International Journal of Agronomy and Agricultural Research (IJAAR)
ISSN: 2223-7054 (Print) 2225-3610 (Online)
http://www.innspub.net
Vol. 19, No. 5, p. 10-15, 2021

RESEARCH PAPER OPEN ACCESS

Zero hunger and green world at a time: A way of agriculture

Manika Rani Debnath*[1], Protap Narayan Nandi[2]

[1]*Senior Scientific Officer, Agronomy Division, Bangladesh Jute Research Institute, Bangladesh*

[2]*Former Consultant, International Maize and Wheat Improvement Centre, Bangladesh*

Article published on November 30, 2021

Key words: Jute, Rice, Intercropping, Spacing, Income, Yield

Abstract

An experiment was conducted at Faridpur, Bangladesh with five treatments to test the feasibility of Jute-rice intercropping system with a view to natural fibre production along with maintain food security. Two plant material namely Jute (*Corchorus capsularis*), variety CVL-1and Rice (*Oryza sativa*), BRRI dhan43 was used at this experiment. Five treatments namely sole jute, jute intercropped with rice at 30cm spacing, jute intercropped with rice at 40cm spacing, jute intercropped with rice at 50cm spacing and sole rice was applied in Randomized Complete Block Design with three replication. Result revealed that jute-rice intercropping system gave beneficial income, land equivalent ratio, area time equivalent ratio than sole rice cropping. Jute intercropped with rice at 30cm spacing treatment gave a better scope of getting fibre and food grain from the same land at a time without sacrificing fibre yield.

* **Corresponding Author:** Manika Rani Debnath ✉ manika00474@yahoo.com

Introduction

Jute is a bast fibre producing crop under the genus *Corchorus* and family Malvaceae. It is a popular natural fibre after cotton. To produce green earth, jute contributes as an important bio degradable natural fiber. Jute grows in parts of Asia including India, Bangladesh, China, and Myanmar (Khan and Khan, 2014; Das, 2017; Shahinur and Hasan, 2019a).

Bangladesh has a bright history of jute production. This country occupied 1st position in jute export and 2nd position in jute production. The Daily Industry reported on 13 October, 2020 that 4.9% of the GDP was obtained from jute in the last fiscal year according to BBS, 2019. Jute is also involved with the genesis of Bangladesh through liberation war (Debnath, 2020). Bangladesh is a populous country also. The population of Bangladesh is now about 1.8 million. To meet the 1st and 2nd goal of Sustainable Development Goal, it becomes a challenge to maintain zero hunger along with poverty elimination from Bangladesh. Jute is also used as vegetable with a lot of food value (Islam, 2013). Jute contributes both to attain 1st and 2nd Sustainable Development Goal. Rice is the staple food of Bangladesh. According to Siddique *et al.*, 2013 generally, rice is cultivated in this country in three seasons namely Aus season (March to August), Aman season (May to December) and Boro Season (November to May). Jute is cultivated for fibre in this country mainly during March to August which also the season of aus rice production. Different strategies have taken to increase rice yield (Khush, 2020). For increasing rice cultivation to meet food security, jute production is hampered. But socio-economic status of most of the farmers of Bangladesh has been improved through jute cultivation (Sheheli and Roy, 2014). If rice can be cultivated along with jute fibre, that will be helpful for providing food security with increasing income of farmer from jute fibre.

Materials and methods

Experimental site

The experiment was conducted at Jute Research Regional Station (JRRS), Faridpur (23.580 N latitude and 89.810 longitude) at 19April 2015 to 17 August 2015.

Plant material

CVL- 1 was used as white jute variety and BRRI dhan43 was used as Aus rice variety in this experiment. CVL- 1 is a popular white jute variety which can withstand stresses. BRRI dhan43 is very popular rice variety during Aus season in the experimental area. Source of jute seed was Jute Research Regional Station, Faridpur. Aus rice seed was collected from Rice Research Regional Station, Faridpur.

Design

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replication and five treatments as T_1 = Sole Jute at 30cm line spacing, T_2 = Jute at 30cm line spacing intercropped with Aus rice, T_3 = Jute at 40cm line spacing intercropped with Aus rice, T_4 =Jute at 50cm line spacing intercropped with Aus rice and T_5 = Sole Aus rice at 25cm line spacing.

Procedure

Aus rice was sown at seed bed on 23 April, 2015 and then transplanted at the intercropping system on 24 May, 2015 when seedlings were about 1 month old. Bangladesh Jute Research Institute recommended Jute fibre production techniques and Bangladesh Rice Research Institute recommended rice production were followed. Weeding and top dressing was done at 23 May, 2015. To control the Rice Green leaf Hopper ethofenprox 10 EC 750ml/ha was sprayed at 05 June, 2015.

Data collection and analysis

Harvesting of rice was done at 11 August, 2015 and then Jute was harvested at 26 August 2015. Plant height, base diameter, fibre yield, stick yield market price of fibre and stick was recorded in case of Jute crop. Rice yield, straw yield, market price of rice and straw was recorded in case of rice crop. All recorded data were analyzed statistically following the ANOVA technique and the means were separated using Least Significant Difference (LSD) by "Statistix 10" software.

According to Willey and Osiru, 1972, LER was calculated as –

LER = (YAB/YAA) + (YBA/YBB),

Where; YAB= Yield of crop A when intercropped with crop B----------(1)

YBA= Yield of crop B when intercropped with crop A
YAA= Yield from sole planted crop A
YBB= Yield from sole planted crop B

ATER provides more realistic comparison of the yield advantage of intercropping over monocropping in terms of time taken by component crops in the intercropping systems than LER. ATER was calculated by formula developed by Hiebsch, 1980-
ATER= (RYa x Ta) + (RYb x Tb)
Where RYa = Relative yield of component A in mixture
Ta = duration (in days) of component A
RYb = Relative yield of component species B in mixture---------- (2)
Tb = duration (in days) of component B
T = Total duration of the intercropping system (in days)
The interpretation of ATER involves that ATER> 1 implies yield advantage;
ATER =1 implies no effect of intercropping;
ATER< 1 implies yield disadvantage.

IER for intercrops may vary in different years as crop prices fluctuate. LER (or IER) can be determined for systems involving more than two crops by summing the intercrop to sole crop yield (or net income) ratios of each crop included in the intercropping system. To calculate the IER market price or gross income (GI) obtained from intercropping a hectare of land were used. It was calculated by the formula developed by Ghaffarzadeh, 1997.

Results and discussions

Plant population, plant and base diameter of jute did not vary significantly with the treatments except treatment of sole rice which are shown at Table 1. Fibre yield varied significantly from treatment to treatment. The highest fibre yield (2.94 tha^{-1}) was obtained at sole jute treatment followed by jute at 30cm line spacing intercropped with Aus rice (2.47 tha^{-1}). The fibre yield was higher at sole jute and Jute intercropped with Aus rice at 30cm spacing due to the lesser competition with rice for nutrients and environment. Miah *et al.,* reported during 2020 the yield of white jute variety CVL-1 as 2.83 tha^{-1}. Besides T_5 (Sole rice) the lowest fibre yield was obtained at T_3 treatment (Jute at 40cm line spacing intercropped with rice) which was statistically identical with fibre yield of T_4 treatment (Jute at 50cm line spacing intercropped with rice). The highest stick yield was obtained at sole jute cultivation 6.20 tha^{-1}followed by the treatment T_4 (Jute at 50cm line spacing intercropped with rice). The highest rice yield was obtained by the sole rice cultivation (2.95tha^{-1}) and highest straw yield from the same treatment as 2.60 tha^{-1}. Karmakar *et al.,* 2019 reported the grain yield of BRRI dhan43as 2.68 tha^{-1}.

Table 1. Yield and yield contributing character from deshi jute fibre production intercropped with aus rice at different spacing.

Treatments	PP (Lakh/ha)	PH (m)	BD (mm)	Fibre Yield (t/ha)	Stick Yield (t/ha)	Grain Yield (t/ha)	Straw Yield (t/ha)
T_1 (Sole jute at 30cm line spacing)	2.69	2.69	17.54	2.94	6.20	0	0
T_2 (Jute at 30cm line spacing intercropped with rice)	2.58	2.59	17.15	2.47	5.10	0.12	0.42
T_3 (Jute at 40cm line spacing intercropped with rice)	2.68	2.68	17.26	2.11	4.52	0.09	0.42
T_4 (Jute at 50cm line spacing intercropped with rice)	2.65	2.66	17.31	2.36	5.15	0.13	0.36
T_5 (Sole rice at 25cm line spacing)	0	0	0	0	0	2.95	2.60
F (5%)	NS	NS	NS	*	*	*	*
LSD	11.23	0.26	1.94	0.52	1.04	1.57	0.69
CV%	16.78	6.51	7.42	14.14	13.14	126.10	48.46

The jute yield and rice yield was statistically decreased by intercropping. Kaysar *et al.*, 2014 also reported such fibre yield reduction of jute during intercropped with others. Same rice yield reduction during intercropping also reported by Oroka and Omeregie, 2007. Light, air, space, competition of nutrient uptake may be the causes of such yield reduction. Problems of performing different intercultural operation and pest control may be another causes of such yield reduction. According to Okunlola and Ofuya (2013), Mixed cropped *C. olitorious* (as vegetable) had given better growth and

yield than sole cropped counter parts where they intercropped *C. olitorious* with *Amaranthus hybridus and Celosia argentea*, two horticultural (flower) crop. Rabbany and Islam (1996) also reported that jute fibre yield was not significantly reduced in mixtures (mungbean and cowpea) except when intercropped with stem amaranthus. Ghosh (2011) found that intercropping rice with jute at 4:1 stand ratio treated with 40 kg N/ha for enhancing total productivity and profitability of the rainfed lowland rice production system.

But we had the limitations to use fertilizer doses. We used fertilizer doses only required for jute crop at all the treatment in lieu of applying fertilizer required for both crop at intercropping treatment. If we used sufficient amount of fertilizer for intercropping, then yield may not be reduced.

Table 2. Income and Income Equivalent Ratio for Jute-rice intercrops at different spacing.

Treatments	Income (Thousand/ha)	IER (Income Equivalent Ratio)
T_1 (Sole jute at 30cm line spacing)	129.9 a	1.00
T_2 (Jute at 30cm line spacing intercropped with rice)	111.9 a	3.81
T_3 (Jute at 40cm line spacing intercropped with rice)	95.8 ab	3.31
T_4 (Jute at 50cm line spacing intercropped with rice)	107.7 ab	3.42
T_5 (Sole rice at 25cm line spacing)	65.4 b	1
P value	0.07	0.12
LSD	43.7	2.84
CV%	22.71	60.19

Price of fibre=40,000/ton, price of stick=2000/ton, price of rice=22000/ton, price of straw=200/ton

Table 2 showed that if per ton jute fibre was sold at BDT 40,000/- rate, stick at BDT 2000/- rate (per ton) and Aus rice was sold at BDT 2200/- per ton, straw at BDT 200/- per ton then highest income (129.9 Thousand taka/ha) was obtained from sole jute production at 30cm line spacing which was statistically identical with the income from Jute at 30cm, 40cm and 50cm line spacing intercropped with aus rice. The lowest income was obtained from sole Aus rice at 25cm line spacing as 65.4 Thousand taka/ha. The cause of such lowest income from sole aus rice cultivation was due to lower price of aus rice than the jute fibre during the experimental period at that local market. Income equivalent ratio also not differed significantly.

Table 3. Land Equivalent Ratio (LER) and Area Time Equivalent Ratio (ATER) for Jute-rice intercrops at different spacing.

Treatments	LER	ATER
T_1 (Sole jute at 30cm line spacing)	1a	1.53a
T_2 (Jute at 30cm line spacing intercropped with rice)	0.91a	1.40ab
T_3 (Jute at 40cm line spacing intercropped with rice)	0.77 b	1.21ab
T_4 (Jute at 50cm line spacing intercropped with rice)	0.92a	1.37ab
T_5 (Sole rice at 25cm line spacing)	1a	1c
LSD	0.12	0.27
CV%	6.71	8.44

At Table 3 we may found that the land equivalent ratio (LER) of the treatment T_2, T_3 and T_4 where the jute was intercropped with different Aus rice at different spacing, was below 1, which indicates advantages through intercropping of Jute with aus rice was lower than the sole crop. But the LER of different treatment differ significantly. LER of T_3 was statistically lower than LER of other treatments which indicated that jute at 40cm line spacing intercropped with aus rice gave lower productivity than other treatments.

Picture of jute-rice intercropping.

The data presented at the Table 3 also showed that ATER differ significantly at different treatments. The highest ATER (1.53) was found at T_1 which was statistically identical with T_2, T_3 and T_4 which indicated an advantage of 53% in sole Jute, jute

intercropped with aus rice at 30cm spacing 40% advantage, intercropping at 40cm spacing 21% advantage and intercropping at 50cm spacing 37% advantage. At Table 3, the ATER values were higher than LER values indicating the efficient estimation of resource utilization in the maturity periods of the crops of which jute stayed longer on the land and had enough time to compensate for the rice competition.

Sarkar *et al.* (2013) reported that strip-cropping of black gram with jute (80% area) grown in 20cm row spacing can enhance the jute equivalent yield of the system upto 13.8%.

System productivity was improved over sole cropping in Jute-green gram intercropping system (Ghorai *et al.,* 2016). Kaysar *et al.* (2014) expressed that the yields of both jute and maize were reduced in intercropping, but the gross return and benefit cost ratio were improved in Jute + Maize at 75cm x 25cm than those in sole crops.

Conclusion

Though some intercropping arrangement give lower fibre yield than sole jute cultivation but from different economical analysis it was found that Jute-rice intercropping system was beneficial than sole rice cultivation. To get both food and fibre crop we may follow Jute- rice intercropping system. We may follow jute cultivation intercropped with aus rice at 30cm spacing to get both economic advantages without sacrificing fibre yield.

Acknowledgement

The authors would like to express their thanks to Dr. Ayub Khan, Director (agri.) and former head of Farm management unit and Dr. Abdul Alim for their valuable suggestion for this research. The authors also like to express thanks to Bisnuepadho Roy and Hasan Chowdhury for the helps during conducting research.

References

Das S. 2017. Mechanical properties of waste paper/jute fabric reinforced polyester resin matrix hybrid composites. Carbohydrate Polymers **172,** 60-67. DOI: 10.1016/j.carbpol.2017.05.036.

Debnath MR, Rafiq MZA, Kamal TB, Nandi PN. 2020. Conservation tillage: Approach of jute cultivation. International Journal of Research and Analytical Reviews **7(1),** 61-64.

Ghaffarzadeh M. 1997. Economic and biological benefits of intercropping Berseem clover with oat in corn-soybean-oat rotations. Journal of Production Agriculture **10,** 314-319.

Ghorai AK, Kumar M, Kar CS. 2016. Weed smothering in jute with green gram intercropping. Indian Journal of Weed Science **48(3),** 343-344.

Ghosh A. 2011. Intercropping rice (*Oryza sativa*) with jute (*Corchorus capsularis*) and its impact on total productivity and profitability under rainfed low land ecology. Indian Journal of Agronomy **56(3),** 196 -201.

Hiebsch CK. 1980. Principles of intercropping. Effect of N fertilization and crop duration on equivalency ratios in intercrops versus monoculture comparisons. PhD thesis, North Carolina State University, Raleigh, N. C., USA.

Islam MM. 2013. Biochemistry, Medicinal and Food values of Jute (*Corchorus capsularis* L. and *C. olitorius* L.) leaf: A Review. International Journal of Enhanced Research in Science Technology & Engineering **2(11),** 35-44.

Karmakar B, Mamun MAA, Rahman MS, Islam MA, Islam MR, Mukul MHR, Shamsunnaher, Zahan A, Barua R, Biswash MR, Parveen S, Akter, Shaikh NY an, Ahmed B. 2019. Adaptation of Promising Rice Genotypes for Broadcast Aus Season. Bangladesh Rice Jounal **23(2),** 35-48, DOI.org/10.3329/brj.v23i2.48246.

Kaysar MS, Sarkar MAR, Rahman MM, Sarker UK. 2014. Growing maize as fodder at different spacings in olitorius jute. Bangladesh Journal of Progressive Science & Technology **12(1),** 17-20.

Khan JA, Khan MA. 2014. The use of jute fibers as reinforcements in composites. In: Biofiber Reinforcements in Composite Materials, Eds. O. Faruk and M. Sain (Woodhead Publishing) 3-34. DOI: 10.1533/9781782421276.1.3

Khush GS. 2007. Strategies for increasing yield potential of rice. Studies in Plant Science **7,** 207-212.

Miah R, Saha NR, Rafiq MZA, Ali MY, Hasanuzzaman M. 2020. Performance study on yield and yield attributes of seven white jute breeding lines at different regions of Bangladesh. Progressive Agriculture **31(1),** 19-25.

Ojeifo IM, Lucas EO. 1987. The growth and development of *Corchorus olitorius* L. grown alone and intercropped with tomato *Lycopersicon esculentum*. Journal of Agricultural Science, UK **109 (1),** 39.

Okunlola AI, Ofuya TI. 2013. Effect of mixed cropping and plant extracts on the growth, yield and pest control of jute (*Corchorus olitorius* L.). Folia Horticulture 25/1: 49-60.

Oroka FO, Omoregie AU. 2007. Competition in a rice-cowpea intercrop as affected by nitrogen fertilizer and plant population. Scientia Agricola 64(6). DOI.ORG/10.1590/S0103-90162007000600010

Rabbany ABMG, Islam N. 1996. Effect of intercropping systems on growth and yield of jute. Thai Journal of Agricultural Science. 29/8: 285-300.

Sarkar S, Majumdar B, Kundu DK. 2013. Strip-cropping of legumes with jute (*Corchorus olitorius*) in jute-paddy-lentil cropping system. Journal of Crop and Weed **9(1),** 207-209.

Shahinur S, Hasan M. 2019. Jute/coir/banana fiber reinforced biocomposites: critical review of design, fabrication, properties and applications. Materials Science and Materials Engineering. DOI: 10.1016/B978-0-12-803581-8.10987-7

Sheheli S, Roy B. 2014. Constraints and opportunities of raw jute production: a household level analysis in Bangladesh. Progressive Agriculture **25,** 38-46. https://doi.org /10.3329070

Siddique MA, Furuya J, Kobayashi S, Salam MA. 2014. A Simulation Study on Impact of Climate Factors on Production and Requirements of Rice in Bangladesh. Research on Ecophysiology **9(1),** 55-69.

The Daily Industry. October 13, 2020. Jute sector to gain $5b export income by 2025.

Willey RW, Osiru DSO. 1972. Studies on mixtures of maize and beans *(Phaseolus vulgaris)* with particular reference to plant population. Journal of Agricultural science **79,** 517-529.