

SELECTION IN F₂ PROGENIES TO EVOLVE ADVANCED GENERATION DESIRABLE LINES OF TOSSA JUTE

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ABSTRACT

The experiment was conducted with tossa jute (*Corchorus olitorius* L) at Jute Agricultural Experimental Station, Jagir, Manikgonj during 2019. Ten F₂ cross combinations were included in this experiment. The mean, variance and range were computed for six morphological characters viz. plant height (m), base diameter (mm), green bark thickness (mm), green weight without leaves (g)/plants, fibre yield (g) /plants and stick yield (g)/plants. In this study the highest plant height was recorded from the cross, P₅ x P₂ (3.26 m), which was followed by the cross, P₃ x P₄ with 3.25 m. The ranges for two crosses were 2.75-3.63 m and 2.22-3.60 m, respectively. The highest base diameter and bark thickness was derived from the cross, P₃ x P₄. The highest green wt. without leaves was recorded 250.04 in the base population against the cross P₈ x P₄ and the character also the highest in the same cross with 262.87 in the selected population. The fiber weight was the maximum in the progenies of the cross, P₈ x P₄ (20.39 g) for the base population, also it was the highest for the same cross with 23.53g in selected population. The highest stick weight was obtained from the cross, P₂ x P₇ with 53.0 g in selected population, which was followed by the cross, P₃ x P₄ with 51.91g in selected population. The progenies of the cross, P₈ x P₄ (Acc-3860×Acc-2381) produced the highest fiber weight (23.53 g), which was followed by the cross, P₃ x P₄ (JRO-524×Acc-2381) further it produced the highest base diameter (20.16 mm), suggested the appreciable potential of the two crosses to evolve outstanding advanced lines of tossa jute in Bangladesh agriculture.

Key words: Selection, segregating generation, tossa jute.

Introduction

The selection of genotypes to serve as parents in crosses is the most important decision that a plant breeder has to face. Each individual's high performance, wide adaptability, and yield potential have been the major features taken into account for choosing parental genotypes. Different statistical procedures such as, mean performances of the parental lines involved in both normal and reciprocal crosses, significant and positive GCAs of the parental lines along with SCAs for the specific crosses employed for selection of cross combinations from experimental hybrids that ultimately led to characterize on variability between and within the crosses, have become important auxiliary tools for the definition of the crosses. Methods predicting the performance of cross combinations could be estimated on the basis of morphological (Cruz and Regazzi, 1997), molecular (Diniz Filho, 2000; Oliveira, 1998), or pedigree (Barbosa Neto *et al.*, 1996; Cao *et al.*, 1997) evaluation. However, current trends show a greater adoption of this technique by plant breeders (Balzarini *et al.*, 2002) for predicting cross performance and choosing parental combinations that would translate into major heterotic effects on their progenies, increasing the possibility of obtaining superior recombinants.

Materials and Methods

The experiment consisted of ten F₂s. It was laid out at Jute Agriculture Experimental Station, Bangladesh Jute Research Institute (BJRI), Manikganj. Seeds were sown in 10 rows of 3m length on April 2019. The recommended standard cropping practices were followed throughout the cropping season to have a good harvest. The observations were made on three hundred plants for each segregant. The mean, variance and range were computed for six morphological characters viz. plant height (m), base diameter (mm), green bark thickness (mm), green weight without leaves (g)/plants, fibre yield (g)/plants and stick yield (g)/plants.

On the basis of plant height, base diameter, green weight without leaves and fibre weight best thirty plants (10% of 300 plants) were selected. Pedigree record of 30 selected plants from each cross were recorded following row to plant selection method. These ten crosses were $P_2 \times P_6$, $P_2 \times P_7$, $P_3 \times P_4$ (JRO-524 \times Acc-2381), $P_3 \times P_5$, $P_7 \times P_8$, $P_5 \times P_2$, $P_6 \times P_3$, $P_7 \times P_5$, $P_8 \times P_2$ and $P_8 \times P_4$ (Acc-3860 \times Acc-2381). Then “t” test was done between the base population (300 plants) and selected population (30 plants) derivatives of selected ten cross to estimate progress from selection.

Results and Discussion

Plant height: The highest plant height was recorded from the cross, $P_5 \times P_2$ (3.26 m), which was followed by the cross, $P_3 \times P_4$ with 3.25 m. The range values for the two crosses were 2.75-3.63 m and 2.22-3.60 m respectively (Table 1). When 30 plants were arbitrarily selected from 300 base plants, the plant height of the two crosses remarkably increased with 3.40 m and 3.34 m, respectively (Table 2). The results suggest that desirable advanced line may be developed from the advanced progenies of the two crosses. Moreover, the variances of the two crosses slightly decreased in the selected populations, indicates rapid fixation of for the expression of the characters. The findings agreed by Hossain and Hossain (2002).

Base diameter: The physical strength of a jute plant is provided by the base diameter, it also indicates fiber and stick yields. The highest base diameters of original segregating populations and selected population are displayed in Tables 1-2. The highest base diameter was derived from the cross, $P_3 \times P_4$, followed by the cross, $P_5 \times P_2$ both for base populations and selected populations. The range of the character in $P_3 \times P_4$ was 13.80-23.40 mm and it was 11.60-23.40 mm in $P_5 \times P_2$. Therefore, desirable advanced lines may derive at the end of continual selfing of the segregating plants. These findings were corroborated with the results of Roy and Ghoshdastidar (2002).

Green bark thickness: Green bark thickness is an indicator of fibre yield in tossa jute. The highest green bark thickness was recorded from the cross $P_3 \times P_4$ with 1.78 mm in the base population, whereas the character was the highest in cross $P_6 \times P_3$ with 1.98 mm in the selected population. The changing of cross from base population to selected population suggests wide segregation in F_2 generation under each of the cross derivatives. In our country new jute fiber retting method includes green bark, is an important character to the farmers to attain higher fiber yield after complete processing. The findings were corroborated with the result of Yassin (1973).

Green wt. without leaves: Green wt. without leaves is directly related to fiber and stick yields in tossa jute. After harvesting of jute plants, leaves rapidly dropped off from the plants and it is better before setting the plants for retting. However, the highest green wt. without leaves was recorded 250.04 in the base population against the cross $P_8 \times P_4$ and the character also the highest in the same cross with 262.87 in the selected population. The results suggest that the contributing alleles for the characters have shown gradual fixation, hence the character may be genetically homozygous at the end of segregation. The second ranked potential of the character was also recorded from the cross, $P_3 \times P_4$ both in base population and selected populations with the values of 235.96 and 246.70g respectively. Besides, the ranges for the character were very close in each cross both in base and selected populations, also an indication of rapid fixation heterozygous alleles responsible for the expression of the character. These findings were corroborated with the results of Sinha *et al.* (2008).

Fiber weight: The most important character, fiber weight was greatly varied in the segregating base and selected populations. The fiber weight was the maximum in the progenies of the cross, $P_8 \times P_4$ (20.39 g) for the base population, also it was the highest for the same cross with 23.53 g in selected population. The magnitude of variance reduced from 12.496 to 5.200 when selection was operated in base population to derive selected population. The results suggest rapid progressing of homozygous loci which might continue in next generations, eventually evolves pure lines. These findings were corroborated with the results of Mahdy *et al.* (2012).

Stick weight: Stick weight of Tossa jute is important because of its multifarious use. The plants derived from the cross, $P_2 \times P_7$ displayed outstanding potential for stick weight both in base and selected populations. Moreover, the mean for the character increased from base to selected populations but variance had decreased. From the Tables 1-2 it is apparent that the highest stick weight was in general obtained from selected population corresponding to base populations. However the highest stick weight was obtained from the cross, $P_2 \times P_7$ with 53.0 g in selected population, which was followed by the cross, $P_3 \times P_4$ with 51.91g in selected population. Additionally it is observed that the plants had high base diameters and high plant heights, usually produced high stick weight. The results supported by Ali (2011).

Table 1. Variability parameters of based population (300 plants) for different characters in F_2 generation of tossa jute

Combinations	Variability parameters	Plant height (m)	Base diameter (mm)	Green bark thickness (mm)	Green wt. without leaves (g)	Fibre weight (g)	Stick weight (g)
$P_2 \times P_6$	Mean	2.89	14.98	1.82	222.00	17.00	40.95
	Variance	0.025	3.243	0.011	311.866	12.403	13.062
	Range	1.70-3.20	12.00-20.40	1.66-2.10	192-252	11.00-23.00	34.00-47.00
$P_2 \times P_7$	Mean	2.99	15.95	1.86	209.86	17.00	49.98
	Variance	0.030	3.038	0.012	317.128	12.490	12.540
	Range	2.20-3.30	12.20-20.60	1.46-1.99	160-240	10.00-24.00	44.00-56.00
$P_3 \times P_4$	Mean	3.25	18.92	1.87	235.96	18.60	49.46
	Variance	0.052	3.795	0.011	314.206	12.489	10.060
	Range	2.22-3.60	13.80-23.40	1.58-2.01	196-266	11.60-25.50	44.00-55.90
$P_3 \times P_5$	Mean	2.98	16.32	1.58	214.00	17.80	43.40
	Variance	0.030	2.435	0.063	311.866	12.462	12.403
	Range	2.20-3.30	13.00-22.40	1.16-2.00	184-244	11.80-24.80	37.40-49.40
$P_7 \times P_8$	Mean	2.90	13.68	1.61	187.37	13.99	35.40
	Variance	0.021	2.308	0.047	392.622	12.496	12.446
	Range	2.65-3.20	11.00-17.20	1.26-1.96	155-220	8.00-22.00	29.40-42.40
$P_5 \times P_2$	Mean	3.26	17.76	1.78	213.93	15.40	41.15
	Variance	0.041	5.463	0.021	317.079	12.504	13.223
	Range	2.75-3.65	11.60-23.40	1.54-2.02	165-244	9.20-23.40	34.00-48.00
$P_6 \times P_3$	Mean	3.04	16.06	1.74	221.94	15.40	45.39
	Variance	0.054	4.503	0.050	313.669	12.329	12.495
	Range	2.64-3.55	11.20-21.40	1.32-2.12	192-252	9.40-21.40	37.50-51.40
$P_7 \times P_5$	Mean	3.05	15.12	1.85	230.97	16.39	47.98
	Variance	0.059	7.288	0.011	311.383	12.404	12.532
	Range	2.27-3.55	10.20-20.20	1.56-1.99	201-261	10.40-22.40	42.00-54.00
$P_8 \times P_2$	Mean	3.17	16.10	1.65	219.93	15.60	42.12
	Variance	0.034	4.423	0.059	317.212	12.489	15.316
	Range	2.70-3.55	12.20-21.60	1.25-2.05	170-250	9.40-22.40	30.80-50.00
$P_8 \times P_4$	Mean	2.74	14.15	1.60	250.04	20.39	47.98
	Variance	0.062	4.692	0.059	321.376	12.496	12.532
	Range	2.18-3.23	10.20-19.00	1.20-2.00	220-280	12.40-26.40	42.00-54.00

Table 1. Variability parameters of selected population (30 selected plants) for different characters in F₂ generation of tossa jute

Combinations	Variability parameters	Plant height (m)	Base diameter (mm)	Green bark thickness (mm)	Green wt. without leaves (g)	Fibre weight (g)	Stick weight (g)
P ₂ × P ₆	Mean	2.97	16.03	1.86	232.26	19.46	43.23
	Variance	0.019	2.764	0.010	221.236	6.836	7.016
	Range	2.65-3.20	13.80-19.00	1.67-2.00	199-252	14.70-23.00	38.50-47.00
P ₂ × P ₇	Mean	3.07	17.47	1.92	225.37	20.56	53.20
	Variance	0.020	2.489	0.012	111.826	5.575	7.760
	Range	2.80-3.30	14.00-20.60	1.76-1.99	200-240	16.00-24.00	44.90-56.00
P ₃ × P ₄	Mean	3.34	20.16	1.93	246.70	21.34	51.91
	Variance	0.041	3.711	0.011	208.424	7.356	6.099
	Range	2.75-3.60	15.00-23.40	1.78-2.01	218-266	16.80-25.50	48.20-55.90
P ₃ × P ₅	Mean	3.12	17.94	1.90	226.40	20.63	46.04
	Variance	0.023	2.198	0.024	148.593	5.843	6.050
	Range	2.80-3.30	15.00-22.40	1.18-2.00	205-243	16.90-23.80	42.50-49.40
P ₇ × P ₈	Mean	2.98	15.44	1.75	203.17	16.58	37.80
	Variance	0.029	1.626	0.038	156.351	5.200	5.726
	Range	2.70-3.20	12.40-17.20	1.26-1.96	178-219	13.20-22.00	31.80-41.40
P ₅ × P ₂	Mean	3.40	19.32	1.90	228.53	18.73	44.46
	Variance	0.021	6.782	0.010	153.292	6.140	5.425
	Range	3.15-3.65	14.80-23.40	1.54-2.02	205-244	14.50-23.40	40.10-47.60
P ₆ × P ₃	Mean	3.27	18.38	1.98	235.20	18.11	48.39
	Variance	0.049	3.494	0.011	163.131	5.862	6.810
	Range	2.70-3.55	14.80-21.40	1.75-2.12	212-252	14.40-21.30	44.40-51.40
P ₇ × P ₅	Mean	3.30	18.20	1.91	244.10	19.44	51.35
	Variance	0.029	2.241	0.011	172.024	7.038	7.107
	Range	3.00-3.55	15.40-20.20	1.78-1.99	221-260	15.40-22.40	47.00-54.00
P ₈ × P ₂	Mean	3.34	18.24	1.89	235.83	18.69	46.07
	Variance	0.026	5.452	0.012	171.178	6.884	7.475
	Range	2.90-3.55	14.00-21.60	1.60-2.05	211-250	14.40-21.80	40.00-50.00
P ₈ × P ₄	Mean	3.09	17.14	1.86	262.87	23.53	51.83
	Variance	0.016	2.089	0.012	237.085	8.488	9.221
	Range	2.74-3.23	14.00-19.00	1.55-2.00	229-279	17.70-26.40	42.30-54.00

Table 3. T-test between the base population and selected population for different characters in F₂ generation

Parameters	Mean of base population	Mean of selected population	t- value	Pr> t
Plant height (m)	3.03	3.18	5.61**	0.0003
Base diameter (mm)	15.90	17.83	8.80**	0.0000
Green bark thickness (mm)	1.74	1.89	4.75**	0.0001
Green wt. without leaves (g)/plant	220.60	234.04	21.19**	0.0000
Fibre weight (g)/plant	16.76	19.71	27.08**	0.0000
Stick weight (g)/plant	44.38	47.43	16.17**	0.0001

** Significant at 1% level

To assess the gain from arbitrary selection mean, mean differences, mean ranges and variances were estimated in ten crosses for the characters, plant height (m), base diameter (mm), green bark thickness (mm), green wt. without leaves (g), fiber weight (g) and stick weight (g). Based population and selected population were tested through t- test (Table 3) and showed significant gain after applying judicious selection. All the characters showed significant differences from base to selected populations. Not only that the magnitudes of the characters significantly increased with 99% confidence level. If the characters should consider in advance generations, developed pure lines may be outstanding to incorporate in future breeding. Therefore, at the end of selfing (F₆ or F₇), a few pure lines may be exploited to release as new variants.

Conclusion

The continuous selection of traits of interest, generation after generation, permits the accumulation of favorable alleles for the traits being improved (increase of allelic frequency). Thus, heterozygous allelic pairs subject to fix with advancing the generations. Hence, this method is to be perfect on a medium-to-long-term basis, and it might produce genetic improvement in tossa jute. To develop varieties and take advantage of the genetic variability available in each segregating generation within the population improvement process, from the ten cross combinations the variability like mean range, mean and variance for each of the selected characters were compared between based population (300) and selected population (30) for a single character. In general, means values of selected characters were higher in selected populations under each of 10 crosses compared to base populations. The progenies of the cross, P₈ x P₄ (Acc-3860×Acc-2381) produced the highest fiber weight (23.53 g), which was followed by the cross, P₃ x P₄ (JRO-524×Acc-2381), further it produced the highest base diameter (20.16 mm), suggested the appreciable potential of the two crosses to evolve outstanding advanced lines for tossa jute in Bangladesh.

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