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Genetic variability studies in jute (*Corchorus olitorius* L.)

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Abstract
Genetic variability was assessed in jute (*Corchorus olitorius* L.) germplasms with 52 genotypes of jute which were evaluated in RBD at Cotton Improvement Project, MPKV Rahuri, during *kharif* 2021. The observations were recorded on randomly selected five plants for eight characters *viz.* days to initiation of flowering, days to 50% flowering, plant height (cm), basal diameter (cm), green weight (g), stick yield (g), fiber yield (g) and fibre recovery.

The results revealed that the Genotypic coefficient of variation (GCV) was lower than the phenotypic coefficient of variation (PCV) for all the characters under investigation. Three characters exhibited high GCV and PCV, green weight (g/plant), stick yield recorded moderate GCV and PCV, while four characters *viz*; days to initiation of flowering, days to 50% flowering, plant height (cm), recorded low GCV and PCV.

All heritability values were more than 60% except basal diameter (cm). High heritability coupled with high genetic advance was observed in plant height indicating that most likely heritability is due to additive gene effect and selection may be effective for these characters.

Fiber yield plant-1 showed highly significant positive correlation with days to 50% flowering, plant height, basal diameter, green weight and stick yield indicating that selection for these characters would benefit in improvement of genotypes. Days to initiation of flowering showed highly significant negative relationship with fiber yield plant^{-1}.

Fifty-two genotypes were grouped into eight clusters. Intra cluster distance was ranged from 1.94 (cluster VI) to 4.23 (cluster VIII). The highest intra cluster distance was observed in cluster VIII (4.23) followed by cluster IV (3.57), cluster V (3.28) and cluster III (3.22). The high intra cluster distance values indicates the existence of variability within the cluster. Hence, there is a scope for exchange of genes among genotypes within these clusters. From the inter cluster D2 values of the eight clusters, it can be seen that the highest divergence occurred between cluster VI and VII so that these clusters would give wider and desirable recombination. The genotypes OIN-211, OIN-202, OIN-210, OIN-203, OIN-209, JRO- 524, JRO-204 should be used in future hybridization program for jute improvement.

Keywords: Genetic variability, *Corchorus olitorius* L., Genotypic coefficient of variation (GCV)

Introduction
Jute (*Corchorus* sp.) is one of the important natural fiber after cotton in terms of cultivation and usage. Jute crop is world being cultivated in Eastern India, Nepal, Bangladesh, and some South East Asian countries. India is the largest producer of jute crop. Almost 85% of the world's jute cultivation is concentrated in the Ganges delta. Since jute was the main cash crop in Bangladesh, it was once referred to as the "Golden fiber" of that nation. Jute has been used for many textile applications for a very long time. Jute fiber is completely biodegradable, recyclable, eco-friendly. Jute is widely used as sacking for agricultural products and it is also being utilized more and more in stiff packaging, reinforced plastic and pulp and paper production to replace wood.

The global demand for natural fiber is rising quickly as a result of rising environmental consciousness. Breeding for high yield benefits from knowing the kind, extent, and relationships of genetic variability for the desired traits in the base material (Kar *et al.* 2009) [5]. Therefore, it is crucial to comprehend the diversity and variability of the jute germplasm that is now available. Therefore, the present investigation was undertaken on genetic variability study in 52 genotypes of jute with the following objectives. To study the components of genetic variability and heritability in jute crop and to assess the genetic diversity in jute crop.

Material and Methods

The experimental material used for the study consisted of 52 genotypes which were obtained from the All-India Network on Jute and Allied Fibers, MPKV, Rahuri.

Experimental Details

Sr. No.	Experimental condition	Details
1	Location	Cotton Improvement Project MPKV, Rahuri
2	Season	*Kharif*, 2021
3	Design	RBD
4	Replications	Three
5	Number of genotypes	52
6	Sowing date	12 June 2021
7	Row length	4.5 m
8	Spacing	45 ×30 cm
9	Fertilizer	80:40:40, NPK kg ha^{-1}
10	Method of sowing	Dibbling

Observations Recorded

The observations were recorded on five randomly selected plants in each genotype in each replication for all the characters except days to initiation of flowering, days to 50% flowering, plant height, basal diameter, green weight, stick yield and fiber yield. The values of five randomly selected plants were averaged and expressed as mean of the respective trait. The details of data recorded were as follows.

- **Quantitative parameter**

1) Days to initiation of flowering
2) Days to 50% flowering
3) Plant height(cm)
4) Basal diameter(cm)
5) Fresh green weight/ plant (on 5 randomly selected plants at harvesting)
6) Fiber yield / plant (on 5 randomly selected plants at harvesting)
7) Stick yield/plant (on 5 randomly selected plants at harvesting)
8) Fiber recovery (%)

- **Statistical Methodology**

1. Genotypic and phenotypic coefficients of variability was calculated as suggested by Burton and De Vane (1953) [1] and Johnson *et al.* (1955) [4].
2. Genotypic and phenotypic correlation coefficient of correlation was calculated as describe by Singh and Chaudhary (1977) [8] and Johnson *et al*. (1955) [4].
3. Direct and indirect effects was calculated by the path analysis as suggested by Dewey and Lu (1959) [2] genotypic level.
4. Genetic diversity analysis was done using Mahalanobis's D^2 statistics (1936) [6] and clustering of genotype into different group will be done as suggested (Rao,1952) [7].

- **Results and Discussion**

Results obtained from the present investigation entitled "Genetic variability studies in jute (*Corchorus olitorius* L.)" are given in following tables.

- **Analysis of Variance**

The mean of square due to genotype showed highly significant difference genotype for all the traits indicating that adequate variability was found in the genotype studied for these characters because of diverse genotypes. Similar result where obtain by Ghosh Dastidar *et al.* (1993) [3].

Table 1: Analysis of variance (ANOVA) for eight different characters in jute

Sr. No.	Characters	Mean sum of squares		
		Replication (2)	Genotype (51)	Error (102)
1.	Days to initiation of flowering	1.00	11.18**	1.38
2.	Days to 50% flowering	0.69	10.89**	1.37
3.	Plant height (cm)	114.46*	1849.94**	30.31
4.	Basal Diameter (cm)	0.01	0.04**	0.01
5.	Green Weight (g/plant)	0.00	0.00**	0.00
6.	Fiber yield (g/plants)	0.14	22.67**	0.40
7.	Stick yield (g/plant)	12.86	345.57**	22.66
8.	Fiber recovery (%)	0.02	19.71**	0.35

*and** indicate significant at 5 and 1 per cent level, respectively Note: Figures in the parenthesis indicates the degrees of freedom.

Table 2: Mean Performance of fifty-two jute genotypes studied for eight characters

Sr. No.	Name of genotype	Days to initiation of flowering	Days to 50% flowering	Plant height (cm)	Basal diameter (cm)	Fresh Green weight (g/plant)	Fiber yield (g/plant)	Stick yield (g/plant)	Fiber recovery (%)
1	OIN-186	54.67	64.33	265.00	1.46	0.23	8.60	88.34	8.83
2	OIN-187	54.67	64.33	268.00	1.28	0.24	8.67	95.44	8.32
3	OIN-188	55.00	65.33	251.00	1.38	0.29	8.13	90.02	8.26
4	OIN-189	53.33	63.33	207.33	1.33	0.22	6.30	88.43	6.60
5	OIN-190	52.67	63.00	251.00	1.26	0.25	5.40	72.32	6.93
6	OIN-191	53.00	63.33	235.67	1.28	0.24	4.43	70.53	5.87
7	OIN-192	54.00	64.67	195.33	1.28	0.17	3.41	70.04	4.60
8	OIN-193	55.67	65.00	227.00	1.27	0.22	4.63	72.17	5.80
9	OIN-194	56.00	65.33	196.33	1.24	0.16	2.93	70.97	3.90
10	OIN-195	56.33	65.67	208.67	1.20	0.16	2.91	68.43	4.04
11	OIN-196	57.00	67.00	215.00	1.19	0.18	3.00	70.23	4.03
12	OIN-197	53.67	64.67	214.67	1.40	0.17	3.02	66.07	4.32
13	OIN-198	54.00	64.00	214.67	1.34	0.17	3.00	68.27	4.22
14	OIN-199	55.00	64.00	210.00	1.42	0.16	2.94	66.63	4.20
15	OIN-200	57.67	67.33	268.67	1.33	0.27	7.80	96.99	7.38
16	OIN-201	57.00	67.00	268.67	1.48	0.25	9.94	71.44	12.21
17	OIN-202	53.33	64.00	275.33	1.30	0.29	7.93	81.33	8.83

18	OIN-203	54.67	64.00	208.33	1.48	0.16	2.94	68.43	4.11
19	OIN-204	55.00	64.66	263.33	1.35	0.24	7.04	97.33	6.70
20	OIN-205	54.33	65.00	229.00	1.21	0.18	6.88	93.31	6.87
21	OIN-206	57.33	67.66	262.00	1.24	0.24	5.71	79.93	6.62
22	OIN-207	52.66	63.00	233.00	1.27	0.19	6.36	85.12	6.95
23	OIN-208	53.00	62.66	218.00	1.44	0.17	3.73	57.26	6.06
24	OIN-209	53.00	64.00	268.00	1.44	0.26	7.63	71.80	9.75
25	OIN-210	54.67	64.67	292.33	1.50	0.24	10.40	72.96	13.08
26	OIN-211	53.00	64.00	291.00	1.31	0.27	12.10	74.60	13.95
27	OIN-212	55.00	65.33	247.67	1.72	0.24	8.73	62.63	12.17
28	OIN-213	55.67	67.00	249.33	1.38	0.24	5.53	68.73	7.40
29	OIN-214	53.66	63.00	250.67	1.31	0.24	4.53	55.40	7.53
30	OIN-215	53.00	63.66	256.33	1.19	0.26	6.70	79.96	7.72
31	OIN-216	53.33	64.00	265.67	1.28	0.26	5.70	79.97	7.75
32	OIN-217	54.00	63.00	261.66	1.33	0.27	7.36	67.43	8.03
33	OIN-218	54.33	64.66	248.33	1.31	0.27	7.70	82.63	8.41
34	OIN-219	54.00	64.00	248.33	1.37	0.26	5.86	83.23	6.63
35	OIN-220	56.00	66.33	238.66	1.38	0.23	5.80	82.30	6.86
36	OIN-221	53.33	63.33	250.00	1.27	0.24	7.80	87.16	8.17
37	OIN-222	53.33	63.33	250.33	1.24	0.25	6.70	70.46	8.67
38	OIN-223	54.66	65.00	251.33	1.32	0.26	6.43	77.30	7.66
39	OIN-224	53.33	64.33	236.00	1.33	0.26	7.80	87.06	8.21
40	OIN-226	53.66	63.66	208.66	1.37	0.13	3.50	85.23	3.94
41	OIN-227	53.00	63.66	242.00	1.45	0.27	9.86	87.20	10.16
42	OIN-228	54.00	64.66	228.66	1.38	0.26	6.13	68.40	8.22
43	OIN-229	56.00	66.33	247.33	1.29	0.25	7.90	86.86	8.31
44	OIN-230	54.00	64.00	259.00	1.49	0.25	9.70	93.63	9.38
45	OIN-231	54.00	64.33	237.00	1.28	0.25	9.04	85.83	9.52
46	OIN-232	53.00	63.66	230.00	1.41	0.24	7.66	82.80	8.45
47	OIN-233	53.33	64.33	248.00	1.34	0.24	8.53	88.03	8.83
48	OIN-234	53.00	63.66	235.00	1.38	0.23	7.96	89.70	8.15
49	OIN-235	54.00	64.33	229.00	1.32	0.24	7.26	84.00	7.96
50	OIN-236	53.00	63.66	209.00	1.36	0.09	2.96	78.56	3.65
51	JRO-524	61.66	72.00	292.00	1.71	0.27	15.13	100.20	13.21
52	JRO-204	62.00	72.33	284.66	1.63	0.27	13.40	92.30	12.96
	Mean	54.61	64.80	243.11	1.35	0.23	6.76	79.10	7.69
	S.E.	0.67	0.67	3.17	0.06	0.00	0.36	2.74	0.34
	C.D. @ 5%	1.90	1.89	8.91	0.17	0.02	1.02	7.7	0.97
	CV	2.15	1.80	2.26	8.04	5.51	9.37	6.01	7.79

Table 3: Estimates of variability parameter for fiber yield and its yield contributing characters in 52 jute genotypes

Sr. No.	Character	Mean	Range	GCV (%)	PCV (%)	ECV (%)	Heritability (bs) (%)	Genetic Advance	Genetic Advance % of Mean
1	Days to initiation of flowering	54.61	52.66-62.00	3.31	3.95	2.15	70.30	3.12	5.71
2	Days to 50% flowering	64.80	63.00-72.33	2.75	3.29	1.81	69.80	3.07	4.73
3	Plant height (cm)	243.11	195.33-292.33	10.13	10.38	2.26	95.2	49.51	20.36
4	Basal Diameter (cm)	1.35	1.20-1.72	7.151	10.76	8.05	44.1	0.13	9.78
5	Green Weight (g/plant)	0.23	0.09-0.29	18.65	19.45	5.51	92.0	0.08	36.86
6	Fiber Yield (g/plant)	6.76	2.90-15.13	40.30	41.37	9.37	94.9	5.46	80.86
7	Stick Yield (g/plant)	79.10	62.63-100.20	13.11	14.43	6.01	82.6	19.42	24.55
8	Fiber Recovery (%)	7.694	3.65-13.95	33.00	33.96	7.80	94.7	5.09	66.17

Table 4: Genotypic and phenotypic correlation coefficient between fiber yield and its components character

Sr.no.	Character		Days to initiation of flowering	Days to 50% flowering	Plant height (cm)	Basal diameter (cm)	Fresh Green weight (g/plant)	Stick yield (g/plant)	Fiber yield (g/plant)
1	Days to initiation of flowering	G	1.00	0.98**	0.33*	0.39**	0.12	0.26**	0.39**
		P		0.93**	0.26**	0.18*	0.09	0.21**	0.32**
2	Days to 50% flowering	G		1.00	0.37**	0.43**	0.20*	0.29**	0.47**
		P		1.00	0.28**	0.22**	0.15*	0.26**	0.39**
3	Plant height (cm)	G			1.00	0.45**	0.79**	0.36**	0.81**
		P			1.00	0.33**	0.76**	0.32**	0.78**
4	Basal diameter (cm)	G				1.00	0.23**	0.25**	0.68**
		P				1.00	0.19*	0.14	0.48**
5	Green weight (g/plant)	G					1.00	0.34**	0.73**
		P					1.00	0.29**	0.68**
6	Stick yield (g/plant)	G						1.00	0.59**
		P						1.00	0.56**
7	Fiber yield (g/plant)	G							1.00
		P							1.00

Table 5: Estimates of genotypic direct (diagonal) and indirect effect (above and below diagonal) of component characters on Fiber yield in 52 jute genotypes

Sr. No.	Name of character	Days to Initiation of flowering	Days to 50% flowering	Plant height (cm)	Basal Diameter (cm)	Fresh Green weight (g/plant)	Stick yield (g/plant)	Fiber yield (g/plant)
1.	Days to Initiation of flowering	-0.568	0.620	0.096	0.141	0.032	0.068	0.390**
2.	Days to 50% flowering	-0.558	0.630	0.109	0.158	0.053	0.078	0.472**
3.	Plant height (cm)	-0.186	0.235	0.293	0.1661	0.207	0.097	0.813**
4.	Basal Diameter(cm)	-0.220	0.274	0.133	0.364	0.610	0.067	0.680**
5.	Green weight (g/plant)	-0.069	0.128	0.230	0.084	0.263	0.090	0.728**
6.	Stick yield (g/plant)	-0.146	0.186	0.107	0.093	0.089	0.265	0.595**

Residual effect = 0.2950

Table 6: Grouping of 52 genotypes of Jute into different clusters based on D2 values

Cluster No.	Number of genotypes	Name of Genotypes
I	9	OIN-199, OIN-203, OIN-198, OIN-197, OIN-195, OIN-194, OIN-196, OIN-208, OIN-192
II	20	OIN-232, OIN-235, OIN-234, OIN-224, OIN-231, OIN-233, OIN-218, OIN-229, OIN-221, OIN-227, OIN-188, 0IN-223, OIN-215, OIN-222, OIN-219, OIN-217, OIN-220, OIN-190, OIN-230, OIN-209
III	3	OIN-205, OIN-207, OIN-189
IV	8	OIN-186, OIN-187, OIN-204, OIN-200, OIN-202, OIN-206, OIN-216, OIN-213
V	4	OIN-191, OIN-193, OIN-214, OIN-228
VI	2	JRO-524 (check), JRO-204 (check)
VII	2	OIN-226, OIN-236
VIII	4	OIN-210, OIN-211, OIN-201, OIN-212

T**able 7:** Average intra and inter cluster D2 and D (in parenthesis) values of eight Clusters

Cluster	I	II	III	IV	V	VI	VII	VIII
I	5.10 (2.26)	55.65 (7.46)	33.52 (5.79)	64.80 (8.05)	27.98 (5.29)	178.75 (13.37)	16.40 (4.05)	127.46 (11.29)
II		8.12 (2.85)	18.06 (4.25)	16.08 (4.01)	17.97 (4.24)	73.61 (8.58)	71.23 (8.44)	36.84 (6.07)
III			10.36 (3.22)	30.69 (5.54)	21.62 (4.65)	111.09 (10.54)	35.52 (5.96)	64.16 (8.01)
IV				12.74 (3.57)	27.24 (5.22)	63.84 (7.99)	75.16 (8.67)	38.81 (6.23)
V					10.75 (3.28)	114.49 (10.70)	51.40 (7.17)	63.20 (7.95)
VI						3.76 (1.94)	196 (14.00)	46.51 (6.82)
VII							5.90 (2.43)	140.89 (11.87)
VIII								17.89 (4.23)

Table 8: Cluster means for eight characters studied in jute

Cluster No.	Days to Initiation of flowering	Days to 50% flowering	Plant height (cm)	Basal Diameter (cm)	Fresh Green weight (g/plant)	Fibre yield (g/plant)	Stick yield (g/plant)	Fibre recovery (%)
I	54.85	64.67	209.00	1.33	0.17	3.10	67.37	4.39
II	53.90	64.22	246.92	1.34	0.26	7.56	83.02	8.31
III	53.44	63.78	223.11	1.27	0.20	6.51	88.96	6.81
IV	55.21	65.42	264.67	1.33	0.25	7.12	84.44	7.71
V	54.08	64.00	235.50	1.28	0.24	4.93	66.63	6.86
VI	61.83	72.17	288.33	1.67	0.27	14.27	96.25	12.96
VII	53.33	63.67	208.83	1.37	0.12	3.23	81.90	3.80
VIII	54.92	65.25	274.92	1.47	0.25	10.29	70.41	12.85
Population mean	54.61	64.80	243.11	1.35	0.23	6.76	79.10	7.69

Table 9: Percent Contribution of different characters

Sr. No.	Characters	Number of times appearing first in the ranking	Contribution %
1	Days to Initiation of flowering	42	3.17
2	Days to 50% flowering	11	0.83
3	Plant height (cm)	573	43.21
4	Basal Diameter (cm)	11	0.83
5	Green weight (g/plant)	169	12.75
6	Fiber yield (g/plant)	333	25.11
7	Stick yield (g/plant)	120	9.05
8.	Fiber recovery (%)	67	5.05
	Total		100

Summary and Conclusion

Variability and Genetic Parameters

Sufficient variability was present among the genotypes for all the eight characters studied. The estimates of GCV and PCV for all the characters studied showed little difference the PCV being slightly greater than the GCV, thus indicating that the variability existing in these characters was not only due to genetic factors but also due to environmental factors.

Correlation

The significant positive correlation was reported for all the characters studied such as days to initiation of flowering, days to 50% flowering, plant height, basal diameter, fiber yield per plant along with stick yield and fiber recovery.

Path coefficient analysis

Path coefficient analysis revealed that days to 50% flowering had highest direct effect on fiber yield per plant followed by basal diameter. These traits also showed significant positive correlation with fiber yield per plant. High magnitude of direct effects accompanied by highly significant correlation with fiber yield per plant signifies true and perfect association between them. Therefore, emphasis should be given on these characters while making selection for desired improvement for fiber yield in jute.

Genetic Divergence

The D^2 values showed adequate genetic diversity among the genotypes studied. Based on D^2 values all the genotypes were grouped into eight clusters with varying number of genotypes in the clusters. Cluster II was largest with 20 genotypes followed by cluster I (9) genotypes, while cluster IV (8) cluster V and VIII (4), cluster III Contains (3) genotypes, cluster VI and VII both contains (2 genotype).

Keeping in view all the above aspects and considering the inter-cluster distance, cluster mean and *per se* performance of genotypes and divergence class, the genotypes listed below may be utilized in future breeding programme for creating maximum spectrum of variability for different yield contributing characters, which would help in developing superior genotypes with high yield and desired traits. Considering the *per se* performance of genotypes, inter cluster distances and cluster mean the genotypes OIN-211, OIN-202, OIN-210, OIN-203, OIN-209, JRO- 524, JRO-204 should be used in future hybridization for jute improvement.

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