Thus the study has revealed that the parent Co.23 with high expression of characters and combining ability possesses considerable breeding value. It has also produced several heterotic hybrid combinations with other parents. The operation of both additive and non-additive types of gene actions in the inheritance of grain yield and yield components is inferred in the present investigation. Of the available breeding procedures, recurrent selection techniques would result in the improvement of yield components in the desired direction effectively harnessing the fixable (additive) and non-fixable (dominance) gene effects as observed in the present study.

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COMBINING ABILITY FOR DAYS TO FLOWERING AND GRAIN YIELD IN GRAIN SORGHUM *(Sorghum bicolor* (L.)Moench.)

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ABSTRACT

Knowledge on the prepotency in the parents of the hybrid is an essential requirement. To have the information on combining ability of the parents and crosses, a set of eighty one cross combinations of nine male sterile lines and nine restorer lines of sorghum were studied. Analysis of variances showed significant differences among the genotypes for days to 50 per cent flowering and grain yield per plant. The variance due to lines was significant and larger in magnitude. Days to 50 per cent flowering is largely under control of non-additive genetic effects. The components of variance for grain yield due to GCA and SCA pointed out the preponderance of non- additive gene action as reflected by high SCA variance. The male steriles 296A, 2077A and TNAU ms 1A among the lines and Co 25, TNS 34 and IL 101 among the testers with more of additive genetic effects could be utilized in exploitation of hybrid vigour.

Among the coarse grain cereals, sorghum ranks first in area and it contributes 43 per cent of the total millet production of the State of Tamil Nadu. Almost all the summer irrigated Sorghum area is covered by the hybrids besides a considerable area during rainfed season. Apart from their yielding ability, hybrids gave more reliable yields than varieties. In the utilization of heterosis, selection is for combining ability of two parents. Studies on combining ability are useful in understanding the nature of genetic variance present in the material and for selecting suitable parents for use in crossing programme for developing superior varieties/hybrids.

MATERIALS AND METHODS

Eighty one hybrid combinations were obtained by crossing nine male sterile lines viz., 296A, 2077A, 2219A, A_2A, TNAU ms 1A, 3002A, 3003A, 3006A, and 3050A with nine restorers namely Co 21, Co 25, Co 26, TNS 30, TNS 32, TNS 34, IL 101, IL 103 and IL 105. These eighty one hybrids along with eighteen parents were raised in three row plot, adopting randomised block design replicated twice. The row to row and plant to plant distance were 45 Cm and 15 Cm respectively. The biometrical observations on days to 50 per cent flowering was recorded by counting number of

Table 1. Estimates of variance for combining ability

Sources	Days to 50% flowering	Grain yield per plant
Hybrids	73.20**	1029.65**
Lines	404.96**	4474.51**
Testers	93.81**	1390.00*
Lines x testers	29.16**	553.85**
Error	0.84	52.52
σ^2 GCA	12.23	132.13
σ^2 SCA	14.16	250.67
GCA : SCA	0.86 : 1	0.53 : 1

** Significant at 1% level.

days taken from sowing to flowering of 50 per cent of the plants in the plot and grain yield per plant was recorded on five randomly selected plants from each variant per replication. The observations recorded on the hybrids were subjected to Line x tester analysis and general combining ability effects of parents and specific combining ability effects of the crosses were estimated based on the method developed by Kempthorne (1957) based on experiment II of Comstock and Robinson (1952). The analysis of variance and mean square expectations are based on the model proposed by Rao *et al.* (1968).

RESULTS AND DISCUSSION

The relative estimates of variance due to general and specific combining ability for days to 50 per cent flowering and grain yield per plant are presented in Table 1. Analysis of variance showed significant differences among the genotypes for the above two characters. Hybrids showed significant variation among themselves. The variance due to lines was significant and larger in magnitude.

Days to 50 per cent flowering is largely under the control of non- additive genetic effects since the variance of SCA is more pronounced than that of GCA variance (GCA:SCA = 0.86:1). The present finding is in accordance with the findings of Tripathi *et al.* (1976), Palanisamy (1977) and Lakshmaiah (1988).

Parents with high negative *gca* effects could be considered best for exploiting earliness in hybrids. Among the lines 3050A recorded the highest significant negative gca effects (-5.27) followed by 2219A (-4.99), 3003A (-2.66), 3006A (-2.66) and A_2A (- 0.88). Among the testers TNS 30 was the best with highest significant negative *gca* effects of (-3.49) followed by TNS 32 (-2.49), IL 105 (-1.49) and Co 26 (-0.99). These parents could be considered as good for imparting earliness. The range of specific combining ability varies from -10.40 to 8.27 in different crosses. (Table 2). The cross A_2A x Co25 exhibited highly significant negative *sca* effects. The *sca* effects of the hybrids revealed that two hybrids viz., 3003A x TNS 30, 3006A x TNS 32 involving both of their respective parents with high negative gca effects would be appropriate for further exploitation of earliness. (Table 2).

The ultimate objective in any breeding programme is the grain yield and the breeding

Table 2. General and specific combined ability effects - days to 50% flowering

Parents	Co 21	Co 25	Co 26	TNS 30	TNS 32	TNS 34	IL 101	IL 103	IL 105	gca of lines
296A	6.66**	-6.73**	0.27	-3.84**	-1.28	0.49	-0.06	3.94**	0.55	6.12**
2977A	1.88*	4.99	0.49	-5.12**	-3.06**	5.22**	-3.34**	0.34	-0.73	8.51**
2219A	1.49	4.10	2.10*	-1.01	-0.45	-4.67**	-1.23	-1.23	0.88	-4.99**
A_2A	-1.51	-10.40**	0.10	3.99**	6.05**	-1.17	-0.73	4.27	-0.62	-0.88**
TNAU ms IA	1.49	-6.40**	0.50	2.99**	7.55**	-3.17**	-1.23	-2.23*	0.38	1.56**
3002A	-0.28	1.33	1.82	4.72**	-2.73**	-1.95*	-1.01	0.01	-1.89*	0.28
3003A	-6.73**	6.88**	0.88	-0.23	-2.67**	-0.90	1.55	0.55	0.66	-2.66**
3006A	0.49	0.60	-4.40**	-2.01*	-2.95**	0.83	8.27**	-2.73**	1.88*	-2.66**
3050A	-3.51**	5.60**	-1.90*	0.49	-0.45	5.33**	-2.23**	-2.23*	-1.12	-5.27**
gca of testers	-0.16	2.12**	-0.99**	-3.49**	-2.49**	2.78**	1.23**	2.51**	2.51**	-

** Significant at 1% level
* Significant at 5% level

SE (gi) (Lines) : 0.22
SE (gi) (testers) : 0.22
SE (si) (Hybruds) : 0.65

Table 3. **General and specific combining ability effects - Grain yield per plant**

Parents	Co 21	Co 25	Co 26	TNS 30	TNS 32	TNS 34	IL 101	IL 103	IL 105	gca of lines
296A	-32.44**	-3.17	16.01*	20.28**	-6.64	-11.78	14.14	-2.78	6.39	22.69**
2977A	6.98	-0.29	0.19	10.35	-25.90**	48.24**	-21.61**	-11.11	-6.84	21.26**
2219A	-5.41	38.35**	4.01	-0.92	-22.21**	-9.71	-1.12	3.60	-6.59	-8.30**
A_2A	-4.64		8.76	3.28	5.22	-4.10	-3.33	28.74**	5.04	-24.25**
TNAU ms IA	12.02	-38.97**	-9.39	-13.26	22.07**	2.76	0.21	-3.94	-9.68	12.27**
3002A	13.18	-0.79	-9.39	-5.49	2.25	-7.41	-15.15*	11.47	9.28	-2.83
3003A	20.17	1.85	-7.52	-19.51**	4.30	6.16	9.35	-2.17	-3.84	-12.96**
3006A	0.54	-6.95	11.53	-3.80	-15.32**	-25.90**	24.68**	-12.53	16.32*	-2.63
3050A	-10.40	4.48	-13.60	9.07	36.23**	1.74	-7.18	-11.27	-10.07	5.25*
gca of testers	3.96	5.48	-0.05	-18.49**	-3.97	5.81*	10.88**	-0.80	-4.17	-

** Significant at 1% level SE (gi) (Lines) : 1.71
* Significant at 5% level SE (gi) (testers) : 1.71
SE (si) (Hybruds) : 5.12

procedures are to be focussed and carefully formulated in increasing the potentiality of this complex trait. Nature of gene action underlying the character will aid the breeders in formulating suitable breeding procedures. The components of variance due to GCA and SCA pointed out the preponderance of non-additive gene action as reflected by higher SCA variance. This situation has been reported by many workers (Nayeem and Bapat, 1984; Selvi, 1984 and Lakshmaiah, 1988).

The presence of considerable non-additive gene action for grain yield in the present study suggested that once high yielding improved lines are isolated, further yield improvement could be achieved by a hybrid programme. In case of non-additive gene action determining the grain yield in sorghum, the more appropriate breeding technique is exploitation of hybrid vigour.

The three male steriles viz. 296A, 2077A and TNAU ms 1A among the lines and Co 25, TNS 34 and IL 101 among the testers possessed high gca effects for grain yield. The hybrids between the positive combiners, 296A x Co 25, 296A x TNS 34, 296A x IL 101, 2077A x Co 25, 2077A x TNS 34, 2077A x IL 101, TNAU ms 1A x Co 25, TNAU ms 1A x TNS 34 and TNAU ms 1A x IL 101 showed low sca effects in general indicating lack of genetic diversity. The cross 2077A x TNS 34 showed high *sca* effects and this had the combination of both best combiners. Hence these six parents with more of additive genetic effects could be utilized in exploiting hybrid vigour. (Table 3).

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