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COMBINING ABILITY AND HETEROSIS FOR FIBRE YIELD AND QUALITY TRAITS OF *TOSSA* JUTE (*CORCHORUS OLITORIUS* L.)

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ABSTRACT

Nine diverse tossa jute (*Corchorus olitorius* L.) indigenous germplasm were selected from twenty seven germplasmon the basis of Mahalanobis D^2 analysis from the pooled mean data over four years *i.e.*, 2007 – 2010. The selected nine genotypes included three namely JRO 128, JRO 620 and JRO 878 which were high fibre yielders, three namely OIN 580, OIN 028 and OIJ 267, which were best for fibre tenacity and the remaining three namely OIJ 015, OIN 574 and OIN 217 were better for fibre fineness. In a crossing programme in half diallel mating design, carried out with the nine parents, combining ability and heterosis was estimated. The findings revealed that the variation due to parents vs. crosses was significant for all the traits except fibre percentage, indicating the presence of substantial differences between parents and crosses. Combining ability analysis revealed predominance of additive gene action for fibre percentage and therefore transgressive breeding was recommended for this trait whereas plant height, basal diameter, green weight per plant, stick weight per plant, fibre yield per plant, fibre tenacity and fibre fineness were controlled predominantly by non-additive gene action and therefore heterosis breeding was suggested to be a better option for them. Among the 36 crosses OIN 028 × OIN 574, OIN 217 × JRO 128 and OIN 028 × OIN 580 were best performers forall the fibre yield related and quality traits with high sca effects for fibre yield per plant and two quality traits. The cross OIN 028 × OIN 574 exhibited the highly significant positive heterosis over mid parent and better parent for fibre yield per plant and non-significant heterosis for fibre tenacity. Significantly negative heterosis over the mid parent and better parent was observed in a few crosses for fibre fineness which indicated that their fibre was finer. Overall eleven crosses OIN 028 × OIN 574, OIJ 015 × OIN 028, OIJ 015 × OIN 217, OIN 028 × OIN 217, OIN 028 × OIJ 267, OIJ 015 × OIN 574, OIN 028 × JRO 878, OIJ 267 × JRO 878, OIJ 015 × JRO 128, OIN 217 × OIN 574 and OIN 217 × OIJ 267 were identified as superior for their superiority for fibre yield and its components and fibre quality traits.

Key words : Genetic divergence, Combining ability, Heterosis, Diallel, *Tossa* jute.

Introduction

Jute, the "golden fibre" of Bengal and the most important bast fibre of the World. Itis extracted from the cultivated species of *Corchorus olitorius* and *Corchorus capsularis*, grown extensively in India and Bangladesh and to a minor extent in Brazil and a few other countries. Jute cultivation provides direct employment to millions of farmers, landless labourers and industrial workers including women and provide livelihood for many more, indirectly. With the recent global acquisition of a good number of jute germplasm, analysis of genetic diversity of physiological traits in the gene pool was necessary to identify rare alleles for utilizing them in crop improvement programme. From the detailed analysis of four morpho-physiological traits in the entire collection, the presence of distinct patterns of diversity between the two jute species has been noted. It was apparent that the accessions of both the species contained fairly low genetic diversity at the intra-specific level. However, differences in geographical location of sources did not affect genetic diversity. The range of heterosis was only 18-25% in jute and 30-40% in Mesta. The cost of hybrid seed production through manual operation was also found prohibitive for commercialization of the technology. Information in relation to the genetic nature of quantitative characters of jute is essential to determine breeding procedure for its varietal improvement. Diallel crosses have been used to obtain information concerning the inheritance of quantitative traits in self-pollinated crops. The analysis of a diallel series of crosses in self-pollinated crops as described by Hayman (1954 and 1957) and Jinks (1954 and 1956) has provided a tool that holds great value in investigating the genetic control of complex characters. It also enables to make predictions based on early generation, which greatly increases the efficiency of a breeding program. Results of the diallel cross for yield and yield components in jute have been reported by Jana (1972), Paul *et al*. (1977) and Srivastava *et al*. (1979). The present study was thus undertaken with a view to study the inheritance of the yield contributing characters of jute in F_1. Combining ability is the ability of a parent to produce inferior or superior combinations in one or a series of crosses (Chaudhary, 1982). Many commercial cultivars, besides their high agronomic performances, perform poorly in the F_1 generation, due to genetic hindrances in diverse cross combinations. Consequently, crossing in a diallel fashion is an effective technique for the measurement, identification and selection of superior genotypes (Mohammad, 2003). In estimating combining ability, diallel analysis is the first step in most plant-breeding programs aimed at improving yield and other related parameters (Pickett, 1993 and Griffing, 1956).

Materials and Methods

Nine diverse tossa jute (*Corchorus olitorius* L.) indigenous germplasm were selected from twenty seven germplasmbased on Mahalanobis D^2 analysis from the pooled mean data for four years *i.e.*, 2007 – 2010. The selected nine genotypes (Fig. 1) included three namely JRO 128, JRO 620 and JRO 878, which were high fibre yielders, three namely OIN 580, OIN 028 and OIJ 267, which were best for fibre tenacity and the remaining three namely OIJ 015, OIN 574 and OIN 217, which were better for fibre fineness. The nine parents namely OIJ 015, OIN 028, OIN 217, OIN 574, OIN 580, JRO 620, OIJ 267, JRO 128 and JRO 878 and their 36 F_1's obtained from a 9×9 half diallel cross were raised in a randomized block design with three replications, in rectangular plots of size 1.5×1 m^2 area, in which there were five rows of 1 m length. The row to row and plant to plant spacing were 30 cm and 10 cm, respectively. These were evaluated by combining ability [suggested by Griffing (1956), Model 1, Method-2] of high fibre yielding genotypes with superior fibre quality in half-diallel fashion (without reciprocals) crossing programme and estimating the heterosis of fibre yield and quality of tossa jute. The observations were recorded on six yield-attributing traits namely plant height (cm), basal diameter (mm), green weight (quintal/ hectare), stick weight (quintal/hectare), fibre percentage per plant (%) and fibre yield (quintal/hectare) and two quality traits namely fibre tenacity (g/tex) and fibre fineness (tex). The data was recorded from five randomly selected plants in each replication for the traits plant height, basal diameter and fibre percentage per plant and the two quality traits *viz.*, fibre tenacity and fibre fineness. The data for the other traits namely green weight, stick weight and fibre yield was recorded per plot and converted

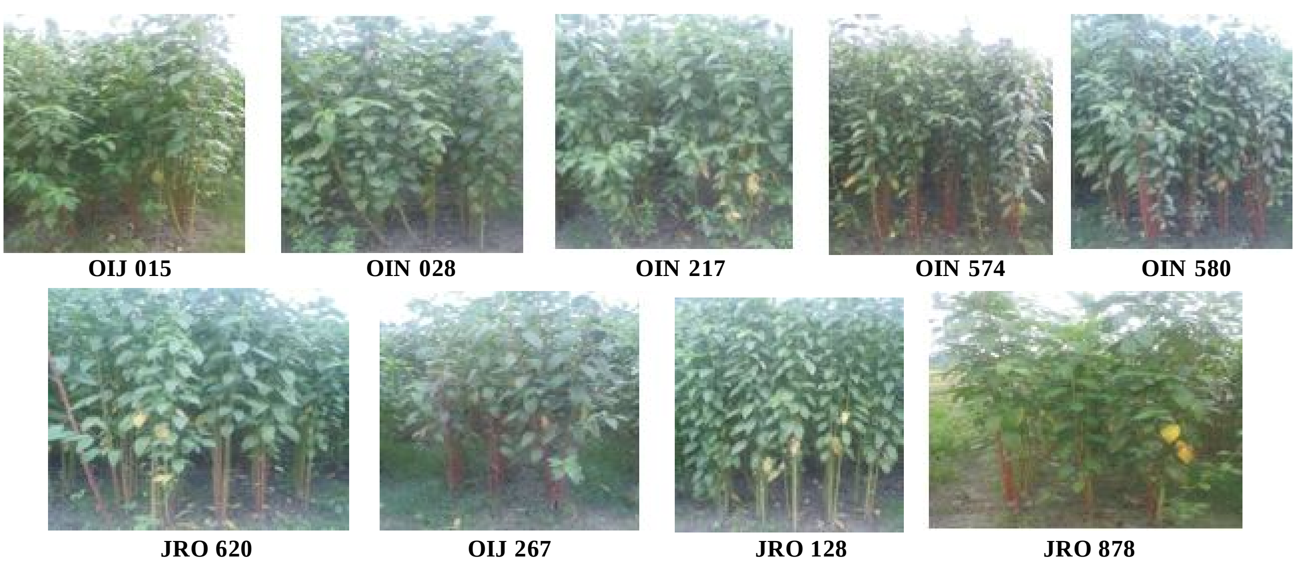

Fig. 1 : Nine parents of *C. olitoirus* selected for diallel crossing programme.

into quintal per hectare (q/ha). The two quality traits namely fibre tenacity and fibre fineness were recorded by the instruments namely Fibre Bundle Strength Tester and Airflow Fineness Tester from ICAR-NIRJAFT (Tallygunj, West Bengal). The statistical analysis was carried out using the software 'Windowstat'.

Results and Discussion

The cluster analysis (Table 1) revealed that the genotypes JRO 128 and JRO 878 in cluster VII; OIN 046, OIN 217, OIN 572, OIN 574, OIN 576, OIN 580 and JRO 620 in cluster VI and OIJ 015, OIN 028, OIN 257 and OIJ 267 in cluster V were found to be distinct with the desirable characteristics and may be incorporated in breeding programme to improve fibre yield and quality. This is in agreement with the findings of Sita Devi *et al.* (1991) and Satyanarayana *et al.* (2016), who were able to identify a few elite genotypes of kenaf from some of the clusters by considering the cluster mean and inter-cluster distance. Moreover, selection of diverse parents for hybridization programme will be more effective by the identification of characters responsible for the total genetic diversity among the population (Murthy and Arunachalam, 1966). Out of those thirteen genotypes nine were selected *i.e.* three namely JRO 128, JRO 620 and JRO 878, were high fibre yielders, three namely OIN 580, OIN 028 and OIJ 267 were better for fibre tenacity and remaining three namely OIJ 015, OIN 574 and OIN 217, were better for fibre fineness, as parents for a diallel crossing programme. Similar identification of divergent parents for a hybridization programme in roselle was done by Satyanaraya *et al.* (2016).

The mean performances of the crosses were comparatively higher than the parents for all the traits (Table 2). The crosses which performed better were OIN 028 × OIJ 267 for basal diameter, green weight per plant, stick weight per plant and fibre yield per plant, OIN 028 × OIN 574 for plant height, OIN 580 × JRO 128 for fibre percentage, OIJ 015 × OIN 574 for fibre tenacity and OIN 217 × OIJ 267 for fibre fineness.

The analysis of variance revealed that mean sum of squares among parents were highly significant for all the traits except basal diameter, green weight per plant and fibre percentage indicating presence of genetic variability among the parents for these traits (Table 3). Significant differences among genotypes for plant height, stick weight per plant and fibre yield per plant were also reported earlier by Ahmed *et al.* (1993) and Islam *et al.* (2002). The crosses differed significantly for stick weight per plant, fibre tenacity and fibre fineness indicating genetic variability among the crosses for these traits. Fibre tenacity showed highly significant differences among accessions of *C. olitorius*, which are in confirmation with the findings of Palve and Sinha, 2005. The variation due to parents vs. crosses was significant for all the traits except fibre percentage, indicating the presence of substantial differences between parents and crosses.

The general combining ability has been equated with additive gene action and specific combining ability with non-additive gene action (Zhang *et al.*, 2015). Finding better parental lines and cross combinations are made easier by the impacts of general combining ability (GCA) and specialized combining ability (SCA) (Sawarkar *et al.*, 2023).

Highly significant variances were observed for general combining ability effects for fibre percentage

Table 1 : Distribution of 27 tossa jute genotypes in different clusters (pooled over four years from 2007-2010).

Cluster No.	Total no. of germplasm accessions	Source	Name of germplasm accessions	Genotypes selected for diallel crossing programme
I	3	CRIJAF, Barrackpore, Kolkata, West Bengal	OIJ 023, OIN 261, OIJ 255	
II	2	-Do-	OIN 025, OIN 563	
III	2	-Do-	OIJ 170, OIN 219	
IV	7	-Do-	OIJ 027, KalyaniTossa, OIJ 166, OIJ 167, OIJ 168, OIJ 239, OIJ 268	
V	4	-Do-	OIJ 015, OIN 028, OIN 257, OIJ 267	OIJ 015, OIN 028, OIJ 267
VI	7	-Do-	OIN 046, OIN 217, OIN 572, OIN 574, OIN 576, OIN 580, JRO 620	OIN 217, OIN 574, OIN 580, JRO 620
VII	2	-Do-	JRO 128, JRO 878	JRO 128, JRO 878

Table 2 : Mean performance of parents and crosses for fibre yield components and quality traits in tossa jute.

Parents/ F_1's	Plant height (cm)	Basal diameter (mm)	Green weight plant^{-1} (g)	Stick weight plant^{-1} (g)	Fibre %	Fibre yield plant^{-1} (g)	Fibre tenacity (g/tex)	Fibre Fineness (tex)
Parents								
OIJ 015	274.50	14.47	131.67	23.50	9.20	11.67	21.61	1.60
OIN 028	286.40	12.29	139.00	27.37	9.28	13.03	22.76	2.30
OIN 217	309.50	13.42	193.07	38.27	7.49	14.43	19.50	1.83
OIN 574	324.10	13.94	233.67	40.70	7.84	17.37	23.50	1.73
OIN 580	326.80	13.67	190.33	38.27	9.67	18.40	21.34	2.40
JRO 620	323.03	14.15	198.00	37.13	9.19	18.07	18.84	3.00
OIJ 267	332.70	14.56	215.67	47.77	9.90	21.30	22.14	2.20
JRO 128	345.57	16.08	243.00	51.33	9.65	23.20	24.25	3.07
JRO 878	359.50	16.06	261.87	53.27	9.52	25.17	23.44	2.33
Mean	**320.23**	**14.29**	**200.70**	**39.73**	**9.08**	**18.07**	**21.93**	**2.27**
Crosses								
OIJ 015 × OIN 028	359.60	16.64	278.17	51.07	7.84	21.80	23.03	2.57
OIJ 015 × OIN 217	371.93	15.73	258.83	52.73	8.74	21.83	19.14	2.87
OIJ 015 × OIN 574	373.67	13.54	289.00	56.27	8.34	24.07	26.78	2.70
OIJ 015 × OIN 580	373.80	16.91	301.67	61.67	7.98	24.10	20.08	2.40
OIJ 015 × JRO 620	363.17	16.24	283.10	51.90	8.87	25.00	21.11	3.10
OIJ 015 × OIJ 267	375.10	16.18	270.53	57.50	8.17	21.37	24.12	2.50
OIJ 015 × JRO 128	352.23	15.33	266.30	51.77	8.67	21.77	18.36	1.90
OIJ 015 × JRO 878	378.47	16.19	274.80	55.97	9.30	24.73	21.93	2.20
OIN 028 × OIN 217	354.33	15.99	278.97	55.43	8.33	23.23	24.18	2.87
OIN 028 × OIN 574	383.40	17.50	295.47	74.20	10.47	29.65	24.39	3.20
OIN 028 × OIN 580	343.40	15.28	258.67	51.73	9.32	23.63	22.12	2.10
OIN 028 × JRO 620	368.90	18.55	313.33	60.05	7.71	24.10	24.79	3.53
OIN 028 × OIJ 267	374.63	18.56	371.67	77.50	8.51	31.30	25.50	1.90
OIN 028 × JRO 128	354.37	16.63	304.33	54.33	8.01	23.97	21.88	2.57
OIN 028 × JRO 878	350.80	16.32	298.30	53.80	7.93	23.57	26.64	3.17
OIN 217 × OIN 574	341.13	15.56	257.03	47.53	6.94	17.83	20.23	1.43
OIN 217 × OIN 580	334.90	15.47	220.57	50.40	10.54	22.90	21.28	2.90
OIN 217 × JRO 620	348.10	17.05	262.60	47.67	8.29	21.60	18.39	2.90
OIN 217 × OIJ 267	352.27	16.97	292.00	48.30	6.90	19.90	19.57	1.37
OIN 217 × JRO 128	342.53	17.24	263.00	58.83	9.45	24.50	25.18	2.17
OIN 217 × JRO 878	346.20	15.66	235.67	50.57	9.09	21.13	23.73	3.33
OIN 574 × OIN 580	351.93	16.78	260.33	54.33	9.16	23.67	23.48	3.47
OIN 574 × JRO 620	365.23	16.05	238.67	49.57	9.36	21.90	24.85	2.70
OIN 574 × OIJ 267	358.47	16.00	260.67	55.50	9.06	23.63	25.39	2.47
OIN 574 × JRO 128	382.20	17.42	305.00	63.00	8.17	24.35	24.06	3.23
OIN 574 × JRO 878	357.77	15.44	284.33	46.20	7.96	22.27	25.33	2.70
OIN 580 × JRO 620	363.70	14.85	223.27	47.10	10.05	22.30	20.41	3.00
OIN 580 × OIJ 267	373.50	15.27	227.00	56.70	10.60	23.87	23.22	2.77
OIN 580 × JRO 128	343.87	14.40	179.63	44.17	11.05	19.53	25.80	3.00
OIN 580 × JRO 878	355.30	14.01	207.97	44.70	9.14	19.03	24.56	3.03
JRO 620 × OIJ 267	358.63	14.79	215.33	45.73	10.45	22.13	19.94	3.60

Table 2 continued...

Table 2 continued...

JRO 620 × JRO 128	350.93	14.89	215.13	47.40	9.57	20.30	24.55	2.97
JRO 620 × JRO 878	351.97	13.67	190.57	44.43	9.51	18.17	24.53	3.23
OIJ 267 × JRO 128	333.93	14.26	192.67	45.03	9.66	18.43	20.40	2.90
OIJ 267 × JRO 878	348.23	15.46	237.57	50.50	9.32	21.30	26.58	2.80
JRO 128 × JRO 878	354.07	15.72	255.70	52.83	8.37	21.27	23.73	2.57
Mean	**358.13**	**15.90**	**260.22**	**53.23**	**8.91**	**22.61**	**23.04**	**2.73**
Grand Mean	**350.55**	**15.58**	**248.31**	**50.53**	**8.95**	**21.71**	**22.81**	**2.64**
SE(±)	**10.66**	**1.07**	**32.36**	**5.92**	**0.84**	**2.48**	**0.93**	**0.13**
CD (P=0.05)	**29.96**	**3.02**	**90.95**	**16.65**	**2.37**	**6.98**	**2.60**	**0.36**

(Sengupta *et al*., 2005), fibre tenacity and fibre fineness and specific combining ability effects for all the traits except fibre percentage (Table 4). Thus, it indicated that both additive and non-additive gene effects were important in the genetic control of fibre tenacity (Palve and Kumar, 1994) and fibre fineness. In the same way, predominance of non-additive gene effects was reported by Dastidar (1986), Alam and De (1995) for stick weight per plant and fibre yield per plant.

Estimates of *gca* effects of the parents and *sca* effects of the crosses revealed that *sca* components of variance were higher than the gca components of variance for plant height, basal diameter, green weight per plant, stick weight per plant, fibre yield per plant, fibre tenacity and fibre fineness which indicated the preponderance of non-additive variance of gene action in these traits (Table 5). Similar findings for plant height and basal diameter were reported by Srivastava (1974) and Dastidar (1986). The estimated value of *gca* variance was higher than its sca variance for fibre percentage which indicated predominance of additive gene action as the ratio of $\sigma^2_{gca}/\sigma^2_{sca}$ was more than unity while rest of the traits showed predominance of non-additive gene action. The value of degree of dominance $(\sigma^2_{gca}/\sigma^2_{sca})^{0.5}$ for fibre percentage was high, which indicated over dominance for this trait. Further partitioning of genetic variances revealed that additive (σ^2_A) gene action was important for fibre percentage, while non-additive (σ^2_D) gene action was important for plant height, basal diameter, green weight per plant, stick weight per plant, fibre yield per plant, fibre tenacity and fibre fineness.

Negative variance, though rare was revealed for basal diameter. Variance by nature must not be negative as they are squared quantities. But they do occur sometime, particularly when estimates of genetic variance are calculated from expectation of ANOVA as done for determination of σ^2_{gca} from ANOVA for combining ability in the present analysis. The possible reasons could be assigned for occurrence of negative estimates of variances: a) small sample size and presence of aberrant values b) presence of genotype × environment (G × E) interaction which may inflate error variance and c) lack of random mating, while developing half-sibs. However, the occurrence of negative estimates should not be considered as invalid results and as such, they should be promptly reported (Sharma, 1998). Repeated experimentation and then averaging will give the correct picture (Dudley and Moll, 1969). The predictability ratios were high *i.e.*, exceeded the value of 0.50, for fibre percentage indicating the predominance of additive gene action for this trait.

Fibre tenacity recorded moderate predictability ratio indicating the importance of additive and non-additive gene action for this trait. Plant height, basal diameter, green weight per plant, stick weight per plant, fibre yield per plant and fibre fineness recorded low predictability ratios, indicating the predominance of non-additive gene action for these traits.

It can be summarized considering all the variance estimates that fibre percentage was controlled predominantly by additive gene action and therefore transgressive breeding may be useful for this trait, whereas plant height, basal diameter, green weight per plant, stick weight per plant, fibre yield per plant, fibre tenacity and fibre fineness were controlled predominantly by non additive gene action and therefore heterosis breeding is a better choice for these traits. This was in confirmation with the findings of Sengupta *et al*. (2005). Moreover, in case of traits controlled predominantly by non-additive gene action, breeding methodology such as biparental mating and dialled selective mating (Jensen, 1970 and Frey, 1975) may be resorted to, then the conventional pedigree or backcross techniques, which would leave the unfixable components of genetic variances unexploited for fibre yield and its components. However, characters predominantly controlled by additive

Table 3 : Analysis of variance of fibre yield components and quality traits for parents and crosses in tossa jute.

Sources of variation	df	Mean Sum of Squares							
		Plant height (cm)	Basal diameter (mm)	Green weight plant^{-1} (g)	Stick weight plant^{-1}(g)	Fibre %	Fibre yield plant^{-1} (g)	Fibre tenacity (g/tex)	Fibre fineness (tex)
Replication	2	568.93	19.76**	21514.75**	382.35*	1.89	71.04*	1.42	0.22*
Treatments	44	1510.25**	5.55*	6615.57**	277.34**	2.82	39.45**	16.70**	0.93**
Parents	8	2158.66**	4.40	5845.11	304.01**	2.13	62.74**	10.04**	0.80**
Crosses	35	518.89	4.37	4794.29	166.68*	3.04	22.51	17.94**	0.86**
Parents vs. Crosses	1	31020.39**	55.99**	76524.15**	3936.87**	0.62	446.08**	26.40**	4.39**
Error	88	340.95	3.47	3141.97	105.24	2.14	18.50	2.58	0.05
Total	134	728.30	4.39	4556.78	165.89	2.36	26.16	7.20	0.34

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

Table 4 : Analysis of variance for combining ability for eight characters in tossa jute.

Sources of variation	df	Mean Sum of Squares							
		Plant height (cm)	Basal diameter (mm)	Green weight plant^{-1} (g)	Stick weight plant^{-1}(g)	Fibre %	Fibre yield plant^{-1} (g)	Fibre tenacity (g/tex)	Fibre fineness (tex)
GCA	8	213.75	0.66	1601.85	52.30	1.81*	6.44	12.71**	0.53**
SCA	36	567.79**	2.11*	2339.27**	101.37**	0.75	14.64**	3.98**	0.26**
Error	88	113.65	1.16	1047.32	35.08	0.71	6.17	0.86	0.02

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

gene action would be amenable to conventional breeding methods.

Combining ability study had led to making choice of suitable parent. While considering *gca* effects of the parents, it was found that none of the parents was observed as good general combiner for all the eight traits and none of the parents showed significant gca effect for basal diameter and fibre yield per plant (Table 6). However, OIJ 015 for weak and fine fibre, OIN 028 for strong fibre, OIN 217 for dwarfness, less fibre percentage, weak and finer fibre, OIN 574 for strong and finer fibre, OIN 580 for less green weight, high fibre percentage and coarser fibre, JRO 620 for lower stick weight, weak and coarser fibre, OIJ 267 for finer fibre, JRO 128 for coarser fibre, JRO 878 for strong and coarser fibre were found.

The specific combining ability effects exhibited that, the number of crosses that had desirable significant effects were nine for plant height, two for basal diameter, three for green weight per plant, stick weight per plant and fibre yield per plant, one for fibre percentage, ten for fibre tenacity and eight for fibre fineness (Table 7). The three best performing crosses showing the highest specific combining ability effect in order to merit were OIN 028 × OIN 574, OIJ 015 × OIN 217, OIN 574 × JRO 128 for plant height; OIN 028 × JRO 620, OIN 028 × OIJ 267 for basal diameter; OIN 028 × OIJ 267, OIJ 015 × OIN 580, OIN 028 × JRO 620 for green weight per plant; OIN 028 × OIJ 267, OIN 028 × OIN 574, OIJ 015 × OIN 580 for stick weight per plant; OIN 028 × OIN 574 for fibre percentage; OIN 028 × OIJ 267, OIN 028 × OIN 574, OIJ 015 × JRO 620 for fibre yield per plant; OIJ 015 × OIN 574, OIN 217 × JRO 128, OIN 580 × JRO 128 for fibre tenacity and OIN 217 × OIJ 267, OIN 217 × OIN 574, OIN 028 × OIN 580 for fibre fineness. Among the 36 crosses, only 3 cross combinations for fibre yield per plant, 10 for fibre tenacity and 9 for fibre fineness were found significant and desirable for fibre yield and its quality. Highest *sca* effects were produced in crosses from high × high and high × low *gca* parents which are in confirmation with the findings of Sasmal

Table 5 : Estimates of genetic components of variance and degree of dominance for fibre yield components and quality traits in tossa jute.

Sources of variation	Mean Sum of Squares							
	Plant height (cm)	Basal diameter (mm)	Green weight plant^{-1} (g)	Stick weight plant^{-1}(g)	Fibre %	Fibre yield plant^{-1} (g)	Fibre tenacity (g/tex)	Fibre Fineness (tex)
σ^2_{gca}	9.10	-0.05	50.41	1.57	0.10	0.03	1.08	0.05
σ^2_{sca}	454.14	0.96	1291.94	66.29	0.04	8.48	3.12	0.24
$\sigma^2_{gca}/\sigma^2_{sca}$	0.02	-0.05	0.04	0.02	2.50	0.003	0.35	0.21
$(\sigma^2_{gca}/\sigma^2_{sca})^{0.5}$	0.14	0.22	0.20	0.14	1.58	0.05	0.59	0.46
σ^2_A	18.20	-0.09	100.82	3.13	0.20	0.05	2.16	0.09
σ^2_D	454.14	0.96	1291.94	66.29	0.04	8.48	3.12	0.24
$\sigma^2_A + \sigma^2_D$	0.04	-0.09	0.08	0.05	5.00	0.01	0.69	0.38
$\frac{\sigma^2_A}{\sigma^2_A + \sigma^2_D}$	0.04	-0.10	0.07	0.05	0.83	0.01	0.41	0.27

gca = general combining ability, *sca* = specific combining ability, σ^2_{gca} = gca variance, σ^2_{sca} = sca variance, $(\sigma^2_{gca}/\sigma^2_{sca})^{0.5}$ = degree of dominance, σ^2_A = additive variance, σ^2_D = dominance variance, $\sigma^2_A/(\sigma^2_A + \sigma^2_D)$ = predictability ratio.

Table 6 : General combining ability (*gca*) effects of parents for fibre yield components and quality traits in tossa jute.

Parents	Plant height (cm)	Basal diameter (mm)	Green weight plant^{-1} (g)	Stick weight plant^{-1} (g)	Fibre %	Fibre yield plant^{-1} (g)	Fibre tenacity (g/tex)	Fibre Fineness (tex)
OIJ 015	-0.78	-0.01	0.24	-1.77	-0.29	-0.82	-0.94**	-0.27**
OIN 028	-3.93	0.39	17.62	2.50	-0.25	0.93	0.90**	0.01
OIN 217	-8.65**	0.06	-2.58	-1.58	-0.57*	-1.39	-1.59**	-0.26**
OIN 574	5.14	0.03	15.88	2.06	-0.39	0.46	1.22**	-0.09*
OIN 580	-1.05	-0.50	-20.31*	-1.64	0.70**	-0.11	-0.41	0.10*
JRO 620	1.02	-0.13	-13.19	-3.38*	0.25	-0.49	-1.08**	0.43**
OIJ 267	3.15	0.07	1.42	2.45	0.27	0.68	0.08	-0.15**
JRO 128	-0.02	0.20	-1.40	1.34	0.25	0.31	0.39	0.10*
JRO 878	5.12	-0.11	2.32	0.02	0.02	0.43	1.43**	0.12**
SE (g_i)	3.03	0.31	9.20	1.68	0.24	0.71	0.26	0.04
SE (g_i-g_j)	4.55	0.46	13.80	2.53	0.36	1.06	0.40	0.05

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

and Biswas (1991) and Sengupta *et al*. (2005). There was very rare case in which high × high general combiners were involved for best combinations. Thus, it is evident that high specific combiners are not always obtained between high general combiners but may occur between high × low or low × low general combiners. This might be probably due to the dominance and epistatic gene interactions. In general, *sca* effects do not make any significant contribution in the improvement of self-pollinated crops except where there is possibility of commercial exploitation of heterosis. Breeder's interest normally, however, vests in obtaining transgressive segregants through crosses in order to produce homozygous lines in self pollinated crops. Therefore, crosses involving high × low general combiners in respect of different traits in the present study may be utilized for obtaining transgressive segregants in the next generation resulting from additive gene interaction. Among combinations based on the *sca* values the crosses namely, OIN 028 × OIJ 267, OIN 028 × OIN 574 and OIJ 015 ×

Table 7 : Specific combining ability (*sca*) effects of crosses for fibre yield components and quality traits in tossa jute.

Crosses	Plant height (cm)	Basal diameter (mm)	Green weight plant^{-1} (g)	Stick weight plant^{-1} (g)	Fibre %	Fibre yield plant^{-1} (g)	Fibre tenacity (g/tex)	Fibre Fineness (tex)
OIJ 015 × OIN 028	13.76	0.69	12.00	-0.20	-0.57	-0.02	0.26	0.18
OIJ 015 × OIN 217	30.81**	0.10	12.86	5.55	0.65	2.34	-1.14	0.76**
OIJ 015 × OIN 574	18.76	-2.06*	24.57	5.44	0.07	2.73	3.69**	0.42**
OIJ 015 × OIN 580	25.07*	1.84	73.42*	14.54**	-1.39	3.33	-1.38	-0.07
OIJ 015 × JRO 620	12.38	0.80	47.74	6.52	-0.04	4.61*	0.32	0.30*
OIJ 015 × OIJ 267	22.18*	0.54	20.56	6.29	-0.77	-0.20	2.17*	0.28*
OIJ 015 × JRO 128	2.48	-0.44	19.15	1.67	-0.24	0.57	-3.90**	-0.57**
OIJ 015 × JRO 878	23.58*	0.73	23.93	7.19	0.62	3.42	-1.38	-0.29*
OIN 028 × OIN 217	16.36	-0.04	15.61	3.98	0.20	1.98	2.05*	0.48**
OIN 028 × OIN 574	31.65**	1.50	13.66	19.11**	2.17**	6.55**	-0.54	0.64**
OIN 028 × OIN 580	-2.17	-0.19	13.04	0.34	-0.07	1.11	-1.18	-0.65**
OIN 028 × JRO 620	21.27*	2.72**	60.60*	10.40	-1.23	1.96	2.16*	0.46**
OIN 028 × OIJ 267	24.87**	2.52*	104.32**	22.01**	-0.45	7.98**	1.71*	-0.60**
OIN 028 × JRO 128	7.77	0.46	39.80	-0.04	-0.94	1.01	-2.23**	-0.18
OIN 028 × JRO 878	-0.94	0.46	30.05	0.75	-0.78	0.50	1.50	0.40**
OIN 217 × OIN 574	-5.91	-0.12	-4.59	-3.49	-1.05	-2.94	-2.21**	-0.85**
OIN 217 × OIN 580	-5.96	0.33	-4.87	3.08	1.46	2.69	0.46	0.42**
OIN 217 × JRO 620	5.18	1.54	30.06	2.09	-0.34	1.78	-1.76*	0.10
OIN 217 × OIJ 267	7.21	1.25	44.84	-3.11	-1.76*	-1.10	-1.73*	-0.86**
OIN 217 × JRO 128	0.65	1.39	18.66	8.54	0.82	3.87	3.56**	-0.31**
OIN 217 × JRO 878	-0.82	0.13	-12.39	1.59	0.69	0.38	1.07	0.84**
OIN 574 × OIN 580	-2.71	1.67	16.44	3.38	-0.09	1.61	-0.14	0.82**
OIN 574 × JRO 620	8.53	0.57	-12.34	0.36	0.56	0.23	1.91*	-0.27*
OIN 574 × OIJ 267	-0.37	0.32	-4.95	0.46	0.23	0.79	1.28	0.07
OIN 574 × JRO 128	26.54**	1.60	42.20	9.07	-0.63	1.87	-0.36	0.59**
OIN 574 × JRO 878	-3.04	-0.06	17.82	-6.41	-0.61	-0.33	-0.13	0.03
OIN 580 × JRO 620	13.18	-0.10	8.45	1.59	0.16	1.20	-0.91	-0.16
OIN 580 × OIJ 267	20.84*	0.11	-2.43	5.35	0.68	1.59	0.73	0.18
OIN 580 × JRO 128	-5.62	-0.88	-46.98	-6.07	1.15	-2.38	3.00**	0.16
OIN 580 × JRO 878	0.68	-0.96	-22.36	-4.22	-0.53	-2.99	0.72	0.17
JRO 620 × OIJ 267	3.91	-0.74	-21.21	-3.87	0.98	0.24	-1.87*	0.69**
JRO 620 × JRO 128	-0.61	-0.76	-18.59	-1.09	0.12	-1.23	2.42**	-0.19
JRO 620 × JRO 878	-4.72	-1.67	-46.87	-2.74	0.30	-3.48	1.36	0.05
OIJ 267 × JRO 128	-19.75*	-1.60	-55.67	-9.29	0.19	-4.27	-2.89**	0.32**
OIJ 267 × JRO 878	-10.59	-0.08	-14.49	-2.50	0.08	-1.52	2.25**	0.19
JRO 128 × JRO 878	-1.58	0.05	6.47	0.95	-0.85	-1.19	-0.91	-0.29*
SE(±)	**10.66**	**1.07**	**32.36**	**5.92**	**0.84**	**2.48**	**0.93**	**0.13**

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

JRO 620 for fibre yield per plant; OIJ 015 × OIN 574, OIN 217 × JRO 128, OIN 580 × JRO 128, OIN 217 × OIJ 267, OIN 217 × OIN 574 and OIN 028 × OIN 580 for fibre quality were found superior and these combinations can be further tested for promotion of F_1 crosses. Best general combiners and few specific combiners for fibre yield and quality traits along with *per se* performance and gca effects of the parents involved in the crosses are listed in Table 8.

When the ranking of the three best crosses and their parents was done on the basis of *sca* for fibre yield per

Table 8 : Best general combiners and a few specific combiners for fibre yield and quality traits.

Characters	**Best general combiners**	***gca* effects**	***Per se* performance of parents**	**Best specific combiners**	***sca* effects**	***Per se* performance of crosses**	***gca* status of parents**
Fibre yield plant^{-1} (g)	-	-	-	OIN 028 × OIJ 267	7.98**	31.30	M × M
				OIN 028 × OIN 574	6.55**	29.65	M × M
				OIJ 015 × JRO 620	4.61*	25.00	L × L
Fibre tenacity (g/tex)	JRO 878	1.43**	23.44	OIJ 015 × OIN 574	3.69**	26.78	L × H
				OIN 217 × JRO 128	3.56**	25.18	L × M
				OIN 580 × JRO 128	3.00**	25.80	L × M
				JRO 620 × JRO 128	2.42**	24.55	L × M
				OIJ 267 × JRO 878	2.25**	26.58	M × H
				OIJ 015 × OIJ 267	2.17*	24.12	L × M
				OIN 028 × JRO 620	2.16*	24.79	H × L
				OIN 028 × OIN 217	2.05*	24.18	H × L
				OIN 574 × JRO 620	1.91*	24.85	H × L
				OIN 028 × OIJ 267	1.71*	25.50	H × M
Fibre Fineness (tex)	OIJ 015	-0.27**	1.60	OIN 217 × OIJ 267	-0.86**	1.37	H × H
				OIN 217 × OIN 574	-0.85**	1.43	H × H
				OIN 028 × OIN 580	-0.65**	2.10	M × L
				OIN 028 × OIJ 267	-0.60**	1.90	M × H
				OIJ 015 × JRO 128	-0.57**	1.90	H × L
				OIN 217 × JRO 128	-0.31**	2.17	H × L
				OIJ 015 × JRO 878	-0.29*	2.20	H × L
				JRO 128 × JRO 878	-0.29*	2.80	L × L
				OIN 574 × JRO 620	-0.27*	2.70	H × L

* Significant at 5% level; ** significant at 1% level; H= high *gca* effect, M= medium *gca* effect and L= low *gca* effect.

Table 9 : Ranking of three best hybrids and their parents on the basis of specific combining ability and *per se* performance for fibre yield and quality traits.

Hybrids/Parents	*Sca/Gca* effects	Rank on the basis of *per se* performance								Total rank	Mean rank
	Fibre yield plant^{-1} (g)	1	2	3	4	5	6	7	8		
Hybrids											
OIN 028 × OIJ 267	7.98**	374.63^{2}	18.56^{1}	371.67^{1}	77.50^{1}	8.51^{3}	31.30^{1}	25.50^{1}	1.90^{1}	11	1.38
OIN 028 × OIN 574	6.55**	383.40^{1}	17.50^{2}	295.47^{2}	74.20^{2}	10.47^{1}	29.65^{2}	24.39^{2}	3.20^{3}	15	1.88
OIJ 015 × JRO 620	4.61*	363.17^{3}	16.24^{3}	283.10^{3}	51.90^{3}	8.87^{2}	25.00^{3}	21.11^{3}	3.10^{2}	22	2.75
Parents											
OIN 028	0.93	286.40^{4}	12.29^{5}	139.00^{4}	27.37^{4}	9.28^{2}	13.03^{4}	22.76^{2}	2.30^{4}	30	3.75
OIJ 267	0.68	332.70^{1}	14.56^{1}	215.67^{2}	47.77^{1}	9.90^{1}	21.30^{1}	22.14^{3}	2.20^{3}	13	1.63
OIN 574	0.46	324.10^{2}	13.94^{4}	233.67^{1}	40.70^{2}	7.84^{5}	17.37^{3}	23.50^{1}	1.73^{2}	20	2.50
OIJ 015	-0.82	274.50^{5}	14.47^{2}	131.67^{5}	23.50^{5}	9.20^{3}	11.67^{5}	21.61^{4}	1.60^{1}	30	3.75
JRO 620	-0.49	323.03^{3}	14.15^{3}	198.00^{3}	37.13^{3}	9.19^{4}	18.07^{2}	18.84^{5}	3.00^{5}	28	3.50
	Fibre tenacity (g/tex)										
Hybrids											
OIJ 015 × OIN 574	3.69**	373.67^{1}	13.54^{3}	289.00^{1}	56.27^{2}	8.34^{3}	24.07^{2}	26.78^{1}	2.70^{2}	15	1.88
OIN 217 × JRO 128	3.56**	342.53^{3}	17.24^{1}	263.00^{2}	58.83^{1}	9.45^{2}	24.50^{1}	25.18^{3}	2.17^{1}	14	1.75
OIN 580 × JRO 128	3.00**	343.87^{2}	14.40^{2}	179.63^{3}	44.17^{3}	11.05^{1}	19.53^{3}	25.80^{2}	3.00^{3}	19	2.38
Parents											
OIJ 015	-0.94**	274.50^{5}	14.47^{2}	131.67^{5}	23.50^{4}	9.20^{3}	11.67^{5}	21.61^{3}	1.60^{1}	28	3.50
OIN 574	1.22**	324.10^{3}	13.94^{3}	233.67^{2}	40.70^{2}	7.84^{4}	17.37^{3}	23.50^{2}	1.73^{2}	21	2.63
OIN 217	-1.59**	309.50^{4}	13.42^{5}	193.07^{3}	38.27^{3}	7.49^{5}	14.43^{4}	19.50^{5}	1.83^{3}	31	3.88
JRO 128	0.39	345.57^{1}	16.08^{1}	243.00^{1}	51.33^{1}	9.65^{2}	23.20^{1}	24.25^{1}	3.07^{5}	13	1.63
OIN 580	-0.41	326.80^{2}	13.67^{4}	190.33^{4}	38.27^{3}	9.67^{1}	18.40^{2}	21.34^{4}	2.40^{4}	24	3.00
	Fibre fineness (tex)										
Hybrids											
OIN 217 × OIJ 267	-0.86**	352.27^{1}	16.97^{2}	292.00^{1}	48.30^{2}	6.90^{3}	19.90^{2}	19.57^{3}	1.37^{1}	15	1.88
OIN 217 × OIN 574	-0.85**	341.13^{3}	15.56^{2}	257.03^{3}	47.53^{3}	6.94^{2}	17.83^{3}	20.23^{2}	1.43^{2}	20	2.50
OIN 028 × OIN 580	-0.65**	343.40^{2}	15.28^{3}	258.67^{2}	51.73^{1}	9.32^{1}	23.63^{1}	22.12^{1}	2.10^{3}	14	1.75
Parents											
OIN 217	-0.26**	309.50^{4}	13.42^{4}	193.07^{3}	38.27^{3}	7.49^{5}	14.43^{4}	19.50^{4}	1.83^{2}	29	3.63
OIJ 267	-0.15**	332.70^{1}	14.56^{1}	215.67^{2}	47.77^{1}	9.90^{1}	21.30^{1}	22.14^{3}	2.20^{3}	13	1.63
OIN 574	-0.09*	324.10^{3}	13.94^{2}	233.67^{1}	40.70^{2}	7.84^{4}	17.37^{3}	23.50^{1}	1.73^{1}	17	2.13
OIN 028	0.01	286.40^{5}	12.29^{5}	139.00^{4}	27.37^{4}	9.28^{3}	13.03^{5}	22.76^{2}	2.30^{4}	32	4.00
OIN 580	0.10*	326.80^{2}	13.67^{3}	190.33^{5}	38.27^{3}	9.67^{2}	18.40^{2}	21.34^{4}	2.40^{5}	26	3.25

*, ** Significant at 5% and 1% levels of probability, respectively; Values in superscript indicate respective ranks within the group; 1= Plant height (cm), 2= Basal Diameter (mm), 3= Green weight per plant (g), 4= stick weight per plant (g), 5= Fibre percentage, 6= fibre yield per plant (g), 7= Fibre tenacity (g/tex), 8= Fibre fineness (tex).

plant as the base character (Table 9), the cross OIN 028 × OIJ 267 ranked the highest followed by OIN 028 × OIN 574 and OIJ 015 × JRO 620. When the ranking of three best crosses and their parents was done on the basis of *sca* for fibre tenacity as the base character, the cross OIN 217 × JRO 128 ranked first followed by OIJ 015 × OIN 574 and OIN 580 × JRO 128. When the ranking of three best crosses and their parents was done on the basis of sca for fibre fineness as the base character, the cross OIN 028 × OIN 580 ranked first followed by OIN 217 × OIJ 267 and OIN 217 × OIN 574. When the ranking of the three best crosses and their parents was done on the basis of sca for fibre yield and fibre quality as the base characters, the cross OIN 028 × OIN 574 ranked first for its better performance for all the six-yield related and two quality traits and was followed by OIN 217 × JRO 128 and OIN 028 × OIN 580, which ranked the same. Thus, when all the fibre yield related

Table 10 : Heterosis (%) over mid-parent (MP) and better-parent (BP) for fibre yield and its attributing traits and quality traits in tossa jute.

Crosses	Plant height (cm)		Basal diameter (mm)		Green weight plant^{-1} (g)		Stick weight plant^{-1} (g)		Fibre percentage		Fibre yield plant^{-1} (g)		Fibre tenacity (g/tex)		Fibre fineness (tex)	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
OIJ 015 × OIN 028	38.34**	25.56**	26.61**	18.88	105.29**	100.12**	98.83**	86.60**	-14.17	-15.45	74.17**	67.26*	2.91	1.20	19.38**	11.59
OIJ 015 × OIN 217	27.48**	20.17**	14.72	12.36	59.25*	34.06	69.38**	37.80	6.03	-2.89	65.20**	51.27*	-7.74	-12.98*	49.57**	43.33**
OIJ 015 × OIN 574	24.95**	15.29**	-3.08	-3.29	58.07**	23.68	73.93**	38.25	-0.99	-7.37	63.90**	38.58	17.71**	13.96*	44.64**	35.00**
OIJ 015 × OIN 580	24.43**	14.38**	22.19**	20.76	87.18**	58.49*	98.07**	61.15**	-14.57	-17.54	58.55**	30.98	-7.33	-8.71	9.09	0.00
OIJ 015 × JRO 620	21.66**	12.42**	15.37	14.77	71.58**	42.98	69.79**	39.77	-2.46	-3.45	66.30**	38.38	3.40	-4.03	24.00**	3.33
OIJ 015 × OIJ 267	23.65**	12.74**	13.29	11.10	55.63**	25.44	60.24**	20.38	-13.57	-17.48	28.33	0.31	9.28	8.93	19.05*	13.64
OIJ 015 × JRO 128	13.70**	1.93	1.93	-4.66	42.03*	9.59	37.43	0.84	-7.04	-10.19	23.67	-6.18	-20.60**	-24.28**	-25.00**	-38.04**
OIJ 015 × JRO 878	19.48**	5.28	7.71	0.79	39.54	4.94	44.87*	5.07	0.45	-2.28	33.09*	-1.72	-3.49	-6.46	1.54	-5.71
OIN 028 × OIN 217	19.00**	14.49**	25.79**	19.12	68.02**	44.49	69.87**	44.86*	1.05	-7.44	69.38**	60.97*	13.79	5.13	49.57**	43.33**
OIN 028 × OIN 574	25.68**	18.30**	34.95**	25.56*	58.57**	26.45	119.20**	82.31**	24.35	16.33	95.28**	70.73**	4.90	3.79	71.43**	60.00**
OIN 028 × OIN 580	12.08**	5.08	19.01	11.73	57.09*	35.90	58.53**	35.19	-0.14	-3.62	50.53*	28.44	-0.22	-3.81	-4.55	-12.50
OIN 028 × JRO 620	21.14**	14.20**	41.92**	31.15**	85.95**	58.25*	87.27**	61.71**	-15.18	-16.04	55.15**	33.39	18.52**	7.80	41.33**	17.78**
OIN 028 × OIJ 267	21.10**	12.60**	39.77**	27.47	109.59**	72.33**	107.31**	62.25**	-9.90	-13.98	82.51**	46.95**	12.97*	10.87	-9.52	-13.64
OIN 028 × JRO 128	12.22**	2.55	18.47	3.44	59.34**	25.24	38.72*	5.84	-14.12	-17.02	32.41	3.30	-7.37	-9.75	1.32	-16.30**
OIN 028 × JRO 878	6.69*	-2.42	16.28	1.58	48.83*	13.91	34.05	1.00	-14.31	-16.64	23.49	-6.36	14.74**	13.67*	46.15**	35.71**
OIN 217 × OIN 574	7.60	5.26	15.54	11.65	20.48	10.00	20.80	16.79	-6.51	-11.52	13.71	2.69	-6.97	-13.90*	-23.21**	-28.33**
OIN 217 × OIN 580	5.18	2.48	16.02	13.16	15.08	14.28	32.17	31.71	26.43*	8.96	41.36*	24.46	2.94	-0.30	31.82**	20.83**
OIN 217 × JRO 620	9.98*	7.76	25.64**	20.55	34.32	32.63	26.89	25.44	2.43	-9.76	34.72	19.56	-5.31	-8.07	16.00*	-3.33
OIN 217 × OIJ 267	9.62*	5.88	23.16*	16.55	42.90*	35.39	12.63	1.12	-18.37	-30.31*	12.75	-6.57	-7.11	-11.61	-34.92**	-37.88**
OIN 217 × JRO 128	4.50	-0.88	18.55*	7.19	20.64	8.23	31.72	14.61	13.53	-2.07	31.72	5.60	13.83**	3.86	-14.47*	-29.35**
OIN 217 × JRO 878	3.42	-3.70	7.79	-2.49	3.62	-10.01	10.81	-5.07	10.03	-4.52	7.91	-16.03	9.25	1.24	53.85**	42.86**
OIN 574 × OIN 580	8.15*	7.69	21.27	19.86	22.70	11.25	37.09*	32.52	3.70	-5.27	33.71	28.62	3.57	-2.17	57.58**	44.44**
OIN 574 × JRO 620	12.89**	12.73**	14.05	13.45	10.49	1.99	26.88	20.89	8.88	1.85	24.90	21.22	16.04**	3.56	8.00	-10.00
OIN 574 × OIJ 267	9.17*	7.74	12.06	9.89	15.94	11.40	25.05	16.19	1.21	-8.49	23.41	10.95	10.05*	5.79	17.46*	12.12
OIN 574 × JRO 128	14.16**	10.60*	15.82	8.33	27.88	25.51	36.46*	22.73	-7.40	-15.33	21.14	4.96	-0.25	-0.76	27.63**	5.43
OIN 574 × JRO 878	4.69	-0.48	2.74	-3.86	14.68	8.58	-1.98	-13.27	-9.15	-16.39	5.61	-11.52	6.79	5.54	24.62**	15.71*
OIN 580 × JRO 620	11.90**	11.22*	5.50	4.95	15.09	12.76	25.38	23.95	4.79	0.53	23.66	23.43	2.47	-2.81	20.00**	0.00
OIN 580 × OIJ 267	13.23**	12.26**	6.90	4.83	11.91	5.26	32.22	18.70	6.55	6.00	21.46	12.05	7.63	4.85	31.75**	25.76**
OIN 580 × JRO 128	2.26	-0.49	-4.26	-10.45	-17.03	-26.08	-1.12	-13.96	12.45	10.50	-5.18	-15.80	14.06**	6.42	18.42**	-2.17
OIN 580 × JRO 878	3.51	-1.17	-6.82	-12.80	-7.95	-20.58	-2.05	-16.08	-6.34	-8.60	-11.81	-24.37	10.52*	4.76	40.00**	30.00**

Table 10 continued...

Table 10 continued...

JRO 620 × OIJ 267	9.39*	7.79	3.54	1.53	4.11	-0.15	7.90	-4.26	10.60	5.59	12.64	3.91	-3.07	-9.95	38.46**	20.00**
JRO 620 × JRO 128	4.98	1.55	-1.00	-7.40	-2.43	-11.47	7.32	-7.66	2.57	-0.90	-1.46	-12.50	13.52*	1.24	-2.20	-3.26
JRO 620 × JRO 878	3.14	-2.10	-9.08	-14.92	17.12	-27.23	-1.55	-16.58	2.75	-0.04	-15.83	-27.81*	15.60**	4.65	21.25**	7.78
OIJ 267 × JRO 128	-1.58	-3.37	-8.22	-11.30	-16.05	-20.71	-9.33	-12.27	-1.73	-3.43	-16.59	-20.55	-11.78*	-15.86**	14.47*	-5.43
OIJ 267 × JRO 878	0.57	-3.13	-0.44	-3.74	-0.57	-9.28	-0.26	-5.19	-4.53	-6.83	-7.73	-15.36	16.99**	13.40*	29.23**	20.00**
JRO 128 × JRO 878	0.37	-1.51	-1.94	-2.14	1.29	-2.35	1.34	-0.81	-14.26	-16.33	-11.70	-15.50	0.06	-1.11	-3.75	-14.44*
SE (±)	9.24	10.66	0.93	1.07	28.03	32.37	5.13	5.93	0.73	0.84	2.15	2.48	0.80	0.93	0.11	0.13

* Significant at 5% level, ** significant at 1% level, MP= Mid parent, BP= Better parent.

and quality traits are considered together the crosses with high sca effects for fibre yield per plant and two quality traits, OIN 028 × OIN 574, OIN 217 × JRO 128 and OIN 028 × OIN 580 were among the best performers.

The success of hybrid programme depends upon the magnitude of heterosis that helps in the identification of potential cross combinations to be used in the conventional breeding programme to enable create wide array of variability in the segregating generations. Among the thirty six crosses (Table 10) studied most of them exhibited significantly positive heterosis over mid-parent and better parent for fibre yield and most of the fibre yield related traits namely plant height, basal diameter, green weight per plant and stick weight per plant with the only exception of fibre percentage in which only one cross exhibited significantly positive heterosis over mid-parent and significantly negative heterosis over better parent. Similar result of significantly positive heterosis over mid and better parent for plant height, basal diameter, stick weight and fibre yield were reported by Palve and Kumar (1991). However, in case of quality traits, some crosses for fibre tenacity showed either non-significant or significantly negative heterosis over mid-parent and better parent with the exception of fibre fineness in which majority of the hybrids exhibited significantly positive heterosis over both mid and better parents.

For fibre yield per plant OIN 028 × OIN 574 exhibited the highest significantly positive heterosis over mid parent and better parent. Palve (2003) reported high estimates of heterosis for fibre yield in jute over mid perent and better parent. The performance of OIN 028 × OIN 574 was disappointing for fibre tenacity, where non-significant heterosis and highest significantly positive hetrerosis over the mid parent and better parent for fibre fineness was not desirable as it served the purpose of improving the quality trait *i.e.*, if one is increased the other is reduced and vice versa. The second heighest heterosis in the positive direction over the mid parent and better parent for fibre yield per plant was exhibited by OIN 028 × OIJ 267 and OIJ 015 × OIN 028, respectively.

Some other crosses recorded significant positive with respect to their mid-parent and better parent for fibre yield per plant were OIJ 015 × OIN 028, OIJ 015 × OIN 217, OIN 028 × OIN 217 and OIN 028 × OIJ 267. Out of these crosses, OIJ 015 × OIN 217 and OIN 028 × OIN 217 recorded significant positive heterosis for fibre yield per plant along with desirable heterosis for the quality trait particularly fibre fineness. OIJ 015 × OIN 574, OIN 028 × JRO 878 and OIJ 267 × JRO 878 recorded significant positive heterosis with respect to their mid-parent and better parent for fibre tenacity and OIJ 015 × JRO 128, OIN 217 × OIN 574 and OIN 217 × OIJ 267 for fibre fineness.

Conclusion

The present study showed that the higher magnitude of all the fibre yield and yield components and quality traits were not expressed in a single cross combination which varied from cross to cross due to genetic background of their diverse parents. Overall, eleven hybrids, OIN 028 × OIN 574, OIJ 015 × OIN 028, OIJ 015 × OIN 217, OIN 028 × OIN 217, OIN 028 × OIJ 267,OIJ 015 × OIN 574, OIN 028 × JRO 878, OIJ 267 × JRO 878, OIJ 015 × JRO 128, OIN 217 × OIN 574 and OIN 217 × OIJ 267 were identified as superior for their superior fibre yield components and fibre quality traits.

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