

Seed Production Potential of Jute (*Corchorus olitorius* Linn.) as Affected by Integrated Nutrient Management under Irrigated Midland Rice Ecology for Self-sufficiency of Marginal Farmers

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ABSTRACT

Jute fibre producing states are completely dependent for its most vital critical input i.e., seed on import from South and West Indian states of India like Maharashtra, Andhra Pradesh, Telengana and Karnataka. For self-sufficiency, jute seed production potential of irrigated midlands (0-30 ponding) were tested by developing shallow ridges (15 cm high and base width 50 cm) on puddled rice soil from Mid-August to January. Scanty rainfall coupled with cool and dry weather from November to January has opened up a new vista for jute seed production in traditional jute fibre producing areas of Eastern India. Jute seed production was recorded highest (635.83 kg/ha) using N:P₂O₅:K₂O::60:40:40 kg/ha (Recommended Dose of Fertiliser, RDF) along with bone meal 1.0 t/ha (23% more over control). In control (RDF) the jute seed production potential was only 518.33 kg/ha. The RDF along with jute leaf manure @ 0.5 t/ha produced 542 Kg jute seed/ha (5% more over control). Combination of recommended fertiliser and Neem cake @ 0.2 t/ha produced 580 kg jute seed/ha (11.89% more over control). Amongst sole chemical fertiliser treatments, treatment T₃ (N:P₂O₅:K₂O:: 100:40:40) produced 579.17 kg jute seed /ha (12% more than RDF). Thus, 3.1 to 3.8 kg jute seed can be harvested from 1.5 cent (60 m²) rice midlands, which is sufficient enough to meet the jute seed requirement of one hectare area, using jute seed drill or jute sowing by regulated broadcast method. Incidentally more than 80% of jute farmers are small and marginal in nature and they grow jute in less than one hectare area. RDF+ jute leaf manures @ 0.5 to 1.0 t/ha recorded higher net returns (₹ 28600 to ₹ 32800/ha) owing to its low cost of production and relatively higher seed yield over RDF alone in both the years with higher B:C ratio from 1.56 to 1.63. Application of augmented chemical fertilization T₂, N:P₂O₅:K₂O::80:40:40 kg/ha fetched higher net returns (₹ 30560 to ₹ 36510/ha) and B: C ratio from 1.58 to 1.70. Thus judicious management can achieve jute seed production in Eastern India and Bangladesh.

Keywords: Jute Seed, Integrated Nutrient Management, Recommended Dose of Fertiliser (RDF), Midland Rice Ecology, Ridge and Furrow, Bone Meal, Jute Leaf Manure, Neem Cake

Jute is an important commercial crop of eastern states of India. Although West Bengal occupies about 70% area and production of jute in the country, jute farmers in this state, grow jute mainly for fibre production rather than for seed purpose. Even though they are sometimes facing acute shortage of quality seeds in the cropping season, they are still dependent on jute seeds from non-jute growing states like Maharashtra, Andhra Pradesh, Karnataka, Telengana etc. Mailk *et al.* 2013 reported

use of quality seeds of an improved variety plays a key role in boosting up jute fibre production.

Jute for fibre is primarily grown in medium (0-30 cm ponding depth in rice season) to low (>50 cm ponding depth) lands and the usual jute based cropping system is Jute-rice-vegetables/pulses/oilseed etc. After jute harvest, the soil becomes waterlogged (0-100 cm or even more in deep water areas) due to rainfall and jute seed production thus is not possible in traditional jute fibre growing areas.

Hence there is a need to investigate the feasibility of jute seed production in traditional jute growing areas, integrated nutrient management (INM) again plays a vital role on quality jute seed production and it will also reduce the production cost maintaining the soil fertility at sustainable level.

A primary report of jute seed production for home scale self-sufficiency has also been made by Ghorai *et al.* 2008.

Therefore, an attempt has been made to explore the possibility of jute seed production in Eastern India with a view to make self-sufficiency in jute seed production.

MATERIALS AND METHODS

The experiments were conducted during 2012 and 2013 in medium land of ICAR-CRIJAF North farm in clay soil, having pH 7.3, EC 0.25 dS/m, Available N, P and K were 374.4, 40.6 and 370.6 kg/ha respectively. The farm is situated at 22°45'35.28" North latitude and 88°25'36.84" East Longitude with an average altitude of 9 meters above mean sea level. The experiment was laid out in complete randomised block design with nine treatments replicated thrice. The treatments were (1)T₁: N:P₂O₅:K₂O::60:40:40 kg/ha (RDF & Control), (2)T₂: N:P₂O₅:K₂O::80:40:40 kg/ha, (3)T₃: N:P₂O₅:K₂O::100:40:40 kg/ha, (4)T₄: N:P₂O₅:K₂O::60:40:40 kg/ha + Jute leaf manure (JLM 1.0 t/ha), (5)T₅: N:P₂O₅:K₂O::60:40:40 kg/ha + JLM 0.5 t/ha (6)T₆: N:P₂O₅:K₂O::60:40:40 kg/ha + Neem cake (NK) 0.5 t/ha, (7)T₇: N:P₂O₅:K₂O::60:40:40 kg/ha + NK 0.2t/ha.(8)T₈: N:P₂O₅:K₂O::60:40:40 kg/ha + bone meal (BM) 0.5 t/ha, (9) T₉: N:P₂O₅:K₂O::60:40:40 kg/ha + BM 1.0 t/ha. The individual plot size was 3 m×3 m each. The ridges were made manually by spade of 15 cm height and 50 cm base width. Drainage channels were made using channels between blocks.

Jute seeds were sown during mid-August in well-drained soil and about forty days old jute seedlings (CV: JRO-204, Suren) were transplanted on fourth week of September on ridges of fertilised soils. Intercultural operation and irrigation (one to two only) were applied as and when required. Plant protection measures were taken as per standard protocol. Before harvest of the crop, biometric observations were taken from 10 matured plants selected randomly from each plot and mean was taken for comparison. The plants were threshed manually and seeds were dried properly in sun up

to 8% moisture content. The seed was harvested on maturity (166 to169 DAS) in the fourth week of January. The data was analyzed following standard statistical methods.

RESULTS AND DISCUSSION

Plant height of jute crop at maturity as affected by different integrated nutrient management

The treatment T₈: N:P₂O₅:K₂O::60:40:40 kg/ha (RDF) + bone meal 0.5 t/ha recorded the maximum plant height (79.0 cm, pooled, 15.8% higher over control i.e. RDF) as compared to other integrated nutrient management options and this treatment was statistically at par with the treatments T₃: (N:P₂O₅:K₂O::100:40:40 kg/ha) and T₉ (RDF + bone meal 1.0 t/ha)(Table 2). The higher plant heights were primarily attributed due to balanced nutrition for combining of bone meal with recommended doses of chemical fertilisers for jute seed crop. Nitrogen fertilization has significant impact in regulating of plant height of jute (Maity *et al.*, 1989).

Basal diameter of jute at maturity as affected by different nutrient management

In terms of pooled value, treatments T₈ (RDF + bone meal 0.5 t/ha) and T₉ (RDF+ bone meal 1.0 t/ha) recorded higher basal diameters (1.03 & 1.02 cm respectively) than the other nutrient management practices (18.6 to 19.8 % higher over control) did. But they did not vary significantly amongst themselves (Table 2). The higher basal diameter of jute plants is accounted primarily for balanced nutrition, with chemical nutrients integrated with bone meal which supplied additional amounts of major and minor nutrients.

Number of branches/plant of jute at maturity as affected by different integrated nutrient management

Number of branch/plant is considered as one of the most important yield attributing parameters of jute, as higher branch/plant is linearly correlated with the higher number of pod production. Integrated nutrient management practice T₉ i.e. RDF + bone meal 1.0 t/ha recorded the highest number of branches per plant (4.37, pooled, 73 % higher over control, RDF) and it was statistically at par with treatments T₈ (4.27), T₄ (4.22) and T₂ (3.97). The

reason behind such higher numbers of branches may be due to balanced nutrition through RDF and bone meal as compared to other integrated nutrient management practices.

Table 1: Weather report of during jute seed production in experimental field

Year	Max. Temp. (°C)	Min. Temp. (°C)	Rainfall (mm)	Max. RH(%)	Max. RH(%)
2012					
September	31.96	25.06	302.0	93.63	76.56
October	31.50	21.57	129.8	91.61	62.12
November	28.52	17.75	44.8	92.70	52.76
December	24.79	17.22	9.4	96.38	56.41
2013					
January	23.86	10.48	0.0	95.67	46.38
September	32.87	26.18	127.4	95.00	67.66
October	29.88	24.02	388.0	96.30	80.06
November	28.78	16.95	0.0	93.70	52.90
December	26.08	13.07	0.0	97.87	54.16
2014					
January	23.41	11.33	0.00	98.25	57.58

Number of pods/plant of jute at maturity as affected by different nutrient management practices

Treatment T₉, i.e. RDF + bone meal 1.0 t/ha recorded the highest number of pods per plant (29.98, pooled, 47.7% higher over control) followed by treatment T₈ (29.65, pooled, 46% higher over control) and treatment T₂: N:P₂O₅:K₂O::80:40:40 kg/ha (26.63, pooled, 31.2% higher over control). Higher number of pods/plant in treatment T₈ and T₉ were primarily achieved due to balanced nutrition (both macro and micro) by bone meal with recommended doses of fertilisers (RDF). Saha *et al.* 2014 also reported that yield attributes *i.e.* no. of pods per plant, no. of seeds per pod, 1000 seed weight and seed yield significantly increased with the increasing irrigation level ($\Psi_{\alpha} = -0.03$ Mpa at 30 cm soil depth) and nitrogen dose (40 kg nitrogen/ha).

Seed yield of jute as affected by different integrated nutrient management practices

Jute seed production was the highest with N:P₂O₅:K₂O::60:40:40 kg/ha (RDF) with bone meal 1.0 t/ha (T₉) *i.e.*, 635.83 kg/ha (23% more over control) followed by treatment T₈: RDF + bone meal 0.5 t/ha (611.67 kg/ha), which were significantly higher

than rest all other treatments (Table 2). In control (RDF) the jute seed production potential was only 518.33 kg/ha. The RDF along with jute leaf manure @ 1.0 t/ha produced 545.83 Kg jute seed/ha (5% more over control). Combination of recommended dose of fertilisers and Neem cake @ 0.2 t/ha produced 580 kg jute seed/ha (11.89% more over control). Amongst the different nutrient management options, treatment T₉ (RDF + bone meal 1.0 t/ha) recorded the highest growth attributes like basal diameter, as well as yield attributes. Augmented fertiliser treatment T₃: N:P₂O₅:K₂O::100:40:40 kg/ha alone recorded the highest jute seed yield (579.17, pooled). Saha *et al.* (2014) also reported beneficial effect of irrigation and N fertilization on growth and yield of jute. Mandal *et al.* (2015) reported integrated application of 75% RDF+25% N from FYM proved best results not only in influencing maximum growth and seed yield but also in maintaining soil nutrient status.

The mechanism behind the higher seed yield in INM practices may be due to protracted release of nutrients from applied chemical fertilisers.

Jute seed yield in the second year is not proportionately high as compare to that of first year in spite of its higher yield attributes (no of branches/plant, no of pods/ plant) primarily due to no rainfall (54.2 mm in November and December 2012, Table 1) which exposed the jute seed crop to moisture stress at pod development and maturity stage.

Economics of jute seed production as influenced by different integrated nutrient managements

The economics presented in Table 3 indicates mean gross return of ₹ 95375/ha was recorded from treatment T₉, (RDF + bone meal @ 1.0 t/ha), which was mainly attributed to its higher seed production/ha. Treatment T₁, RDF (N:P₂O₅:K₂O::60:40:40 kg/ha) recorded the lowest mean gross return (₹ 77750/ha) due to its poor productivity under this fertilization practice. Cost of seed production were lower (₹ 51800 to ₹ 53800/ha) in chemical fertiliser treatments alone in T₂ and T₃. Treatment T₉, RDF+ jute leaf manure @ 0.5 t/ha recorded lower total cost (₹ 51000 to ₹ 51400/ha) owing to its zero cost involvement in jute leaf manure and its gross returns ranged from ₹ 80000/ha-₹ 82500/ha. In both the years, highest cost of seed production were

Table 2: Biometric observations of jute seed crop at maturity and its seed yield

Treatments	Plant height (cm)		Basal diameter (cm)		Number of branches/plant		Number of pod/plant		Jute seed yield Kg/ha						
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013					
	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled	Pooled					
T ₁ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha (Control)	47.7	88.7	68.2	0.66	1.05	0.86	2.47	2.60	2.53	14.13	26.47	20.30	503.33	533.33	518.33
T ₂ : N(80)P ₂ O ₅ (40)K ₂ O(40) kg/ha	47.7	94.3	71.0	0.77	1.14	0.96	3.33	4.60	3.97	19.47	33.80	26.63	553.33	592.33	572.83
T ₃ : N(100)P ₂ O ₅ (40)K ₂ O(40) kg/ha	50.7	96.0	73.3	0.63	0.68	0.65	2.67	2.27	2.47	15.60	20.13	17.87	566.67	591.67	579.17
T ₄ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + JLM 1.0 t/ha	45.7	77.7	61.7	0.67	1.29	0.98	3.37	5.07	4.22	20.73	33.40	27.07	541.67	550.00	545.83
T ₅ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + JLM 0.5 t/ha	50.0	86.9	68.5	0.65	1.08	0.87	2.97	3.73	3.35	15.73	24.10	19.92	533.33	550.00	541.67
T ₆ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + NK 0.5 t/ha	53.0	89.3	71.2	0.71	1.07	0.89	2.80	3.93	3.37	15.33	35.40	25.37	575.00	583.33	579.17
T ₇ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + NK 0.2 t/ha	49.7	88.3	69.0	0.69	1.11	0.90	2.60	4.00	3.30	18.60	31.27	24.93	560.00	600.00	580.00
T ₈ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha. + BM 0.5 t/ha	59.3	98.7	79.0	0.73	1.32	1.03	3.47	5.07	4.27	20.50	38.80	29.65	606.67	616.67	611.67
T ₉ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + BM 1.0 t/ha	50.7	95.3	73.0	0.75	1.29	1.02	3.53	5.20	4.37	20.33	39.63	29.98	630.00	641.67	635.83
SEM±	2.60	3.40	2.10	0.03	0.12	0.06	0.21	0.49	0.26	1.56	3.77	2.04	16.04	21.31	13.33
CD (P≤0.05)	7.70	10.3	6.20	0.09	0.36	0.18	0.62	1.46	0.76	4.69	11.31	5.88	48.07	63.87	38.41

Table 3: Economics of jute seed production as influenced by different nutrient managements

Treatment	Common Cost		Treatment Cost		Total Cost		Gross Return		Net Return		B:C Ratio	
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2	Year 1	Year 2
T ₁ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha (Control)	52400	51800	0	0	52400	51800	75500	80000	23100	28200	1.44	1.54
T ₂ : N(80)P ₂ O ₅ (40)K ₂ O(40) kg/ha	52100	52000	340	340	52440	52340	83000	88850	30560	36510	1.58	1.70
T ₃ : N(100)P ₂ O ₅ (40)K ₂ O(40) kg/ha	53000	53000	680	680	53680	53800	85000	88750	31320	34950	1.58	1.65
T ₄ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + JLM 1.0 t/ha	52000	52200	0	0	52000	52200	81250	85000	29250	32800	1.56	1.63
T ₅ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + JLM 0.5 t/ha	51400	51000	0	0	51400	51000	80000	82500	28600	31500	1.57	1.62
T ₆ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + NK 0.5 t/ha	51400	52100	30000	30000	81400	82100	86250	87500	4850	5400	1.06	1.07
T ₇ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + NK 0.2 t/ha	52000	51000	12000	12000	64000	63000	84000	85000	20000	22000	1.31	1.35
T ₈ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha. + BM 0.5 t/ha	52000	50800	15000	15000	67000	65800	91000	91250	24000	25450	1.36	1.39
T ₉ : N(60)P ₂ O ₅ (40)K ₂ O(40) kg/ha + BM 1.0 t/ha	50900	51800	30000	30000	80900	81800	94500	96250	13600	14450	1.17	1.18

recorded from treatment T₆ (RDF+ neem cake 0.5 t/ha) and treatment T₉ (RDF + bone meal 1.0 t/ha) which were primarily due to higher individual cost of bone meal and neem cakes. Augmented fertiliser treatment T₂ (N:P₂O₅:K₂O::80:40:40 kg/ha) recorded higher net returns (₹ 30560 to ₹ 36510/ha) owing to its low cost of production. RDF+ jute leaf manures @ 0.5 to 1.0 t/ha recorded higher net returns (₹ 28600 to ₹ 29250/ha) owing to its low cost of production and relatively higher seed yield over RDF alone in both years. Treatment T₆ (RDF + neem cake 0.5 t/ha) recorded the lowest net return of ₹ 4850/ha in the first year and ₹ 5400/ha in the second year. The highest B: C ratio, 1.58 to 1.70 was recorded from treatment T₂, (N:P₂O₅:K₂O::80:40:40 kg/ha) and followed by treatment T₃, N:P₂O₅:K₂O::100:40:40 kg/ha. RDF + jute leaf manures @ 0.5 to 1.0 t/ha also recorded relatively higher B:C ratio over RDF + Bone meal and RDF + neem cakes at their doses applied.

CONCLUSION

The results convincingly indicates that recommended dose of NPK in combination with bone meal has proved to be most important integrated nutrient management practice for achieving higher productivity in traditional jute growing areas of Eastern India specially in West Bengal.

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