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Performance of Different Jute (*Corchorus olitorius* L.) Varieties Based on Growth and Yield in Coastal Soils of West Bengal

Binita Dey, Pijush Das*, Jayeeta Maji and Chandan Sourav Kar[1]

Department of Agronomy, School of Agriculture and Allied Sciences,
The Neotia University, South 24 Parganas-743 368, India
[1]Department of Plant Breeding, Central Research Institute for Jute and Allied Fibres,
Indian Council of Agricultural Research, Kolkata-700 120, India
**E-mail: pijush.das@tnu.in*

***Abstract*:** Jute (*Corchorus olitorious* L.) is an environment friendly natural fibre crop responsible for out doing synthetic fibres. However, fibre yields have been decreasing daily in recent decades due to lack of long-term promising varieties, climate change issues and complexity of crop yields. The field experiment was carried out to study the performance of different *olitorius* jute varieties under coastal soils of West Bengal during *pre-kharif* season of 2023 comprising seven *olitorius* jute varieties - JRO 524, JRO 2407, JRO 204, CO 58, JBO 1, JROM 1 and NJ 7005. Variety JBO 1 showed superiority on growth and yield contributing characters and resulted in maximum plant height, leaf per plant and aerial dry biomass at harvest among the tested varieties. JBO 1 was superior with respect to fibre yield (28.2 q/ha), stick yield (78.3 q/ha), and harvest index (26.04) among all the tested jute varieties. Variety JBO 1 could be more successful productive variety under coastal soils of West Bengal.

***Keywords*:** Varietal performance, Natural fibre, Growth parameters, Fibre yield, Economics

Jute (*Corchorus spp*.) is an important natural fibre crop in India next to cotton. It is versatile, biodegradable, recyclable, eco-friendly lignocellulose and considered as the second most common natural cellulosic fibre in the world. *Corchorus olitorius* is the most cultivated species in the country as well as other parts of world. It is one of the important bast fibre crop species being cultivated in India, Bangladesh, China, Nepal, Thailand and some South-East Asian countries (Miah et al., 2020). In India, West Bengal is the major producing state contributing about 71% of national production and is mainly restricted to the Terai regions of the state. Jute production is essential for the agrarian economy since it not only generates revenue but also creates rural employment. The economic importance is further enhanced by its quick growth and capacity to flourish in low-input agricultural systems (FAO 2021). In an era marked by concerns about environmental sustainability, jute has emerged as an eco-friendly alternative to synthetic materials. Its biodegradability and low carbon footprint make it a favoured choice in various industries seeking to reduce their environmental impact (GCI and UNCTAD 2018). Despite technological advancements in crop production, jute yields have been decreasing daily in recent decades for a number of reasons (Islam and Ali, 2017, Karim et al., 2020, Karki et al., 2021). One of them is the lack of long-term promising varieties and the complexity of crop yields, which are greatly influenced by a variety of genetic factors as well as a series of environmental changes. Furthermore, with continuous variation in the present weather conditions, jute crop production is greatly affected by such climate change issues (Kalita and Bhuyan 2018). The jute industry is plagued by a number of issues, such as small and marginal growers with little negotiating power, a lack of institutional credit, a flawed marketing structure, declined productivity, competition from synthetics, high labour costs, frequent industrial disruptions, outdated machinery, and stagnating export facilities. These issues have all contributed to the widespread sickness in the jute industry. Varietal performance is the best tool to combat this situation by producing higher yield and good quality fibres of jute (Karki et al., 2021). The present experiment was undertaken to assess the performance of different *olitorius* jute varieties for their adaptability depending on crop growth and yield in coastal soils of West Bengal.

MATERIAL AND METHODS

Experimental site: Field trial was conducted at The Neotia University, Diamond Harbour, South 24 Parganas, West Bengal to evaluate the performance of few *olitorius* jute varieties during the *pre-kharif* season of 2023. The experimental field is situated at 22°26' N latitude and 88°19' E longitude with an average altitude of 8 m above MSL. The soil type of experimental field was clayey in nature, having 213.6 kg/ha available N, 22.08 kg/ha available P_2O_5, 312.26 kg/ha available K_2O and 0.46 % organic carbon. The experimental period was hot and received moderate rainfall partly effective for the crop grown (Table 1).

Field layout and treatment details: The experiment was carried out in a randomized complete block design comprising seven *olitorius* jute varieties (treatments) with three replications (Table 2). The size of each plot was 4 m × 3

m and gross cropped area was 336 m^2. Irrigation channels of 1 m width were provided along the length of the experimental field whereas the bund width of each plot was 0.5 m. Jute seeds were collected from ICAR-Central Research Institute for Jute and Allied Fibres, Nilganj, Barrackpore, West Bengal.

Crop management: Jute seeds were sown on 3rd week of March, 2023. All the standard agronomic practices were followed for raising the crop. Recommended dose of N-P_2O_5-K_2O @ 60-30-30 kg/ha were applied for the crop with seed rate of 5 kg/ha. Crop was harvested on 4th week of July, 2023 and thereafter, it was continuously kept below 10 cm of water depth for retting by making bundles after 3 days of harvesting. Considering the complete retting (after 14 days of complete submergence) of jute fibre it was then separated from the sticks and kept under the sun for drying and finally stored by making bundles.

Data recorded: Agronomic observations were taken by selecting ten plants randomly from each plot. Observations on crop growth parameters *viz*. plant population, plant height, leaf/plant, basal girth, aerial dry biomass, LAI, NAR, RGR were taken on regular interval and yield components *viz*. fibre yield, stick yield, biological yield and harvest index were recorded finally at harvest. Occurrence and severity of different pests were also monitored to understand the resistance of the tested varieties against a particular pest.

Statistical analysis: Statistical data analysis was carried out using OPSTAT software and Fisher's least significant test was used to compare the mean values at a probability level of 0.05.

RESULTS AND DISCUSSION

Crop growth parameters: Various crop growth parameters *viz*. plant population, plant height, leaf/plant, basal girth and aerial dry biomass of *olitorius* jute were significantly varied with different cultivars during the period of experimentation (Table 2). The highest plant population was observed under variety JBO 1 (49.7) while the lowest (44.7) in JRO 2407. Survival of more plants per unit area might be attributed to higher adaptability of JBO 1 variety in local environment as compared to all other jute varieties. Greater plant height (388.6 cm) and leaf/plant (54.26) were in JBO 1 which was closely followed by CO 58, NJ 7005, JROM 1 and JRO 524. Variation in plant height might have been seen due to genetic makeup of all the cultivars and their suitable adaptation in these soils of coastal Bengal. More thicker plants (7.21 cm) with maximum aerial dry biomass (2732.20 g/m^2) were in JBO 1 which was statistically at par with JRO 524 and CO 58. This increment in aerial dry biomass by JBO 1 might be attributed to a greater number of taller plants and more leaf/plant as achieved by the variety. Similarly, Karim *et al.,* (2020) reported that total aerial dry biomass of jute differed significantly among the cultivars depending upon the height

Table 1. Meteorological data pertaining to the year of experimentation

Months	Temperature (^{0}C)		Rainfall (mm)	Relative humidity (%)		Bright sunshine (hrs)
	Maximum	Minimum		Maximum	Minimum	
March	32.4	20.5	36.2	95.7	64.5	7.1
April	35.9	24.4	12.2	95.7	66.4	6.3
May	38.8	22.5	21.4	93.7	57.0	6.2
June	35.7	25.4	41.5	94.8	57.1	6.0
July	33.9	27.5	61.5	83.9	61.5	5.9

Source: Department of Soil Science & Agricultural Chemistry, SAAS, TNU

Table 2. Performance of different *olitorius* jute varieties based on morpho-physiological characters

Variety		Plant population	Plant height (cm)	Leaf/plant	Basal girth (cm)	Aerial dry biomass (g/m^2)
T_1	JRO 524	47.7	350.9	53.73	6.57	2595.40
T_2	JRO 2407	44.7	322.8	45.51	5.76	2192.86
T_3	JRO 204	45.7	350.0	47.26	5.90	2393.96
T_4	CO 58	48.3	374.8	52.73	6.75	2591.70
T_5	JBO 1	49.7	388.6	54.26	7.21	2732.20
T_6	JROM 1	46.7	352.0	47.33	6.20	2461.96
T_7	NJ 7005	46.3	372.6	51.03	6.41	2522.73
CD (p=0.05)		3.43	38.51	5.52	0.76	184.25

of plants. In contrast, JRO 2407 recorded the shortest plant (322.8 cm), lowest number of leaf/plant (45.51), basal girth (5.76 cm) and aerial dry biomass (2192.86 g/m^2) among the tested jute varieties during the study period.

The leaf area index (LAI) was significantly influenced while there was no significant influence on net assimilation rate (NAR) and relative growth rate (RGR) of all the tested *olitorius* jute varieties (Table 3). The increasing LAI and NAR was observed with the progress of crop growth while RGR recorded the opposite trends with time advancement. The highest LAI of 6.91, 7.28 and 7.77 was in JBO 1 during 31 - 60 DAS, 61 - 90 DAS and 91 - harvest, respectively. NAR followed a similar trend during 31 to 60 DAS and 61 to 90 DAS. The highest value of NAR (1.0504 g/dm^2/day) was in JBO 1 which was closely followed by JRO 204 and CO 58 at harvest. This increased NAR values of variety JBO 1 might be attributed to its positive correlation with LAI as the optimum leaf area, in general, should give highest rate of net assimilation in any crop. Initially all the tested jute varieties recorded higher values of RGR thereafter resulted in decreased value with time progress. Among all the jute varieties the highest RGR (0.0079 g/g/day) was observed in JBO 1 which was followed by the variety CO 58, JROM 1, NJ 7005 and JRO 204 from 91 DAS to harvest. In contrast, variety JRO 2407 recorded the lowest LAI, NAR and RGR.

Yield performance: Different *olitorius* jute varieties revealed significant variations in terms of dry fibre yield, stick yield, biological yield and harvest index under coastal soil conditions (Table 4). The highest fibre yield (28.2 q/ha) was in JBO 1 which was significantly differed with all other varieties while JRO 2407 recorded the least yield (21.2 q/ha). JBO 1 recorded an increase in fibre yield to the tune of 11.46% to 33.02% in respect of all other varieties. This increased fibre yield is directly linked with taller and thicker plants with higher dry matter partitioning that obtained in JBO 1. Plant height is the most efficient morphological trait which is directly related to increased fiber yield of jute (Hassan et al*.,* 2018). It was also reported that maximum plant height returned the highest fibre yield of jute in Bangladesh (Karim et al., 2020, Rafiq et al., 2020). The highest stick and biological yield (78.3 q/ha and 108.2 q/ha respectively) were in JBO 1 followed by CO 58, JRO 524, NJ 7005 and JROM 1. Taller and thicker plants

Table 3. Leaf area index, net assimilation rate and relative growth rate of different *olitorius* jute verities in coastal soils of West Bengal

Variety	Leaf area index			Net assimilation rate (g/dm^2/day)			Relative growth rate (g/g/day)		
	31 - 60 DAS	61 - 90 DAS	91 DAS - Harvest	31 - 60 DAS	61 - 90 DAS	91 DAS - Harvest	31 - 60 DAS	61 - 90 DAS	91 DAS - Harvest
T1	6.57	7.20	7.39	0.7502	0.7764	1.0013	0.0143	0.0097	0.0075
T2	6.07	6.30	6.41	0.6788	0. 7390	0.9681	0.0148	0.0091	0.0075
T3	6.32	6.55	7.06	0.6914	0. 7619	1.0424	0.0151	0.0094	0.0076
T4	6.60	6.94	7.44	0.7487	0.7509	1.0323	0.0143	0.0097	0.0077
T5	6.91	7.28	7.77	0. 7297	0.7817	1.0504	0.0146	0.0093	0.0079
T6	6.31	6.87	7.19	0.7223	0.7263	0.9992	0.0139	0.0095	0.0077
T7	6.59	7.01	7.23	0.7280	0.7473	1.0027	0.0140	0.0095	0.0076
CD (p=0.05)	0.537	0.567	0.515	NS	NS	NS	NS	NS	NS

See Table 2 for treatment details

Table 4. Yield performance of different *olitorius* jute varieties in coastal soils of West Bengal

Variety	Fibre yield (q/ha)	Stick yield (q/ha)	Biological yield (q/ha)	Harvest index (%)
T1	24.7	71.9	96.9	25.48
T2	21.2	61.8	85.3	24.84
T3	22.8	66.2	89.6	25.41
T4	25.3	73.8	99.2	25.72
T5	28.2	78.3	108.2	26.04
T6	23.5	68.3	92.8	25.30
T7	24.4	70.9	95.9	25.45
CD (p=0.05)	2.32	6.07	9.01	0.26

See Table 2 for treatment details

resulted from the varieties with higher dry matter partitioning increases stick as well as biological yield of jute (Maji et al., 2024). Similar findings were also observed by Khan and Tareq (2018), Karim et al. (2020) and Miah et al. (2020). In contrast, JRO 2407 resulted in the least stick and biological yield. The highest harvest index (26.04) was observed in JBO 1 because of its increased economic yield in terms of dry fibre production while the lowest (24.48) was recorded in JRO 2407.

Pest infestation and its severity: Significant infestation of anthracnose and stem rot disease in terms of percent plant infestation and severity had been observed in all the jute varieties (Table 5). Maximum percent plant and leaf infestation of anthracnose was in NJ 7005 (23.07 and 11.22, respectively) which was statistically at par with JROM 1, JRO 204 and CO 58. JBO 1 showed the least percent plant and leaf infestation (13.43 and 6.77). Disease severity of anthracnose was maximum in JROM 1 (1.37) while JBO 1 recorded the minimum severity (0.70). The maximum percent plant infestation (34.70) and disease severity (4.20) of stem rot was noted in NJ 7005 followed by JROM 1, JRO 204 and JBO 1 while variety JRO 2407 recorded the minimum percent plant infestation and severity. JRO 2407 variety showed less infestation from anthracnose and stem rot disease as it is less susceptible to both the diseases while NJ 7005 showed highest susceptibility during the study period.

Infestation of insect pests like yellow mite and Bihar hairy caterpillar varied significantly in terms of percent plant and leaf infestation (Table 6). The maximum percent plant and leaf infestation of yellow mite was in JRO 204 (46.59 and 15.96 respectively) which was followed by CO 58 and JRO 2407. Variety JRO 524 attained minimum percentage of plant infestation (25.56) while JBO 1 recorded the least percent infestation in leaf (8.56). The maximum percent plant and leaf infestation of Bihar hairy caterpillar was observed in NJ 7005 (32.41 and 16.04 respectively). JRO 524 recorded the minimum percent plant and leaf infestation because of its least susceptibility to yellow mite and Bihar hairy caterpillar.

Production economics

The cost of production for all the jute varieties under cultivation was equal *i.e.* Rs. 55997 per ha as because similar types of management practices and inputs were applied to all the treatments (Table 7). Overall, JBO 1 recorded highest

Table 5. Disease infestation in different *olitorius* jute varieties in coastal soils of West Bengal

Treatment	Stem rot (percent)		Anthracnose		
	Plant infestation (%)	Severity	Plant infestation (%)	Leaf infestation (%)	Severity
T_1	18.09	1.20	13.99	7.43	0.73
T_2	15.90	1.16	14.31	7.35	0.73
T_3	25.62	2.80	19.15	9.94	1.03
T_4	19.30	1.20	16.55	10.07	1.03
T_5	21.61	1.73	13.43	6.77	0.70
T_6	25.87	3.06	20.03	11.16	1.37
T_7	34.70	4.20	23.07	11.22	1.33
CD (p=0.05)	12.803	2.278	6.046	3.466	0.324

See Table 2 for treatment details

Table 6. Insect infestation in different *olitorius* jute varieties in coastal soils of West Bengal

Treatment	Yellow mite (Per cent)		Bihar hairy caterpillar (Per cent)	
	Plant infestation	Leaf infestation	Plant infestation	Leaf infestation
T_1	25.56	9.37	18.94	11.24
T_2	37.58	12.64	25.61	12.64
T_3	46.59	15.96	29.01	15.98
T_4	42.05	14.31	26.79	15.22
T_5	30.96	8.56	19.50	12.17
T_6	29.98	10.44	28.61	14.22
T_7	31.72	9.56	32.41	16.04
CD (p=0.05)	9.147	3.828	5.583	4.499

See Table 2 for treatment details

Table 7. Production economics of *olitorius* jute as influenced by different cultivars

Variety	Cost of production (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
T1	55997	161662	105665	1.88
T2	55997	138814	82817	1.48
T3	55997	149044	93047	1.67
T4	55997	165882	109885	1.97
T5	55997	182196	126199	2.25
T6	55997	153654	97657	1.74
T7	55997	159714	103717	1.85

See Table 2 for treatment details

gross return (Rs. 182196 per ha), net return (Rs. 126199 per ha) and B:C ratio (2.25) followed by CO 58, JRO 524, NJ 7005, JROM-1 and JRO 204 while JRO 2407 recorded the lowest value of each parameter. Much variation in gross return, net return and B:C ratio was seen due to significant variation in fibre and stick yield of different jute varieties during the study period.

CONCLUSIONS

JBO 1 recorded a greater number of taller and thicker plants with maximum aerial dry biomass among all the tested jute varieties. Highest fibre, stick yield and harvest index was also observed in this variety along with maximum monetary return and B:C ratio. Therefore, it can be concluded that the variety JBO 1 could be more successful, efficient and productive compared to the other tested *olitorius* jute varieties under coastal soils of West Bengal.

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