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Diallel Analysis of Forage Yield and its Components in Sorghum

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The genetic analysis was carride out for green fodder yeild and other eight quantitative characters in forage sorghum. The material consisted of seven forage sorghum varieties and their 21 F_1 Crosses. Both additive and non-additive components of genetic variance were contributing in the control of yield and other quantitative traits. Additive genetic variance was predominant for number of tillers and number of leaves while non-additive for days to flowering, plant height, leaf length, leaf width, flag leaf area, green fodder and dry matter yield per plant. To get significant genetic advance exploitation of both additive and non-additive part of genetic variance was suggested by following appropriate recurrent selection procedures.

Sorghum (*Sorghum bicolar* (L) Moench) is a food as well as a forage crop in the country. The present day varieties are poor in forage yield and low in quality. In order to develop sorghum varieties possessing high green forage yield and good nutritional quality systematic breeding approach is desirable. To know the genetic architecture of the material used will be of great help for an efficient planning of breeding methodology. Diallel analysis techniques of Jink and Hayman (1953) and Hayman (1954) will provide information on the genetic make up of the parents used. In the present study, therefore, seven released varieties of sorghum were crossed in a diallel system to collect genetic information.

MATERIAL AND METHODS

Seven promising parents, viz., S 1049, SSG 59-3, MP Chari, SL 44, C 10-2, PC 1 and PC 6 and their 21 F_1 crosses (without reciprocals) were grown in a randomized block design with three replications. The rows were 3 meter in length having 30 cm distance between rows and 10 cm within rows. Observations were recorded on five randomly selected plants in each plot on nine quantitative characters, i.e. days to flowering, plant height, number of tillers, number of leaves, leaf length, leaf width, flag leaf area, green fodder yield per plant and dry matter yield per plant.

Genetic parameters were estimated according to the method proposed by Jinks and Hayman (1953) and Hayman (1954).

RESULTS AND DISCUSSION

The analysis of variance revealed high significant differences among the entries for each of the nine traits under study (Table 1). Estimates of the genetic variance for all the characters are presented in Table 2. Non-significant t^2 values for all the nine characters suggested validity of all the assumptions as emphasized by Hayman (1954) underlying diallel analysis.

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Days to flowering: The additive genetic variance (D) was less than that due to dominance (H_1) and the degree of dominance ratio was 1.21 thereby suggesting that dominance component was making a major contribution to the expression of this character even though both were equally important. The mean level of dominance was in the over dominance range. The KD/KR was 1.48 indicating that the dominant alleles were more than the recessives. This was further confirmed by the positive value of F. The values of H_1 and H_2 differed, thereby, suggesting the presence of unequal allelic frequencies.

Plant height: The value of H_1 was 4.83 times more than that of D indicating that dominance component was making a major contribution in the expression of this character. The value of $(H_1/D)^{0.5}$ was 2.20 suggesting over dominance. Preponderance of positive alleles was indicated. The values of H_1 and H_2 differed widely thereby, suggesting unequal allelic frequencies. The values of 0.43 for $H_2/4H_1$ was more than that can be theoretically expected and may be dueto experimental bias.

Number of tillers: The additive genetic variance was slightly higher than dominance component. The value of $(H_1D)^{0.5}$ was 0.81 indicating the presence of partial dominance. Presence of unequal gene frequencies was evident. Predominance of dominent alleles was indicated by positive value of F. The environmental influence was also evident.

Leaf characters: The leaf characters included in the study were number of leaves, leaf length, leaf width and flag leaf area. The non-additive component (H_1) was more than the additive (D) for the characters leaf length, leaf width and leaf area. The degree of dominance was 0.79 for number of leaves indicating partial dominance while it was 1.71, 1.79 and 3.80 for leaf length, leaf width and flag leaf area respectively showing that the mean degree of dominance was in the over dominance range. The expression F was positive for number of leaves and leaf length and negative for leaf width and flag leaf area indicating an excess of dominant alleles for the former two characters and excess of negative for the latter two traits. This was further supported by the KD/KR ratio which was more than unity for leaf number and leaf length but less than unity for leaf width and leaf area.

Green fodder and dry matter yield: The additive genetic variance (D) was less than that due to dominance (H_1) and the ratio $(H_1/D)^{0.5}$ was 1.68 and 1.70 respectively for green fodder and dry matter yield thereby indicating that dominance component was the major contributor in the expression of these two traits and the mean level of dominance was in the over dominance range. The values of H_1 and H_2 differed suggesting the presence of unequal allelic frequencies F value was negative for green fodder yield and positive for dry matter yield indicating excess of recessive alleles in former and dominant in the latter case. This was further confirmed by the ratio of dominant alleles to recessives which was 0.94 and 10.1 respectively for green godder and dry matter yield. The influence of environment (E) was non-significant.

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The date presented indicates that fodder yield and its components, i. e. plant height, leaf length, leaf width and leaf area are guided more by non-additive genetic variance, although the additive portion was also present. Two yield components that is, number of tillers and number of leaves showed preponderance of additive genetic variance but the presence of sufficiently large non-additive genetic variance was also shown. Similar results were also obtained by Kukadia and Singhania (1980). It, therefore, appeared from the present investigation both additive genetic and non-additive were important and as such reciprocal recurrent selection procedure would lead to significant genetic advance.

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TABLE 1. Analysis of variance of 7+7 diallel cross of nine quanititative characters studied.

Source	d.f.	Mean squares								
		Days to flowering	Plant height	Number of tillers	Number of leaves	leaf length	Leaf width	Flag leaf area	Green fodder yield/plant	Dry matter yield/plant
Replication	2	8.46	415.25	0.06	0.05	3.25	2.09**	1740.55	604.50	8.23
Genotypes	27	72.90**	2970.61	0.88**	42.18**	102.13**	3.49**	5928.36**	17704 63**	1275.17**
Parents	6	104.10**	2139.99**	3.35**	125.18**	114.25**	2.73**	2048.21**	14712.48**	1148 58**
Hybrids	20	54.25**	2922.44**	0.09*	13.33**	93.91**	3.80**	6894.85**	19411.60**	1347.82**
Parent vs. Hybrid	1	204.49**	8917.81**	2.00**	119.32**	193,67**	1.67**	9879.54**	1518.08	581.78
Error	54	2.91	707.84	0.05	3.40	6.67	0.33	708.69	714.12	136.19

* Significant at 5% level.

** Signfiicant at 1% level.

TABLE 2 Estimates of genetic components of variation of nine characters of forage sorghum

Paraments		Days to flowering	Plant height	Number of tillers	Number of leaves	Leaf length	Leaf width	Flag leaf area	Green fodder yield/plant	Dry matter yield/plant
D		33.68	480.91	1.10	40.63	35 80	0.78	434.16	4667.57	339.03
	±	6.74	155.84	0.06	2.44	9.48	0.29	745.58	1607.60	168.92
H_1		49 63	2326.93	0.72	25.70	105.22	2.51	6260.69	13113.65	984 25
	±	16.21	375.19	0.14	5.87	22.83	0.69	1794.87	3870.04	406.65
H_2		38.13	1680.24	0.46	16.70	81.43	2.20	5184.21	9668.72	746.98
	±	14.29	330.59	0.12	5.18	20,12	0.61	1581.54	3410.07	358.32
F		15.80	45.40	1.20	36.16	29.22	-0.37	-329.75	-502.54	5.37
	±	16.16	373.85	0.14	5.85	22.75	0.69	1788.49	3858.28	405.20
h^2		37.69	12331.78	0.08	21.75	37.13	0.26	1722 12	167.65	87.07
	∓	9.60	222.04	0.08	3.48	13.51	0.41	1062.22	2290.33	240.66
E		1.04	232.47	0.02	1.09	2.38	0.13	248.51	236.74	43.87
	±	2.38	55.13	0.02	0.86	3.36	0,10	263.72	568.62	59.75
$(H_1/D)^{0.5}$		1.21	2.20	0.81	0.79	1.71	1.79	3.80	1.68	1.70
$H_2/4H_1$		0.91	0.43	0.18	0.16	0.17	0.19	0.22	0.18	0.19
KD/KR		1.48	1.00	5.16	1.56	1.63	0.75	0.82	0.94	1,01
t^2		0.29	0.76	0.11	0.16	0.09	2.98	2.98	3.46	5.25