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RESEARCH PAPER

Varietal Performance of Jute (*Corchorus capsularis* L.) Based on Crop Growth and Yield in the Coastal Region of South Bengal

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ABSTRACT

Jute (*Corchorus spp.*) is considered as the main cash crop in the history of Bengal and second most important natural fibre crop in the world next to cotton. It is becoming popular in the textile industry as a replacement for synthetic fibres. However, despite improvements in production technique, jute yields have been steadily declining in recent decades due to unavailability of sustainable, promising varieties, and yield complexity of any crop, which is greatly influenced by a number of genetic factors and environmental fluctuations. Keeping this in view, a field experiment was carried out at the Instructional Farm, School of Agriculture and Allied Sciences, The Neotia University to study the performance of few *capsularis* jute varieties in the coastal region of South Bengal during the *pre-kharif* season of 2023. The soil of the experimental field was fine textured clay type, 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. Experiment was conducted in Randomized Complete Block Design and the treatments were comprised of six *capsularis* jute varieties namely JRC 9057, JRC 80, JRC 517, JRC 532, Monalisa and JRCJ 11. Results revealed that there was statistically significant variation in crop growth parameters and yield attributes under JRC 9057 during the study period. JRC 9057 resulted in maximum plant height, leaf plant^{-1} and aerial dry biomass at harvest. Furthermore, JRC 9057 outperformed all other tested jute varieties in terms of fibre yield (25.25 q ha^{-1}), stick yield (66.44 q ha^{-1}), and harvest index (29.57%) as well as highest profitable return. Therefore, variety JRC 9057 is the most economically viable alternative among all other tested *capsularis* varieties in the region.

HIGHLIGHTS

- Production of environment friendly fibre crops for outdoing synthetic fibres.
- Understanding superiority among jute cultivars based on growth and yield.
- Identification of long-term promising jute varieties considering climate change issues.

Keywords: Cash crop, Natural fibre, Varietal performance, Crop growth, Fibre yield

Jute (*Corchorus spp.*) has a glorious contribution as the main cash crop of Bengal in the history of time. Jute fibre is becoming more and more popular among industry as a supplement to or replacement for synthetics in a variety of applications. Jute fibre is the most affordable natural vegetable fibre that can be easily spun into strong threads. It is soft, lustrous, long and off-white to brown in colour. Jute fibre is the second most common lignocellulosic composite natural fibre in the world (Liu *et al*. 2010) and is next to cotton. It is the most economically viable textile fibre and is widely used in the production of packaging materials for industrial and agricultural goods. Being biodegradable it is

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environmentally safe to dispose of its products that can potentially prevent environmental degradation as well as soil and climate degradation. Jute is mainly cultivated in eastern as well as north eastern part of India and all over Bangladesh. India is the world's top producer of jute products, making up almost 70% of the total production (Ministry of Textiles, Govt. of India). Due to the significant local market demand, 90% of the total production of jute is often used domestically. India's jute industry is predominantly based in West Bengal, and presently over 75% of the country's raw jute production comes from West Bengal. Jute contributes significantly to the economy of the state as well as nation by creating jobs, bringing in foreign currency, addressing a number of socioeconomic issues etc.

However, despite improvements in production technique, jute yields have been steadily declining in recent decades for a variety of reasons (Karim *et al.* 2020; Karki *et al*. 2021). The most significant of them is the absence of a sustainable, promising varieties, and yield complexity of any crop, which is greatly influenced by a number of genetic factors and environmental fluctuations (Hossain *et al.* 2012). In contrast, synthetic fibre has emerged as a stronger competitor to jute in recent years. Only suitable jute types counteract this dilemma by providing quality fibres (Islam, 2007). The quality of jute fibre is influenced by climate, soil and cultivation practices. The process of improving jute quality is ongoing and involves a number of strategies, including plant breeding, biotechnology, and the creation of new varieties. Successful evaluation of stable genotypes that could be utilized for general cultivation or in upcoming breeding programs is made possible by the knowledge of genotype-environment interaction (Prabhakar *et al*. 2010). Furthermore, by identifying promising characteristics and choosing superior lines for additional breeding attempts, varietal trials are essential to develop new crop varieties. Agriculture may become more resilient, sustainable, and productive by applying varietal trials to continuously improve crop varieties (Maitra *et al*. 2023; Sarkar *et al*. 1997; Ray *et al*. 2024). Varietal selection generally plays a key role in identifying improved varieties preferred by the farmers and offers a sustainable remedy for the limitations that force farmers to cultivate landraces that are susceptible to biotic and abiotic stressors and have low yields. It is necessary to significantly increase production to make jute cultivation more economical for farmers. Therefore, varietal performance is the most effective method in the aspect of increasing and improving jute productivity and to obtain higher production through sustainable cultivars. Considering these facts in mind, a research program entitled 'Varietal performance of jute (*Corchorus capsularis L.)* based on crop growth and yield in the coastal region of South Bengal' was undertaken in the field to identify the suitable *capsularis* varieties in terms of fibre yield and monetary returns.

MATERIALS AND METHODS

A field experiment was conducted at the Instructional Farm, School of Agriculture and Allied Sciences, The Neotia University, West Bengal (22°26' N latitude and 88°19' E longitude with an average altitude of 8 m above MSL) in order to evaluate the performance of few *capsularis* jute varieties during the *pre-kharif* season of 2023. The soil of experimental plot was clay in texture, having 0.46 % organic carbon, 213.6 kg ha^{-1} of available N, 22.08 kg ha^{-1} of available P_2O_5, 312.26 kg ha^{-1} of available K_2O. The experimental period was hot and received a moderate rainfall (Table 1). The experiment was laid out in a randomized complete block design (RCBD) comprising six *capsularis* jute varieties (treatments) with four replications. The tested jute varieties were as follows: JRC 9057, JRC 80, JRC 517, JRC 532, Monalisa and JRCJ 11. The experimental field was ploughed by tractor drawn cultivator firstly followed by power tiller to make the soil loose and friable. Experimental field was then divided into 4 blocks each of which comprising 6 plots and total number of plot was 24. The size of each plot was 4 m × 3 m. Irrigation channels of 1 m width were made along the length of experimental field and bund width of each plot was 0.5 m. Jute seeds were sown on 3rd week of March, 2023. All the standard agronomic practices of cultivation were followed for raising the crop. A recommended dose of NPK (60:30:30 kg ha^{-1}) was applied to meet the nutritional requirement of the crop. The crop was harvested on 4th week of July, 2023. Observations were taken on crop growth and yield parameters on regular interval and at the time of harvest. All the data recorded were analyzed statistically using analysis of variance method (Gomez and Gomez, 1984) and

Table 1: Meteorological data pertaining to the year of experimentation (2023)

Months	Temperature (^{0}C)		Rainfall (mm)	Relative Humidity (%)		Bright sunshine (hrs)
	Max.	Min.		Max.	Min.	
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 *capsularis* jute varieties based on crop growth parameters in coastal region of South Bengal

Variety	Plant height (cm)	Leaf plant^{-1}	Basal diameter (cm)	LAI at maximum growth stage	Aerial dry biomass (g m^{-2})	NAR at maximum growth stage	RGR at maximum growth stage
JRC 9057	318.4	55.1	2.15	5.89	2270.82	1.0335	0.0070
JRC 80	305.2	50.4	2.07	5.78	2188.55	0.9930	0.0068
JRC 517	301.9	50.2	2.03	5.71	2114.88	0.9512	0.0066
JRC 532	300.6	48.9	2.00	5.60	1966.20	0.8583	0.0062
Monalisa	289.1	46.2	1.94	5.39	1855.30	0.8630	0.0060
JRCJ 11	296.3	49.6	1.96	5.54	1962.30	0.8762	0.0063
S.Em (±)	5.42	1.08	0.05	0.023	36.09	0.035	0.0002
CD (*P*=0.05)	16.36	3.26	0.14	0.069	108.79	NS	NS

significance of different sources of variations were assessed by error mean square using Fisher and Snedecor's 'F" test at a probability level of 0.05.

RESULTS AND DISCUSSION

Crop growth parameters

Various crop growth parameters *viz.* plant height, leaf plant^{-1}, basal diameter, leaf area index (LAI) and aerial dry biomass of *capsularis* jute were significantly differed with the varieties grown while there were no significant influence on net assimilation rate (NAR) and relative growth rate (RGR) of all the tested jute varieties during the study period (Table 2). Among the tested jute varieties JRC 9057 recorded the maximum plant height (318.4 cm) which was statistically at par with the variety JRC 80 (305.2 cm) and shortest plant height of 289.1 cm was recorded by the variety Monalisa. Variety JRC 9057 consistently outperformed other varieties in promoting taller plant growth across all stages of development, probably due to the genetic makeup responsible for variation in height of any crop. Similar findings were also obtained by Pervin (2012). Again, JRC 9057 had the maximum number of leaf plant^{-1} (55.1) followed by variety JRC 80 (50.4) and JRC 517 (50.2). On the other hand, variety Monalisa produced the least number of leaf plant^{-1} (46.2) during the experimental trial. JRC 9057 recorded maximum value of basal diameter (2.15 cm) and found to be the most effective variety for jute stem girth enhancement. Variety JRC 9057 achieved the highest value of LAI (5.89) when the crop was at its maximum vegetative growth while the least value was recorded by variety Monalisa. Highest value of aerial dry biomass (2270.82 g m^{-2}) was achieved by the variety JRC 9057 and the increase was to the tune of 3.76% to 22.39% in comparison to all other varieties. These results are in agreement with the findings of Islam *et al.* (2011). The highest value of NAR (1.0335 g dm^{-2} day^{-1}) and RGR (0.0070 g g^{-1} day^{-1}) was observed under variety JRC 9057 which was closely followed by the variety JRC 80 and JRC 517 at maximum crop growth stage. In contrast, minimum NAR (0.8583 g dm^{-2} day^{-1}) and RGR

(0.0060 g g^{-1} day^{-1}) value observed under the variety JRC 532 and Monalisa respectively.

Yield performance

Different *capsularis* jute varieties showed significant variations on fibre yield, stick yield, biological yield and harvest index during the study period (Table 3). Maximum dry fibre yield (25.25 q ha^{-1}) and stick yield (66.44 q ha^{-1}) were recorded under variety JRC 9057 which was statistically at par with the variety JRC 80. In contrast, Monalisa variety resulted in the least values for both the parameters among all the tested varieties. Increased values of fibre as well as stick yield under the variety JRC 9057 is directly linked with higher values of all the growth parameters specifically plant height and basal diameter that obtained by the variety during the experimental period. Earlier findings also revealed that among the morphological characteristic plant height is most effective parameters and immediately correlates with higher fibre yield of jute (Karim *et al.* 2020; Al Rafiq *et al.* 2020 and Hassan *et al.* 2018). JRC 9057 was the most efficient variety in maximizing the production of total biomass and produced the highest biological yield (92.11 q ha^{-1}) outperforming all other jute varieties. Higher values of biological yield were observed with the varieties those produced more numbers of taller and thicker plants. The highest value of harvest index (29.57) was observed under variety JRC 9057 while the least value (27.43) was recorded by Monalisa due to significant reduction in fibre yield observed under the variety.

Production economics

It is essential to evaluate the production economics of any crop cultivars in order to choose the best one for any agro-ecosystem. Assessment of production cost of different *capsularis* jute varieties was essential in this regard. All the jute varieties had the same production cost (₹ 56103) as because same management procedures and inputs were used to each during the trial period (Table 4). Variety JRC 9057 recorded the highest gross and net return (₹ 161054 ha^{-1} and ₹ 104951 ha^{-1} respectively) followed by variety JRC 80, JRC 517, JRC 532 and JRCJ 11. On the other hand, variety Monalisa displayed the lowest gross return (₹ 131544 ha^{-1}) as well as net

Table 3: Yield performance of different *capsularis* jute varieties in coastal region of South Bengal

Variety	Fibre yield (q ha^{-1})	Stick yield (q ha^{-1})	Biological yield (q ha^{-1})	Harvest index (%)
JRC 9057	25.25	66.44	92.11	29.57
JRC 80	24.69	65.44	86.11	28.74
JRC 517	23.23	61.33	82.78	28.21
JRC 532	22.08	59.75	76.58	28.57
Monalisa	20.54	54.90	72.46	27.43
JRCJ 11	22.04	58.64	74.08	28.59
S.Em (±)	0.565	1.255	1.734	0.387
CD (*P*=0.05)	1.704	3.784	5.229	1.165

Table 4: Production economics of different *capsularis* jute varieties in coastal region of South Bengal

Variety	**Cost of production (₹ ha^{-1})**	**Gross return (₹ ha^{-1})**	**Net return (₹ ha^{-1})**	**B:C ratio**
JRC 9057	56103	161054	104951	1.87
JRC 80	56103	157761	101658	1.81
JRC 517	56103	148299	92196	1.64
JRC 532	56103	141849	85746	1.53
Monalisa	56103	131544	75441	1.34
JRCJ 11	56103	140980	84877	1.51

return (₹ 75441 ha^{-1}) during the experimental year. Highest B:C ratio (1.87) was achieved by the variety JRC 9057 and Monalisa recorded the lowest B:C ratio value (1.34) during the period of experimentation. A large variation in the gross return and net return was led by the significant differences in the fibre and stick yield of various jute cultivars.

It is evident from the results obtained that variety JRC 9057 has higher adaptability in the local environment as compared to all other tested jute varieties. It consistently performed well in respect of producing taller plants, more number of leaf $plant^{-1}$ and higher amount of aerial dry biomass production which ultimately resulted in higher fibre and stick yield. With the highest returns and profitability, JRC 9057 is the most economically viable alternative among all other tested *capsularis* varieties in the region while Monalisa is the least desirable.

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