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RESEARCH PAPER

Effect of magnesium and organic manure on growth, yield and nutrient uptake of olitorius jute under rainfed condition

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Abstract : A field experiment was carried out during 2019–20 to 2020–21, at Kendrapara, to study the effect of nutrient management with magnesium and farm yard manure on yield, nutrient uptake and economics of tossa jute (*Corchorus olitorius* L.) under rainfed situation. Application of 80 kg N, 40 kg P_2O_5 and 40 kg K_2O/ha (recommended dose for tossa jute) along with $MgSO_4$. $7H_2O$ @ 10 kg/ha + FYM (@5t/ha) to jute crop recorded the highest fibre yield (3.24 tonnes/ha), This resulted an fibre yield increase of 36.6% over the recommended dose of fertilizers . Application of $MgSO_4.7H_2O$, helped to increase the fibre yield of 0.2,2.1 and 1.6q/ha over the recommended fertilizer dose, indicating better response of jute plants to secondary nutrients.Nutrient uptake (N,P,K, Ca, Mg and S) of jute increased owing to combined appliacation NPK + 10 kg MgSO4,when preceded with FYM@5t/ha.The maximum net returns (Rs. 22,628/ha) and the highest benefit : cost ratio (1.71) were recorded with the recommended NPK along with $MgSO_4$ and FYM under rainfed condition.

Key Words : Fertilizer, Magnesium sulphate, Nutrient uptake, Nutrient management, fibre yield, Jute

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INTRODUCTION

Jute, being bio-degradable and annually renewable source, it is considered as an environment-friendly crop and it helps in the maintenance of the environment and ecological balance. It plays an important role in our countrys economy, particularly in eastern and north eastern states. Jute and allied fibre farming, trading and industry provide sustenance to more than five million people of our country (Mahapatra *et al*., 2009). About 0.25 million people are employed in the jute industry and 2.5 million people are engaged in jute-based ancillary sector (Chaudhury and Sinha, 2004). Jute is mostly cultivated in eastern India comprising the states of West Bengal, Bihar, Odisha, Asam, Tripura, Meghalaya and eastern part of Uttar Pradesh covering an area of about 0.85 million ha. Jute cultivation in these areas is mainly confined to small and marginal farmers where the crop is nourished only with the inherent fertility of the soil. In some cases use of fertilizers is confined to only NPK fertilizer. In addition to NPK, magnesium is the next effective nutrient for increasing fibre yield of jute (Ray and Chowdhury, 2000). Hence, balanced nutrient supply through a combination of chemical fertilizers including

the secondary nutrient and organic sources is the key factor for sustainable production of jute. However, systematic information on secondary nutrient-management practices are meagre in jute crop. Based on this, a two year study was carried out to study the effect of nutrient management on yield, nutrient uptake and economics of jute.

MATERIAL AND METHODS

The experiment was conduced at Jute Research Station, Kendrapara, Orissa, in rainfed medium land during 2019 and 2020. The soil was acid lateritic and clay loam, with 5.1 pH. Soil organic carbon was estimated at 5.8 g/kg and soil available N, P_2O_5 and K_2O were estimated at 272, 32 and 175 kg/ha, respectively. Soil samples were analyzed following standard procedures (Page *et al.,*1982). Average annual rainfall received during cropping years was 1128 mm. The field experiment was laid out in a Randomized Block Design with three replications and eight treatments, *viz.,* T_1:NPK recommended dose (80 kg N, 40 kg P_2O_5 and 40 kg K_2O/ha, *i.e.* N80P40K40), T_2:NPK (recommended dose) + FYM (5 tonnes/ha), T_3:NPK + $MgSO_4.7H_2O$ (5 kg/ha), T_4:NPK + $MgSO_4.7H_2O$ (10 kg/ha), T_5:NPK + $MgSO_4.7H_2O$ (15 kg/ha), T_6:NPK + $MgSO_4.7H_2O$ (5 kg/ha)+ FYM (5 tonnes/ha),T_7: NPK + $MgSO_4.7H_2O$ (10 kg/ha)+ FYM (5 tonnes/ha), T_8 NPK + $MgSO_4.7H_2O$ (15 kg/ha)+ FYM (5 tonnes/ha).

Sources of N, P and K fertilizers were urea, single super phosphate and muriate of potash, respectively for all the treatments. Phosphatic and potassic fertilizers were applied as basal dose during land preparation.

Nitrogenous fertilizer was applied in two equal split doses. The 1st split of N was applied 21 days after emergence of the crop and the second one was applied 2 weeks after the first split application. Well decomposed farmyard manure containing 0.50, 0.30 and 0.65% of N, P and K, respectively and Magnesium sulphate were applied and mixed well in the soil 15 days prior to sowing of the crop. *Olitorius* jute (cv JRO 524) was sown with a seed rate of 5 kg/ha maintaining a row to row and plant to plant spacing of 25 and 5 cm, respectively during 2nd week of April in each year. Need based irrigation was given to the crop and the crop was harvested at maturity 120 days after sowing. The jute crop after harvest was kept for 3 days in the field for defoliation of the leaves. The jute plants were then placed in retting tank. After completion of retting within 20 days, the fibre was extracted and washed in clean water, sun-dried and dry weight of the fibre was taken. The plant samples were collected at harvest and dried, processed and analyzed for total N, P ,K, Ca, Mg and S following standard procedures (Tandon, 1993).

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Biological parameters and fibre yield :

Pooled data of both the years showed that application organic manure in combination with the recommended fertilizer dose or chemical fertilizers had shown a positive impact on crop growth, in terms of height, diameter and fresh weight of the crop (Table 1) . Similarly, the treatments supplied with secondary nutrient *viz.,* $MgSO_4.7H_2O$, had shown better growth of crop as compared to the recommended fertilizer dose. Recommended fertilizer dose in combination with organic manure (FYM) @5t/ha and $MgSO_4.7H_2O$

Table 1 : Effect of different nutrient management practices on yield attributes of jute

Treatments	Plant height (cm)	Basal diameter (cm)	Green yield (q/ha)
T_1RDF ($N_{80}P_{40}K_{40}$ kg/ha)	320.0	1.6	417.6
T_2RDF ($N_{80}P_{40}K_{40}$kg/ha)+FYM@5t/ha	326.0	2.0	456.0
T_3RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@5kg/ha	321.7	1.9	427.0
T_4RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@10kg/ha	326.3	2.1	433.6
T_5RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@15kg/ha	325.7	1.9	436.0
T_6RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@5kg/ha+FYM@5t/ha	341.0	1.9	487.7
T_7RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@10kg/ha+FYM@5t/ha	352.0	2.2	575.0
T_8RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@15kg/ha+FYM@5t/ha	338.7	2.0	481.7
C.D.(P=0.05)	9.4	0.3	92.2

@10kg/ha, recorded maximum plant height, basal diameter and green yield of jute among all the treatments. A positive response in terms of growth and development of jute plant was observed with increasing dose of $MgSO_4.7H_2O$. However, maximum response to Mg was observed, when it was applied @10kg.ha, either alone or in combination with organic manure. The positive effect of manure on plant growth could be due to the contribution made by manure to fertility status of the soils as the soils were low in organic carbon content. Manure when decomposed increases both macro and micronutrients as well as enhances the physico-chemical properties of the soil. This could have led to high vegetative growth. Nayak *et al.* (2000) also reported the beneficial effect of recommended NPK + farmyard manure applied to jute showed an increase in seed yield of mustard in the sequential cropping. These results are also in close conformity with the findings of Ray and Chowdhury (2000).

Fibre yield :

Among the treatments the highest fibre yield was recorded under the T_7 treatment (Table 2) which was at par with NPK + FYM treatments and significantly higher than the other treatments. This treatment showed fibre yield increase of 36.6% over the recommended dose of fertilizers. Combined application of FYM (T_2) helped to enhance the yield level of jute upto 20.8% over the RDF. Application of $MgSO_4.7H_2O$, helped to increase the fibre yield of 0.2,2.1 and 1.6q/ha over the recommended fertilizer dose, indicating better response of jute plants to secondary nutrients. This might be owing to their higher yield attributes and more availability of required nutrients in the soil, resulting higher uptake by crop plants (Paikray *et al.,* 2006). Jana and Ghorai (2004), reported that sustainable and potential fibre yield of jute could be obtained by applying the primary nutrients along with $MgSO_4$. Result indicated that application of $MgSO_4$ @10kg/ha, was sufficient for increasing the fibre production as increment in $MgSO_4$ dose could not further increase the jute fibre yield significantly. Stick yield also followed the similar trend.

Although, application of $MgSO_4$ to jute increased the fibre yield of jute over RDF, however, it could not

Table 2 : Effect of different nutrient management practices on fibre yield and economics of jute

Treatments	Fibre yield (q/ha)	Stick yield (q/ha)	Net return (Rs./ha)	B:C ratio
T_1RDF ($N_{80}P_{40}K_{40}$ kg/ha)	23.7	1.6	34267	1.4
T_2RDF ($N_{80}P_{40}K_{40}$kg/ha)+FYM@5t/ha	28.7	2.0	55180	1.7
T_3RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@5kg/ha	23.9	1.9	35344	1.4
T_4RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@10kg/ha	25.8	2.1	42641	1.5
T_5RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@15kg/ha	25.3	1.9	39173	1.5
T_6RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@5kg/ha+FYM@5t/ha	28.3	1.9	52724	1.6
T_7RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@10kg/ha+FYM@5t/ha	32.4	2.2	70410	1.8
T_8RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@15kg/ha+FYM@5t/ha	29.5	2.0	55420	1.7
C.D. (P=0.05)	5.2	11.6		

Table 3 : Effect of different nutrient management practices on nutrient uptake of jute

Treatments	Uptake by jute (kg/ha)					
	N	P	K	Ca	Mg	S
T_1RDF ($N_{80}P_{40}K_{40}$ kg/ha)	94.1	24	131.7	79.5	23.9	9.2
T_2RDF ($N_{80}P_{40}K_{40}$kg/ha)+FYM@5t/ha	109.5	29	143.0	106.5	30.3	12.4
T_3RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@5kg/ha	102.4	25	135.0	88.8	27.6	10.5
T_4RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@10kg/ha	101.7	28	138.7	93.2	28.3	10.7
T_5RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@15kg/ha	100.3	22	133.3	90.1	26.8	10.8
T_6RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@5kg/ha+FYM@5t/ha	109.2	29	148.7	99.4	31.4	12.1
T_7RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@10kg/ha+FYM@5t/ha	112.3	28	151.7	112.0	35.0	14.4
T_8RDF ($N_{80}P_{40}K_{40}$kg/ha)+$MgSO_4$@15kg/ha+FYM@5t/ha	104.7	28	144.0	102.7	29.6	13.0
C.D. (P=0.05)	4.6	3.02	2.9	14.7	5.05	2.4

surpass the yield obtained under FYM treated plots. This might be due to higher microbial activities that affect nutrient recycling and availability of inorganic nutrients. Organically farmed soils had greater microbial abundance and activity compared to chemically fertilized soils. (Gunapala *et al.*, 1998). Furthermore, prior application of FYM @5t/ha, followed by application of NPK and $MgSO_4.H_2O$ (treatments *viz.,* T_6, T_7 and T_8), recorded significant yield increase over the treatments T_3, T_4 and T_5.

Application of FYM , improved crop growth as well as root development of plant, which resulted in better growth of crop and higher fibre yield. Shaha *et al.* (2008) and Singh *et al*. (2011), also reported the similar results.

Nutrient uptake:

Nitrogen, phosphorus, potassium, calcium, magnesium and sulphur uptake was significantly influenced by different nutrient-management practices in jute (Table 3). Highest nutrient uptke was recorded with recommended dose of fertilizer along with $MgSO_4.7H_2O$@10kg/ha and FYM @5t/ha, which was significantly superior over all other treatments. This resulted in an increase in uptake of 18.2kg N, 5.8 kg P, 20 kg K, 32.5 kg Ca, 11 kg Mg and 5.3kg S/ha over the recommended fertilizer dose. Uptake of all macronutrients showed an increasing trend over the RDF, when RDF was combined with $MgSO_4.7H_2O$. Besides, in all the treatments, where prior application of FYM, before sowing of crop was done, uptake of both primary and secondary nutrients was higher as compared to the treatments without application of FYM. Ray and Chowdhury (2000), also reported that combination of organic and inorganic fertilizers increased the fibre yield of jute.This might be due to higher population of beneficial microbes in FYM treated plots due to maintenance of water stable aggregates, organic matter and availability of respirable substances for micro organisms (Rupela *et al*., 2005, Mandal, 2005 and Sharma *et al.*, 2011). Nutrient uptake by jute showed an increasing trend with increasing dose $MgSO_4$, upto 10kg/ha over the RDF. Uptake of nutrients was further enhanced, when the same treatments were preceded with application of FYM. This indicated that, balanced application could greatly influence the uptake of macronutrients. Khan *et al*. (2002) also reported an increase in uptake of nutrients with balanced fertilization.

Economics:

The mean data (Table 2), revealed that highest net return recorded with recommended RDF, along with $MgSO_4.7H_2O$@10kg/ha, preceded by application of FYM @ 5t/ha, before sowing of the crop. This treatment increased the net profit by Rs. 5500/ha over the NPK only. The highest benefit cost ratio (1.84) was obtained under T_7 treatment. This might be owing to higher fibre yield and stick yield of jute in this particular treatment. Hence, it can be concluded that, positive response of jute crop in terms of growth and fibre yield may be obtained with supplement of $MgSO_4$ with the primary nutrients. Integration of FYM @5t/ha, is proved to be best possible option for jute fibre production an sustainability.

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