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Late Jute seed production in cropland agroforestry system

Kazi Noor-E-Alam Jewel[1*], Md. Mujibur Rahman[2], Mohammad Shahjahan[3] and Sayeeduzzaman[4]

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ABSTRACT

Farmers were not self-sufficient in jute seed production and cultivation to avoid use exotic jute seed from different resources. Though the conventional method of jute seed production was not enough to meet the demand of farmers because of shrinkage of jute seed production land. So, late jute seed production technique was applied in agroforestry systems at both established and newly developed orchards. The study was conducted in the selected three sites of Rangpur, Dinajpur and Faridpur. Both White (*Corchorus capsularis* L.cv. CVL-1) and Tossa (two popular cultivars, eg., *Corchorus olitorius* L. cv. O-9897, and cv. O-72) varieties were used for to evaluate the late jute seed production in cropland agroforestry in 2011- 2013. It was observed that 600 kg ha^{-1} to 725 kg ha^{-1} of jute seed was produced in different types of orchard plantation. Seeds from Litchi orchard showed the higher fiber yield (1051.11, 2511.11 and 3555.56 kg ha^{-1} at Rangpur, Dinajpur and Faridpur, respectively) than the mango orchard. Nutrient contents of soil in three sits were improved significantly due to the cultivation of late jute seed production. Moreover, late jute seed production in early stages of orchard plantation was more profitable and late jute can be produced economically for five to seven years depending on the plantations type and age.

INTRODUCTION

Jute is a long, soft, shiny vegetable fibre that can be spun into coarse, strong threads. It is produced from plants in the genus *Corchorus*, which was once classified with the family Tiliaceae, more recently with Malvaceae, and has now been reclassified as belonging to the family Sparrmanniaceae. The primary source of the fibre is *Corchorus olitorius*, but it is considered inferior to *Corchorus capsularis* (Anonymous 2015). Jute is one of the most affordable natural fibers and is second only to cotton in amount produced and variety of uses of vegetable fibers. Jute fibers are composed primarily of the plant materials cellulose and lignin. It falls into the bast fibre category (fiber collected from bast, the phloem of the plant, sometimes called the "skin") along with kenaf, industrial hemp, flax (linen), ramie, etc. "Jute" is the name of the plant or fiber that is used to make burlap, Hessian or gunny cloth. In Bangladesh jute is grown mainly for fibre rather than for seed. Annually 1.40 million ha of land was cultivated for the production of 806 million Kg of fibre (Anonymous 1998). Total area under jute crop has been estimated at 16,62,100 acres (6,72,615 hectares) which was 1.03% higher than the year of 2013-14 that of 2014-2015 (Salima Sultana 2015). Farmers of Bangladesh conventionally grow seed and fibre simultaneously from the same plant of jute. But the conventional method of jute seed production is not enough to meet the demand of farmers. Seed supplied by Bangladesh Agricultural Development Corporation (BADC) only covers 31.58 to 62.5% of the total demand of certified seed (BADC 2015). Rest of the seed came from farmers own production and exotic source (Indian seed), of which the larger one is exotic source. In addition, the market price of jute seed is not satisfied by the production cost. So, every

1- Scientific Officer, Forestry Unit, NRM Division, SPGR-NATP Coordinated Sub-project on Improvement of Agroforestry Practices for better livelihood and environment (Agroforestry Project)-BARC Component, BARC, Farmgate, Dhaka, Bangladesh
2- Chief Scientific Officer, PTC Division, Bangladesh Jute Research Institute (BJRI), Manik Mia Avenue, Dhaka-1207, Bangladesh, and Principal Investigator (PI), SPGR-NATP-Agroforestry Project: BJRI component
3-Chief Scientific Officer, Forestry Unit, NRM Division, Bangladesh Agricultural Research Council (BARC), Farmgate, Dhaka-1215, Bangladesh, and Associate Coordinator, SPGRNATP-Agroforestry Project: BARC component.
4- Scientific Officer, PTC Division, SPGR-NATP-Agroforestry Project-BJRI Component, BJRI, Manik Mia Avenue, Dhaka, Bangladesh.
*Email: wwwjewel@gmail.com

village of the country has been facing acute shortage of good quality jute seed. Certified seeds of an improved variety provide 20 percentage additional yield of the crop (Hossain et al. 1994). Farmers usually suffer from early immature flowering of jute crop using exotic seed. Seeds of Bangladesh Jute Research Institute (BJRI) developed varieties have great acceptance to the farmers, but government production contribution is negligible in comparison to the need. In this situation there was no alternative to motivate the farmers to cultivate their own seed using BJRI developed varieties and technology. BJRI has been advocating late or off season seed production for higher seed yield and economic return, which to be sown in the month of August and September and harvested in December and January (Hossain et al. 1994). But at the same time, jute seed crop experienced competition with the winter vegetables for main land. Since winter vegetables are high value crop, farmers are not even interested to intercrop the jute seed crop with winter vegetables. So, farmers may decide to produce jute seed crop in their homestead, pond bank and in orchards where sunlight is available by using modern agroforestry systems for their economic benefit. Sowing time for jute crop largely depends on early rainfalls, which is a short spell and needed a huge amount of jute seed. To overcome jute seed problems and to ensure supply of required good quality seeds, agroforestry system was introduce in farmers homestead, newly developed and established orchards. In this study, attempts have been made to introduce agroforestry system for good quality jute seed production in farmer's newly developed and established orchard.

MATERIALS AND METHODS

The field experiment was conducted at Dinajpur, Rangpur and Faridpur in 2011 to 2013, and data were collected from 20 selected farmers from each of the three sites. The experimental site belongs to newly developed orchard and early stages of established orchard. The modern variety of jute, eg. white (*Corcorus capsularis,* cv. CVL-1) and tossa (*Corcorus aulitorious,* cv. O-9897, and cv. O-72) varieties were used for the consecutive production. Farmers have sown their jute seed at mid-July to mid-August and harvested at mid-December. An average (three years) plot size of 0.08 ha (0.08 ha in Rangpur, 0.09 ha in Faridpur and 0.08 ha in Dinajpur) in the three selected areas. Soil fertility status and moisture content of the selected area were measured. Seed yield data were analyzed by Gomez and Gomez (1983) and the mean differences were adjudged by Duncan's Multiple Range Test. Jute seed produced in agroforestry systems were tested in the seed pathological laboratory of Bangladesh Jute Research Institute (BJRI) for the insects and pests infestation. Laboratory tests, eg., germination test was also evaluated. Field experiment for comparison of the produced seed with Breeders Seed and TLS (as control) were executed in the fibre crop growing season.

RESULTS AND DISCUSSION

On an average 447.5 kg jute seed and 4027.5 ka of jute by product was produced from per ha of land. Local market price (LMP) of jute seed and jute by-product were USD 1.73 and Tk 0.03 per kg on an average. Average price of other crop/vegetables produced from the same piece of land earned USD 734.64per ha. (USD 460.45 at Rangpur, USD 230.51 at Faridpur and USD 1512.97 at Dinajpur respectively in an average) whereas jute seed crop earned USD 884.82 from each decimal of land (Table 1).

In the Rangpur area farmers sown jute seed in the orchard (most of the cases are Mango and some are Litchi) in mid-August to late-September. Jute varieties in most of the cases are O-9897, in very few cases O-72. It was observed that 600 kg to 750 kg of jute seed was produced in per ha of land in different types of orchard plantation (Table 2). Best benefit cost ratio (BCR) was observed from jute seed produced in the mango plantation 2.5 years of age in Dinajpur, where tree height average was 1.52m and canopy diameter was 2.03m.

Fibre crop yield performance studies were done by the seed produced from different agroforestry systems were conducted in the experimental sites. Fibre production results were presented in the following tables 3(a), 3(b) and 3(c).

It was observed in the table 4 (a - c), that jute seed from litchi plantation at Faridpur shown highest (10666.67 kg ha^{-1}) fiber yield.

Test results showed that, fibre production was better considering the seed produced in the agroforestry systems to the normal seed (TLS) at all of the 3 experimental sites.

Collected soil samples of selected 20 farmer's field were tested in Soil Resource Development Institute (SRDI) laboratory for changes of major macro nutrients/contents before jute seed sowing and after jute seed harvesting from the field. Average results of 20 (Dinajpur and Rangpur) and 11 (Faridpur) samples with statistical analyzed (T test) and presented with the initial soil status of before and after cultivation of the jute seed crop (with tree plantation) in the tables 5 (a to c).

It is seen from the table 5(a) that the P, S and Zn contents in the soil of Dinajpur region improved significantly (statistically) and OM also physically improved though it is not statistically significant due to the cultivation of late jute seed crop in the

Table 1. Comparative Statement of Late Jute Seed Production

Items	**Experimental Site**									**Grand Average**
	Rangpur			**Faridpur**			**Dinajpur**			
Year	*2011*	*2012*	*2013*	*2011*	*2012*	*2013*	*2011*	*2012*	*2013*	
Average Plot Size (ha.)	0.12	0.05	0.07	0.12	0.06	0.08	0.12	0.05	0.09	0.08
Average Seed Yield (kg ha^{-1})	675	437.5	445	675	305	250	675	305	265	447.5
Average Seed LMP* (USD kg^{-1})	1.75	1.43	1.81	1.91	1.27	1.84	1.75	1.91	1.95	1.73
Average By-product (kg ha^{-1}	5000	4285	5445	4020	4175	3522.5	3040	4125	2632.5	4027.5
Average By-product LMP (USD kg^{-1})	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.02	0.03	0.03
Total Sale (USD ha^{-1}	1305.74	745.12	982.01	1381.87	493.40	556.55	1246.30	659.62	535.53	884.82
Average price of Other crop/vegetables produced (USD ha-1)		460.45			230.51			1512.97		734.64
Other **Crop/Vegetables**	Garlic, Cauliflower, Reddish, Rice, Banana, Turmeric, Chili, Maize									

LMP* = Local Market Price

Table 2. Average late jute seed production in three experimental sites under mango and litchi orchard

No.	**Area**	**Orchard type**	**Land (ha)**	**Plantation detail**	**Seed yield (kg ha^{-1})**	**BCR**
01.	Rangpur	Mango	0.2	3 yrs, ht. 2.05 m, BD 20.16cm, Canopy dia. 2.74m	600	1.54
02.	Dinajpur	Mango	0.1	2.5yrs, ht. 1.52m, BD 17.78cm, Canopy dia. 2.03m	750	1.70
03.	Faridpur	Mango	0.1	2yr, ht.(Avg.) 0.61m, BD 7.62cm, Canopy dia. 0.76.	700	1.60
04.	Three Sites	Litchi	0.1	2yr, ht.(Avg.) 0.61m, BD 7.62cm, Canopy dia. 1.22.	650	1.67
	Average		**0.125**		**670**	**1.62**

Note: yrs.=Years, ht.= Height, BD= Diameter at Breast height, Avg. = Average

Table 3(a). Fibre yield (kg ha^{-1}) at Rangpur site

Seed production system	**Average fibre yield (Kg ha^{-1})**			**Total**	**Average**
	1st Year	**2nd Year**	**3rd Year**		
Mango based agroforestry system	626.67	793.33	866.67	2286.67	762.223
Litchi based agroforestry system	986.67	833.33	1333.33	3153.33	1051.11
Control	713.33	1033.33	1066.67	2813.33	937.777
Block total	2326.67	2659.99	3266.67	**8253.33**	

Table 3(b). Fibre yield (kg ha^{-1}) at Dinajpur site

Seed production system	**Average fibre yield (Kg ha^{-1})**			**Total**	**Average**
	1st Year	**2nd Year**	**3rd Year**		
Seed produced in **Mango** plantation	1866.67	2333	2066.67	6266.67	2088.89
Seed produced in **Litchi** plantation	2333.33	2133	3066.67	7533.33	2511.11
Control	2000	2467	2333.33	6800	2266.67
Block total	6200	6933	7466.67	**20600**	

Table 3(c). Fibre yield (kg ha^{-1}) at Faridpur site

Seed production system	**Average fibre yield (Kg ha^{-1})**			**Total**	**Average**
	1st Year	**2nd Year**	**3rd Year**		
Seed produced in **Mango** plantation	3000	3400	3666.67	10066.67	3355.56
Seed produced in **Litchi** plantation	3866.67	3333.33	3466.67	10666.67	3555.56
Control	3600	4000	2333.33	9933.33	3311.11
Block total	10466.67	10733.33	9466.67	**30666.67**	

Table 4(a). Analysis of variance table for fibre yield at Rangpur

Source of variation	Sum of Squares	df	Mean Squares
Between treatments	127118.9235	2	63559.4617*
Between blocks	151418.0939	2	75709.0469*
Error within treatments	86182.35067	4	21545.5877
Total	364719.368	8	45589.921

* Significant at p≤0.05.

Table 4(b). Analysis of variance table for fibre yield at Dinajpur

Source of variation	Sum of Squares	df	Mean Squares
Between treatments	269626.8148	2	134813.407*
Between blocks	269630.8148	2	134815.407*
Error within treatments	438522.3704	4	109630.593
Total	977780.0001	8	122222.5

* Significant at p≤0.05.

Table 4(c). Analysis of variance table for fibre yield at Faridpur sites

Source of variation	Sum of Squares	df	Mean Squares
Between treatments	151112.8889	3	50370.963*
Between blocks	856295.037	2	428147.519*
Error within treatments	1928905.111	6	321484.185
Total	2936313.037	11	

* Significant at p≤0.05.

Table 5(a). Soil status of Dinajpur on before and after jute seed cultivation

Averages of 20 samples	pH	OM%	TN%	P	S	Zn
				µg/g soil		
Before	5.5820	0.7980	0.0935	44.0725	52.8355	0.8385
After	6.9300	1.8125	0.10245	130.2700	60.2775	2.9760
T calculated	3.1037	1.4297	0.0005	10270	1288	4.0291
T critical (5%)			1.6944			

Table 5(b). Soil status of Rangpur on before and after jute seed cultivation

Averages of 20 samples	pH	OM%	TN%	Zn
				µg/g soil
Before	5.0810	1.6895	0.0835	1.1960
After	5.1715	1.7440	0.0845	2.0545
T calculated	5.4400	0.3534	0.1215	1.7134
T critical (5%)			1.6944	

Table 5(c). Soil status of Faridpur on before and after jute seed cultivation

Averages of 11 samples	pH	S	P	K
			µg/g soil	
Before	7.8727	5.6181	5.9272	0.2609
After	8.1727	15.5000	11.1000	0.2272
T calculated	2.6187	4.8588	1.0190	1.5591
T critical (5%)			1.7250	

farmers orchards areas. Similarly it is clear from the tables 5(b) and 5(c) that the Zn content in Rangpur (Table 5b) site and S in Faridpur (Table 5c) region improved significantly and physical (visible) improvement occurred for the other important soil contents/ nutrients due to the cultivation of late jute seed crop in the farmers orchards areas. So it can be concluded that the production late jute seed crop improves the soil condition of the land.

CONCLUSION

The experiment was conducted in the late jute production season at farmers' field in Rangpur, Dinajpur and Faridpur region to introduce the BJRI developed late jute seed production technology in farmer's orchard based agroforestry systems to made them self-sufficient in jute seed production. On an average total earn from jute seed and jute by product was 884.82 USD ha^{-1} whereas only crop/vegetables earn 734.64 USD ha^{-1}. In addition, it was found that the soil OM status was improved in the three experimental sites also. So late jute

seed production (both White and Tossa) in the cropland agroforestry system indicated to improve soil and farmers' livelihood also.

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