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Variability and inbreeding depression studies in segregating population of pearl millet [*Pennisetum glaucum* (L.) R. Br.] for dual purpose

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ABSTRACT

An evaluation was undertaken to study the breeding value of the F_2 population of six crosses (IP 20381 x PT 5665, IP 20381 x GP15071, IP 20381 x IP 19125, IP 20381 x IP20350, IP 20334 x IP 20350 and IP 19125 x GP 16239). Mean performance, variability, heritability, genetic advance and inbreeding depression were estimated for stover cum grain yield and six associating traits *viz*., plant height (cm), number of tillers per plant, number of productive tillers per plant, number of leaves per plant, leaf length (cm) and panicle length (cm). The results revealed that the cross IP 20381 x IP 19125 was found suitable for fodder improvement, IP 20334 x IP 20350 for grain improvement and IP 20381 x GP 1507 for dual purpose. The high estimates of heritability and genetic advance for almost all characters indicated the presence of additive gene action and hence selection for these traits could be effective in improving stover and grain yield of pearl millet.

Key words : Pearl millet, variability, heritability, genetic advance, inbreeding depression, dual purpose

INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.) R. Br.]is a staple diet for the vast majority of poor farmers and also forms an important fodder crop for livestock population in arid and semi arid regions of the country. Though it has dual utility value, breeding in the past was mainly concerned with increasing its grain yield but fodder aspect was considered as secondary (Suthamathi and Stephan Dorairaj, 1995). So now emphasis is increased on development of dual purpose pearl millet for ensuring high grain yield as well as higher dry fodder yield under rainfed cultivation

The F_2 is the critical generation in plant breeding and it determines eventual success or failure of the hybridization programme (Jennings *et al.*, 1979). Selection for the improvement of quantitative characters can be effective only when the segregating generation display the potential variability. According to Allard (1960), high mean and variability for a character in the F_2 population constitute the ideal source for exercising selection. Mean performance serves as basis for eliminating undesirable crosses and variability helps to choose a potential cross since variability indicates the extent of recombination for initiating effective procedures. At the same time studies on inbreeding depression would be helpful in knowing the stability of hybrids when they are advanced to further generations. In the context of the above considerations, mean performance, variability and inbreeding depression of the pearl millet for grain cum stover yield and its associating traits were studied.

MATERIALS AND METHODS

The F_2 generation of the six crosses (IP 20381 x PT 5665, IP 20381 x GP 15071, IP20381 x IP 19125, IP 20381 x IP 20350, IP 20334 x IP 20350 and IP19125 x GP 16239) was used for the study. The experiment was laid out in the new area, Department of Forage crops, Tamil Nadu Agricultural University, Coimbatore. Seeds of the parent, F_1 and F_2 generations were raised in rows with spacing of 45 cm between rows and 15 cm between plants. Fifty plants for parents and $F_{1,}$ two hundred plants for F_2 were chosen for this study. Need based cultural and plant protection measures were followed. Observations were recorded on plant height (cm), number of tillers per plant, number of productive tillers per plant, number of leaves per plant, leaf length (cm), panicle length (cm), stover yield (g) and grain yield (g).

Statistics such as mean and phenotypic and genotypic co-efficient of variation (PCV and GCV) were computed based on the method suggested by Burton (1952). Heritabilty in the broad sense was computed with the formula suggested by Lush (1940). The genetic advance was estimated by adopting the method suggested by Johnson *et al.* (1955). Inbreeding depression was worked out as per the formula suggested by Rao and Murthy (1970).

RESULTS AND DISCUSSION

The values of mean, coefficient of variation, heritability and genetic advance as per cent of mean are given in Table 1. The cross IP 20387 x GP 15071 occupied first position based on mean for three characters *viz*.,

Table 1 : Mean, variability, heritability and genetic advance of various characters in second generation of Pearl millet

Crosses	Mean	PCV (%)	GCV (%)	Heritability (%)	Genetic advance as per cent of mean
Plant height					
P_1 x P_2	182.77	17.39	17.38	99.90	35.79
P_1 x P_3	200.61	7.83	7.82	99.57	16.06
P_1 x P_8	206.26	6.67	6.65	99.48	13.67
P_1 x P_{11}	191.49	11.34	11.33	99.81	23.31
P_6 x P_{11}	196.52	11.15	11.14	99.81	22.93
P_8 x P_{10}	190.25	12.62	12.61	99.86	25.97
Number of tillers					
P_1 x P_2	10.08	36.61	35.31	93.00	70.14
P_1 x P_3	8.87	36.73	35.04	91.01	68.87
P_1 x P_8	8.22	27.79	25.12	81.72	46.78
P_1 x P_{11}	8.91	31.39	29.41	87.79	56.78
P_6 x P_{11}	8.03	41.50	40.38	94.67	80.92
P_8 x P_{10}	7.63	33.35	31.79	90.85	62.42
Number of productive tillers					
P_1 x P_2	7.57	31.27	29.96	91.82	59.15
P_1 x P_3	7.85	33.66	32.54	93.44	64.79
P_1 x P_8	6.82	40.28	38.67	92.16	76.46
P_1 x P_{11}	7.14	37.98	35.99	89.81	70.27
P_6 x P_{11}	6.32	45.94	43.85	91.12	86.24
P_8 x P_{10}	6.51	36.11	34.13	89.30	66.43
Number of leaves					
P_1 x P_2	60.00	19.14	19.07	99.28	39.15
P_1 x P_3	53.57	14.50	14.28	96.90	28.95
P_1 x P_8	57.39	13.59	13.47	98.13	27.48
P_1 x P_{11}	59.56	20.33	20.29	99.56	41.70
P_6 x P_{11}	53.36	23.57	23.53	99.70	48.41
P_8 x P_{10}	49.29	15.86	15.71	98.13	32.06
Leaf length					
P_1 x P_2	52.47	10.74	10.53	96.16	21.27
P_1 x P_3	50.68	11.62	11.37	95.72	22.92
P_1 x P_8	48.85	12.06	11.89	97.20	24.15
P_1 x P_{11}	53.04	11.31	11.15	97.21	22.65
P_6 x P_{11}	43.98	15.35	15.22	98.33	31.10
P_8 x P_{10}	52.03	13.50	13.39	98.38	27.36
Panicle length					
P_1 x P_2	22.48	20.36	19.94	95.93	40.24
P_1 x P_3	23.43	21.13	20.65	95.50	41.57
P_1 x P_8	22.82	20.74	20.39	96.66	41.29
P_1 x P_{11}	26.86	16.96	16.59	95.71	33.44
P_6 x P_{11}	23.60	21.35	21.11	97.73	42.98
P_8 x P_{10}	23.21	19.05	18.74	96.73	37.96
Green fodder yield					
P_1 x P_2	374.79	11.54	11.53	99.82	23.73
P_1 x P_3	404.29	11.37	11.36	99.82	23.38
P_1 x P_8	396.29	13.27	13.26	99.90	27.31
P_1 x P_{11}	393.39	11.06	11.05	99.82	22.73
P_6 x P_{11}	357.15	9.88	9.87	99.83	20.33
P_8 x P_{10}	382.91	6.61	6.60	99.62	13.56
Grain yield					
P_1 x P_2	27.29	17.29	16.87	95.13	33.89
P_1 x P_3	28.81	14.39	14.02	94.95	28.14
P_1 x P_8	26.48	17.22	16.89	96.16	34.11
P_1 x P_{11}	28.54	18.33	18.11	97.52	36.83
P_6 x P_{11}	26.80	19.10	18.94	98.27	38.67
P_8 x P_{10}	24.05	22.37	22.16	98.16	45.23

number of productive tillers per plant, stover yield and grain yield. The cross IP 20381 x PT 5665 recorded high mean performance for number of tillers and number of leaves and the cross IP 20381 x IP 20350 observed high per se for leaf length and panicle length. Cross or family with higher mean would throw reasonably more number of superior sergeants (Finker *et al.*, 1973).

The probability of obtaining superior lines can be worked out in early generation provided estimates of first and second degree of statistics of genetic variation are available (Jinks and Pooni, 1976). Such information would be of immense use to plant breeders for differentiating crosses (Snape, 1982). Out of the eight characters studied, number of tillers and number of productive tillers showed high variability in all the six crosses. High GCV for theses characters indicated the possibilities for utilization the variation for further improvement. Similar trend for these two characters was also reported by Yuvaraja (2003). In general moderate to high variability was existed for almost all characters in all the crosses. The trait stover yield alone recorded low variability in two crosses (IP 20334 x IP 20350 and IP 19125 x GP 16239). But the cross IP 20334 x IP 20350 recorded high variability among all crosses for number of productive tillers, number of leaves, leaf length and panicle length. For grain yield, only one cross (IP 19125 x GP 16239) recorded high variability and remaining crosses possess moderate variability. But Yuvaraja (2003) reported high variability for plant yield.

The estimates of genotypic coefficient of variation alone may not be adequate for selection and hence heritability estimates and genetic advance as per cent of mean should also be considered (Johnson *et al.*, 1955). The high habitability estimates for all the characters revealed the minor role of environment in the expression of the characters. A similar result was reported by Yuvaraja (2003).

High heritability indicates that effectiveness of selection for phenotypic performance was high, but it did not necessarily mean a high genetic gain for a particular character. So high heritability estimates along with high genetic gain render the selection effective. All the eight biometrical characters in all the six crosses showed high genetic advance as per cent of mean except for plant height in cross IP 20381 x GP 15071 and IP 20381 x IP 19125 where it was moderate and for green fodder yield per plant in cross IP 19125 x GP 16239 where it was moderate.

High estimates of heritability and genetic advance for almost all character indicated the presence of additive gene action and hence selection for these traits could be effective in improving yield in pearl millet. This may also

Table 2 : Inbreeding depression for fodder and grain yield in six F_2 cross combination

F_2 crosses	Green fodder yield (gm)			Grain yield (gm)		
	F_1 mean	F_2 mean	Inbreeding depression (%)	F_1 mean	F_2 mean	Inbreeding depression (%)
P_1 x P_2	494.83	374.79	24.26	39.11	27.29	30.22
P_1 x P_3	498.22	404.29	18.85	37.83	28.81	23.84
P_1 x P_8	494.83	396.29	19.91	35.43	26.48	25.26
P_1 x P_{11}	467.92	393.39	15.93	38.11	28.54	25.11
P_6 x P_{11}	431.69	357.15	17.27	32.56	26.80	17.69
P_8 x P_{10}	419.53	382.91	8.73	33.92	24.05	29.10

help in establishing a close relationship between the genotypes and phenotypes.

The inbreeding depression for green fodder yield per plant and grain yield per plant of all six crosses are presented in Table 2. The comparison of F_2 mean in relation to F1 mean revealed that there was substantial amount of inbreeding depression in all the crosses for both grain and fodder yield except in the cross IP 19125 x GP 16239. This cross recorded low inbreeding depression for green fodder yield. The cross IP 20381 x PT 5665 possessed high inbreeding depression for both grain yield and fodder yield.

The study, therefore, reveals that the cross IP 20381 x IP 19125 displayed some what high mean for green fodder yield with high variability, heritability, genetic advance and moderate inbreeding depression and hence suited for fodder improvement. The cross IP 20334 x IP 20350 secured high mean, moderate variability, high heritability and genetic advance and low inbreeding depression for grain yield. So this hybrid may be suitable for improving grain yield. For dual purpose, the cross IP 20381 x GP 15071 was suitable as it posses good mean for almost all character include green fodder yield and grain yield and appreciable amount of variability (except plant height) and high heritability and genetic advance with moderate inbreeding depression.

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