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Research Article

Combining Ability Analysis in Designated B–lines of Pearl Millet (*Pennisetum glaucum*)

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ABSTRACT

In present experiment 11 lines, 3 testers and 33 hybrids were used to studies combining ability at three locations during kharif 2016. Analysis of variance for combining ability indicated that the mean squares due to lines, testers and line x tester were found significant for days to 50% flowering, plant height, effective tillers per plant and grain yield. General combining ability effects suggested that ICMB-13111, ICMB-13555, ICMB-13777, ICMB-14222 and ICMR-1201 were found to be the best general combiners for grain yield whereas, ICMB-13555, ICMB-13666, ICMB-14111 and ICMR-356 were good general combiners for earliness. ICMB-13555 was found to be good general combiner for grain yield and days to 50% flowering whereas, for effective tillers per plant ICMB-13444 was only line showed good general combining ability. The SCA estimates revealed that no cross combination was consistently superior for all four characters under study as reported. Four crosses viz., ICMB-13333 x ICMR-356, ICMB-13777 x ICMR-1301, ICMB-14111 x ICMR-1301 and ICMB-14444 x ICMR-1201 were identified as the best specific combiners for yield. ICMB-13333 x ICMR-356 cross showed highest SCA values for days to 50% flowering in negative direction that can be used for earliness, whereas ICMB-14333 x ICMR-1301, ICMB-14444 x ICMR-356 and ICMB-14444 x ICMR-1201 showed positive significant SCA effect for plant height.

Key words: *Line x tester, Combining ability, Gene action, B-lines, Pearl millet,*

INTRODUCTION

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] is the staple food of majority of the poor and small land holders, as well as feed and fodder for livestock in rainfed regions of the country. Pearl millet excels all other cereals due to its unique features - C_4 plant with high photosynthetic efficiency, high dry matter production capacity and is grown under the most adverse agro-climatic conditions where other crops like sorghum and maize fail to produce economic yields. It requires less inputs, matures in short duration and is considered as nutritious food, feed and fodder. It is grown on 7.5 million ha with an average production of 9.73 million ton and productivity of 1305 kg/ha during 2016-17[1].

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Pearl millet is rightly termed as "nutricereal" as it is a good source of energy, carbohydrate, protein, fat, ash, dietary fiber, iron and zinc by Satyavathi *et al*.[2]. For boosting per unit yield through genetic improvement, the selection of suitable parents is very crucial. Information about genetic architecture is the best tool for the selection of best parents. Combining ability analysis (CAA) is one of the best techniques for exploring the genetic mechanism of crop plants revealed by Jagendra Singh and Sharma R.[3]., Jeeterwal *et al.*[4] and Mungra *et al.*[5]. Testing the parents for their combining ability is very important because many times the high yielding parents may not combine well to give good hybrids. Line x tester analysis helps in testing a large number of genotypes to assess the gene action and combining ability. Such study also elucidate the genetic variability which can successfully be used in future hybridization programs. Equipped with such information, a breeder can select desirable parents which when crossed would produce best performing segregates as suggested by Jagendra Singh and Sharma R.[3]. This technique also provides information to choose an appropriate and efficient breeding scheme for selection in the segregating population. The present study were, therefore, under taken to identify and assess the pattern of inheritance of grain yield and other quantitative traits and to select the parents having good GCA and cross combinations with good SCA values through line x tester analysis in pearl millet.

MATERIAL AND METHODS

The present study on pearl millet was conducted under ICAR-ICRISAT partnership project. Eleven diverse designated B-lines viz., ICMB-13111, ICMB-13333, ICMB-13444, ICMB-13555, ICMB-13666, ICMB-13777, ICMB-14111, ICMB-14222, ICMB-14333, ICMB-14444 and ICMB-14666 were crossed with three R-line testers viz., ICMR 356, ICMR 1201 and ICMR 1301 in a line x tester mating design seed received from ICRISAT. The resulted 33 hybrids along with 14 parents were evaluated in separate block during Kharif-2016 in a Randomized Block Design with two replications across environmentally different three locations- Coimbatore, Jamnagar and Gwalior. Each plot with a spacing of 60 x 15 cm consisted of two rows of 4.0 m length. All need based agronomic practices were followed during the crop growth period to raise a good crop. Observations were recorded on randomly selected five plants in each replication and entry for 4 quantitative traits viz., days to 50% flowering, plant height (cm), number of effective tillers per plant and grain yield per plant (g), The mean values were used for the analysis of variance for experimental design. The data were statistically analyzed for combining ability as per the method suggested by Kempthorne[6].

RESULT AND DISCUSSION

Analysis of variance for combining ability

The results of ANOVA for combining ability indicated that the mean squares due to lines were found highly significant for days to 50% flowering, plant height, effective tillers per plant and grain yield. In case of testers highly significant values were obtained for days to 50% flowering, plant height and effective tillers per plant at 1% level of significant and grain yield was significant at 5% level of significant, whereas the mean squares due to line x tester were found highly significant for all four characters under study (Table 1).

Estimates of general combining ability effects:

The estimates of GCA effects of parents for all four traits have been given in Table 2. General combining ability effects suggested that ICMB-13111, ICMB-13555, ICMB-13777, ICMB-14222 and ICMR-1201 were found to be the best general combiners for grain yield and other traits also. Good general combiners for earliness were ICMB-13555, ICMB-13666, ICMB-14111 and ICMR-356. ICMB-14222 showed maximum GCA effect for grain yield but for other three traits it is not a good general combiner. ICMB-13555 was found to be good general combiner for grain yield and days to 50% flowering. For plant height, ICMB-13333, ICMB-13777, ICMB-14333 and ICMR-1201 were found good general combiners in positive direction whereas

ICMB-13444 was only line to showed good general combiner for trait effective tillers per plant.

Estimates of specific combining ability effects:

The SCA estimates revealed that no cross combination was consistently superior for all four characters under study as reported by Basavararaju *et al.*[7], Pokhariyal *et al.*[8], Singh and Sharma[3] and Upadhyaya and Murthy[9]. Four crosses viz., ICMB-13333 x ICMR-356, ICMB-13777 x ICMR-1301, ICMB-14111 x ICMR-1301 and ICMB-14444 x ICMR-1201 were identified as the best specific combiners for yield and ICMB-14444 x ICMR-1201 was also having highly significant positive values for plant height (Table 3). ICMB-13333 x ICMR-356 cross showed highest SCA values for days to 50% flowering in negative direction that can be used for earliness, whereas ICMB-14333 x ICMR-1301, ICMB-14444 x ICMR-356 and ICMB-14444 x ICMR-1201 showed positive significant SCA effect for plant height. For the trait effective tillers per plant only two crosses viz., ICMB-13444 x ICMR-1301 and ICMB-13555 x ICMR-356 were having significant positive SCA effect. Analysis of SCA effects revealed that good combining parents yield better hybrids because parents with significant positive GCA effect were involved more in selected crosses than those with non-significant GCA effect and negative GCA effects. Several workers Dass *el al.*[10], Mathur and Mathur[11] and Singh *et al.*[12] have also made similar results in pearl millet.

Table 1. Analysis for combining ability for 4 traits in Pearl millet (Mean sum of square)

S.No.	Source	D.F.	Days to 50% flowering (No.)	Plant height (cm)	Effective tillers/plant (No.)	Grain yield (Kg)
1	Replication	1	78.6	75.2	75.2	75.2
2	Line	10	87.2**	134**	123**	104**
3	Tester	2	87.2**	134**	123**	104**
4	Line x Tester	20	87.2**	134**	123**	104**
5	Location	2	78.6	90.6	87.6	87.2
6	Treatment	46	87.2**	134**	123**	104**
7	Error	96	71.2*	88.1**	83.8**	83.3**

*, **Significant at 1% and 5% level respectively

Table 2. Estimates of general combining ability effects of parents for 4 traits in Pearl millet

S.No.	Parents	Days to 50% flowering (No.)	Plant height (cm)	Effective tillers/plant (No.)	Grain yield (Kg)
	Line (Females)				
1	ICMB-13111	-0.81	-3.77	-0.24	317.29**
2	ICMB-13333	3.58**	12.78**	-0.29*	26.18
3	ICMB-13444	0.08	-6.55*	0.37**	-434.38**
4	ICMB-13555	-3.20**	-2.33	0.04	353.90**
5	ICMB-13666	-1.37	-4.66	-0.13	-143.10
6	ICMB-13777	0.63	12.51**	0.04	461.95**
7	ICMB-14111	-1.76**	-5.16	-0.07	-403.82**
8	ICMB-14222	-0.54	2.78	0.10	630.62**
9	ICMB-14333	1.13	12.45**	0.10	182.07
10	ICMB-14444	0.91	-12.72**	0.15	-310.93**
11	ICMB-14666	1.35*	-5.33	-0.07	-679.77**
	SE (g_i)	0.61	3.20	0.13	107.16
	SE (g_i-g_i)	0.86	4.52	0.17	151.58
	Tester (Males)				
1	ICMR-356	-1.11**	-3.86*	0.09	-180.04**
2	ICMR-1201	0.05	6.73**	-0.06	258.56**
3	ICMR-1301	1.06**	-2.87	-0.03	-78.52
	SE (g_i)	0.32	1.67	0.06	55.98
	SE (g_i-g_i)	0.45	2.36	0.09	79.16

*, **Significant at 1% and 5% level respectively

Table 3. Estimates of specific combining ability effects of crosses for 4 traits in Pearl millet

S.No.	Crosses	Days to 50% flowering	Plant height	Effective tillers/plant	Grain yield
1	ICMB-13111 xICMR-356	-0.01	0.30	0.30	-283.74
2	ICMB-13111 x ICMR-1201	-0.66	2.55	-0.22	340.33
3	ICMB-13111 x ICMR-1301	0.66	-2.85	-0.08	-56.59
4	ICMB-13333 x ICMR-356	-2.73**	-3.59	0.19	863.87**
5	ICMB-13333 x ICMR-1201	2.79**	-3.18	0.17	-408.72*
6	ICMB-13333 x ICMR-1301	-0.06	6.76	-0.36	-455.15*
7	ICMB-13444 x ICMR-356	-0.73	6.91	-0.65**	114.59
8	ICMB-13444 x ICMR-356	0.95	1.82	0.01	3.83
9	ICMB-13444 x ICMR-1201	-0.23	-8.74	0.64**	-118.42
10	ICMB-13555 x ICMR-1301	1.05	-10.64	0.52*	298.98
11	ICMB-13555 x ICMR-356	-0.10	3.93	-0.33	-311.44
12	ICMB-13555 x ICMR-1201	-0.95	6.71	-0.19	12.46
13	ICMB-13666 x ICMR-1301	1.38	4.69	-0.31	45.81
14	ICMB-13666 x ICMR-356	-0.77	-9.40	0.17	-338.11
15	ICMB-13666 x ICMR-1201	-0.62	4.71	0.14	292.30
16	ICMB-13777 x ICMR-1301	-0.95	0.69	-0.15	-605.74**
17	ICMB-13777 x ICMR-356	0.57	-0.23	-0.16	-163.33
18	ICMB-13777 x ICMR-1201	0.38	-0.46	0.31	769.08**
19	ICMB-14111 x ICMR-1301	1.44	1.19	0.30	-242.96
20	ICMB-14111 x ICMR-356	-0.71	-5.07	-0.05	-143.72
21	ICMB-14111 x ICMR-1201	-0.73	3.87	-0.25	386.69*
22	ICMB-14222 x ICMR-1301	0.88	-6.42	-0.04	23.59
23	ICMB-14222 x ICMR-356	-0.27	-3.34	0.12	52.67
24	ICMB-14222 x ICMR-1201	-0.62	9.76	-0.08	-76.26
25	ICMB-14333 x ICMR-1301	0.72	-6.75	-0.20	-170.19
26	ICMB-14333 x ICMR-356	0.23	-5.34	0.28	60.39
27	ICMB-14333 x ICMR-1201	-0.95	12.10*	-0.08	109.80
28	ICMB-14444 x ICMR-1301	-0.39	23.41**	0.08	-121.19
29	ICMB-14444 x ICMR-356	0.29	15.49**	-0.11	560.39**
30	ICMB-14444 x ICMR-1201	0.11	-38.90**	0.03	-439.20*
31	ICMB-14666 x ICMR-1301	-0.67	-9.81	-0.04	76.88
32	ICMB-14666 x ICMR-356	-2.32*	2.77	0.12	347.72
33	ICMB-14666 x ICMR-1201	2.99**	7.04	-0.08	-424.70*
	SE (s_{ij})	1.05	5.53	0.21	185.65
	SE (s_{ij-} s_{ij})	2.96	15.64	0.61	525.10

*,** Significant at 5 % and 1% level respectively

CONCLUSION

Combining ability studies revealed that both general and specific combining ability variances were important for all four traits. Thus, this will indicate the presence of additive as well as dominance gene action equally.

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