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Line x Tester Analysis in Local Ecotypes of Pearl Millet [*Pennisetum typhoides* (BURM.) S & h] of Sikar District of Rajasthan for Quality Attributes

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Abstract A line x tester analysis with 143 lines (S_1 progenies) developed from local ecotypes collected from Sikar district of Rajasthan and 5 testers of fodder pearl millet revealed that differences between the progenies were significant for all the quality characters studied. Combining ability analysis indicated that variances due to GCA were non-significant while the variances due to SCA were significant for all the qualitative traits studied, indicating preponderance of non-additive gene action in the control of the inheritance of the quality traits. Comparison on the basis of GCA effects indicated that lines 62 and 131 are the desirable ones for most of the quality traits studied. The crosses exhibiting desirable SCA effects had testers which did not have desirable GCA effects for the quality traits.

Key words Pearl millet, Combining ability, Quality traits, S_1 progenies.

Pearl millet is a valuable grain as well as fodder crop which is extensively cultivated in Rajasthan. However, systematic approach toward improvement of the pearl millet plant for quality higher fodder yield is limited. However, the yield improvement in pearl millet in the recent years is accrued through the utilization of the hybrid vigour. For any hybrid program to be successful, the knowledge of the genetic architecture of the parents to be used in the hybrid program is essential. There are several methods for the estimating the genetic architecture and the combining ability of the parents. One of these is Kempthorne's (1957) line x tester method of combining ability analysis. The present experiment was therefore planned to get information on the genetic architecture of quality traits in a group of lines developed from local ecotypes of pearl millet collected from Sikar district of Rajasthan, as it is expected that the use of local type will help in the production of hybrids/varieties which will be more adaptive for the environment of their origin.

Materials and Methods

Local ecotypes of pearl millet were collected from farmers' fields in the Sikar district of Rajasthan and were evaluated for the variability for fodder yield and quality. Based on the evaluation, several lines (S_1 progenies) were developed from which 14 lines were selected at random and were crossed to 5 varieties namely UUJ-IV-M, 15-P-Synthetic, L-72, L-74 and K-84 using them as testers in a Line x Tester manner as described by Kempthorne (1957). The resultant F_1 s (totaling 70) along with parents were evaluated in RBD with three replications during summer of 1990 at SKN College of Agriculture, Jobner. At 50% earing stage, sugar content, crude protein, calcium and oxalic acid in leaves, and calcium and oxalic acid content in stems were estimated following standard methods. The analysis of variance and estimation of GCA and SCA effects was done as described by Kempthorne (1957).

Results and Discussion

The progenies (parents and crosses) mean sum of squares showed significant differences for all the quality characters studied. Thus, significant diversity exsits for these traits used in the present study. The material is, therefore, suitable for combining ability analysis. Further partitioning of progenies mean squares into variances due to lines, testers and line x testers proved that the lines are genetically different from each other. Highly significant interaction components were recorded for all the quality traits studied (Table 1).

Variances due to testers were non-significant for all the traits studied, indicative of low variability

Table 1 *Mean sum of squares (X 10^{-3}) for combining ability and estimates variances for various traits.*

Characters	Source (X 10^{-3})								
	Replication	Crosses	Lines	Testers	Line x Tester	Error	σ^2_{GCA}	σ^2_{SCA}	$\frac{\sigma^2_{GCA}}{\sigma^2_{SCA}}$
DF	2	69	13	4	52	138			
Sugar	0.79	255.09**	296.79**	291.50**	202.06**	18.94	4.2	61.0**	0.07
Crude protein									
Leaves	4.30	380.20**	196.80**	716.20**	400.20**	12.50	−3.1	129.2**	–
Stem	0.19	150.03**	73.43**	282.66**	158.97**	4.54	1.3	51.5**	0.25
Calcium									
Leaves	1.66**	28.23**	57.73**	31.14**	20.63**	0.31	1.4	6.8**	0.21
Stem	0.77**	10.34**	20.78**	11.69**	7.63**	0.13	0.5	2.5**	0.20
Oxalic acid									
Leaves	0.35	64.51**	132.59**	60.93**	47.76**	0.78	3.0	15.7**	0.19
Stem	1.10	56.83**	76.92**	56.46**	40.86**	0.51	1.4	13.5**	0.10

** Significant at p = 0.01

Table 2 *General combining ability of lines for various traits.*

Line	Content						
	Sugar	Crude protein		Calcium		Oxalic acid	
		Leaves	Stem	Leaves	Stem	Leaves	Stem
1	−0.13**	−0.06**	−0.03**	−0.08**	−0.05**	0.02**	0.02**
3	0.07**	0.08**	0.05**	−0.03**	0.02**	0.09**	0.08**
59	0.13**	−0.15**	−0.09**	0.01*	0.01	0.01	0.01
61	0.04	0.14**	0.08**	−0.12**	−0.07**	−0.18**	−0.17**
62	0.08*	0.09**	0.06**	−0.00	−0.01*	0.07**	0.06**
64	−0.15**	0.10**	0.07**	0.03**	0.02**	0.14**	0.13**
75	−0.29**	−0.13**	−0.08**	−0.05**	−0.03**	−0.05**	−0.07**
76	−0.03**	0.09**	−0.03	0.09**	0.06**	0.13**	0.12**
86	0.12**	−0.02	−0.02	−0.05**	−0.03**	−0.05**	−0.04**
115	−0.09*	0.05	0.03	0.03*	0.017**	−0.13**	−0.12**
131	0.01	−0.13**	−0.08**	0.08**	0.03**	−0.10**	0.10**
140	−0.03	0.16**	0.09**	0.04**	0.02**	0.04**	0.04**
183	−0.03	0.07*	0.05**	−0.01*	−0.01	0.00	0.01
195	0.28**	−0.05**	−0.09**	0.09**	0.06**	0.01	0.03**
SE (GCA of line)	0.034	0.026	0.016	0.004	0.003	0.007	0.005

* Significant at p = 0.05

** Significant at p = 0.01

for the quality traits among the testers. Interestingly even the variances due to lines were also non-significant for most of the traits excepting, calcium and oxalic acid content in both, leaves and stems. This can be expected because the base material had unique origin (Sikar district). The σ^2_{GCA} was non-significnat for all the triats while σ^2_{SCA} was significant for all the traits and the $\frac{\sigma^2_{GCA}}{\sigma^2_{SCA}}$ indicated the

Table 3 *General combining ability effects of testers for various characters*

Character	Tester					SE
	L 72	15-P-Synth.	UUJ-IV-M	K 84	L 74	(GCA of tester)
Sugar	−0.103**	0.115**	0.025	0.047	−0.034	0.019
Crude protein						
leaves	−0.058*	0.097**	−0.196**	0.127**	0.029	0.015
stem	−0.040*	0.066**	−0.120**	0.078**	0.016	0.009
Calcium						
leaves	−0.026**	−0.016**	−0.013*	0.015**	0.040**	0.002
stem	−0.017**	−0.009**	−0.007*	0.009*	0.025**	0.002
Oxalic acid						
leaves	−0.027**	−0.029**	−0.012**	0.005*	0.064**	0.004
stem	−0.026**	−0.029**	−0.009	0.003	0.061**	0.003

* Significant at p = 0.05

** Significant at p = 0.01

presence of non-additive gene action in the control of the characters (Table 1).

The present investigation, thus supports the earlier reports on preponderance of SCA and non additive gene action for various qualitative traits in pearl millet as reported for protein content (Harinarayana & Murty 1970, Phul & Gill 1970, Dwivedi *et al.* 1978) and calcium (Chawla & Gupta 1982). However, preponderance of general combining ability effects and /or additive gene actions in the inheritance of protein content (Barnett 1976, Singh & Gupta 1987) and calcium content (Sidhu 1984) are also in reports. Moreover, importance of both additive as well as non-additive gene actions are also reported for protein content (Nanda & Phul 1974, Barnett 1976, Kumar *et al.* 1978) and calcium content (Chawla & Gupta 1982).

Pearl millet, when grown for fodder should have high protein, phosphorus and calcium; low oxalic acid and crude fiber content. Therefore, for developing high yielding, high quality fodder hybrids/synthetics, positive GCA and SCA estimates are desired for protein, phosphorus and calcium and negative estimates for oxalic acid and crude fiber contents.

The GCA estimates of lines 62 and 131 were positive and significant for sugar content. Line 62 also had desirable GCA effects for crude protein and oxalic acid content in leaf and stem, and in case of line 131 for calcium content in leaf and stem. These lines also exhibited desirable GCA effects for green fodder yield (Gill 1990) and thus are the most ideal parents for use in any crop improvement program aimed at increasing the fodder yield in pearl millet (Table 2). Among the testers, L 72, 15-P-synthetic and UUJ-IV-M were found to be undesirable for all the quality traits excepting oxalic acid content, while K 84 and L 74 were found to be desirable for most of the quality traits (Table 3). Lines 1, 3, and 86 exhibited undesirable negative GCA effects for most of the traits of the present study along with green fodder yield (Gill 1990) making them poor combiners and undesirable parents.

Crosses namely Line 75 x 1 72, Line 62 x 14-P-Synthetic, Line 140 x 15-P-Synthetic, Line 61 x UUJ-IV-M, Line 64 x K-84 and Line 115 x L-74 exhibited positive and desirable SCA effects for one or more of the quality traits.

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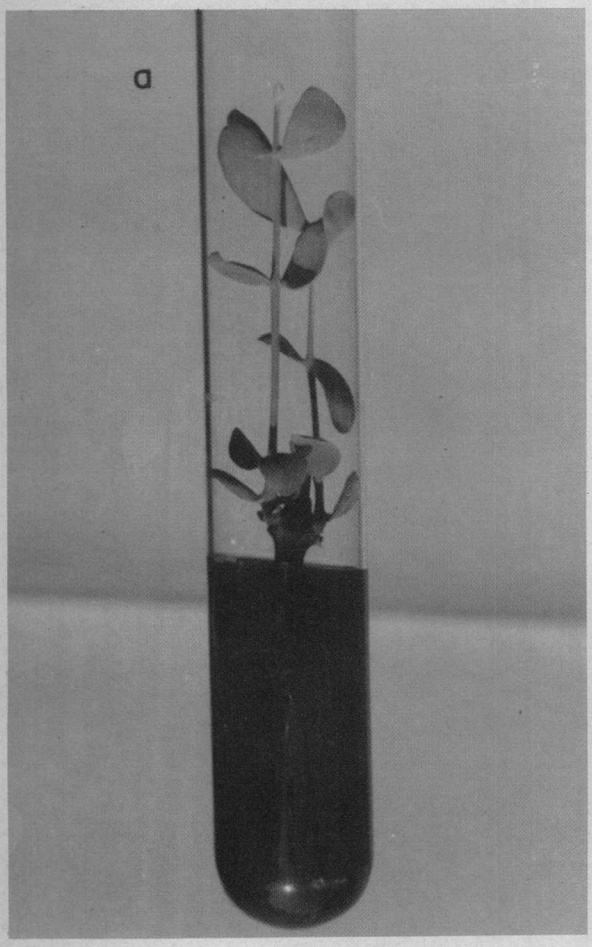

Fig 1 (a) Two axillary shoots per explant (nodal segment) on medium MS-1.

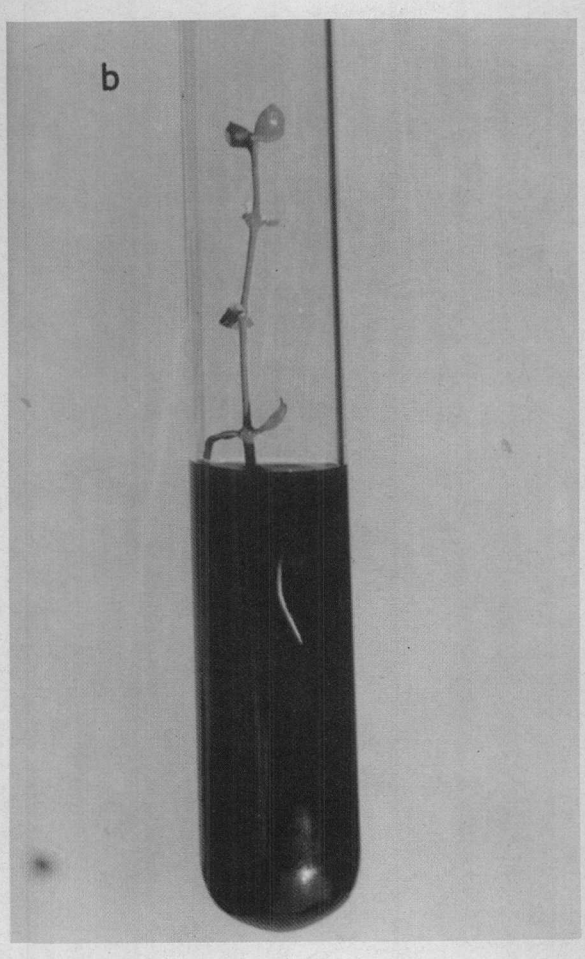

Fig 1 (b) Axillary shoot on rooting medium MS-3

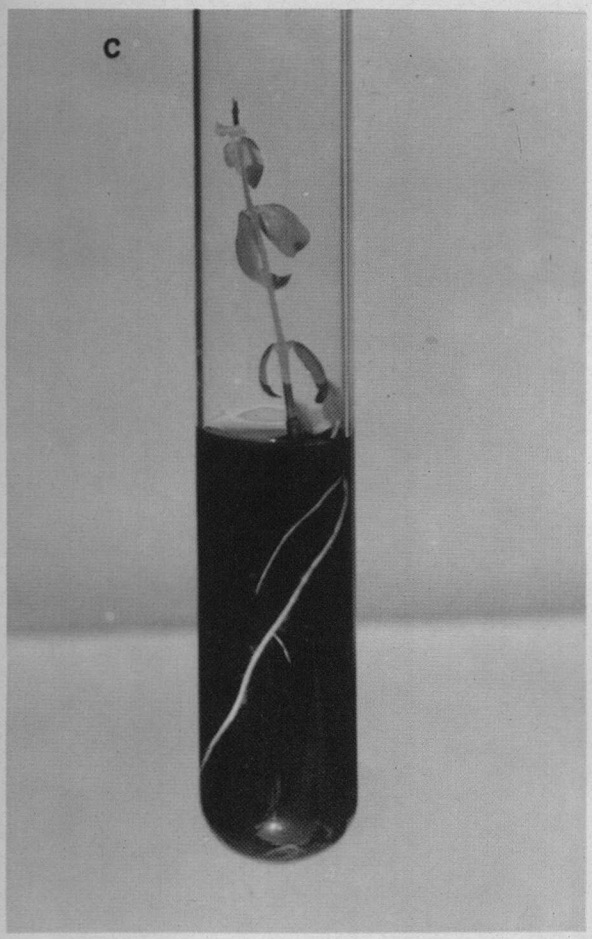

Fig 1 (c) Root developent on MS-3 medium after about 20 days.

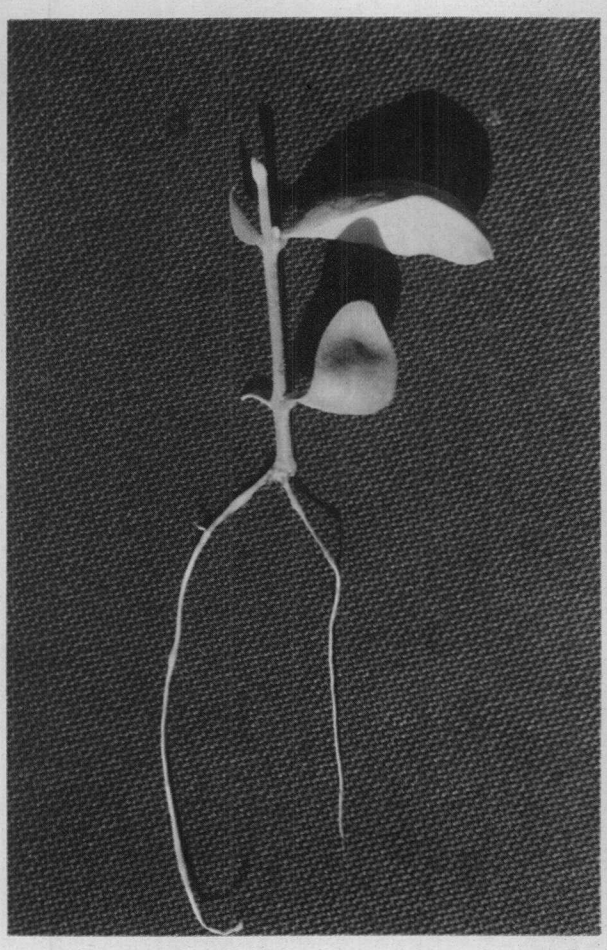

Fig 1 (d) Complete *in vitro* cultured plants of *Simmondsia chinensis*