Research Article

Combining ability for fodder yield and its components in Sorghum (*Sorghum bicolor* L)

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Abstract

Seven lines were crossed with five testers in a L x T mating design to estimate the combining ability for fodder yield in sorghum. Non-additive genetic variance played a preponderant role in the inheritance of all the characters studied *viz.,* days to 50 % flowering, plant height, number of tillers, number of leaves, leaf length, leaf breadth, stem diameter, green fodder yield and dry fodder yield. The parent's *viz.,* ICSA 693 and PKB 192 can be considered as superior parents in the present study as they recorded high *per se* performance with positively significant general combining ability effect for green fodder yield/plant. Among the 35 hybrids evaluated, crosses *viz.,* ICSA 547 x PKB 192, ICSA 374 x PKB 161, ICSA 403 x CSV 15-217 were considered as superior hybrids as they recorded high *per se* performance and significant *sca* effect for green fodder yield/plant.

Key words:
Combining ability, *gca, sca,* fodder sorghum

Introduction

Sorghum plays a very important role in providing nutrition to human race along with wheat, rice, maize and barley in many countries of the world. It is one of the most important food and feed crops of India. Thus, improvement of sorghum is much emphasized owing to its importance as food and fodder crop. The demand for fodder sorghum is fast increasing. To meet the demand increase in the production should come from same or even less area in the present situation of shrinking agricultural land. Improvement of the genetic potential of the crop in order to maximize the economic gain per unit of input remains the most possible means of increasing the production. It is necessary to improve the fodder sorghum yield with nutritionally superior qualities in order to obtain better animal performance. The fodder yield is the primary trait targeted for improvement of fodder sorghum productivity through exploitation of heterosis. The combining ability analysis gives useful information regarding the selection of parents in terms of the performance of their hybrids. Further, their analysis elucidates the nature and magnitude of various types of gene actions involved in the expression of quantitative traits (Dhillon, 1975, Sanderson *et al,* 1993, Mohammed, 2007 and Mohammed and Talib, 2008). Line x tester mating design is used routinely to generate material for estimation of combining ability effects which provide basic idea about the genetic potential of parents.

The objective of this study was to determine the combining ability of 12 parents for fodder yield and its yield components. The study envisaged assessing general combining ability of parents and specific combining ability of crosses by following a line x tester (L x T) mating design.

Material and methods

Seven male sterile lines (ICSA 547, ICSA 403, BJ 3A, ICSA 693, ICSA 374, ICSA 744 and TNSPV 14094) were crossed with five testers (PKB 291**,** PKB 161, CSV 15-217, CSV 15-310 and PKB 192) in a L x T mating design during summer 2008. The parental line selection criteria were based on characters contributing to increased fodder yield and its component traits. Thirty five F_1 hybrids along with their 12 parents and two standard checks *viz.,* CO 27

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and COFS 29 were grown in a randomized block design with three replications during kharif 2008 in the Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore. Both parents and F_1 were raised each in one row of 4 m length with a spacing of 60 cm x 15 cm. The biometrical observations on fodder yield and other related components *viz.,* days to 50 per cent flowering, plant height, number of tillers, number of leaves, leaf length, leaf breadth, stem diameter, green fodder yield and dry fodder yield were recorded on five randomly selected plants from each of the three replications at the time of 50 per cent flowering. The mean values of observations were subjected to L x T analysis (Kempthorne, 1957) to estimate combining ability effects. Analysis of variance (ANOVA) was performed to test the significance of differences among the genotypes including crosses and parents (Snedecor and Cocharan, 1967 and Panse and Sukhatme*,* 1994).

Results and discussion

The ANOVA indicated that the variance due to genotypes were highly significant for all the nine characters studied indicating the existence of wide variability among the genotypes. For efficient selection, presence of variability among the genotypes for the traits of interest is a prerequisite.

Analysis of variance for combining ability revealed that variances due to lines were significant for all the characters except number of leaves. This indicates that all the characters other than number of leaves contribute much for genetic diversity among the lines. The variance due to testers was significant for all the traits except number of tillers. The variance among the hybrids was highly significant for all the characters. The interaction effect (L × T) was also highly significant for all the characters studied; it indicates significant difference of *sca* effects among the hybrids. The variance due to specific combining ability was greater than the variance due to general combining ability, which indicated the predominant role of non-additive gene action in the expression of these traits. Non-additive gene action for these traits was earlier reported by Paroda *et al*. (1978) and Jayamani (1991).

The *per se* performance of parents was considered as the first important criterion for selection. Perusal of the *per se* performance of parents indicated that the parents BJ 3A, ICSA 693, PKB 192 and PKB 161 recorded high green fodder yield among the parents. Apart from green fodder yield, the parent BJ 3A also registered significantly superior *per se* performance for days to 50% flowering (earlier), number of leaves, stem diameter and dry fodder yield; ICSA 693 for leaf breadth and dry fodder yield; PKB 192 for days to 50% flowering, plant height, number of tillers, leaf length, leaf breadth, stem diameter and dry fodder yield and PKB 161 for plant height, leaf length, stem diameter and dry fodder yield.

The second criterion of selection is the general combining ability (*gca*) effects of parents as the parents with high mean values may not necessarily be able to transmit their superior traits to their progenies. The result indicated that two lines *viz.,* ICSA 403, ICSA 693 and the one tester, PKB 192 recorded significantly positive *gca* effects for green fodder yield/plant. The line ICSA 403 also recorded positive and significant *gca* effects for days to 50% flowering, plant height, number of tillers, leaf length, leaf breadth and dry fodder yield; ICSA 693 for plant height, leaf length, leaf breadth, stem diameter and dry fodder yield and the tester PKB 192 for plant height, leaf length, leaf breadth, stem diameter and dry fodder yield (Table 1). Thus, it would be worthwhile to use above parents in breeding programme for exploiting additive gene effects. Similar results were reported by Patel and Desai (1990) and Jayamani (1991).

Among the 35 crosses evaluated, the crosses ICSA 547 x PKB 192, ICSA 374 x PKB 161 and ICSA 403 x CSV 15-217 recorded significant *sca* effects for green fodder yield and its component traits (Table 2). The cross ICSA 547 x PKB 192 involved one good combiner and one poor combiner for green fodder yield. Such occurrence of good hybrids by the combination of one good combiner and one poor combiner may be due to accumulation of favorable genes and partly due to dominance and recessive interaction. Some cross combinations due to crossing between parents with poor *gca* and yet the hybrids had highly significant *sca*. These could be because of cancellation of undesirable effects. In such combinations, to obtain better segregants, selection may be postponed to later generation to develop high yielding inbreds.

Thus, based on *gca*, the parents ICSA 693 and PKB 192 could be better choices for improvement of yield and component traits through hybridization. The crosses ICSA 547 x PKB 192, ICSA 374 x PKB 161 and ICSA 403 x CSV 15-217 which had highly significant *sca* effect for most of the yield contributing traits may be exploited for the development of fodder sorghum hybrids since they also had high *per se* performance.

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Table 1. Estimates of general combining ability (*gca*) effects for fodder yield and yield components in sorghum

Parents	Days to 50% flowering	Plant height (cm)	Number of tillers	Number of leaves	Leaf length (cm)	Leaf breadth (cm)	Stem diameter (cm)	Green fodder yield (g)	Dry fodder yield (g)
Lines									
ICSA 547	2.92 **	-6.65 **	0.15	-0.24	-1.06	-0.39 **	-0.19 **	-4.49 *	-0.33
ICSA 403	-3.54 **	4.02 *	0.22 *	0.10	2.65 **	1.10 **	-0.07 **	31.45 **	11.33 **
BJ 3 A	-0.08	-4.78 *	0.29**	-0.30	-2.28 **	-0.38 **	-0.07 **	-31.55 **	-13.73 **
ICSA 693	0.68	35.09 **	-0.25 *	0.30	5.23 **	0.75 **	0.21 **	88.31 **	33.87 **
ICSA 374	3.46 **	-13.31 **	-0.18	0.16	-0.90	-0.26 **	0.21 **	-40.75 **	-15.93 **
ICSA 744	0.52	-10.25 **	-0.11	0.10	-0.05	-0.42 **	-0.09 **	-18.02 **	-5.87 **
TNSPV 14094	-2.61 **	-4.11 *	-0.11	-0.10	-3.58 **	-0.40 **	0.01	-24.95 **	-9.33 **
Testers									
PKB 291	1.30 **	7.06 **	-0.14	0.01	-0.01	0.18 **	-0.03	3.26	3.37 **
PKB 161	-2.23 **	3.72 *	0.10	-0.42 **	-1.64 **	-0.04	0.01	-13.41 **	-1.91 **
CSV 15-217	0.82	-13.66 **	0.14	0.49 **	-2.76 **	-0.44 **	-0.06 **	-18.36 **	-8.25 **
CSV 15-310	0.30	-20.51 **	-0.05	-0.13	1.37 *	0.01	0.05 **	-16.60 **	-5.96 **
PKB 192	-0.18	23.39 **	-0.05	0.06	3.03 **	0.28 **	0.03 *	45.11 **	12.75 **
SE lines	0.50	1.84	0.10	0.17	0.69	0.07	0.02	1.97	0.76
SE tester	0.42	1.55	0.09	0.14	0.58	0.06	0.01	1.66	0.64

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

Table 2. Estimates of specific combining ability (*sca*) effects of best three crosses based on *per se* performance

Characters	ICSA 547 × PKB 192		ICSA 374 × PKB 161		ICSA 403 × CSV 15-217		SE	CD (at 5% level)
	per se	*sca*	*per se*	*sca*	*per se*	*sca*	*per se*	*per se*
Days to 50% flowering	55.00	-3.35**	61.00	4.16**	48.00*	-4.89**	0.16	3.16
Plant height (cm)	293.00*	67.74**	241.00*	42.08**	222.00*	23.12**	3.92	10.98
Number of tillers	4.00*	0.85**	3.00	0.04	4.00*	0.59*	0.22	0.61
Number of leaves	10.33	0.81*	9.33	-0.11	9.33	-0.95	0.37	1.03
Leaf length (cm)	91.17*	8.56**	88.03*	9.93**	77.20	-3.33*	1.48	4.16
Leaf breadth (cm)	8.53*	1.12**	8.17*	0.94**	8.87*	0.68**	0.16	0.44
Stem diameter(cm)	1.80*	0.37**	2.10*	0.30**	1.70	0.23**	0.04	0.12
Green fodder yield (g)	597.33*	170.49**	421.00*	94.94**	472.00*	78.70**	4.12	11.53
Dry fodder yield (g)	207.33*	54.38**	155.67*	32.98**	174.67*	31.05**	1.58	4.41

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