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## Integrated Nutrient Management For Jute and Allied Fibre Crops in Bangladesh: A Review

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### ABSTRACT

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Jute is well-known for its distinctive versatility in Bangladesh and comes in first place in terms of output, which illustrates the jute crop's dual character of quantity and quality. This review discusses the significance of the jute crop and the advantages of nutrient management techniques in the jute and allied fibre crops (JAF), which increase output, fecundity, and output to fulfill the nation's potential fibre requirements. Due to the demand for JAF fibres in the production of various goods, fibres make a significant economic contribution to Bangladesh. It not only gives the rural population a job, but it also generates cash for the area. If integrated nutrient management strategies are used, it will be simple to meet future demand for jute-based products while still preserving agriculture.

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## INTRODUCTION

Since the start of the green revolution, Bangladesh has made significant advancements in the production of food, utilizing and promoting high yield varieties (BBS, 2018). Producing enough food grains is the main goal, but to meet the nation's materialistic needs, there is also a pressing need to grow fibre crops like cotton, jute and allied fibre crops. Jute production in Bangladesh has benefited from the favorable climate and rich soils. Jute, the second essential natural fibre plant after cotton, is grown throughout the country. Jute is produced in the Ganges Delta area of Bangladesh and India, accounting for around 85% of global production. Jute prefers a warm environment with temperature level ranges 25 °C to 30 °C and RH ranges of 70% to 90%. It requires additional irrigation during the early growing stages and roughly 160-200 cm of the rainfall year-round.

Jute is grown on a greater scale than other natural fibres like kenaf, and mesta because of its superior characteristics (Elbadry et al., 2012). The loamy soils in Bangladesh are ideal for the jute crop's ability to yield as well as the barren and unfertile land is also suitable for kenaf and mesta fibre production, especially in the haor, char and coastal regions. The jute crop's best quality is that it is environmentally safe and biodegradable. After the crop is harvested, jute fibre is gathered and used to make clothing and grain-carrying ropes. Jute fibre is very tensile and has strong flexure and strength because it is rich in cellulose, hemicelluloses, and lignin. Jute fibres are of high quality, which makes them a desirable substrate for flexible electronics (Manjakkal et al., 2021). *Corchorus olitorious* and *corchorus capsularis* are the two main species of jutes. Compared to *capsularis* jute, *olitorious* jute is stronger, silkier, and softer. The stems and outer layer of the crop are used to make jute. The fibre plant has a variety of unique qualities that define its actual potential. Jute can be used to extract cellulose, which can be utilized to create environmentally friendly paper bags as an alternative to non-biodegradable polymer, which contributes to ecological and environmental damage. (Hossen et al., 2020). It is a versatile plant because of the different ways it is used. Jute leaves can be utilized therapeutically, and both their juice and entire green leaves are employed in the creation of skin care products (Islam, 2013). Leaf of jute is a rich source of various nutrient element, counting numerous minerals (such as Ca, Fe), amino acids, vitamins (namely A, C E), and pro-vitamin, that is beneficial to balance eye-vision, balance RBC, strong bones and teeth, healthy skin, strong immune cells, and quick recovery of wound (Sarkar et al., 1997; Gruhn et al., 2000; Das et al., 2021).

To get the jute fibre from the jute plant, retting and stripping techniques are used. To acquire excellent fibre from the jute, several processes and procedures are used, such as mechanical retting (hammering) or inorganic retting (boiling and applying chemicals), steam/vapor/dew retting, water or microbiological means (Elbadry et al., 2012). Jute's adaptability has proved useful in the creation of a variety of items. Jute can be used to create pulp for paper, face wash, charcoal, mats, ropes, garments, and covers for household items (Hossen et al., 2020). The composites created with raw jute have strong adhesion and high energetic properties, which enhance their qualitative characteristics. (Kumar et al., 2019; Acha et al., 2005). The INM approach of jute is relatively less research has been conducted in Bangladesh. This review study will help to the jute researchers to conduct advance nutrient management in jute and allied fibre crop for increasing the national fibre yield and healthy contribution to our national economy through earning foreign currency.

### Integrated Nutrient Management (INM)

In order to achieve the desired productivity, INM aims to increase soil quality, nutrient concentration, and fertility while providing plants with an optimal as well as proper addition of nutrients. The microbial activity is improved and the crop receives the necessary nutrients when all available organic, inorganic, and biological nutrient supply sources are used in an integrated manner. Due to its negative impacts on crop quality, nutrient imbalances in the soil, nitrate leaching, and many other factors, the dependence on the use of chemical fertilizers has always been a reason for concern. In order to achieve sustainable production, INM in JAF crops is the combination of organic, and inorganic fertilizers, and natural agents. This method is the best one for more effectively using the existing resources to grow crops while using less money (Srivastava and Nguilie, 2009). Any agricultural sustainable system should take INM into account and accept it as a core component.

Consumers' rising demands for food variety and nutritional quality have created a difficult issue for energy production and wise energy use for resource sustainability (Gezahegn, 2021). INM is the process of increasing soil fertility by providing sufficient amounts of macro and micronutrients to the crop in order to maximize crop productivity and improve soil quality. The abuse of inorganic fertilizer, which compromises plant improvements well as soil nutrient status, has heightened awareness of the need for INM.

Over the last five decades, extensive studies and improvement was already been conducted on nutrient management in the JAF crop. But the results have been sparse due to a lack of exploration of the research's progressing components. Farmers can benefit greatly from the most recent research and development into the nutrient management of JAF. The literature that is currently available demonstrates the integrated use of compost as well as biochar shows increased plant growth, yield, nutritional status, and nutrient usage efficiency. The experiment including the combination of chemicals and vermi-compost produced the highest level of productivity in jute, demonstrating the significance of INM in JAF crop (Midya et al., 2021).

The desire of using INM strategies in the JAF crops has been stimulated by the deficit of secondary and micronutrients caused by the dominating and prudent use of chemical fertilizer. In plots treated with 75% RDF+25% N FYM in the experiment with INM, the most branches per plant, pods per plant, and seeds per pod were generated. A similar outcome was also achieved in plots treated with 75% RDF+25% N-Neem seed powder. This amplifies the value of INM in the JAF crops (Mandal et al., 2015). According to the advice of BJRI, Bangladesh, jute crops need roughly 20 kg of N, P, and K fertilizers and 5 tons of FYM, and they need less fertilizer if organic matter or bio fertilizers are applied alongside fertilizers. The jute crop's productivity could be increased because to this integration, which could also help to keep the soil fertile. The integrated management treatments, consisting of 75% RDF+25% N-FYM, were successful in maximizing growth and output while regulating the soil's nutrient levels (Mandal et al., 2015).

Manures are a principal reservoir of macro and micronutrients that help in plant flourishing and supply necessary elements while doing minimal damage to the land or ecosystem. The investigation highlights the value of INM in JAF crops by showing that the highest fibre production was attained when both organic (10 FM t ha<sup>-1</sup>) and chemical origin of nutrient (N: P: K at 40: 20: 30 kg ha<sup>-1</sup>) were used as treatments (Majumdar et al., 2019). Monitoring all plant nutrient delivery pathways in crops and cropping systems is a key component of INM, which also necessitates the thoughtful blending of inorganic, organic, and bio-fertilizers. Additionally, One of the Sustainable Development Goals (SDG) 15 (life on land) may be achieved by the work (UN, 2021).

### Key Principles of INM

The following are regarded as the primary INM concepts to consider when formulating INM strategies:

- (1) Traditional agricultural practices, such as the field's biotic attributes (weeds, insects, and diseases), soil texture, water management, machinery accessibility, and meteorological factors, must be appropriate with INM approaches.
- (2) Utilizing nutrition resources not only enhances fertilizer supply but also plant absorption of nutrients (macro and micro), reducing crop nutrient requirements, reducing agricultural contamination, and lowering final expenditures.
- (3) Co-ordinating soil nutrient inputs spatially and seasonally to crop requirements with a view to conserving natural soil components.
- 4) The INM approach maximizes plant potentiality, reduces fertilizer wastage, as well as maximizes profit.
- (5) The physical and chemical attributes of the soil are improved with time.
- (6) In the root zone, where the main interactions between plants and soil occur, INM approaches function as a "pinch point" and control how nutrients are converted, solubilized, made available, released, and absorbed by crop roots. In order to enhance bioactivities, such a workout can stimulate the soil's microbial population.

### Ingredient of Integrated Nutrient Management:

1. Chemical fertilizers
2. Bio fertilizers
3. Composts
4. Green manures
5. Plant byproducts
6. Vermi-compost
7. Leguminous crop
8. All locally available organic sources.

### Benefits of INM in JAF Crop Agriculture

1. The availability of both added and naturally occurring soil nutrients improves, and this benefits plants as well.
2. According to a coordinated availability of nutrients from natural and artificial methods, the crop's nutrient needs are also met.
3. Crops receive a balanced nutrition, reducing the likelihood of nutrient imbalances and shortages.
4. The soil's physical, chemical, and biological functions are maintained.
5. Additionally, there is an increase in carbon sequestration, which slows down the deterioration of ecosystems, water supplies, and soil conditions.
6. There is less loss of macro and micronutrients.
7. Systems can boost the availability and solubility of fertilizers that can be employed, as well as the natural nutrients in the soil.
8. Utilize the nutrient supply harmonic behavior and tailor them to the needs of the crop.
9. Provide the crops with a nutritional balance to decrease the aggressive effects brought on by nutrient imbalance and nutrient fractionation.
10. Advance and maintain the biological and physiochemical processes that occur in soil.
11. By increasing carbon separation and limiting nutrient losses to ground and surface water forms or environmental contamination, we can slow the rate of soil erosion, water pollution, and biodiversity declination.
12. Reduce increased production costs overall and boost farmer net income. Boost the ability to withstand biotic and abiotic stressors
13. An efficient system of farming methods to assure a wholesome diet, meeting mass dietary demands as well as having a substantial effect on soil and the eco-system, especially in nations where the population is expanding quickly.
14. Additionally, it increases crop yield while saving total expenditures at a minimal level.
15. Because it is very simple for farmers to use, it is regarded as substantially hopeful strategies in light of upcoming requirements. INM has considered as a beneficial impact on a plant's susceptibility to or tolerance to a variety of biotic and abiotic stressors.
16. Following INM will make it possible to obtain water and nutrients from a broader area of soil. Additionally, enhanced root enhancement allows crop absorbing moisture from depth soil level, which in turn increases the ability of crops to withstand drought.

### OUTCOME OF PRIOR INM IN JUTE RESEARCH

The combination of RDF with 10 ton FYM ha<sup>-1</sup> showed to be the finest dose for efficient approaches of jute fibre production and enhancing soil physical health and productivity status (Mujmdar et al. 2014). The INM strategy of 75% fertilizer NPK + 25% organic N was shown to have produced a greater yield of jute. Additionally, crops with 100% INM had the highest nutrient uptake and productivity rates (Ghosh, 2008). The only way to deal with the soil-related problems that are currently emerging is to integrate inorganic, organic, and bio-fertilizers as well as their nutrient sources. He also emphasized that INM is the only approach to sustainable agriculture. Jute's fibre yield improved when the chemical N-fertilizer was coupled with compost made from water hyacinths and FM, and the soil's original fertility level was also preserved (Mitra et al., 2010). The benefit of INM is that it boosts soil microbial reaction while also giving the jute crop all the nutrients it needs. The only way to ensure the sustainability of agriculture while improving crop output and soil quality is through integrated nutrient management. Substituting water hyacinth compost or FM for inorganic N-fertilizer by 25% enhanced fibre output while also maintaining soil nutrients under Aquic Ustifluent (Mitra et al. 2014). INM is a significant energy source that offers the most organic C, and readily reachable N for the development of microorganisms and the enhancement of the natural characteristics of the soil. Remaining nutrients are more effective on succeeding crops, which furthers their reputation as an environmentally favorable approach. By using organic nutrient sources in place of massive amounts of chemical fertilizers, the soil's nutritional equilibrium is preserved. Additionally, the crop's nutrient needs are met, and maximum profit is made, which ultimately reduces environmental pollution. To improve the biological qualities of the soil, it is preferable to carefully combine and apply organic, inorganic, and bio-fertilizers simultaneously (Ghanbari and Nejad, 2021). Demonstrating long-term soil health and output consistency of JAF crops, the fraction of carbon storage was higher with INM (Mazumdar et al., 2021). Because of degeneration in soil physical and biological properties, perhaps of equitable usages of sole chemical fertilizer, greater output levels might not be sustained over time (Khan et al., 2008).

According to a review of numerous research studies, combining chemical and organic nutrient sources contributed to relatively high final income and B: C ratios than applying 100% NPK by chemical fertilizer (50% decrease of nitrogen and phosphorus fertilizer coupled with bio-fertilizer). Because nutritional effectiveness and plant utilization are both high, integrating both chemical and organic nutritional elements is remarkably beneficial in JAF crop production. The results of the experiment showed that when NPK and FYM were administered together, jute crop nutrient uptake and soil nutrient status were at their maximum, even three years later. Inorganic and organic fertilizer used in combination (FYM) produced the desired yield while maintaining the fertility of the soil (Singh et al., 2015). When fertilizers are provided in an integrated manner, the jute crop absorbs far more of them. It is also established that even if all the nutrient sources are applied at once, it is possible to apply them in smaller amounts throughout time to ensure that the crop can absorb all the nutrients. Numerous studies have demonstrated that the incorporation of integrated techniques has improved the soil's nutritional status and the rate at which plants are able to absorb nutrients.

The INM research on jute found that applying 50% N and P fertilizer along with organic seed infusion of bio-fertilizer resulted in the highest fibre output and highest net return. In addition, INM practice enhanced the B: C ratio of soil nutrients compared to using 100% of the required NPK fertilizer (Guha et al., 2008). If the current learning of inorganic-dependent dietary practices is continued, it may be predicted that the necessity for plant nutrients would increase to a greater extent in the future. Due to its chemical makeup, which includes jute fibres and sticks rich in cellulose, hemicelluloses, and lignin, jute is a good source of pure nano-cellulose, nano-lignin, and nano-carbon preparation (Shah et al., 2021).

## CONCLUSION

We have noted that the soils of Bangladesh are deficient in micronutrients through numerous large-scale soil tests, and this could pose a new threat to agricultural growth in the future. Therefore, using organic fertilizer might be seen as a helpful strategy to address the issue of micronutrient insufficiency. Expanding the use of biological components, that further will be incredibly helpful in promoting farm conservation for long terms, the basic aim could perhaps be on enriching soil enrichment instead of plants. One of the agricultural practices that appear to be most effective at preserving the soil's quality and enhancing its attributes is integrated nutrient management. Finally, INM can act as a magic wand in agriculture, giving farmers in the nation better economic options by supplying an adequate amount of infused supplements, generating desirable soil physiochemical situations and an environmental sustainability by removing of the limitations, and preserving the soil nutrient availability.

## CONFLICT OF INTEREST

The author has no conflict of interest.

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