatti *et al.* (1957) observed that the hybrids had higher growth rate, plant height and leaves per plant than the better parent. Khan and Ali (1965)

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by the use of cytoplasmic male sterile lines of sorghum produced hybrids which were quick-growing and possessed better tillering capacity.

The present studies aimed at determining the extent of hybrid vigour manifested in different plant characters in crosses involving sorghum male sterile lines and sudangrass varieties.

MATERIALS AND METHODS

The studies reported in this paper were made in square No. 43 of West Pakistan Agricultural University, Lyallpur. The parental lines comprising four varieties of Sudangrass and four varieties of Sorghum and their hybrids were sown in triplicated randomized blocks. The Sudangrass and Sorghum varieties included in the plan were Sudangrass : 9580, 58, 4158 and Local; and Sorghum male sterile lines Redland, Kafir, 802 and KS4.

Observations on plant height, stem thickness, number of tillers, number of leaves, leaf area, and green weight per plant in respect of the parental lines of Sorghum and Sudangrass and their hybrids were taken. Fortnightly growth rate was observed. However, the growth reached after 75 days of sowing has been mentioned in this paper. The stem thickness was measured in cm by the help of vernier caliper at 3 places on the stem. The average was noted. The number of leaves were counted to obtain the total number of leaves. Leaf area was calculated by measuring the length and breadth of the leaf and multiplying it with the factor 0.747 as suggested by Stickler *et al.* (1961). The number of tillers were counted taking into account all the basal shoots. The green weight of the plant was obtained in ounces when the plants reached height at 125 cms.

The data with respect to these characters of the parental lines and their hybrids were analysed by the analysis of variance.

RESULTS AND DISCUSSIONS

The F values in respect of the characters of the parental lines and their hybrids are summarized in Table 1. It clearly indicated that the F values in respect of all the characters studied are highly significant indicating significant differences among parental lines and their hybrids.

The performance of the parental lines and their hybrids for different characters studied are summarized in Table 2.

Height of the Plant.—The height of the plant 75 days after planting showed highly significant differences (Tables 1 and 2). Sorghum male sterile lines were shorter in stature as compared with sudangrass parental lines. The hybrids

TABLE 1.—*F values in respect of the characters of the parental lines and their hybrids.*

Due to	D.F.	F values in respect of the characters/plant					
		Plant height	Stem thickness	Tillering capacity	Number of leaves	Leaf area	Green weight
Blocks	2						
Varieties	23	28.32**	12.09**	21.78**	45.89**	5.07**	96.76**
Errors	46						
Total	71						

**Significant at 1% level.

of sorghum 802, KS4 with sudangrass 58, 4158 and 9580 gave the greater heights as compared with the remaining parents and hybrids. The hybrid between sorghum 802 and sudangrass 58 gave the maximum height.

Stem Thickness.—Sorghum parental lines have greater stem thickness as compared with the sudangrass parents. The hybrids between sorghum parental lines Redland, Kafir and 802 with sudangrass 4158, local, 9580 and 58 respectively gave greater stem thickness. Among these the highest stem thickness was obtained from a cross of Redland and sudangrass 4158.

Number of Tillers.—It is a well known fact that sudangrass has greater tillering capacity than the sorghum male sterile lines. It is quite evident from Table 2 that sudangrass local, 4158 and 58 respectively gave the highest tillering capacity. It further indicated that the hybrids Redland × 4158, KS4 × 4158, 802×4158 and Kafir × 4158 gave the greater number of tillers than the remaining parental combinations and sorghum parents.

Number of Leaves.—The hybrids between sorghum KS4, 802 and Redland with sudangrass 4158, 58, local and 9580 produced greater number of leaves as compared with the remaining parental lines and hybrids. The hybrid between sorghum KS4 and sudangrass 4158 produced the maximum leaves.

Leaf Area.—A thorough look into the results presented in Table 2 pointed out that the hybrids between sorghum parent KS4, Redland, 802 and Kafir with sudangrass 58, 4158 and local gave higher leaf area. Among these the hybrid between KS4 and 58 showed greater potential for leaf area.

Green Weight.—The green weight per plant is considered to be the most important character for forage yield. It is also well established that the sudangrass is high yielder as compared to sorghum. A close observation of Table 2 revealed that crosses between Redland and 4158, 802 and 58; and KS4 and 4158

TABLE 2.—*The performance of the parental lines and their hybrids for different characters.*

	Green Weight (Ounces)	No. of Tillers	Stem Thickness (cm)	Plant Height (cm)	Number of Leaves	Leaf Area (cm)
Redland × 4158 ..	65.1	10.0	2.7	134.0	11.8	457.64
802 × 58 ..	57.7	5.4	2.5	167.0	12.5	397.41
KS4 × 4158 ..	48.6	77.5	2.3	148.0	12.7	411.57
Sudangrass 58 ..	40.2	10.0	1.5	142.6	9.3	343.83
Sudangrass Local ..	40.1	16.7	1.1	100.0	9.7	137.64
Sudangrass 9580 ..	39.1	7.8	1.4	141.2	10.5	267.14
KS4 × Local ..	34.6	4.4	2.5	124.6	10.4	414.95
Sudangrass 4158 ..	33.6	13.2	1.1	126.1	9.7	231.69
KS4 × 58 ..	27.3	2.7	2.2	164.8	10.6	474.66
Redland × Local ..	27.0	4.3	1.9	123.1	10.7	297.47
802 × 4158 ..	26.3	5.9	2.2	106.4	8.7	372.46
Sorghum KS4 ..	26.1	1.8	2.1	93.6	10.4	266.74
KS4 × 9580 ..	23.3	4.7	2.0	125.8	10.7	324.12
802 × 9580 ..	21.6	4.5	2.4	140.2	10.4	320.39
Redland × 9580 ..	19.6	4.1	2.0	109.0	8.9	168.62
Kafir × 4158 ..	18.9	5.6	2.4	115.9	9.7	309.02
Kafir × 9580 ..	18.8	5.4	2.6	82.9	10.2	214.52
Sorghum 802 ..	18.6	1.6	2.0	98.3	9.6	239.17
Sorghum-Kafir ..	15.9	3.6	2.0	105.4	9.6	402.21
Kafir × Local ..	13.4	3.6	2.6	70.5	8.5	370.69
802 × Local ..	12.4	3.3	2.3	95.1	9.7	168.55
Kafir × 58 ..	10.0	3.6	2.2	65.4	9.6	297.68
Redland × 58 ..	9.4	2.5	2.1	75.0	9.3	329.45
Sorghum Redland ..	6.0	3.0	1.9	64.3	8.5	230.51
LSD at 5% ..	4.24	2.63	0.34	16.30	0.97	111.90
LSD at 1% ..	5.65	3.49	0.45	21.70	1.29	155.70

gave the highest green fodder yield respectively indicating significant differences as compared with the remaining parental lines and hybrids.

The results of the present study confirm the conclusions already reported by Luescher (1968), Bhatti *et al.* (1957) and Khan and Ali (1965) that hybrid vigour is manifested in crosses between sorghum and sudangrass. Furthermore, it is emphasized that the sorghum male sterile lines can serve

useful purpose in obtaining the hybrid vigour on commercial scale. The sorghum varieties Redland, KS4 and 802 showed better combining ability with sudangrass types 4158, 58 and 9580. The hybrids between Redland and 4158, KS4 and 58; and 802 and 58 proved best combiners for forage yield and stem thickness, number of leaves, leaf area and height of the plant respectively.

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