It can be inferred form the results of genotypic correlation coefficients and path analysis that panicle length, grains per panicle, 100 - grain weight and harvest index showed not only positive correlation coefficients but also positive direct effects on yield.

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HETEROSIS AND COMBINING ABILITY IN INTER-SPECIFIC HYBRIDS BETWEEN CMS OF *Bajra* AND NAPIER GRASS

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ABSTRACT

General and specific combining ability variances and effects for seven fodder characters were studied in bajra-napier interspecific hybrids obtained in line x tester programme involving 9 CMS lines of *bajra* as female and 6 genotypes of napier grass, as male. The mean squares due to general and specific combining ability were significant indicating the importance of both additive and dominance components. The magnitude of sca variances was greater than that of gca for all characters suggesting the predominance of non-additive gene action. The parents, 405 A, 306 A, and 732 A among the CMS lines of *bajra* and FD 466 and FD 435 among napier grass were identified as best general combiners. The crosses 306 A x FD 466, 306 A x FD 435, 437 were the best specific combinations for forage yield. High heterosis observed for different forage yield characters was mostly due to the desirable sca effects.

KEY WORDS : *Bajra*, Napier Grass, Inter - Specific Hybrids, Heterosis, Combining Ability

Among the cultivated perennial grasses, bajra-napier hybrid grass has been acclaimed as the highest forage yielder in an unit time and space. Bajra-napier hybrid grass is an inter-specific hybrid produced after crossing *bajra (Pennisetum glaucum)* with napier *(P. purpureum)*. In the past, the production of bajra- napier grass had been due to the involvement of *bajra* genotypes that were either grain or fodder types (Patil and Goshe, 1962; Gupta 1969; Narayanan and Debadghao, 1972; Gupta and Bhardwaj, 1975; Amirthadevarathinam and Stephan Dorairaj, 1992 ; Suthamathi, 1993). The set seeds obtained in such crosses that involved grain or fodder bajra genotypes as ovule parents, were made of both hybrid and selfed seeds of *bajra*. The CMS lines of *bajra* were used in hybridisation programme with napier and the resulting inter - specific hybrids were studied for their performance relating to fodder yield and its component characters besides estimating the

Table 1. ANOVA for combining ability in bajra-napier hybrids

Source	df	Plant height	Tillers per clump	Leaves per tiller	Leaf length	Leaf breadth	Stem thickness	Fodder yield per clump
Replication	1	33.56	7.79	0.60	1.45	0.03	0.05*	0.05**
Crosses	53	1446.81**	27.18**	4.54**	349.79**	0.15**	0.02**	0.05**
Females	8	993.06**	62.79**	2.52**	220.30**	0.34**	0.04**	0.34**
Males	5	1652.12**	17.54**	9.69**	318.43**	0.06**	0.02	0.02**
Femalex x Males	40	1511.89**	21.26**	4.80**	379.55**	0.12**	0.01	0.13**
Error	107	54.37	2.07	1.72	2.95	0.01	0.01	0.003
6^2 gca		N.E.	1.026	0.12	N.E.	0.05	0.001	0.003
6^2 sca		728.76	9.59	2.45	188.30	0.06	N.E.	0.064

*, ** Significant at 5% and 1% level respectively; N.E. : Not estimable

genetic potential of the CMS lines of *bajra* in the development of high yielding hybrids.

MATERIALS AND METHODS

Nine CMS lines of *bajra* (303 A, 306 A, 405 A, 732 A, 834 A, 852 A, TRI 23 A, 111 A and 81 A) were crossed with six genotypes of napier (FD 435, 444, 458, 466, 437 and 439) to raise 54 hybrids according to the model of Kempthorne (1957) during *rabi* 1991. The hybrids and their 15 parents, and Co 2 bajra-napier hybrid were sown/planted in a randomised block design with two replications, in the experimental plots at the Department of Forage crops, Tamil Nadu Agricultural University, Coimbatore, during *kharif* 1992. The trials for the hybrids and parents inclusive of Co 2 were conducted separately in the adjacent blocks. Each experimental plot was made of three rows of 4m length spaced at 50 cm. Seeds of hybrids and CMS A lines of *bajra* were hand drilled in rows. Two or three budded stem cuttings of napier and Co2 BN hybrids were planted adopting a spacing of 50 x 50 cm. Thinning was done at appropriate time in the seed sown crop. Standard cultural, manurial and management practices were followed. At the time of second cut, data were recorded on five competitive clumps in each plot for green fodder yield and its component characters: plant height, number of tillers per clump, number of leaves per tiller, leaf length, leaf breadth, stem thickness and green fodder yield. Five tallest tillers, one each from five random

Table 2. General combining ability effects (gi) of parents of bajra-napier hybrids

	Plant height		Tillers		Leaves		Leaf length		Leaf breadth		Stem thickness		Fodder yield	
	m	gi	m	gi	m	gi	m	gi	m	gi	m	gi	m	gi
Females (CMS lines)														
303 A	100.6	-13.56**	6.1	-0.40	6.5	0.28	44.5	4.53**	1.82	0.01	0.91	0.05	0.31	-0.18**
306 A	149.3	-1.60	8.9	1.27**	6.3	0.78**	50.0	5.67**	1.93	-0.14**	2.21	0.03	0.43	0.20**
405 A	168.5	8.33**	7.8	1.52**	6.8	0.19	64.5	1.56**	2.81	0.20**	1.16	0.11**	0.45	0.19**
732 A	45.4	-4.61*	2.9	1.18**	6.0	-0.22	42.6	4.71**	3.03	-0.06	1.52	0.03	0.49	0.05**
834 A	119.7	-4.76*	4.1	-0.82	5.4	0.36	57.1	0.14	2.84	-0.08*	1.06	-0.01	0.26	-0.06**
852 A	98.5	14.73**	5.1	-3.57	5.6	-0.56	36.8	-4.86**	2.45	0.25**	0.95	-0.02	0.24	-0.25**
TRI 23 A	119.6	-5.36*	3.8	-3.07**	5.0	0.11	40.2	-3.77**	2.32	0.16**	0.87	-0.10**	0.26	-0.17**
81 A	71.9	10.26**	8.0	-0.32	7.0	-0.56	45.7	-3.95**	1.65	-0.24**	0.93	-0.06	0.35	0.05**
111 A	82.7	-3.42	3.7	3.18	6.2	0.39	44.6	-4.03**	2.18	-0.10	0.75	-0.03	0.19	0.14**
Males (napier)														
FD 435	162.8	14.44**	7.9	-1.40	7.0	1.00**	99.2	-5.08**	2.12	0.00	1.02	-0.01	0.65	0.01
FD 444	169.7	-1.81	9.0	0.66	7.6	0.00	61.9	4.03**	1.98	0.09**	0.76	0.05	0.58	0.02
FD 458	135.4	7.96**	5.3	0.16	8.0	0.50	78.2	-0.33	2.56	0.00	1.00	0.02	0.41	-0.01
FD 456	168.8	-11.96**	10.2	1.43**	8.4	-1.17**	98.2	4.05**	1.64	0.04	1.24	0.01	0.99	0.02
FD 437	154.6	-3.01	8.8	-0.57	6.8	-0.06	84.9	2.30**	2.08	-0.06	0.80	-0.5	0.35	-0.03**
FD 439	161.5	-5.62**	8.4	-0.29	7.2	-0.28	75.0	-4.96**	2.26	-0.07**	0.82	0.00	0.65	0.02

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

Table 3. Estimates of mean, sca effects and heterosis for important high forages yielding bajra napier hybrids

Characters	Crosses					
	306 A x FD 466	306 A x FD 435	306 A x FD 437	I RI 23 A x FD 466	852 A x FD 439	834 A x FD 437
Fodder yield per clump						
m (kg)	2.4	2.05	2.03	1.95	1.65	1.55
sca	0.68**	0.32**	0.22**	0.22**	0.70**	0.30**
h	115.0	113.5	110.9	103.1	71.9	61.5
Plant height						
m (cm)	118.5	167.8	148.1	107.5	141.6	119.0
sca	-3.21	19.63*	17.43*	-10.46	-67.67	-8.5
h	-12.4	24.0	9.5	20.6	4.6	-12.1
Tillers / clump						
m (cm)	17.5	14.0	15.0	5.5	10.5	8.5
sca	3.39**	1.45	2.05*	-2.19*	3.26*	3.30*
h	30.2	21.3	3.6	-3.20	-20.1	24.3
Leaves/tiller						
m (cm)	10.0	12.5	11.5	10.0	8.0	9.0
sca	0.83	1.17	1.22	-0.50	0.28	-0.40
h	8.7	35.9	25.0	-13.0	8.7	3.3
Leaf length						
m (cm)	88.8	61.5	49.2	69.7	52.5	69.0
sca	27.13*	9.00*	-10.67	17.51*	10.40	14.10*
h	77.2	22.8	-1.8	39.1	4.8	37.7
Leaf breadth						
m (cm)	2.2	2.5	2.5	2.8	2.6	2.1
sca	-0.29*	0.09	0.15	0.20*	0.02	-0.28
h	-6.5	8.7	-8.7	21.7	13.0	-8.7
Stem thickness						
m (cm)	0.85	0.95	0.90	0.90	0.90	0.10
sca	-0.12	0.04	0.02	-0.15	0.02	0.10
h	-2.3	9.2	3.5	-19.5	3.4	3.4

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

clumps were used for measuring plant height, number of leaves, leaf length, leaf breadth and stem thickness. Longest leaf was taken for measuring its length and breadth. Combining ability analysis was done following the method of Kempthorne (1957). Heterosis was estimated as per cent improvement over the standard Co 2 bajra-napier hybrid.

RESULTS AND DISCUSSION

The seeds obtained by crossing CMS lines of *bajra* and napier were used for raising bajra-napier hybrids. The ANOVA for combing ability (Table 1) showed significant differences for all the characters in the females. The differences due to males and females x males interaction were also significant for all the characters excepting stem thickness. This brought out the importance of both additive and non-additive type of gene action in the inheritance of fodder yield characters in the interspecific bajra-napier hybrids. Non- significant differences observed for stem thickness in males as well as females x males interaction suggested that the gca of female lines i.e. CMS lines of *bajra* was largely responsible for the expression of this character in the hybrids. The non-additive genetic variance was higher than additive genetic variance was higher than additive genetic variance for all the character under study. Preponderance of non additive genetic effects has already been observed for fodder yield characters in the interspecific bajra-napier hybrids (Amirthadevarathinam and Stephan Dorairaj, 1992; Suthamathi, 1993)

The larger differences for gca in the CMS lines of *bajra* for tillers per clump, leaf breadth, stem thickness, and fodder yield indicated that the CMS lines of *bajra* were responsible for the majority of additive gene effects for the above characters and selection among the *bajra* would help genetic improvement for fodder yield characters. The gca effects of the parents are presented in Table 2. Parents with desirable gca effect were found in both female lines and males in respect of each character. However, the gca effects of few desirable combiners for fodder yield in the males *i.e.* napier, were all non-significant. The female parents 852 A, 81 A and 405 A and the male parents FD 435 and FD 458 showed positive and significant gca effects for plant height. For tillers per clump, 111 A, 405 A, 306 A and 732 A among females and FD 466 among males were the good general combiners with positive and significant gca effect. The female parent 306 A and the male parent FD 485 had the desirable gca effect for number of leaves. As many as six parents, four from the female lines (306 A, 732 A, 303 A and 405 A) and two from the males (FD 466 and FD 444) showed positive and significant gca effect for leaf length. For leaf length, 405 A and TRI 23 A among females and FD 444 among males were the good general combiners. 405 A was the only general combiner that showed positive and significant gca effect for stem thickness. Five parents, all from the female lines *via.* 306 A, 405 A, 111 A, 732 A and 81 A were the general combiners with desirable gca effect for fodder yield.

Some of the parents with desirable gca effect were good general combiners for more than one character. The parent 405 A was an outstanding general combiners for as many as six character with the exception of leaves per tiller. 306 A was another good general combiner four characters *via.*, tillers per clump, leaves per tiller, leaf length and fodder yield. 732 A would merit consideration as a general combiner for three characters *viz.*, tiller per clump, leaf length and fodder yield. Other parents like 81 A, 111 A, FD 435, FD 444 and FD 466 showed positive and significant gca effect for any two characters together.

Among the hybrids that were evaluated, 14 for plant height, 11 for tiller per clump, 1 for leaves per tiller, 20 for leaf length, 8 for leaf breadth and 17 for fodder yield showed positive and significant sca effects and consequently high heterosis. It was thus obvious that non-additive genetic and interaction exerted considerable influence in the control of fodder yield characters in the bajra -napier hybrids. Positive standard heterosis was observed upto a maximum of 34.9 per cent for plant height (81 A x FD 466), 53.9 per cent for tillers per clump (303 A x FD 444), 35.9 per cent for leaves per tiller (306 A x FD 435), 77.2 per cent for leaf length (306 A x FD 466), 21.7 per cent for leaf breadth (TRI 23 A x FD 466), 20.7 per cent for stem thickness (732 A x FD 466), and 115.0 per cent for fodder yield (306 A x FD 466). All the hybrids that exhibited maximum heterosis had high and desirable sca efforts. Similar was the case with other hybrids that manifested high heterosis. The hybrids of the cross 306 A x FD 466, 306 A x FD 435, 306 A x FD 437, TRI 23 A x FD 466, 852 A x FD 439 and 834 A x FD 437 were the best specific combinations each of which showed significant sca effects for three characters including forage yield as well (Table 3.) As bajra-napier hybrids are amenable for vegetative propagation, these high yielding specific combination would be worthy of consideration form the utility point of view.

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