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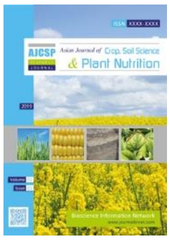

Influence of plant nutrient management on yield and yield attributes of BJRI tossa pat-8

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ABSTRACT

The experiment was conducted at Jute Research Substation, Manirampur, Jashore, in 2021 to determine the optimal doses of plant nutrient treatment for better jute growth, yield and yield attributes. A completely randomized block design with three trials was used to set up the investigation. The treatment combination were: T_0= control, T_1= poultry manure @ 5 t ha^{-1}, T_2= recommended dose of fertilizer (RDF), T_3= recommended dose of fertilizer (RDF) + Poultry manure @ 5 t ha^{-1}, T_4= 50% RDF + poultry manure @ 5 t ha^{-1}, T_5= 75 % RDF + poultry manure @ 5 t ha^{-1}, T_6= 125% RDF + poultry manure @ 2.5 t ha^{-1}, T_7= 150% RDF + poultry manure @ 2.5 t ha^{-1}, T_8= 150% RDF + poultry manure @ 5 t ha^{-1} with variety BJRI tossa pat-8. Nutrient management substantially impacted the growth, yield attributes, and yield of BJRI tossa pat-8. Application of 150% RDF + poultry manure @ 5 t ha^{-1} resulted in the maximum plant height (258 cm), leaf $plant^{-1}$ (44.67), fresh leaf weight (1.55 g), base diameter (17.13 mm), middle diameter (11.63 mm), terminal diameter (7.13 mm), number of nodes $plant^{-1}$ (50.73), fibre yield (4.30 t ha^{-1}) and harvest index (26.46%) whereas control treatment produced the lowest values in the most parameters. It was concluded that 150% RDF + poultry manure @ 5 t ha^{-1} was an enticing exercise for increasing fibre and stick yield.

Key Words: *Jute, Nutrient management, Poultry manure, Fibre yield and Stick yield.*

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I. Introduction

Jute would be the globe's most crucial bast fiber crop and a source of honor for Bangladesh. Bangladesh generates about 42% of the world's production of jute fibre. Besides, in global business, raw fibre is produced from two jute species, namely *Corchorus capsularis* (white jute) and *Corchorus olitorius* (tossa jute). *Habiscus cannabanus* (Kenaf) and *Hibiscus sabdariffa* (Mesta) also produced a small amount of fibre. In Bangladesh, jute is mostly grown in Faridpur, Jashore, Manikganj, Kishorganj, Mymensingh and Rangpur regions. *Corchorus olitorius* is widely cultivated throughout the country and belongs to the Tiliaceae family. The production of jute in Bangladesh is decreasing daily for different reasons, among them, improper fertilizer management is one of the significant problems. Integrated plant nutrient management of an improved variety itself provides about 30- 50% more yield along with standard agricultural practices (Islam et al., 2012). A vital component of the farming system, soil health and crop nutrients comprise adequate supplies of vital elements for soil productivity, plant nutrition and high-quality crop output. The plant's development and production are significantly influenced by the accessibility of those elements (Aluko et al., 2014). Incorporating poultry manure with inorganic fertilizers helps enhance the efficiency with which nutrients are utilized for crop development and productivity and contributes to soil bio materials replenishment. Because poultry manure is the primary source of available nutrients, maintaining an improved soil physiological state is crucial for plant production and higher yield (Haruna et al., 2009). It has already been indicated that the intensive cropping and use of chemical fertilizers severely burden the soil organic matter and essential nutrient availability, resulting in decreased crop production (Akanbi et al., 2009). Therefore, enormous efforts are needed to formulate poultry manure, inorganic fertilizers and their combination that will be technologically feasible, economically viable, communally appropriate and eco-friendly (Pushpa et al., 2016, Sarkar et al., 2000). Because of limited research on the situation, an investigation was initiated to determine the appropriate nutrient management option for growth, yield components as well as yield of BJRI tossa pat-8.

II. Materials and Methods

Area of the experiment

A study was performed at Bangladesh Jute Research Substation, Manirampur, Jashore, Bangladesh (latitude: 23˚ 01ʹ 0.12ʺ N and longitude: 89˚13ʹ 59.88ʺ E) from March 2021 to September 2021. The research site is in the Agro-Ecological Zone 11 (AEZ- 11) and is a calcium deep greyish floodplain soil part of a series of calceric combosols and Gleysols (UNDP and FAO, 1988). The soil of the research site was slightly alkaline in reaction, with pH value of 8.0 with 2.4% organic matter. High to moderate height land with a silty loam structure was present. The study area is substantially suitable for tossa pat cultivation.

Design and treatments

An investigation was carried out in RCBD with three trials. The treatment combination was made of organic and chemical fertilizers such as T_0= Control, T_1= Poultry manure (PM) @ 5 t ha^{-1}, T_2= Recommended dose of fertilizer (RDF), T_3= RDF + PM @ 5 t ha^{-1}, T_4= 50% RDF + PM @ 5 t ha^{-1}, T_5= 75 % RDF + PM @ 5 t ha^{-1}, T_6= 125% RDF + PM @ 2.5 t ha^{-1}, T_7= 150% RDF + PM @ 2.5 t ha^{-1}, T_8= 150% RDF + PM @ 5 t ha^{-1}. BJRI tossa Pat-8 was used as a variety. Unit plot size was nine metre square. Spacing of plot to plot, block to block, was one meter with a 20 cm deep drainage system. Line to Line distance was 30 cm. At the last plowing, poultry manure, half of the nitrogenous fertilizer, and all additional fertilizer were supplied and other half of urea was applied at 45 DAS. All other agronomic practices were done as per requirement.

Seed sowing

Jute seeds were taken at the Jute Research Substation, Monirampur, Jashore and sown on March 25, 2021, @ 4.5 kg ha^{-1} in line. Uniform density of plant was maintained during the investigation.

Harvesting

When the crop reached 120 days, the jute plant was harvested on 23 July 2021. Ten crop specimens were taken randomly from individual treatments before harvesting to study the growth, yield attributes, and yield. The leaves of the jute crops were removed after harvesting by making them into little bundles and leaving them lying for four days.

Retting, stripping, washing and drying of jute

On July 26, 2021, the jute bundles were immersed in treatment based on tank water after losing their leaves in preparation for retting. After soaking, the retting was finished in 25 days. The fibers in the bark become looser and removed from the wooden stem through the retting procedure because pectins, gums, and other mucilaginous compounds are eliminated. The combined action of water temperature with microorganisms usually enhances the process. The fibers were stripped off and thoroughly rinsed in water following an appropriate retting. Obtained fibre was dried plot-wise in the sun on wooden frames. The fibre yield was calculated after drying. The jute sticks were stripped

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before being daylight by standing them up on wooden posts. To determine the stick yield, the daylight-dried sticks were weighed. The sample plants were also retted, washed and dried similarly.

Data collection

Ten crop specimens were chosen randomly from individual treatments and marked with an experimental plot to determine the growth, output attributes and fibre output (Annual Report: Report on jute Agriculture: 2008-2009, BJRI, PP, 78-80). The harvest index (HI) is the ratio of economic and biological yield (Khandakar, 1985).

$$HI\% = \frac{Economic\ \ yield}{Biological\ yield} \times 100$$

Where, EY= Economic yield as fibre of jute, BY= Total dry weight of biological product including dry weight of leaf, stick and bark

Statistical analysis

The comparison of treatment means was estimated using DMRT, and ANOVA was performed with the aid of MSTAT-C. (Gomez and Gomez, 1984).

III. Results and Discussion

Plant density and plant height

Organic and inorganic fertilizers have no substantial impact on plant density. A trend of increase in the plant population was obtained in the studied plot (Table 01). The maximum plant population (258) was observed when the plot was fertilized with 150% RDF + poultry manure @ 5 t ha^{-1} and the least plant density (221) was recorded at the control treatment. Nutrient management had a substantial impact on plant height (PH). The maximum PH (3.89 m) was recorded at 150% RDF + PM @ 5 t ha^{-1} followed by 150% RDF + PM @ 2.5 t ha^{-1}. The least plant height (2.97 m) was recorded in the control treatment. PH is the major physical characteristic mainly associated with more fiber yield and the longest plant with the highest jute fiber yield. Equivalent results were obtained by (Pervin et al., 2012). The treatment of 150% RDF + PM @ 5 t ha^{-1} most likely supplied sufficient nutrition to crops, and as a result of increased nutritional uptake, the plant obtained the maximum amount of fibre. Similar findings agree with Pal et al. (2016); Biswas et al. (2016); Islam et al. (2015); Roy et al. (2015). Sarkar et al. (2014) also noted the variations in fibre and fibre producing parameters in case application of organic and inorganic fertilizers.

Number of leaf, fresh leaf weight and dry leaf weight

Organic and inorganic fertilizers had a substantial influence on dry leaf weight (DLW) and had no substantial impact on the number of leaf $plant^{-1}$ (NLP), and fresh leaf weight $plant^{-1}$ (FLW) (Table 01). Statistically, the highest NLP (44.67) and FLW (1.59 g) were recorded in 150% RDF + PM @ 5 t ha^{-1} while the least (38.00) and (1.07 g) were in the control plot. The highest dry leaf weight (DLW) (.018 g) was observed in 150% RDF + PM @ 5 t ha^{-1} followed by RDF + PM @ 5 t ha^{-1} and 50% RDF + PM @ 5 t ha^{-1}. The lowest DLW (0.11 g) was found in the control plot. Piya et al. (2019) reported a similar result, as we found in our investigation.

Base diameter, middle diameter and terminal diameter

Base diameter, middle diameter, and terminal diameter are considered one of the main yield-attributing components. The more diameter in size contributes more fibre and stick yield. Integrated nutrient management had a significant effect on base diameter (BD) and middle diameter (MD) except terminal diameter (TD) (Table 01). The highest base diameter (17.43 mm) was found in 150% RDF + PM @ 5 t ha^{-1} followed by 50% RDF + PM @ 5 t $ha^{-1,}$ whereas the lowest (12.43 mm) was recorded in no fertilizer application. The highest middle diameter (11.63 mm) was found in 150% RDF + PM @ 5 t ha^{-1} that, substantially equivalent to 150% RDF + PM @ 2.5 t ha^{-1}. The highest TD (7.13 mm) was found in 150% RDF + PM @ 5 t ha^{-1}, whereas the lowest (5.00 mm) was in PM @ 5 t ha^{-1}. Ali et al. (2017) and Piya et al. (2019) were reported similar findings.

Number of nodes

Organic and inorganic nutrient management had a substantial impact on Number of node $plant^{-1}$ (NNP). The maximum NNP (50.73) was observed in 150% RDF + Poultry manure @ 5 t $ha^{-1,}$ whereas the least was recorded in PM @ 5 t ha^{-1} (Table 01). Piya et al. (2019) recorded a similar result.

Fibre and stick Yield

Principal economic part of jute consists of fibre as well as stick. Combine application of organic and inorganic supplement had a substantial influence in fibre output and had no impact on stick output (Table 01). Applying 150% RDF + PM @ 5 t ha^{-1} produced the highest fibre output (4.31 t ha^{-1}) that was substantially equal to 150% RDF + PM @ 2.5 t ha^{-1} and the least fibre output 2.17 t ha^{-1} was obtained in control (Figure 01). Combination of organic and inorganic supplement obtained the expected output yield and probably ensured the nutritional status of land. Equivalent results were noted by researchers (Ghanbari and Nejad, 2021, Mazumdar 2021, Majumdar 2019, Ali et al., 2017, Singh et al., 2015, Mandol et al., 2015, Aluko et al., 2014, Mitra et al., 2010, Paikaray et al., 2006). Statistically the maximum stick output (9.66 t ha^{-1}) was recorded at 150% RDF + PM @ 5 t ha^{-1} whereas the least (6.40 t ha^{-1}) at no fertilizer application plot. Piya et al. (2019) also found similar results. Pahalvi et al. (2021) noted that the overuse of chemical fertilizer could alter the pH of soil, increase pest, acidification, and soil crust, which results in decreasing organic matter status, humus load, useful organism, stunting plant growth, and reducing crop yield.

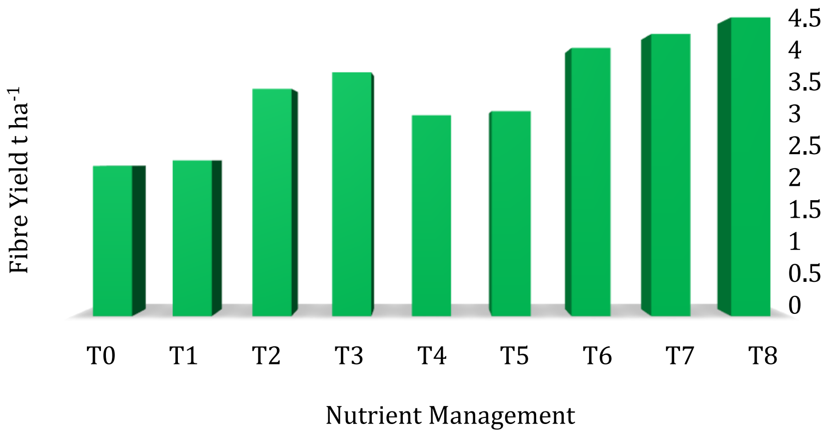

Figure 01. Influence of nutrient management on the fibre output of jute

Harvest index

Nutrient management had a substantial impact on HI (Table 01). The maximum HI (26.46 %) was found in 150 % RDF + PM @ 5 t ha^{-1} followed by 150 % RDF + PM @ 2.5 t ha^{-1}. The least HI (20.92 %) was recorded at no fertilizer application plot. It may occur due to the scarcity of nutrients in the control plot providing more competition between the plant and weeds.

Table 01. Influence of organic and inorganic fertilizer on BJRI tossa pat-8.

Treatments	Plant density Plot^{-1}	Plant height (m)	No. of leaf plant^{-1}	Fresh leaf weight (g)	Dry leaf weight (g)	Base diameter (mm)	Middle diameter (mm)	Terminal diameter (mm)	No. of node plant^{-1}	Fibre output (t ha^{-1})	Stick output (t ha^{-1})	HI (%)
T_0	221	2.97cd	38.67	1.13	0.11d	12.43c	8.10cd	5.47	43.87abc	2.17f	6.40	20.92d
T_1	232	2.78d	38.33	1.07	0.13bcd	11.83c	7.70d	5.00	39.03c	2.25ef	7.40	19.26e
T_2	245	3.68ab	41.33	1.55	0.17ab	15.47ab	10.43ab	5.93	49.03ab	3.28cd	9.14	21.95c
T_3	261	3.78ab	44.67	1.59	0.17abc	17.03a	10.63ab	7.00	49.93a	3.52bc	8.33	21.96c
T_4	250	3.53ab	44.67	1.50	0.17ab	15.17ab	10.00abc	6.80	47.83ab	2.90de	8.68	23.18b
T_5	242	3.32bc	42.00	1.21	0.12d	14.03bc	9.10bcd	6.23	42.13bc	2.96d	8.28	20.62d
T_6	256	3.71ab	43.67	1.61	0.15abcd	16.17ab	10.10abc	6.40	46.73ab	3.87ab	8.91	22.75b
T_7	214	3.60ab	38.00	1.39	0.13cd	15.37ab	11.03ab	6.60	48.23ab	4.07ab	9.48	25.80a
T_8	258	3.89a	44.67	1.64	0.18a	17.43a	11.63a	7.13	50.73a	4.31a	9.66	26.46a
CV(%)	11.88	7.58	15.39	20.84	15.27	10.38	12.83	15.76	9.00	12.21	16.43	1.84
LSD	49.86	0.46	11.13	0.51	0.04	2.69	2.19	1.71	7.23	0.69	2.41	0.72
Sig. level	NS	**	NS	NS	*	**	*	NS	*	***	NS	***

*= 5 % significant level, **= 1 %significant level, ***= .01% significant level; NS= Not significant, V= BJRI tossa pat-8, T_0= Control, T_1= PM @ 5 t ha^{-1}, T_2= Recommended dose of fertilizer (RDF), T_3= RDF + PM @ 5 t ha^{-1}, T_4= 50% RDF + PM @ 5 t ha^{-1}, T_5= 75 % RDF + PM @ 5 t ha^{-1}, T_6= 125% RDF + PM @ 2.5 t ha^{-1}, T_7= 150% RDF + PM @ 2.5 t ha^{-1}, T_8= 150% RDF + PM @ 5 t ha^{-1}

Economics of nutrient management practices

The economics of various nutrient management approaches are shown in Table 02. According to the partial budget analysis of BJRI tossa pat-8, the treatment 150% RDF + 5 t ha^{-1} had the biggest net income (173625 TK) and B:C ratio (2.16) among all the treatments. At the same time, the treatment 150% RDF + PM @ 2.5 tha^{-1} produced the second largest net profit (158125 TK) and B: C ratio (2.07). In addition, higher net profit was also obtained from the treatment of 125% RDF + PM @ 2.5 tha^{-1} (net income: 142260 TK and B: C ratio: 1.96) that was substantially equitable to RDF (net income: 116250 TK ha^{-1} and B: C ratio, 1.89). The lowest profit (23750) and B: C (1.16) ratio were achieved from the PM @ 5.0 tha^{-1}.

Table 02. Economics of integrated nutrient management approaches on BJRI tossa pat-8

Treatment	Variable cost	Fertilizer cost	Total cost	Gross income	Net income	Benefit-cost ratio
T_0	120000	0	120000	162750	42750	1.35
T_1	120000	25000	145000	168750	23750	1.16
T_2	120000	9750	129750	246000	116250	1.89
T_3	120000	34750	154750	264000	109250	1.70
T_4	120000	29875	149875	217500	67750	1.45
T_5	120000	32930	152930	222000	69070	1.45
T_6	120000	37990	147990	290250	142260	1.96
T_7	120000	27125	147125	305250	158125	2.07
T_8	120000	39625	149625	323250	173625	2.16

T_0= Control, T_1= PM @ 5 t ha^{-1}, T_2= Recommended dose of fertilizer (RDF), T_3= RDF + PM @ 5 t ha^{-1}, T_4= 50% RDF + PM @ 5 t ha^{-1}, T_5= 75 % RDF + PM @ 5 t ha^{-1}, T_6= 125% RDF + PM @ 2.5 t ha^{-1}, T_7= 150% RDF + PM @ 2.5 t ha^{-1}, T_8= 150% RDF + PM @ 5 t ha^{-1}

IV. Conclusion

Results revealed that the different nutrient management approaches trended higher growth, output attributes, and fibre output. The treatment of 150% RDF + PM @ 5 t ha^{-1} performed well in net return and BCR among the different nutrient management practices. Finally, it can be concluded that BJRI tossa pat-8 coupled with 150 % RDF + PM @ 5 t ha^{-1} is a hopeful exercise in jute farming regarding growth, output attributes, and yield.

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