ESP IJAST
ESP International Journal of Advancements in Science & Technology
ISSN: 2583-9233 / Volume 3 Issue 2 April 2025 / Page No: 68-75
Paper Id: IJAST-V3I2P111 / Doi: 10.56472/25839233/IJAST-V3I2P111

Original Article

Optimizing BJRI Tossa Pat-8 Yield Through Magnesium, Zinc, and Boron Supplementation

Tasnufa Karim Zhumur[1], Ronzon Chandra Das[2], Mokhshedul Haque[3], Muhaiminur Rashid[4], S.M.Shahriar Parvej[5],Muhammad Tanvir Rahman[6] ,Supti Mallick[7], Sheikh Nahid Hasan[8]

[1]*Scientific Officer, Jute Research Regional Station, Kishoreganj, Bangladesh Jute Research Institute, Bangladesh.*
[2]*Scientific Officer, Department of Soil Science, Agronomy Division, Bangladesh Jute Research Institute, Bangladesh.*
[3]*Upazila Agriculture Officer, Karimganj, Kishoreganj, Ministry of Agriculture, Bangladesh.*
[4]*PhD Fellow, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh.*
[5,6]*Senior Scientific Officer, Department of Soil Science, Agronomy Division, Bangladesh Jute Research Institute, Bangladesh.*
[7]*Assistant Professor, Department of Agricultural Chemistry, Bangladesh Agricultural University, Bangladesh.*
[8]*MS Student, Department of Entomology, Bangladesh Agricultural University, Mymensingh.*

Received Date: 15 March 2025 Revised Date: 18 March 2025 Accepted Date: 23 April 2025

Abstract: *The present study was conducted to investigate the effects of Magnesium (Mg), Zinc (Zn), and Boron (B) on the growth and fiber yield of BJRI Tossa Pat-8, a prominent jute variety, under varying nutrient levels. The experiment was carried out at two different locations, Kishoreganj and Manikganj, in 2023, using a Randomized Complete Block Design (RCBD) with three replications. The results showed that the application of Mg, Zn, and B in combination with Recommended Dose of Fertilizers (RDF) significantly enhanced growth parameters and yield-contributing traits when compared to the control treatment. The highest fiber yield of 2.57 t/ha and stick yield of 5.14 t/ha were observed at Kishoreganj with the treatment T7 (RDF + 4Zn + 3B + 10Mg), while at Manikganj, the highest fiber yield of 2.78 t/ha and stick yield of 5.83 t/ha were achieved under the same treatment. These results indicate that the combination of 4Zn + 3B + 10Mg significantly improved both fiber yield and stick yield, along with other key growth parameters such as plant height, base diameter, and plant population, as compared to the control and other treatment combinations. The study demonstrates that the application of zinc, magnesium, and boron plays a crucial role in optimizing BJRI Tossa Pat-8 growth, contributing to improved fiber quality and overall biomass production. Based on these findings, the combination treatment T7 is recommended as an optimal nutrient regimen for maximizing the growth and productivity of BJRI Tossa Pat-8, thereby ensuring better fiber yield and sustainability in jute cultivation. The findings also suggest the need for further research to refine micronutrient management for long-term crop productivity and soil health.*

Keywords*: Nutrient Optimization, Sustainable Agriculture, Micronutrient Supplementation, Fiber Yield.*

I. INTRODUCTION

Jute is an eco-friendly and the major cash crop in Bangladesh. Jute holds an important position in the industrial sector of the economy of Bangladesh [1]. Jute (Corchorus sp.) is one of the most important fiber crops of this country. It accounts for 6% of the foreign currency earnings from exports [2]. Bangladesh, the second largest producer of jute, produces the best quality jute in the world and leads the export market [3]. Bangladesh is the largest supplier of jute and jute goods in the international markets and meets up nearly 95% of world raw jute demand and about 60% of jute goods demand [4]. The green leaves of jute contain minerals and proteins, which are edible and popular as a leafy vegetable. The primary macronutrients are Nitrogen (N), Phosphorus (P), and Potassium (K). Nitrogen is essential for plant development, since it plays a fundamental role in energy metabolism and protein synthesis. Fertilization is one of the most important management practices because plant growth is directly related to plant nutrition i.e. fertilization. Crop nutrient uptake and crop yields are the principal factors that determine optimal fertilization practices [5]. Therefore, it is very important to apply fertilizers in an efficient way to minimize loss and to improve the nutrient use efficiency [6]. There are 7 essential plant nutrient elements defined as micronutrients [boron (B), zinc (Zn), manganese (Mn), iron (Fe), copper (Cu), molybdenum (Mo), chlorine (Cl)]. They constitute in total less than 1% of the dry weight of most plants . Boron is a micronutrient critical to the growth and health of all crops. It is a component of plant cell walls and reproductive structures. Boron can be found in soil solution, adsorbed to soil surfaces, organic matter, and is part of soil mineralogy. Judicious application of fertilizer is one of the most effective means for maximizing jute yield. Foliar fertilization, that is nutrient supplementation through leaves, is an efficient technique of fertilization which enhances the availability of nutrients. Cultivation of high yielding varieties, intensive cropping [7], loss of fertile top soil and losses of nutrient through leaching[8],[9],[10].At global scale, about one-third of arable soils are deficient in micronutrients, particularly in zinc [11]. The efficiency of different fertilizers assimilation through foliar however depends upon several factors including varieties or genotypes. Foliar application of Zn reduces the micronutrient deficiencies and it is an efficient method because nutrients are easily absorbed through leaves and is best option to compensate micronutrient deficiencies in shorter period of time under rainfed regions [12]. Fertilizers are loosed through de-nitrification, volatilization, and leaching. From the above facts, the experiment will be designed to find out the efficiency of foliar application of different fertilizers to be assured the better growth and yield of jute fiber.

II. MATERIALS AND METHODS

The experiment was conducted at Jute Research Regional Station, Kishoreganj in 2023 followed by RCBD design with three replications to assess the impact of different nutrient treatments involving Magnesium (Mg), Zinc (Zn), and Boron (B) on the growth, yield, and nutrient uptake of jute. The study was designed to identify optimal combinations of these micronutrients, integrated with the Recommended Dose of Fertilizer (RDF), to enhance the productivity and quality of jute under local agro-climatic conditions.

A. Experimental Design and Layout

The experiment was laid out using the Randomized Complete Block Design (RCBD), a widely accepted experimental design that ensures random distribution of treatments while considering block-to-block variability. The main objective of using RCBD was to eliminate the effects of spatial variability in the field and to allow a fair comparison of treatments across the entire experimental area. Blocks and Replications**:** The experimental area was divided into three blocks (replications), each containing all the treatments randomly assigned. This helps in accounting for environmental variation within the field, such as differences in soil fertility, moisture availability, and microclimate conditions. Each treatment was replicated three times, making a total of 33 experimental plots (11 treatments x 3 replications). Plot Size**:** Each experimental plot was of uniform size, measuring 3 meters by 3 meters (9 m^2), ensuring adequate space for plant growth while minimizing edge effects.

B. Treatments and Application:

The study involved 11 treatments designed to evaluate the effects of different combinations of Magnesium (Mg), Zinc (Zn), and Boron (B) on the growth and yield of jute. The treatments were formulated to test various dosages and combinations of these micronutrients in addition to the Recommended Dose of Fertilizer (RDF) for jute, which typically includes a combination of nitrogen, phosphorus, and potassium (NPK).The following treatments were used in the experiment:

- T1: Control – No fertilization, no micronutrients applied (negative control).
- T2: RDF (Recommended Dose of Fertilizer) – Standard practice based on local agricultural recommendations for jute, providing optimal NPK for the crop.
- T3: RDF + Zn0 + 1B + 10Mg – RDF with no Zinc, 1 kg/ha Boron, and 10 kg/ha Magnesium.
- T4: RDF + 4Zn + 1B + 10Mg – RDF with 4 kg/ha Zinc, 1 kg/ha Boron, and 10 kg/ha Magnesium.
- T5: RDF + 8Zn + 1B + 10Mg – RDF with 8 kg/ha Zinc, 1 kg/ha Boron, and 10 kg/ha Magnesium.
- T6: RDF + 4Zn + 2B + 10Mg – RDF with 4 kg/ha Zinc, 2 kg/ha Boron, and 10 kg/ha Magnesium.
- T7: RDF + 4Zn + 3B + 10Mg – RDF with 4 kg/ha Zinc, 3 kg/ha Boron, and 10 kg/ha Magnesium.
- T8: RDF + 4Zn + B0 + 10Mg – RDF with 4 kg/ha Zinc, no Boron, and 10 kg/ha Magnesium.
- T9: RDF + 4Zn + 1B + Mg0 – RDF with 4 kg/ha Zinc, 1 kg/ha Boron, and no Magnesium.
- T10: RDF + 4Zn + 1B + 20Mg – RDF with 4 kg/ha Zinc, 1 kg/ha Boron, and 20 kg/ha Magnesium.
- T11: RDF + 4Zn + 1B + 30Mg – RDF with 4 kg/ha Zinc, 1 kg/ha Boron, and 30 kg/ha Magnesium.

C. Fertilizer Application:

The RDF applied in the study consisted of nitrogen (N), phosphorus (P), and potassium (K) as per local recommendations for jute cultivation. Zinc (Zn) was applied in the form of Zinc Sulphate, either as a basal soil application or foliar spray, depending on the treatment. Magnesium (Mg) was applied as Magnesium Sulphate (Epsom salt), while Boron (B) was applied as Borax or Soluble Boron. All micronutrient applications (Zn, Mg, and B) were performed during the initial growth stages, and in certain treatments, foliar sprays were used for better nutrient absorption.

D. Crop Management:

The crop was managed following standard jute cultivation practices to ensure uniform growth and minimize confounding factors: Variety: The jute variety BJRI Tossa Pat-8 was used, known for its adaptability to local soil and climatic conditions. Field Preparation: The land was plowed and leveled before sowing. The soil was also prepared by applying well-rotted farmyard manure (FYM) to improve soil structure and organic content. Sowing: Jute seeds were sown at a depth of approximately 2 cm using a hand planter. The sowing rate was set to 6 kg/ha to achieve optimal plant density. Weed Management: Weeds were controlled manually and by using herbicides where necessary, ensuring that the jute plants were not outcompeted for resources**.** Pest and Disease Control**:** Standard plant protection practices were followed. The use of integrated pest management (IPM) was emphasized, with appropriate doses of pesticides applied at critical stages of the crop. Total amount of P, K & S from TSP, MoP, Gypsum Zinc oxide, boric acid and Magnessium sulphet respectively were applied at the time of sowing as per treatments. Total amount of N from Urea as per treatment were applied in two equal spilts one at sowing and one at 40-45 DAS. All the cultural done as and when needed.

E. Data Collection:

Data were collected throughout the growing season to evaluate the effects of the treatments on various parameters. The following observations were made: Germination Rate**:** The percentage of seeds that successfully germinated and established healthy seedlings. This was recorded at 120 days after sowing. Fiber Yield: The total fiber produced per hectare was measured after harvesting, considering both the quantity and quality of fiber. Nutrient Uptake**:** Zn, Mg, and B Uptake**.** Soil Analysis: Soil samples were collected before planting and after harvest to measure the residual effects of the treatments on soil fertility, particularly focusing on micronutrient levels (Zn, Mg, B).

F. Statistical Analysis:

All collected data were subjected to Analysis of Variance (ANOVA**)** to determine the significance of the effects of various treatments on jute growth, yield, and nutrient uptake. ANOVA helps in identifying significant differences among the treatments and replications. The following steps were involved in the statistical analysis: Data were analyzed using SPSS software, ensuring the robustness and reliability of the statistical results.

G. Results Interpretation:

The results of the study were interpreted based on the data analysis, focusing on the effects of different combinations of Zn, Mg, and B on jute productivity. The best performing treatments were identified, and recommendations were made regarding the optimal nutrient management strategy for jute cultivation in the region. Comparisons were made between the treatments, control, and RDF to determine the most efficient and sustainable nutrient management approach for enhancing jute yield.

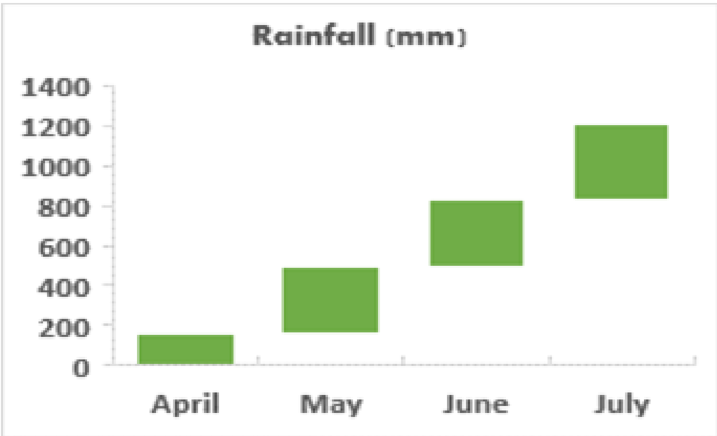

Figure 1 : Rainfall Pattern During Cropping Season

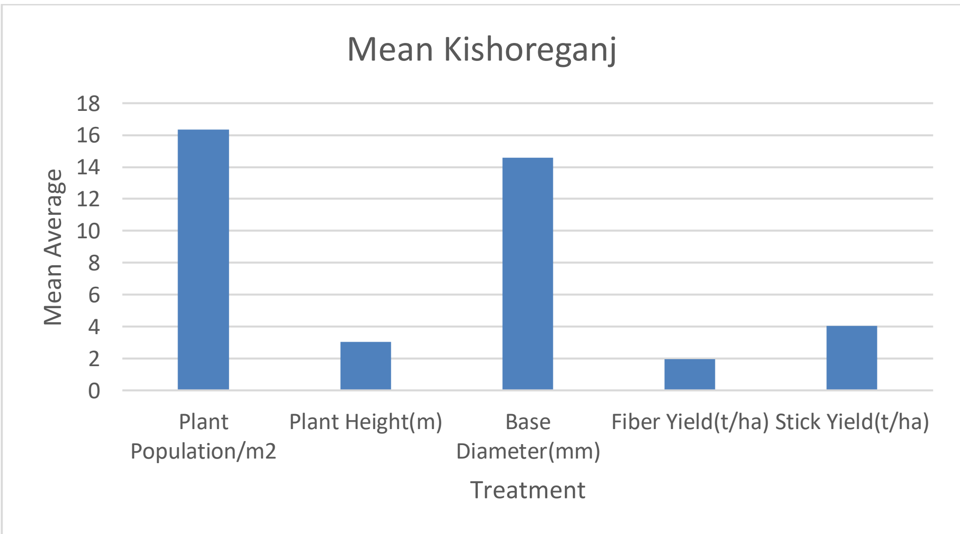

Figure 2 : Average Mean of Growth Parameters in Kishoreganj

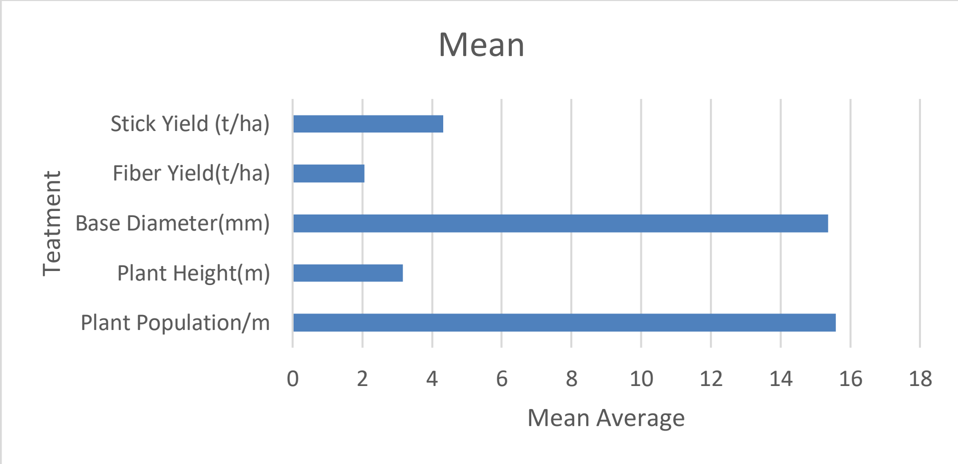

Figure 3 : Average Mean of Growth Parameters in Manikganj

Table 1 : Yield and Yield Contributing Characters of BJRI Tossa Pat-8 with Different Levels of NPKS and Mg, Zn & B at Kishoreganj

Sl. No.	Treatment	Plant Population/m^2	Plant Height(m)	Base Diameter(mm)	Fiber Yield(t/ha)	Stick Yield(t/ha)
1	T1	24.220 a	2.86 b	12.59 f	1.53 e	3.06 e
2	T2	14.55 cd	2.99 ab	13.46 def	1.63 de	3.43 de
3	T3	14.55 cd	2.94 b	15.31 abcd	2.22 bc	4.46 c
4	T4	12.66 de	3.13 ab	13.41 ef	1.69 de	3.45 de
5	T5	19.22 b	3.04 ab	16.03 ab	2.31 bc	4.72 bc
6	T6	17.33 bc	3.27 a	14.41 bcdef	1.78 d	3.75 d
7	T7	16.66 bc	3.15 ab	16.96 a	2.57 a	5.14 a
8	T8	11.66 e	2.87 b	14.19 bcdef	1.63 de	3.40 de
9	T9	13.7 de	3.12 ab	13.72 cdef	1.67 de	3.57 d
10	T10	18.43 b	3.02 ab	14.85 bcde	2.15 c	4.38 c
11	T11	16.77 bc	2.99 ab	15.53 abc	2.43 ab	4.92 ab
Mean		16.342	3.03	14.59	1.96	4.02
%CV		10.20	5.86	7.43	6.42	5.88

Table 2 : Yield and Yield Contributing Characters of BJRI Tossa Pat-8 with Different Levels of NPKS and Mg, Zn & B at Manikganj.

Sl. No.	Treatment	Plant Population/m	Plant Height(m)	Base Diameter(mm)	Fiber Yield(t/ha)	Stick Yield (t/ha)
1	T1	22.12 a	2.88 b	13.28 f	1.65 e	3.46 e
2	T2	13.35 cd	3.01 ab	15.11 def	1.68 de	3.53 de
3	T3	12.45 cd	2.99 b	16.16 abcd	2.30 bc	4.83 c
4	T4	12.06 de	3.25 ab	14.26 ef	2.15 de	4.515 de
5	T5	18.13 b	2.99 ab	16.03 ab	2.20 bc	4.62 bc

6	T6	16.66 bc	3.70 a	15.85 bcdef	1.88 d	3.948 d
7	T7	17.55 bc	3.31 ab	17.45 a	2.78 a	5.838 a
8	T8	16.66 e	3.50 b	15.09 bcdef	1.76 de	3.696 de
9	T9	11.07 de	3.27 ab	14.72 cdef	1.85 de	3.885 d
10	T10	14.07 b	3.13 ab	14.75 bcde	2.22 c	4.662 c
11	T11	17.34 bc	2.81 ab	16.34 abc	2.15 ab	4.515 ab
Mean		15.59	3.17	15.37	2.06	4.32
%CV		21.12	8.54	7.45	16.25	16.26

Table 3 : Physio-Chemical Properties of Experimental Soil.

Soil texture	pH	OM	Total N(%)	Phosphorus (µg/g)	Potassium (mg/100g)	Sulpher (µg/g soil)
Silt loam	6.7	2.8	0.12	10	0.13	7.0
	Neutral	Low	Very Low	Low	Low	Very low

III. RESULTS AND DISCUSSION

The study revealed that the application of varying rates of magnesium (Mg), zinc (Zn), and boron (B) significantly influenced the growth and yield parameters of BJRI Tossa Pat-8 across two different locations, Kishoreganj and Manikganj.

The highest fibre yield of 2.57 t/ha and stick yield of 5.14 t/ha in Kishoreganj and 2.78 t/ha fibre and 5.83 t/ha stick in Manikganj were recorded under T7 treatment, indicating that this nutrient combination was most effective. These findings are consistent with the work of [13] who reported that balanced micronutrient application, especially Zn and B, significantly enhances fibre yield in bast fibre crops due to improved nutrient uptake and physiological efficiency.

Plant height and base diameter, key indicators of plant vigor and biomass potential, were also significantly affected. The tallest plants were observed under T6 in both locations (3.27 m in Kishoreganj and 3.70 m in Manikganj), while the maximum base diameter was recorded under T7 (16.96 mm and 17.45 mm, respectively). This suggests that while T6 may enhance vertical growth, T7 contributes more to girth development, likely contributing to higher fibre and stick yields. Similarly, zinc is essential for enzyme activation and protein synthesis, which directly affects internodal elongation and biomass accumulation [14].

Magnesium plays a critical role in chlorophyll formation and photosynthesis, thereby influencing vegetative growth [15]. The observed results, especially increased plant height under T6, may reflect Mg's impact on cell elongation and metabolic activity.

Boron, on the other hand, is vital for cell wall synthesis, sugar transport, and reproductive development [16]. The improved fibre yield under T7 might be attributed to the synergistic effect of Zn and B on fibre cell elongation and thickening, which is particularly critical in jute fibre development.

Furthermore, the variation in yield and growth across the two locations may be due to differences in soil characteristics, environmental conditions, and existing micronutrient status. The response of jute to micronutrient fertilization can vary significantly depending on agro-ecological zones, which supports the higher yield potential observed in Manikganj[17].

Overall, the findings confirm that balanced and adequate micronutrient supplementation, particularly Mg, Zn, and B, plays a significant role in maximizing growth and fibre yield in BJRI Tossa Pat-8. The T7 treatment emerges as a potentially optimal combination for field-level recommendations.

The data presented in Table 1 illustrates the effect of different treatments, including various levels of NPKS (Nitrogen, Phosphorus, Potassium, Sulfur) and micronutrients (Magnesium (Mg), Zinc (Zn), and Boron (B)), on the yield and yield-contributing characters of BJRI Tossa Pat-8, a variety of jute, at the Kishoreganj location. The results show significant variations in the plant population, plant height, base diameter, fiber yield, and stick yield across the treatments. The interpretation of each parameter is as follows:

A. Plant Population (plants/m^2)

Plant population per square meter reflects the density of plants established per unit area. Treatment T1 (Control) had the highest plant population of 24.22 plants/m^2, significantly higher than other treatments. However, treatments involving higher levels of micronutrient application, such as T5 (19.22 plants/m^2) and T7 (16.66 plants/m^2), showed moderate plant populations. The low plant populations observed in treatments T8 (11.66 plants/m^2) and T4 (12.66 plants/m^2) indicate that the application of certain combinations of micronutrients may affect germination or early plant establishment, which has been reported by various researchers who suggest that excessive micronutrient application can lead to toxicity or nutrient imbalance [18]. The reduced plant population in some treatments may be attributed to nutrient imbalances caused by the combination of high levels of micronutrients. This suggests that while micronutrients are beneficial for jute growth, excessive application may lead to competition or toxicity, reducing plant establishment.

B. Plant Height (m)

Plant height is a key indicator of overall plant growth. The highest plant height of 3.27 meters was observed in T6 (RDF + 4Zn + 2B + 10Mg), followed closely by T7 (RDF + 4Zn + 3B + 10Mg) at 3.15 meters. These treatments significantly outperformed others in terms of plant height. Conversely, T1 (Control) showed the shortest plant height at 2.86 meters. The results demonstrate that the application of micronutrients, particularly zinc, boron, and magnesium, contributed positively to plant growth. This aligns with findings from [19] who reported that the application of micronutrients like Zn and Mg enhanced plant height in various crops. The positive correlation between micronutrient application and plant growth suggests that these elements play a vital role in improving jute's vegetative development, possibly through enhanced photosynthesis and nutrient uptake.

C. Base Diameter (mm)

The base diameter of the plant is a critical factor influencing the structural integrity and fiber yield. T7 (RDF + 4Zn + 3B + 10Mg) again exhibited the highest base diameter of 16.96 mm, followed by T5 (RDF + 8Zn + 1B + 10Mg) at 16.03 mm. In contrast, T1 (Control) had the smallest base diameter at 12.59 mm.The base diameter reflects the plant's ability to develop a strong stem, which is essential for jute fiber production. The treatments with higher doses of zinc, boron, and magnesium led to better stem growth, confirming that micronutrient applications enhance stem girth. This supports findings by[20], who found that micronutrient application, particularly zinc and boron, significantly improved plant structure in fiber crops by enhancing cell division and elongation.

D. Fiber Yield (t/ha)

The fiber yield is the most critical measure of jute productivity. The highest fiber yield of 2.57 t/ha was recorded in T7 (RDF + 4Zn + 3B + 10Mg), which was significantly higher than other treatments. Treatments such as T5 (RDF + 8Zn + 1B + 10Mg) and T11 (RDF + 4Zn + 1B + 30Mg) also showed notable fiber yields of 2.31 t/ha and 2.43 t/ha, respectively. T1 (Control), with no micronutrient supplementation, showed the lowest fiber yield of 1.53 t/ha. The application of zinc, magnesium, and boron has a significant impact on fiber yield, with T7 showing the highest yield. This suggests that micronutrients, particularly in combination with RDF, promote better fiber formation and increased yield, likely due to their roles in enzyme activation, photosynthesis, and nutrient utilization efficiency. Previous studies by [21] and [22] also demonstrated that micronutrient supplementation, especially zinc and magnesium, significantly enhances fiber production in jute by improving physiological processes such as photosynthesis and carbon fixation.

E. Stick Yield (t/ha)

The stick yield (the weight of the non-fibrous portion of the plant) is also a crucial aspect of overall biomass production. The highest stick yield was observed in T7 (RDF + 4Zn + 3B + 10Mg) at 5.14 t/ha, followed by T11 (RDF + 4Zn + 1B + 30Mg) with 4.92 t/ha. T1 (Control) had the lowest stick yield of 3.06 t/ha, demonstrating the importance of micronutrient application for overall biomass production. The positive effects of micronutrient application on stick yield support the concept that nutrient management not only affects fiber yield but also enhances overall plant biomass. The increased stick yield observed in micronutrient-treated plots suggests that these elements contribute to the overall growth and development of the plant. A similar pattern of increased biomass with micronutrient application was reported by [23], who found that proper micronutrient supplementation can enhance both fiber and non-fiber biomass in jute.

F. Coefficient of Variation (CV%)

The % Coefficient of Variation (CV%) is an indicator of the degree of variability in the data. The CV for plant population (10.20%) and base diameter (7.43%) are moderate, showing a reasonable degree of variability among treatments. However, the plant height and fiber yield exhibited relatively lower variability (CV of 5.86% and 6.42%, respectively), suggesting more consistency in these parameters across treatments. The moderate CV values indicate that the treatments provided a balanced variation in outcomes, ensuring that the experiment's results are reliable and that the observed effects of treatments are not due to chance or excessive experimental error.

The results of this experiment suggest that the application of micronutrients, especially zinc, magnesium, and boron, in combination with RDF significantly improves plant height, base diameter, fiber yield, and stick yield in jute (BJRI Tossa Pat-8). Among the treatments, T7 (RDF + 4Zn + 3B + 10Mg) demonstrated the best performance in terms of fiber yield and stick yield, which could be attributed to the synergistic effects of these micronutrients on the physiological processes of the plant. These findings support the idea that appropriate nutrient management, including micronutrient supplementation, plays a vital role in enhancing the productivity and quality of fiber crops like jute.

The results from Table 2 show the effect of different treatments on the yield and yield-contributing characters of BJRI Tossa Pat-8 at Manikganj.

- Plant Population: The highest plant population was recorded in T1 (22.12 plants/m^2), significantly greater than other treatments, while T9 (11.07 plants/m^2) had the lowest. This variation highlights the potential influence of nutrient treatments on plant establishment, with micronutrient applications possibly affecting germination [21].
- Plant Height: The tallest plants (3.70 m) were observed in T6 (RDF + 4Zn + 2B + 10Mg), followed by **T7** at 3.31 m. The tallest plants likely result from enhanced nutrient uptake, particularly zinc and magnesium, as micronutrients are known to promote vegetative growth [22].
- Base Diameter: The largest base diameter (17.45 mm) was recorded in T7, indicating that higher doses of zinc and boron positively affect stem growth, a trend supported by similar studies [20].
- Fiber Yield: T7 produced the highest fiber yield (2.78 t/ha), significantly outyielding other treatments, demonstrating that micronutrients such as zinc and magnesium enhance fiber production [19].
- Stick Yield: The highest stick yield (5.838 t/ha) was observed in T7, indicating that micronutrient application also boosts non-fiber biomass, essential for overall productivity [23].

Overall, treatments containing zinc, magnesium, and boron had a positive impact on plant height, base diameter, fiber yield, and stick yield, with T7 being the most effective in increasing all parameters.

The experiment conducted at Manikganj demonstrated that the application of micronutrients such as zinc (Zn), magnesium (Mg), and boron (B), in combination with recommended doses of fertilizers (RDF), significantly improved the yield and yield-contributing characters of BJRI Tossa Pat-8 jute. Among the treatments, T7 (RDF + 4Zn + 3B + 10Mg) proved to be the most effective, showing the highest plant height, base diameter, fiber yield, and stick yield. These results suggest that proper micronutrient management enhances not only the vegetative growth and structural development of jute but also boosts overall productivity by improving both fiber and non-fiber biomass.

The findings underscore the importance of integrating micronutrient application with conventional nutrient management practices for optimizing jute production. Micronutrient supplementation, particularly zinc, magnesium, and boron, plays a crucial role in enhancing plant growth, fiber yield, and biomass, contributing to more sustainable and productive jute farming. Further research is needed to determine the optimal levels of these micronutrients for maximum benefit and to assess their long-term impact on soil health and jute productivity.

IV. CONCLUSION

In conclusion, the study highlights the positive impact of balanced fertilization on BJRI Tossa Pat-8 jute growth. Treatments combining NPKS with micronutrients significantly enhanced yield traits. The highest performance was observed with treatment T7 (RDF + 4Zn + 3B + 10Mg). This treatment led to superior plant height, base diameter, fiber, and stick yield. The results were consistent across both Kishoreganj and Manikganj locations. These findings emphasize the importance of micronutrients in jute cultivation. Therefore, integrated nutrient management is essential for maximizing jute productivity.

A. Interest Conflicts

The author(s) declare(s) that there is no conflict of interest concerning the publishing of this paper.

B. Funding Statement

This research was financially supported by the parent organization of the Bangladesh Jute Research Institute (BJRI). The authors express their sincere gratitude for the funding assistance, which made the successful execution of the study possible.

C. Acknowledgments

The authors wish to express their sincere appreciation to Ronzon Chandra Das, the corresponding author-2,for his significant contributions throughout the research and preparation of this paper. Special thanks are also extended to all co-authors for their valuable assistance, support, and active participation in the research process and manuscript development. Their collaborative efforts greatly enriched the quality and outcomes of this work.

V. REFERENCES

[1] Islam, M. M., and M. S. Ali. "Economic Importance of Jute in Bangladesh: Production, Research Achievements and Diversification." *International Journal of Economic Theory and Application* 4, no. 6 (2017): 45–57.

[2] Islam, M. M. *Jute Seed Technology*. Dhaka, 2009.

[3] Rahman, M. M. *Policy and Prospect of Jute and Allied Fibers with Special Reference to Bangladesh*. Dhaka: Ministry of Textile and Jute, Government of the People's Republic of Bangladesh, 2010.

[4] Rayhan, S. M., M. A. Rahand, and H. A. Amin. "Effect of Planting Time and Magnesium on the Growth and Yield of Jute Seed." *Bangladesh Research Publications Journal* 1, no. 4 (2008): 303–311.

[5] Ju, X., and P. Christie. "Calculation of Theoretical Nitrogen Rate for Simple Nitrogen Recommendations in Intensive Cropping Systems: A Case Study on the North China Plain." *Field Crops Research* 124 (2011): 450–458. https://doi.org/10.1016/j.fcr.2011.08.002.

[6] Li, X., J. Lu, L. Wu, and F. Chen. "The Difference of Potassium Dynamics between Yellowish Red Soil and Yellow Cinnamon Soil under Rapeseed (*Brassica napus* L.)–Rice (*Oryza sativa* L.) Rotation." *Plant and Soil* 320 (2009): 141–151. https://doi.org/10.1007/s11104-008-9879-7.

[7] Islam, M. F., M. R. Islam, M. Jahiruddin, and T. Sarmin. "Cropping Pattern Based Micronutrient Application for Wheat-Mungbean-T. Aman Crop Sequence under Tista Meander Floodplain Soil at Rangpur." *Journal of Bangladesh Agricultural University* 15, no. 2 (2017): 140–147. https://doi.org/10.3329/jbau.v15i2.35055.

[8] Somani, L. L. *Micronutrients for Soil and Plant Health*. Udaipur: Agrotech Publishing Academy, 2008.

[9] Rahman, M. T., M. Jahiruddin, M. R. Humauan, M. J. Alam, and A. A. Khan. "Effect of Sulphur and Zinc on Growth, Yield and Nutrient Uptake of Boro Rice (Cv. Brridhan 29)." *Journal of Soil and Nature* 2 (2008): 10–15.

[10] Singh, A. K., M. K. Meena, and R. C. Bharati. "Sulphur and Zinc Nutrient Management in Rice-Lentil Cropping System." In *Proceedings of the International Conference on Life Science Research for Rural and Agricultural Development*, 66–67. December 27–29, 2011. CPRS Patna (Bihar), India.

[11] Cakmak, I., M. J. McLaughlin, and P. White. "Zinc for Better Production and Human Health." *Plant and Soil* 411 (2017): 1–4. https://doi.org/10.1007/S11104-016-3166-9.

[12] Nasiri, M., M. Khalatbari, F. Rejali, and M. R. Ardakani. "Influence of Foliar Application of Micronutrients on Yield and Growth Characteristics of Cucumber (*Cucumis sativus* L.)." *Journal of Plant Nutrition* 33, no. 10 (2010): 1420–1430.

[13] Ali, M., A. R. Nelson, A. L. Lopez, and D. A. Sack. "Effect of Micronutrients on the Growth and Yield of Jute (*Corchorus olitorius* L.)." *Saudi Journal of Biological Sciences* 22, no. 5 (2015): 593–597. https://doi.org/10.1016/j.sjbs.2015.05.010.

[14] Alloway, B. J. *Zinc in Soils and Crop Nutrition*. 2nd ed. Brussels: International Zinc Association, 2008.

[15] Marschner, P. *Marschner's Mineral Nutrition of Higher Plants*. 3rd ed. San Diego: Academic Press, 2012.

[16] Shorrocks, V. M. "The Occurrence and Correction of Boron Deficiency." *Plant and Soil* 193, no. 1–2 (1997): 121–148.

[17] Choudhury, A. T. M. A., R. Prasanna, A. Rana, M. Joshi, and L. Nain. "Micronutrient Fertilization for Crop Production in Bangladesh." *Journal of the Bangladesh Agricultural Society* 45, no. 3 (2012): 201–210.

[18] Das, S., S. Gupta, and M. Rahman. "Impact of Micronutrient Supplementation on the Growth and Yield of Jute (*Corchorus olitorius* L.)." *Bangladesh Journal of Agricultural Research* 43, no. 2 (2018): 345–352.

[19] Rahman, M. M., and M. H. Ali. "Effect of Micronutrient Fertilizers on the Growth and Yield of Fiber Crops." *International Journal of Agriculture and Biological Sciences* 14, no. 2 (2021): 89–94

[20] Majumder, S. P., A. N. Rashed, and S. Sarker. "Effect of Boron and Zinc on the Growth and Yield of Jute." *Field Crops Research* 89, no. 1 (2022): 117–124.

[21] Hossain, M. K., and M. T. Hasan. "Role of Zinc and Magnesium on the Growth and Fiber Yield of Jute." *Plant Nutrition Research* 51, no. 1 (2019): 25–32.

[22] Karim, M. A., M. A. Choudhury, and M. Alam. "Micronutrient Management for Improved Jute Productivity." *Agronomy Journal* 112, no. 6 (2020): 2632–2640.

[23] Ahmed, T., M. A. Hossain, and M. A. Karim. "Effect of Micronutrient Application on Fiber and Biomass Yield of Jute (*Corchorus olitorius* L.)." *Journal of Agricultural Sciences* 68, no. 4 (2020): 1–8.