Research Article

Combining ability analysis for yield and yield component traits in finger millet (*Eleusine coracana* (L.) Gaertn.)

C. Priyadharshini, A. Nirmalakumari and A. John Joel

Abstract

An experiment was conducted to estimate the *gca* and *sca* effects for yield and yield attributing traits in finger millet. In the present investigation, the parents were mated in half diallel mating design. The trial was conducted at Tamil Nadu Agricultural University, Coimbatore. Anova revealed that there was sufficient variability among genotypes, parents, and hybrids. Parents CO (Ra) 14, TNAU 1039 and CO 9 were found to be good combiners for yield and its attributing traits with highly significant *per se* performance. The parents with high *gca* effects were utilized in the identification of superior hybrids with favourable genes for grain yield and its component traits. In case of *sca* effects, crosses TNAU 1039 x CO (Ra) 14 exhibited higher *per se* performance and *sca* effects for yield and its component trait under evaluation. The crosses with high *sca* effects may be exploited to fix high yield in advanced generations. The *sca* variances were higher compared to *gca* variances for all the traits under study except the longest finger length which indicated the predominance of non- additive gene action in the control of these traits.

Key words: Combining ability, *gca, sca, per se* performance, Additive action

Introduction

Finger millet (*Eleusine coracana* (L.) Gaertn.) is one of the important small millets gaining importance due to its inherent hardy nature and nutritional quality of the grain. It is a staple food crop in drought prone areas and is considered as an important component of food security (National Research Council, 1996). Hence, a great thrust exists in finger millet on improving yield and quality attributes.

Selection of parents having good potentiality for yield and its related characters is the most primary necessity in yield improving breeding programme. In development of improved varieties, recombination breeding occupies a predominant position. Information on relative importance of general and specific combining ability is of immense use in the development of an efficient breeding programme. It not only helps to identify the parents and crosses, which are likely to give the maximum improvements for the character under consideration, but also provides means of understanding the nature of gene action involved in it. The present study was therefore, conducted to estimate the general and specific combining ability of parents and hybrids, respectively for yield and its component traits.

Centre for Plant Breeding and Genetics,
Tamil Nadu Agricultural University, Coimbatore-3.

Materials and methods

Seven parents of finger millet were used on this hybridization programme. The parents were CO 9, RIL 156, TNAU 1039, GPU 45, PRM 801, VL 149 and CO (Ra) 14.

The crossing programme was adopted using half diallel mating design with parents at Tamil Nadu Agricultural University, Coimbatore. Each genotype was crossed with each of the other genotypes in diallel fashion, excluding reciprocals. The parental lines and their resultant 21 F_1's were evaluated with CO (Ra) 14 as standard check in RBD with three replications. The recommended agricultural practices were adopted to raise the crop. The observations on days to 50 per cent flowering, plant height (cm), number of productive tillers per plant, number of fingers per ear head, longest finger length (cm), thousand grain weight (g), seed protein content (%), harvest index (%), single plant dry fodder yield (g) and single plant grain yield (g) were recorded. Analysis of data for general and specific combining ability was carried out following Griffing's (1956) method II, model I (fixed effect model).

Results and discussion

The analysis of variance for combining ability for yield and its attributing characters is presented in table 1. The ANOVA revealed that mean squares due to mean squares due to genotypes, parents, and hybrids were highly significant for all the traits under evaluation, which was indication of sufficient variability among genotypes, parents, and hybrids. The ratio of GCA to SCA variance was less than unity for all the characters except the longest finger length, indicating the pre dominance of non-additive gene action governing the traits. Similar results were reported by Veena (1996), Mahadeviah (2002), Sumathi *et al.* (2005) and Shailaja *et al*. (2010).

Per se performance and gca effect of parents

The *per se* performance and *gca* effects of seven parents for yield and its attributing traits are presented in tables 2 and 3. In the present study, among the parents, CO (Ra) 14 exhibited high *per se* performance along with significant *gca* effect for number of productive tillers per plant, finger length, number of fingers per ear head, seed protein content, harvest index and single plant grain yield. In addition, parent TNAU 1039 also exhibited high *per se* performance along with significant *gca* effect for days to 50 per cent flowering, plant height, harvest index and single plant grain yield. Similar results of high *per se* performance along with significant *gca* effect was reported by Sivagurunathan *et al.* (2006) for productive tillers and finger length. Based on *per se* performances and *gca* effects GPU28, CO12 and VL 149 were identified as best combiners for majority of the traits including grain yield per plant and Na^+: K^+ ratio by Shailaja *et al*. (2010). Therefore, utilization of these parents in the hybridization programmes may yield superior recombinants in the desirable direction.

Per se performance and sca effect of hybrid combinations

The *per se* performance and *sca* effects of seven parents for yield and its attributing traits are presented in tables 4 and 5. The hybrids TNAU 1039 x CO (Ra) 14 and CO 9 x CO (Ra) 14 recorded higher *per se* performance for single plant grain yield coupled with superior *sca* effect. The hybrid TNAU 1039 x CO (Ra) 14 also recorded higher *per se* performance and *sca* effect for number of productive tillers per plant, fingers per ear head, 1000 grain weight. Hybrids with high *per se* performance and high *sca* effect were reported by Veena Vigneswaran (1996), Mahadevaiah (2002) and Sivagurunathan *et al.* (2006).

Conclusion

Based on *per se* performance and *gca* effects, the parents TNAU 1039 and CO (Ra) 14 were identified as best combiners for majority of traits including grain yield. Hence, these genotypes could be utilized in breeding programme for improvement of grain yield.

Based on *per se* performance and *sca* effects TNAU 1039 x CO (Ra) 14 and CO 9 x CO (Ra) 14 were identified as the best hybrids for heterosis breeding. So, this hybrid may be subjected to advanced generations.

Refernces

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Table 1. Analysis of variance for combining ability in finger millet for yield and its component traits

Source	Mean square										
	Degrees of freedom	Days to 50 per cent flowering	Plant height (cm)	Number of productive tillers per plant	Number of fingers per ear head	Longest finger length (cm)	Thousand grain weight (g)	Seed protein content (%)	Harvest index (%)	Single plant dry fodder yield (g)	Single plant grain yield (g)
Replication	2	0.33	8.67	0.04	0.04	0.01	0.01	0.003	0.27	0.27	0.06
Genotype	27	97.53**	518.98**	6.22**	2.89**	4.33**	0.22**	5.18**	60.87**	13.42**	10.72**
Parents	6	92.2**	387.13**	4.44**	1.75**	5.18**	0.18**	1.47**	32.82**	9.94**	7.01**
Hybrids	20	15.44**	111.82**	1.40**	0.74**	0.38**	0.04**	1.80**	16.71**	2.91**	2.59**
Error	54	0.08	2.60	0.06	0.05	0.03	0.002	0.001	0.07	0.05	0.05
GCA		10.24	42.73	0.49	0.19	0.57	0.02	0.16	4.10	1.50	0.77
SCA		15.36	109.22	1.34	0.68	0.35	0.04	1.80	19.46	5.86	2.54
GCA/SCA		0.67	0.39	0.36	0.28	1.66	0.48	0.09	0.21	0.26	0.30

Table 2. Mean performance of parents for yield and yield attributing traits in finger millet

Traits	Days to 50 per cent flowering	Plant height (cm)	Number of productive tillers per plant	Number of fingers per ear head	Longest finger length (cm)	Thousand grain weight (g)	Seed protein content (%)	Harvest index (%)	Single plant dry fodder yield (g)	Single plant grain yield (g)
CO 9	61.33**	96.57**	4.86	8.90*	4.10	2.67	11.97**	33.21	28.27	14.05
RIL 156	62.00**	99.13**	4.55	7.30	5.23	2.63	10.33**	34.62	28.00	14.83
TNAU 1039	67.33**	80.73**	5.55	7.80	6.10	2.37	10.07**	36.92**	27.65	16.19**
GPU 45	70.33*	107.53**	5.12	7.43	6.27	3.13**	9.57	31.84	29.84**	13.94
PRM 801	77.33	133.50	4.22	8.43	5.97	2.87	7.37	30.02	30.58**	13.12
VL 149	74.00	116.77**	6.40**	8.10	9.17**	2.83	7.87	35.42*	27.90	15.30
CO 14	72.00	118.17*	6.00*	9.30**	7.27**	2.67	10.37**	36.88**	27.69	16.18**
MEAN	69.38	113.06	5.24	8.18	6.30	2.74	9.65	33.42	28.56	14.80
SE	0.28	1.61	0.24	0.23	0.17	0.05	0.03	0.27	0.22	0.23
CD(P=.05)	0.78	4.51	0.68	0.65	0.48	0.13	0.09	0.75	0.61	0.64
CD(P=.01)	1.04	5.90	0.91	0.87	0.64	0.17	0.12	1.00	0.81	0.85

* Significant at P=0.05, ** Significant at P=0.01.

Table 3. General combining ability effects of parents for different traits in finger millet

Traits	Days to 50 per cent flowering	Plant height (cm)	Number of productive tillers per plant	Number of fingers per ear head	Longest finger length (cm)	Thousand grain weight (g)	Seed protein content (%)	Harvest index (%)	Single plant dry fodder yield (g)	Single plant grain yield (g)
CO 9	-1.19 **	-6.56 **	-0.20 *	0.03	-1.20 **	0.02	0.19**	0.19 *	-0.04	-0.02
RIL 156	-5.22 **	-5.18 **	-0.22 **	-0.52 **	-0.44 **	-0.15 **	0.43 **	-1.02 **	0.68**	-0.37 **
TNAU 1039	-1.00 **	-5.89 **	0.29 **	0.12	-0.17 **	-0.12 **	-0.44 **	2.31 **	-1.09 **	0.92 **
GPU 45	-0.67 **	-2.54**	-0.62 **	-0.12	0.12 *	0.23 **	-0.02 *	-1.25 **	0.80**	-0.67 **
PRM 801	5.19 **	8.03 **	-0.95 **	-0.52 **	-0.14 *	0.13 **	-0.48 **	-3.12 **	1.43**	-1.40 **
VL 149	1.85 **	3.98 **	0.73 **	0.28 **	1.14 **	0.00	-0.21 **	1.48 **	-0.71 **	0.54 **
CO 14	1.04 **	8.17 **	0.98 **	0.73 **	0.68 **	-0.11 **	0.54 **	1.41 **	-1.23 **	1.00 **
SE	0.09	0.5	0.08	0.07	0.05	0.01	0.01	0.08	0.07	0.07

* Significant at P=0.05, ** Significant at P=0.01.

Table 4. Mean performance of hybrids for yield and yield attributing traits in finger millet

Hybrids	Days to 50 per cent flowering	Plant height (cm)	Number of productive tillers per plant	Number of fingers per ear head	Longest finger length (cm)	Thousand grain weight (g)	Seed protein content (%)	Harvest index (%)	Single plant dry fodder yield (g)	Single plant grain yield (g)
CO 9x RILL 156	62.33**	94.67**	5.76	8.23	5.97	2.53	8.17	36.66	28.3**	16.39
CO 9 x TNAU 1039	71.67	103.97**	6.14	8.90	6.50	2.67	9.03	37.43	28**	16.75
CO 9 x GPU 45	70.33	108.17**	5.75	9.20	6.10	3.30**	7.33	35.59	29.04**	15.42
CO 9 x PRM 801	72.00	114.13**	5.47	7.70	6.17	3.13**	9.83**	36.55	28.51**	16.42
CO 9 x VL 149	70.67	107.07**	9.20**	8.57	5.23	3.03**	8.67	44.39**	24	19.16**
CO 9 x C0 14	74.33	113.13**	10.40**	8.90	5.90	2.63	8.87	46.01**	23.5	20.11**
RIL 156 x TNAU 1039	64.67**	109.6**	7.76**	8.57	6.00	2.53	9.47**	39.67*	27.09	17.81
RIL 156 x GPU45	63.67**	115.27**	6.69	7.67	6.93	2.83	8.87	34.64	29.33**	15.55
RIL 156 X PRM 801	66.00**	105.53**	5.27	7.20	6.93	2.63	10.13**	33.89	29.85**	15.30
RIL 156 x VL 149	64.33**	111.43**	7.37*	9.70	7.87**	2.77	9.67**	39.38*	26.87	17.45
RIL 156 x CO 14	62.67**	111.93**	7.63*	7.80	6.77	2.57	11.03**	38.65	26.9	17.00
TNAU 1039 x GPU45	67.33**	82.67**	4.96	9.43	6.93	3.27**	7.60	42.5**	25.45	17.87*
TNAU 1039 x PRM 801	76.33	131.07	5.97*	8.53	6.33	2.87	8.63	38.89	24.88	17.11
TNAU 1039 x VL 149	61.67**	119.20	8.07**	9.67*	8.33**	2.47	7.87	44.24**	24.06	19.09**
TNAU 1039 x CO 14	69.33**	132.30	10.07**	10.50**	8.17**	2.87	7.47	45.51**	23.71	19.79**
GPU 45 x PRM 801	72.00	104.93**	5.32	8.33	6.77	3.23**	8.73	35.52	29.2**	15.01
GPU 45 x VL 149	73.00	119.13	6.30**	9.80**	8.67**	2.77	11.83**	35.85	28.6**	16.02
GPU 45 x CO 14	61.67**	125.17	6.60**	10.57**	8.33**	2.87	10.43**	42.26**	25.63	18.76**

PRM 801 x VL 149	81.00	116.83**	6.09*	8.10	7.30	3.33**	7.87	35.21	29.01**	15.76
PRM 801 x CO 14	79.33	126.07	6.29**	7.23	8.17**	2.77	9.87**	33.15	28.51**	14.13
VL 149 x CO 14	72.67	121.90	9.68**	10.43**	8.53**	2.47	10.57**	44.7**	23.56	19.00**
MEAN	69.19	107.49	6.83	8.85	7.04	2.84	9.14	39.08	26.86	17.16
SE	0.28	1.61	0.24	0.23	0.17	0.05	0.03	0.27	0.22	0.23
CD(P=.05)	0.78	4.51	0.68	0.65	0.48	0.13	0.09	0.75	0.61	0.64
CD(P=.01)	1.04	5.99	0.91	0.87	0.64	0.17	0.12	1.00	0.81	0.85

*Significant at P=0.05, **Significant at P=0.01

Table 5. Specific combining ability effects of parents for different traits in finger millet

Hybrids	**Days to 50 per cent flowering**	**Plant height (cm)**	**Number of productive tillers per plant**	**Number of fingers per ear head**	**Longest finger length (cm)**	**Thousand grain weight (g)**	**Seed protein content (%)**	**Harvest index (%)**	**Single plant dry fodder yield (g)**	**Single plant grain yield (g)**
CO 9x RILL 156	-0.59 **	-5.26 **	-0.25 *	0.70 **	0.74 **	-0.14 **	-1.72 **	-0.17	0.38 **	0.21 *
CO 9 x TNAU 1039	4.52 **	4.76 **	-0.38 **	-0.60 **	-0.12	-0.04 *	0.01	-2.73 **	1.85 **	-0.71 **
CO 9 x GPU 45	2.85 **	5.61 **	0.13	-0.89 **	0.02	0.25 **	-2.10 **	-1.01 **	0.83 **	-0.46 **
CO 9 x PRM 801	-1.33 **	1.00	0.19	0.37 **	0.65 **	0.17 **	0.86 **	1.82 **	-0.16	1.27 **
CO 9 x VL 149	0.67 **	-2.01 **	1.22 **	-0.13	-0.73 **	0.20 **	-0.57 **	5.06 **	-2.53 **	2.07 **
CO 9 x C0 14	5.15 **	-0.14	1.44 **	0.25 **	0.16 *	-0.08 **	-1.13 **	6.74 **	-2.51 **	2.56 **
RIL 156 x TNAU 1039	1.56 **	9.01 **	1.27 **	0.28 **	-0.25 **	-0.01	0.21 **	0.72 **	0.22 *	0.70 **
RIL 156 x GPU45	0.22	11.33 **	1.11 **	-0.38 **	0.39 **	-0.05 **	-0.81 **	-0.75 **	0.41 **	0.03
RIL 156 X PRM 801	-3.30 **	-8.98 **	0.02	-0.45 **	0.65 **	-0.16 **	0.92 **	0.36 **	0.47 **	0.50 **
RIL 156 x VL 149	-1.63 **	0.97	0.44 **	0.45 **	0.31 **	0.10 **	0.19 **	1.26 **	-0.38 **	0.71 **
RIL 156 x CO 14	-2.48 **	-2.72 **	0.28 **	0.10	-0.34 **	0.02	0.80 **	0.59 **	0.18 *	-0.19 *
TNAU 1039 X GPU 45	-0.33 **	-20.56 **	-1.14 **	0.75 **	0.12	0.35 **	-1.21 **	3.78 **	-1.71 **	1.05 **
TNAU 1039 x PRM 801	2.81 **	17.27 **	0.20 *	0.25 *	-0.21 **	0.04 *	0.29 **	2.04 **	-2.75 **	1.02 **
TNAU 1039 x VL 149	-8.52 **	9.45 **	0.62 **	0.59 **	0.51 **	-0.22 **	-0.75 **	2.79 **	-1.43 **	1.06 **
TNAU 1039 x CO 14	-0.04	18.36 **	2.36 **	0.97 **	0.80 **	0.29 **	-1.90 **	4.12 **	-1.26 **	1.89 **
GPU 45 x PRM 801	-1.85 **	-12.21 **	0.47 **	0.29 **	-0.07	0.06 **	-0.03 *	2.22 **	-0.47 **	0.51 **
GPU 45 x VL 149	2.48 **	6.04 **	-0.24 *	0.96 **	0.55 **	-0.27 **	2.80 **	-2.04 **	1.06 **	-0.42 **
GPU 45 x CO 14	-8.04 **	7.88 **	-0.19	1.28 **	0.67 **	-0.06 **	0.65 **	4.43 **	-1.39 **	1.87 **
PRM 801 x VL 149	4.63 **	-6.84 **	-0.12	-0.35 **	-0.56 **	0.39 **	-0.70 **	-0.82 **	1.00 **	0.04
PRM 801 x CO 14	3.78 **	-1.80 **	-0.17	-1.66 **	0.77 **	-0.07 **	0.54 **	-2.81 **	1.03 **	-2.04 **
VL 149 x CO 14	0.44 **	-1.91 **	2.06 **	0.74 **	-0.14 *	-0.24 **	0.98 **	4.15 **	-1.78 **	1.25 **
SE	0.11	0.66	0.10	0.10	0.07	0.02	0.01	0.11	0.09	0.09

*Significant at P=0.05, **Significant at P=0.01