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Effect of varieties and nutrient levels on fibre yield and economics of tossa jute (*Corchorus olitorius* L.) in Chhattisgarh plains

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Abstract
A field experiment entitled "Effect of fertility levels on growth and fibre yield of tossa jute varieties (*Corchorus olitorius* L.)" was conducted during *kharif* season 2021 at Agriculture Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh) to find out performance of varieties of tossa jute under different fertility levels. The experimental soil was clayey having slightly alkaline reaction, low available soil nitrogen, medium available soil phosphorous and high available soil potassium. The experiment consisted of two varieties (V1-JRO 204 and V2-JRO 2407) as main plot treatment and five different fertility levels (F0-Control, F1-60:40:40, F2-80:60:50, F3-100:80:60 and F4-120:90:70 kg $N:P_2O_5:K_2O$ ha^{-1}) as sub plot treatment was laid out in split-plot design with three replications. Among the tested varieties, the variety JRO 2407 gave the maximum green biomass yield (138.18 q ha^{-1}), Fibre yield (20.54 q ha^{-1}), Stick yield (41.45 q ha^{-1}), gross monetary return (Rs. 1,13,130 ha^{-1}), net monetary return (Rs. 68,606 ha^{-1}) and benefit : cost ratio (2.52) than variety JRO 204. Among the fertility levels, the highest green biomass yield (155.42 q ha^{-1}), fibre yield (20.86 q ha^{-1}), stick yield (45.01 q ha^{-1}), net monetary return (Rs. 68,626 ha^{-1}) and benefit: cost ratio (2.44) was recorded with application of 120:90:70 kg $N:P_2O_5:K_2O$ ha^{-1} followed by 100:80:60 and 80:60:50 kg $N:P_2O_5:K_2O$ ha^{-1}.

Keywords: *Corchorus olitorius*, fertility levels, tossa jute, variety, fibre yield

Introduction
Jute is one of the most important commercial crop known as golden fibre. Jute (*Corchorus olitorius* L.) is an important lingo-cellulosic natural, annual, herbaceous bast (phloem) fibre crop. It is a principal coarse fibre crop grown for commercial purposes in many South Asian countries, predominantly in India and Bangladesh.

India is the largest producer of jute fibre (50.64%) and jute goods (60%) in the world. In world, total area under jute cultivation was about 1.44 million ha and total production was about 3.38 million tonnes. With regard to area Bangladesh ranked 1st followed by India and China with regard to production, India ranked 1st with 1.71 million tonnes followed by Bangladesh and China. India and Bangladesh, alone account for 98% of global production (FAO 2019). On small scale, Thailand, Myanmar, Pakistan, Nepal and Bhutan are also cultivating jute crop. In India, area under jute was 0.68 million ha and production 9.91 million Bales with productivity 2641 kg ha^{-1} during 2019-20 (https://eands.dacnet.nic.in). Jute is mostly cultivated in eastern India comprising the states of West Bengal, Bihar, Odisha, Assam, Tripura, Meghalaya and eastern Uttar Pradesh. According to current data, India imported 28.9 MT of raw jute worth Rs 179.28 crores as well as jute goods (including hessian, sacking, yarn, JDPs and others) of Rs 1116.84 crores in the year 2020-21 and exported 102.8 MT of jute goods worth Rs 2740.46 crores in the year 2020-21, and 88.1 MT of jute goods of worth Rs 2021.45 crores in the year 2021-22 (https://www.jute.com).

Jute was grown previously in Chhattisgarh and jute mills were established in Raigarh district of the state. The climatic requirements (Rainfall) for jute cultivation is well suited in Chhattisgarh. In Chhattisgarh, area under jute was 0.66 thousand ha and production 1.31 thousand Bales with productivity 358 kg ha^{-1} during 2020-21 (http://jutecomm.gov.in). Recently short supply of jute fibre bags from jute growing areas of the country for packing of rice and other grains has created a lot of problem.

The varieties play an important role in growth as well as fibre production of jute. Alternatively, agronomic methods such as fertilizing crop through fertilizers can be used for enhancing the yield. Imbalanced use of fertilizers also affect the crop growth that leads to decline the fibre yield.

Information on the effect of nutrients on jute varieties is meagre Therefore an experiment was laid out to evaluate the effect of varieties and levels of nutrients on growth and yield attributes of tossa jute.

Materials and Methods

A field experiment was conducted during *kharif* season of 2021 at Agriculture Instructional Cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). Geographically, Raipur is situated in the central part of Chhattisgarh at 21°16'N latitude, 81°36'E longitude and at an altitude of 298 m above mean sea level. Raipur comes under the seventh Agro-climatic region of India *i.e.* Eastern plateau and hills and situated in tropical region. The climate of Raipur region is sub humid to semi-arid. The experimental soil was clayey having slightly alkaline reaction, low available soil nitrogen, medium available soil phosphorous and high available soil potassium. The experiment consisted of two varieties (V1-JRO 204 and V2-JRO 2407) as main plot treatment and five different fertility levels (F0-Control, F1-60:40:40, F2-80:60:50, F3-100:80:60 and F4-120:90:70 kg $N:P_2O_5:K_2O$ ha^{-1}) as sub plot treatment was laid out in split-plotdesign with three replications. The crop was sown on 29th June 2021. The spacing of 30 cm row to row and approx. 10 cm plant to plant spacing was maintained after two thinning of crop. The 5 kg seeds ha^{-1} was used for sowing. 50 per cent nitrogen and entire amount of phosphorous and potassium was applied as basal dressing through urea, single superphosphate and muriate of potash and remaining 50 per cent nitrogen was splited in two equal parts and applied at 30-35 and 60-65 days after sowing of crop as top dressing. All agronomical practices like weeding, intercultural operations, irrigations and plant protection measures were followed time to time. The crop was harvested at 110 days after sowing at early pod stage and data were recorded for green biomass yield, fibre yield and stick yield. All data obtained from the experiment was statistically analyzed using *F*-test as procedure given by Gomez and Gomez (1984). Critical difference values at *P*=0.05 were used to determine the significance of mean differences of treatments.

Results and Discussion

Effect of varieties

Variety JRO 2407 produced the maximum green biomass yield (138.18 q ha^{-1}), fibre yield (20.54 q ha^{-1}), stick yield (41.45 q ha^{-1}). The fibre yield of variety JRO 2407 was found 28.5 per cent higher over tossa jute variety JRO 204 (Table 1). This might be due to higher bole length and stem diameter of plant under the variety. It was seen that the fibre yield in jute is significantly correlated with various yield contributing characters *i.e*. bole length (cm), stem diameter (cm) and dry weight $plant^{-1}$ (g). Similar findings were supported by Sobhan and Khatun (1982) [6], Aruna *et al*. (1989) [1] and Roy and Ghosh (2004) [4]. Among the tested varieties, the variety JRO 2407 recorded higher gross monetary return (Rs 1,13,130 ha^{-1}) , net monetary return (Rs 68,606 ha^{-1}) and benefit: cost ratio (2.52) than variety JRO 204.

Effect of fertility levels

The data (Table 1) indicated that the green biomass yield, fibre yield and stick yield increased significantly with the application of increasing levels of fertilizer over control. The highest green biomass yield (155.42 q ha^{-1}), fibre yield (20.86 q ha^{-1}) and stick yield (45.01 q ha^{-1}) were recorded with application of 120:90:70 kg $N:P_2O_5:K_2O$ ha^{-1}, which was at par with 100:80:60 and 80:60:50 kg $N:P_2O_5:K_2O$ ha^{-1}. The minimum green biomass yield, fibre yield and stick yield were observed under the control with significant difference to other treatments. The increased in green biomass yield is due to increase in growth attributes *viz*, plant height, number of leaves and stem diameter which increased with increasing levels of fertilizer ultimately lead to increase in green biomass yield, fibre yield and stick yield. Similar findings were supported by Khanom *et al*. (2012) [3] and Safari (2003) [5]. Application of 60:40:40, 80:60:50, 100:80:60 and 120:90:70 kg $N:P_2O_5:K_2O$ ha^{-1} recorded 51.6 per cent, 66.8 per cent, 72.2 per cent and 74.9 per cent higher fibre yield compare to control plot. It was also noted that the rate of increase in fibre yield was decreased with increasing fertilizer dose (Fig.1). The data (Table 2) indicated that highest cost of cultivation (Rs 47,750 ha^{-1}), gross monetary return (Rs 1,16,376 ha^{-1}), net monetary return (Rs 68,626 ha^{-1}) and B:C ratio (2.44) was recorded with application of 120:90:70 kg $N:P_2O_5:K_2O$ ha^{-1} followed by 100:80:60 and 80:60:50 kg $N:P_2O_5:K_2O$ ha^{-1}. The lowest cost of cultivation (Rs 39,323 ha^{-1}), gross monetary return (Rs 66,441 ha^{-1}), net monetary return (Rs 27,118 ha^{-1}) and B:C ratio (1.69) was observed under the control.

Table 1: Green biomass yield, fibre yield and stick yield of tossa jute as influenced by varieties and different fertility levels

Treatments	Green biomass yield (q ha^{-1})	Fibre yield (q ha^{-1})	Stick yield (q ha^{-1})
Varieties			
V1-JRO 204	133.63	15.99	35.52
V2-JRO 2407	138.18	20.54	41.45
SEm±	2.65	0.39	0.55
CD (*P* = 0.05)	NS	2.37	3.34
Fertility levels (kg $N:P_2O_5:K_2O$ ha^{-1})			
F0- Control	85.56	11.93	25.56
F1- 60:40:40	137.92	18.08	38.89
F2- 80:60:50	147.95	19.90	39.63
F3- 100:80:60	152.70	20.54	43.32
F4- 120:90:70	155.42	20.86	45.01
SEm±	2.82	0.49	0.85
CD (*P*=0.05)	8.44	1.47	2.55
Varieties x Fertility levels CD (*P*=0.05)	NS	NS	NS

Table 2: Economics of tossa jute as influenced by varieties and different fertility levels

Treatments	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
Varieties				
V1-JRO 204	44524	89717	45194	2.00
V2-JRO 2407	44524	113130	68606	2.52
Fertility levels (kg N:P_2O_5:K_2O ha^{-1})				
F0- Control	39323	66441	27118	1.69
F1-60:40:40	43667	100822	57155	2.31
F2-80:60:50	45182	109373	64191	2.42
F3-100:80:60	46697	114107	67410	2.44
F4-120:90:70	47750	116376	68626	2.44

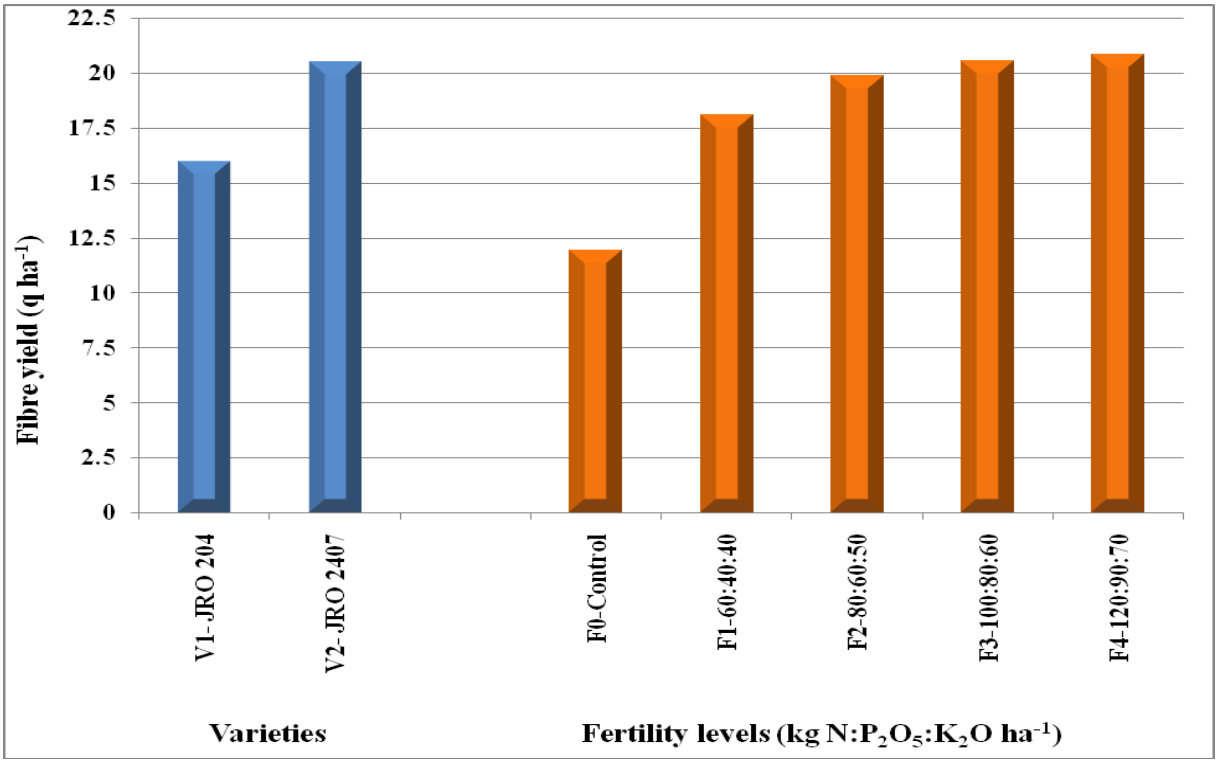

Fig 1: Effect of varieties and different fertility levels on fibre yield of tossa jute

Interaction effect of varieties and fertility levels

The interaction effect of varieties and fertility levels were found non-significant. Moreover, the variety JRO 2407 at 120:90:70 kg N:P_2O_5:K_2O ha^{-1} recorded the highest gross monetary return (1,27,967 Rs ha^{-1}),net monetary return (80,217 Rs ha^{-1}) followed by JRO 2407 at 100:80:60 kg N:P_2O_5:K_2O ha^{-1} with gross monetary return(1,26,182 Rs ha^{-1}), net monetary returns (79,485 Rs ha^{-1}) and JRO 2407 at 80:60:50 kg N:P_2O_5:K_2O ha^{-1} with gross monetary returns (1,21,282 Rs ha^{-1}), net monetary returns (76,100 Rs ha^{-1}), while the highest B:C ratio was recorded with JRO 2407 at 100:80:60 kg N:P_2O_5:K_2O ha^{-1} (2.70) followed by JRO 2407 at 120:90:70 kg N:P_2O_5:K_2O ha^{-1} (2.68) and JRO 2407 at 80:60:50 kg N:P_2O_5:K_2O ha^{-1} (2.68).

Table 3: Economics of various treatment combinations

Treatment	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
Varieties x Fertility levels				
V1F0 (JRO 204 x Control)	39323	55520	16197	1.41
V1F1 (JRO 204 x 60:40:40 kg N:P_2O_5:K_2O ha^{-1})	43667	88787	45120	2.03
V1F2 (JRO 204 x 80:60:50 kg N:P_2O_5:K_2O ha^{-1})	45182	97463	52281	2.16
V1F3 (JRO 204 x 100:80:60 kg N:P_2O_5:K_2O ha^{-1})	46697	102032	55335	2.19
V1F4 (JRO 204 x 120:90:70 kg N:P_2O_5:K_2O ha^{-1})	47750	104785	57035	2.20
V2F0 (JRO 2407 x Control)	39323	77362	38039	1.97
V2F1 (JRO 2407 x 60:40:40 kg N:P_2O_5:K_2O ha^{-1})	43667	112857	69190	2.58
V2F2 (JRO 2407 x 80:60:50 kg N:P_2O_5:K_2O ha^{-1})	45182	121282	76100	2.68
V2F3 (JRO 2407 x 100:80:60 kg N:P_2O_5:K_2O ha^{-1})	46697	126182	79485	2.70
V2F4 (JRO 2407 x 120:90:70 kg N:P_2O_5:K_2O ha^{-1})	47750	127967	80217	2.68

Conclusion

On the basis of the data it could be concluded that among the tested varieties, the variety JRO 2407 gave maximum green biomass yield, fibre yield, stick yield, gross monetary returns, net monetary returns and benefit: cost ratio than variety JRO 204. With regard to fertility levels, the highest green biomass yield, fibre yield, stick yield, net monetary returns and benefit: cost ratio were recorded with the application of 120:90:70 kg $N:P_2O_5:K_2O$ ha^{-1}, which was at par with 100:80:60 and 80:60:50 kg $N:P_2O_5:K_2O$ ha^{-1}.

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