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Genetic Analysis for Fiber Yield and its Components in Tossa Jute (*Corchorus olitorius* L.)

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Abstract

Genetic analysis for fiber yield and its eight components in tossa jute were studied using half diallel set involving eight parents. Gene action as estimated through Hayman approach revealed greater importance of non-additive gene action for plant height, basal diameter, green plant weight and stick weight and additive gene action for flowering (day to flowering), nodes per plant, bark thickness and fiber yield per plant. Dominant alleles were predominant among the parents for all the nine characters. There was presence of at least two gene complexes for internode length and basal diameter whereas it was less than unit for rest seven characters including fiber yield per plant. Though high heritability (h^2) in broad sense was observed for all the characters, the heritability in narrow sense was high for days to flowering and bark thickness. The result suggested that there is ample scope of improving fiber yield through selection for yield *per se* and or its component traits like bark thickness, day to flowering and nodes per plant in any breeding program. The yield correlated characters like plant height, basal diameter, green weight and stick weight can be improved through heterosis breeding.

Key words : Genetic analysis, Fiber yield, Genetic components, *Corchorus olitorius,* Bark thickness.

Jute is an important commercial fiber crop of India next to cotton. The low productivity of fiber in many jute growing states like Orissa, is mainly due to low yield potential of the jute varieties and poor crop husbandry. Among the two cultivated species of jute, tossa jute has its better position as compared to white jute with respect to their fiber quality. Thus, it is imperative to augment the productivity of the tossa jute by genetic manipulation through crop improvement program. The major approach to crop improvement in self pollinated crop like tossa jute is hybridization followed by selection in segregating generation. Knowledge of gene action of the plant characters is essential for success of any breeding program. Such information is limited in jute where bast fiber, unlike many other crops, is the economic product. Therefore, a diallel analysis, which is extensively used for genetic study, has been made in tossa jute using eight parent diallel crosses.

Methods

A half diallel cross using eight diver parents namely Tanganayika, Russian-1, TRO-4, UP 43A, CHNP 12A, AP5A, KOM-62 and JRO 524 were made. The seeds of 28 F_1s along with eight parents were grown in a randomized block design with four replications during *kharif* at Jute Research Station, Kendrapara. Each plot consisted of a single row of 3.0 m in length with a plant spacing of 7—10 cm. Fertilizers were applied at 40 kg N, 20 kg each of P_2O_5 and K_2O/ha. Timely intercultural operations were made to get a good crop. Observations were recorded on 10 randomly selected plants of each genotype in each replication for all the characters except days to flowering which was taken on plot basis. The data were analyzed following Hayman (1954a , 1954 b) and Jinks (1954) to estimate genetic components like D, H_1, H_2, F, h^2, E for days to flowering, plant height, nodes per plant, inter node length, basal diameter, bark thickness and green plant weight, stick weight and fiber yield per plant. Using these genetic components different parameters like $(H_1/D)^{1/2}$, $(H_2/4H_1)$, (KD/KR), h^2/H_2 and heritability (both narrow and broad sense) were estimated.

Results and Discussion

The analysis of variance indicated that there was highly significant difference among parents, hybrids

Table 1. Analysis of variance for nine characters in an 8 × 8 diallels set of crosses (F_1) in tossa jute. Figures in parentheses indicate degrees of freedom. *, ** Significant at 5 and 1% levels respectively.

Characters	Mean sum of squares					
	Replication (3)	Genotype (35)	Parent (7)	Hybrid (27)	P vs F_1 (1)	Error (105)
Days to 50% flowering	1.26	219.37*	413.64**	176.31**	13.34*	2.748
Plant height (cm)	34.92	1910.81**	4383.57**	1278.55**	1677.37**	88.908
Nodes per plant	7.04	68.12**	149.86**	49.57**	1.32	12.322
Inter-node length (cm)	0.08*	0.19*	0.22**	0.16**	0.75**	0.022
Basal diameter (mm)	1.24*	8.65**	16.01**	5.34**	46.66**	0.440
Bark thickness (mm)	0.005	0.13**	0.26**	0.10**	0.03**	0.002
Green weight (g/plant)	49.34	5532.23**	4405.51**	8115.14**	17873.22*	24.963
Stick weight (g/plant)	17.58	256.09**	313.38**	219.84**	833.66**	10.121
Fiber yield (g/plant)	0.034	31.68**	63.44**	22.95**	45.00**	2.573

and parents versus hybrid interaction for all the nine characters (Table 1). Thus the parents were genetically diversed which therefore, produced diverse hybrids. The significance of parent vs hybrid indicated the presence of over all heterosis in all characters.

The estimates of genetic components of variation for nine characters revealed that the additive (D) and non-additive (H_1 and H_2) components were significant for all the characters suggesting the importance of both additive and dominance effects of genes governing the trials (Table 2). Similar observations were also reported earlier (Sengupta et al. 2005, Sinhamohapatra and Ghosh Dostidar 1986). Under this situation the population improvement in the from of diallele selective mating system or mass selection with random mating is suggested. However, the higher magnitude of H_1 compared to D component in plant height , basal diameter, green plant weight and stick weight indicated greater importance of non-additive gene action. So, there was limited scope of improvement of these yield components through simple breeding technique. But there is greater scope of improving the yield of fiber directly or though selection of days to flowering nodes per plant and bark thickness.

As indicated from degree of dominance $(H_1/D)^{1/2}$ partial dominance was observed for bark thickness where, over dominance was observed for inter node length, basal diameter, green weight and stick weight. Dominance was observed in rest of characters including fiber yield per plant. $H_2/4H_1$ was less than 0.25 for all the characters suggesting asymmetry in distribu-

Table 2. Estimates of genetic components of variation for nine characters in an 8 × 8 diallels analysis in tossa jute.*,** Significant at 5 and 1 % levels respectively.

Genetic components	Characters								
	Days to flowering	Plant height	Nodes/ plant	Inter node length	Basal diameter	Bark thickness	Green weight	Stick weight	Fiber yield
D	102.58**	1073.67**	34.34**	0.05**	3.87**	0.063**	2023.51**	75.89**	15.21**
H_1	83.00**	1299.87**	28.48**	0.06**	6.05**	0.017**	4083.08**	196.35**	14.85**
H_2	66.54**	963.92**	23.35**	0.04	4.84**	0.014**	3391.01**	165.42**	12.20**
F	43.08**	1034.46**	25.07**	0.06*	3.68**	0.009**	1612.92**	61.18	9.92**
h^2	1.30	195.43**	1.40	0.09**	5.78**	0.003	2197.12**	101.21**	5.21**
E	0.69	22.23	3.08**	0.006	0.11	0.001	6.24	2.53	0.64*
$(H1/D)^{1/2}$	0.90	1.10	0.91	1.13	1.25	0.519	1.42	1.61	0.99
$(H_2/4H_1)$	0.20	0.18	0.20	0.15	0.20	0.210	0.21	0.21	0.21
KD/KR	1.61	2.56	2.34	3.22	2.23	1.303	1.78	1.67	1.98
K	0.02	0.20	0.06	2.29	1.19	0.212	0.65	0.61	0.43
h^2 (ns)	68.67	41.61	44.68	33.77	34.75	87.400	39.20	34.22	51.86
h^2 (ns)	98.70	95.07	80.89	75.44	94.55	96.900	98.50	98.02	91.64

tion of dominant and recessive alleles in the parents. However, there was higher proportion of dominant alleles for these characters in the parental population as indicated by KD/KR. This condition is also indicated from the positive value of F from all the characters. The K value indicated that the number of effective factors controlling days to flowering, plant height, nodes per plant, bark thickness, green weight, stick weight and fiber yield per plant were found to be below one while at least two number of effective factors were involved in controlling inter node length and basal diameter. As reported by Hayman (1954b), the lower values of K may be depressed by the complementary gene action. Mather (1949) pointed out that the estimate of K might indicate lower values in the event of h^2 effect of all the gene being unequal in size and in the event of uncorrelated gene distribution.

Moderate heritability estimates (narrow sense) was observed in all the characters except bark thickness (87.4%) and days to flowering (68.7%). The high heritability in these two characters in both narrow and broad sense indicated the predominance of genetic components in inheritance of the traits.

The genetic analysis of fiber yield and its component characters in the present study in tossa jute provides clear indication of importance of considering bark thickness, days to flowering, nodes per plant and fiber yield per plant in any selection program. Alternatively heterosis breeding is suggested for improvement of plant height basal diameter, green weight and stick weight.

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