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Variability Parameters in Pearl Millet

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The investigation was carried out with 65 genotypes of Pearl millet *Pennisetum americanum* (L.) K. Shum., comprised of 15 parents and their 50 crosses, to know the pattern of genetic variability for twelve metric traits. The genotypes showed highly significant differences for all the characters included. Almost all the traits had high values of heritability estimates excepting early growth vigour and grain yield. Genetic coefficient of variation was high for synchrony of tillering, flag leaf area, grain yield and grain density in a ear. Selection would be effective for synchrony of tillering, ear length, grain density and 1000 grain weight.

Adequate genetic variability is a first step and prerequisite for any crop improvement programme to be a success. Metric characters are under heavy influence of environmental factors which necessitates the knowledge of (i) variability owing to genetic factors, (ii) actual genetic variation heritable in the offsprings and (iii) the advance which can be made through selection exerted upon the superior individuals. The aim of the present investigation was to study these aspects in pearl millet.

MATERIAL AND METHODS

Five females (ms 5071 A, ms 5371 A, ms Tift 23 D_2 A, ms 126 D_2 A and ms L_{111} A) and Ten males (K559, K 560, BIL 3B, L 6 Dwarf, L 6 Tall, PIR 228, PIB 155, J 104, J 934 and Saharapur inbred) were crossed in line × tester fashion. Parents together with all 50 crosses were evaluated during summer 1976 in single row plots keeping row-to-row and plant-to-plant distance of 60 cm and 15 cm respectively in randomized block design with three repeats. Five random competitive plants were chosen from each row to record data on plant height, ear length, ear girth, grain density and flag-leaf area. Data on early growth vigour, synchrony of tillering, chlorophyll content, days to heading, ears per metre-row length, 1000 grain weight and grain yield were recorded on the plot basis. For yield and its components 'B' lines of female parents were used to record the data since genetically both lines are isogenic lines.

The replication-wise mean values of the genotypes were subjected to statistical analyses. In case of chlorophyll content, synchrony of tillering and early growth vigour, the data were analysed after angular transformation. Various variability parameters were

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worked out following Burton (1952) and de Vane (1953). Heritability in narrow sense was computed after Gardner (1963). Expected genetic advance at 5 per cent selection inten sity were arrived at employing the formula of Johnson *et al.* (1955).

RESULTS AND DISCUSSION

Mean performance of all the 65 genotypes for various characters are presented in Table I. Wide range of variability was conspicuous for almost all the characters including grain yield. BIL 3B, L6 Dwarf and PIB 155 among parenrs and 5071A × K559, $23D_2A$ × K559, 5054A × BIL 3B, 5074A × PIB 218 and 5054A × PIB 155 among hybrids were identified as the high yielding genotypes. The analysis of variance revealed highly significant differences among the genotypes for various characters studied.

Genetic coefficient of variation (GCV) measures the range of genetic variability present in a character and also provides a measure to compare the genetic variability in various characters. The values of GCV (Table II) ranged from 5.19 (days to heading) to 29.39 per cent (synchrony of tillering). Relatively high GCV was conspicuous for synchrony of tillering, flag-leaf area, grain yield and grain density which indicated that these traits were much less influenced by environment and it is possible to effect further improvement.

Estimation of GCV alone does not assess the amount of heritable variation. GCV computed in conjunction with heritability estimates would Provide a better picture for selection on the phenotypic performance (Burton, 1952). Further, Ramanujam and Tirumalachar (1967) have discussed the limitations of using broad-sense heritability as it included both additive and non-additive gene effects. In the present investigation, the estimates of heritability worked out in narrow sense ranged from 7.82 (early growth vigour) to 85.12 per cent (ear length). Almost all the characters had high heritability values indicating high transmission index for these characters. This is akin to the findings of Singh *et al.* (1972). High heritability for days to flower and length of ear were also reported by Burton (1951), Gill *et al.* (1968) and Phul (1969). Lower heritability value for grain yield is in confirmation with the results of Gupta and Dhillon (1974).

The heritability value in itself provides no indication of the genetic progress which can be expected from selecting the superior genotypes. Heritability indicates only the effectiveness with which selection of genotypes can be based on the phenotypic performance but fails to indicate the expected genetic progress (Johnson *et al.* 1955). However, in the present investigation the characters with low heritability values had also, in general, low genetic advances expressed in per cent of mean indicating close harmony between two genetic parameters. Therefore, improvement could be achieved for synchrony of tillering ear length, grain density and 1000—grain weight. These characters being the major yield components, a rational improvement in yield could likely be achieved by selecting for high mean values of these characters.

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TABLE I Mean values of entries for different metric characters in pearl millet

Entry/character	Flag leaf area (cm²) (1)	Synchrony of tillering (2)	Ear length (cm) (3)	Grain density (4)	1000 grain weight (gm) (5)	Grain yield (gm) (6)
K 559	66.6	4.3	22.7	21.5	5.0	142.6
K 560	55.4	4.6	20.6	21.0	5.2	191.3
BIL 3B	86.1	4.0	18.3	22.9	5.1	125.0
L 6 Dwarf	119.7	4.6	23.5	15.9	5.5	247.3
L 6 Tall	89.3	4.0	20.6	14.7	5.3	186.6
PIB 228	85.4	4.0	23.5	16.8	6.3	204.3
PIB 155	77.6	3.6	32.3	20.4	6.2	265.3
J 104	40.5	3.6	13.2	13.6	5.4	127.3
J 934	33.5	5.0	22.1	15.5	4.6	123.0
Saharanpur inbred	50.5	2.3	23.8	22.6	6.0	157.0
5054 A	62.3	4.0	16.4	21.7	5.3	172.0
5071 A	54.7	3.6	16.1	22.5	5.0	105.3
Tift 23D$_2$ A	52.2	4.6	31.4	17.2	5.5	173.0
126D$_2$ A	62.0	4.0	31.9	15.8	5.4	171.3
L 111 A	102.5	4.0	20.1	22.4	5.8	174.0
5054 A × K 559	68.7	4.0	18.7	21.1	6.5	228.3
5071 A × K 559	73.1	3.6	22.8	22.0	5.9	322.6
23 D^2 A × K 559	87.9	5.0	20.3	21.6	5.7	301.6
126 D$_2$ A × K 559	98.1	3.6	29.7	12.0	8.6	178.6
L 111 A × K 559	93.2	4.6	25.2	16.7	6.1	171.3
5054 A × K 560	49.7	5.0	21.1	22.9	5.8	255.6
5071 A × K 560	64.8	4.0	20.8	20.0	6.5	206.6
23 D$_2$ A × K 560	66.8	5.0	20.7	23.3	6.7	276.6
126 D$_2$ A × K 560	74.7	4.3	26.6	13.4	7.6	227.0
L 111 A × K 560	86.0	4.6	30.5	17.5	6.0	241.0
5054 A × BIL 3B	77.0	4.3	19.0	23.2	5.9	319.3
5071 A × BIL 3B	71.4	4.0	20.5	23.2	5.7	215.2
23 D$_2$ A × BIL 3B	74.2	4.3	20.0	23.3	5.7	258.6
126 D$_2$ A × BIL 3B	82.8	3.0	28.1	13.2	7.4	132.3
L 111 A × BIL 3B	95.4	4.3	28.8	18.1	4.8	174.0
5054 A × L 6 Dwarf	92.6	5.0	19.2	16.2	6.3	237.3

	(1)	(2)	(3)	(4)	(5)	(6)
5071 A × L 6 Dwarf	85.8	4.0	24.6	22.2	6.3	312.3
23 D_2 A × L 6 Dwarf	87.0	3.6	20.1	20.4	6.2	280.6
126 D_2 A × L 6 Dwarf	100.2	4.3	28.1	10.2	8.5	168.0
L 111 A × L 6 Dwarf	105.1	4.3	27.7	13.6	6.6	181.6
5054 A × L 6 Tall	80.5	4.3	22.0	18.1	7.4	280.0
5071 A × L 6 Tall	76.1	3.6	22.3	23.5	6.0	222.6
23 D_2 A × L 6 Tall	80.7	3.6	19.8	20.1	7.0	235.0
126 D_2 A × L 6 Tall	89.1	4.0	28.9	11.1	9.5	218.6
L 111 A × L 6 Tall	91.1	4.0	33.0	15.3	6.4	276.6
5054 A × PIB 228	76.3	4.0	20.9	20.3	5.3	252.0
5071 A × PIB 228	82.5	3.3	25.2	20.9	4.9	324.3
23D_2 A × PIB 228	84.7	3.0	24.3	18.3	6.7	223.3
126 D_2 A × PIB 228	89.1	4.0	31.6	11.1	7.8	163.3
L 111 A × PIB 228	81.6	5.0	30.4	17.2	6.4	267.6
5054 A × PIB 155	81.0	4.6	20.2	25.1	5.7	336.6
5071 A × PIB 155	79.0	4.3	22.5	23.0	4.9	228.6
23 D_2 A × PIB 155	87.3	4.6	22.4	25.5	5.0	197.6
126 D_2 A × PIB 155	92.2	4.0	31.5	11.2	8.6	137.0
L 111 A × PIB 155	111.1	4.3	31.6	15.2	8.1	231.3
5054 A × J 104	43.5	4.3	16.2	20.7	8.4	145.0
5071 A × J 104	48.9	4.6	20.4	23.1	5.4	241.3
23D_2 A × J 104	42.1	4.6	16.8	21.6	5.7	202.3
126 D_2 A × J 104	68.0	4.3	23.5	15.9	7.2	181.0
L 111 A × J 104	78.5	4.6	21.7	16.0	6.8	208.3
5054 A × J 934	50.7	4.6	22.3	22.3	5.6	229.0
5071 A × J 934	88.6	4.3	22.6	20.8	7.0	251.6
23 D_2 A × J 934	55.8	5.0	21.1	19.4	6.0	266.0
126 D_2 A × J 934	68.8	5.0	27.5	12.3	8.0	286.0
L 111 A × J 934	68.5	4.6	27.1	15.8	7.0	203.6
5054 A × Saharanpur inbred	70.7	2.6	19.8	19.6	6.1	190.0
5071 A × Saharanpur inbred	57.6	1.6	20.8	23.0	5.1	180.3
23 D_2 A × Saharanpur inbred	65.4	1.6	21.3	20.3	6.5	141.6
126 D_2 A × Saharanpur inbred	71.2	1.6	30.7	11.8	7.8	179.2
L 111 A × Saharanpur inbred	96.8	3.3	28.3	17.0	6.3	237.3
Mean	75.53	4.05	23.63	18.68	6.28	216.69
Range	33.6 to 119.7	2.3 to 5.0	13.2 to 33.0	10.2 to 25.5	4.6 to 9.5	105.3 to 336.6
CD (5%)	10.3	0.83	2.6	3.0	0.53	51.5

TABLE II Estimates of heritability, genetic coefficient of variation and genetic advance.

Character	Heritability % (narrow-sense)	GCV	GA	GA as % of mean
Flag leaf area	67.00	23.39	25.91	34.37
Plant height	51.05	19.76	23.63	21.91
Synchrony of tillering	54.50	29.39	1.62	39.91
Early growth vigour	7.82	11.09	0.14	2.00
Days to heading	59.15	5.19	6.26	7.16
Ears per metre	39.07	20.54	5.20	20.48
Ear girth	39.56	10.78	0.64	10.35
Ear length	85.12	19.68	8.68	36.73
Grain density	82.93	20.83	7.40	39.60
1000-grain weight	70.98	16.56	1.59	25.38
Grain yield	17.10	22.37	20.49	9.46