OPEN ACCESS
Haya: The Saudi Journal of Life Sciences
Abbreviated Key Title: Haya Saudi J Life Sci
ISSN 2415-623X (Print) |ISSN 2415-6221 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: http://scholarsmepub.com/haya/

Review Article

Research and Development Advances of Jute Seed in Bangladesh: A Review

Md. Mahbubul Islam; Md. Nasir Uddin
Agronomy Division of Bangladesh Jute Research Institute, Dhaka, Bangladesh

***Corresponding author:** Md. Mahbubul Islam
| **Received:** 03.03.2019 | **Accepted:** 15.03.2019 | **Published:** 30.03.2019
DOI:10.21276/haya.2019.4.2.2

Abstract

Jute seed production season, methods and related practices for yield and their economics were selected for its being large concentration point in relation to production methods, yield and cost in Bangladesh. The technical review paper provides crucial insights regarding the past, present status and future prospects of jute seed scenarios of the country. The whole contents of the article covering all aspects of jute seed including strategies in overcoming the acute jute seed shortage of the country. Data were collected from different print media like different annual reports and journals during the year 2018 at Agronomy Division, Bangladesh Jute Research Institute (BJRI), Dhaka. Jute is grown in about 0.8 million hectares of land by about 3.5-4.0 million farmers. To cultivate that amount of land, the it require about 5000 to 5500 tons of seed. One of the most important problems for jute production in Bangladesh is the non-availability of quality seed at proper time of sowing. Only about 15%-20% quality jute seeds are supplied by institutional sources however the rest amount of quality seeds yet to be managed to supply. Bangladesh Jute Research Institute (BJRI) produces nucleus seed to produce "Breeder seed" duly certified by Seed Certification Agency (SCA). Bangladesh Agricultural Development Corporation (BADC) collects Breeder seeds from BJRI for producing Foundation seeds at its own multiplication farms. BADC produces certified seeds through its contract growers. Besides, BJRI also produces 8-10 tons of Truthfully Leveled Seed (TLS) and distributed to the farmers. Since its inception BJRI has developed 42 varieties of jute fibre crops. Jute seed could be produced by direct seeding, plant top/stem cutting and seedling transplanting methods, called improved methods. In traditional method it took 240 to 270 days of field duration for seed production. In contrast 120 to 160 days of field duration required for any improved method. Seed sowing generally done during March-April for jute fibre, a part of matured plant's of the same land kept for seed production in traditional system. However, in off-season, June-July was proved appropriate sowing time for *Corchorus capsularis* L. and August-September for *C. olitoriu*s L. for quality and higher seed production. The average flowering days, pod maturation days and total field duration also varied significantly due to the planting dates in *C. olitorius* L. and *C. capsularis* L. *C. capsularis* L. yielded 100-150 kg/ha; however, *C. olitorius* L. 200-300 kg/ha of lower quality seed in traditional system. On the other hand, in improved method *C. capsularis* L. and *C. olitorius* L. yielded 500-700 kg/ha and 600-1000 kg/ha of good quality seed, respectively. Pest and diseases infestation recorded higher in traditional method. In contrast lower infestation observed in improved method. Net return and as well as BCR found higher in improved direct seeding method (1.25%), which followed by top/stem cutting (1.16%) and seedling transplanting method (1.07%). The future thrust are development of HYV, short day and stress tolerant jute varieties. Meet up the seed shortage in Bangladesh searching of suitable seed growing areas. Seed production in nontraditional areas. Location specific seed production technologies research. In spite of its success there has some constraints for producing quality jute seed like-Manpower shortage in seed management and research. Lands of different stations of BJRI are not suitable for seed production specially tossa jute. Lack of modern laboratory facilities in different regional and sub-stations.

Keywords: Jute (*C. olitorius* L. and *C. capsularis* L.), research, seed, constraints, future thrust, BJRI, BADC, SCA, BCR.

Copyright @ 2019: This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

INTRODUCTION

Jute (Corchorus spp.) is one of the main cash crops of Bangladesh. It plays an important role earning about 5-6% foreign exchange through exporting jute and jute goods. Jute covers about 2.86% of total cropped area. In Bangladesh, annually covering 0.461 millions ha of land with the production of 0.912 million tons of fibre. The farmers require about 4,000 tons of seed to cultivate the said area [1]. Jute accounts for about 4% of the foreign currency earnings from export. It is a common term used both for plant and the fibre obtained from the bark of the plants, *Corchorus*

capsularis L. and *Corchorus olitorius* L. These two species are annual and short day plants belonging to the family *Tiliaceae*. Bangladesh is not only the second largest producer of jute but also produces the best quality jute fibre and leads the export market. In Bangladesh, jute is grown in about 0.7 - 0.8 million hectares of land by about 3.0-3.5 million out of 10 million farm families. It is a rapid growing renewable biomass and photo-reactive crop with only100-120 days harvesting period. It is mainly grown for fibre rather than the seed. It is a photo-period sensitive and short day plant. The critical photo-period is being 12 hours for *C. capsularis* L. and 12.5 hours for *C. olitorius* L. plants [2, 3]. Due to photo-sensitivity, jute plants sown or planted subjected to short days (less than the critical photo-period) giving stunted growth and premature flowers [4, 5]. Its fibre is primarily used for making hessian, sack and carpet backing clothes. It has versatile uses for making mats, blankets, furnishing fabrics, packaging materials & other diversified jute products in the jute mills.

The demand of seed of departmental seed was higher but there was no seed production farm and registered farmers under the then established. Chitla jute seed farm in Kustia was established to produce pedigree jute seeds and to supply the Department. Later on another farm of 833 acres was established in Nasipur, Dinajpur in 1960. In 1976 a Seed Wing was established in BJRI as per recommendation of FAO/ADB. Since then BJRI plays a vital role for production and supplying quality jute seeds in the country. But, this Seed Wing of BJRI was merged with the BADC in 1988 [6]. Jute is predominantly grown for fibre rather than seed production. Farmers usually grow seeds by keeping a part of their fibre crops planted in March-April. Remnant part of the fibre crop due to prolonged stay in the field is usually affected by natural calamities, becomes physiologically weak and produces low yield of poor quality seeds. Besides, fibre quality on seed maturity becomes degraded and sells at a low price. This results in a chronic problem in the cultivation practice of jute crop. Besides the use of jute fibre, jute sticks are traditionally used as fuel and fencing in the rural areas. Recent uses of jute sticks are in making activated charcoal. Moreover, the sticks are used as house construction materials either directly or with mill processed hardboard while the leaves continue to be used as a favorite vegetable. In addition, jute plants improve soil productivity because of its huge leaf defoliation and root proliferation in the field [7-9].

Predominantly jute is grown for fibre and thus little attention is given to its seed production. Earlier, farmers of Bangladesh grow jute seed along with the fibre crop. Jute crop requires 7-8 months for producing seeds and farmers keep a piece of land for this purpose at the corner of the field during harvesting of the crop for fibre. After harvesting fibre crop, the crop for seed remains almost uncared for a long period. Due to weathering, diseases and insects affect the seed crop and as such, poor quality seed is produced. For lower seed yield and poor quality of jute seed, the farmers become more interested to procure seeds from government sources. Sometimes, farmers cannot grow good crop for using poor quality seeds obtained from markets. To overcome the problem the scientists of BJRI evolved improved technique for quality seed of jute crop [7].

To cultivate about 0.80 million hectares of land, the farmers require about 5000 to 5500 tons of seed. Some jute farmers use to produce jute crops by their own seeds but such seeds are inadequate and sometimes poor in quality. One of the most important problems for jute production in Bangladesh is the non-availability of quality seed at optimum time of sowing. Only about 15% - 20% quality jute seeds are supplied by institutional sources the Bangladesh Agricultural Development Corporation (BADC) but the rest of the seeds are produced and managed by the farmers themselves [7].

The most disappointing situation persists in the processing and preservation methods of jute seeds at farm level. Early sowing of jute seed crops are normally planted in the month of March-April, harvested in October-November, preserved at the storage from November through February and again sown in the following season in the months of March and April. The late seed crop is planted in the month of August and September, harvested in December and preserved from January through February. During this preservation period, cool and dry weather of the winter season does not cause any adverse effect on deterioration of seed quality. However, the real problem arises with the carry-over seeds and the seeds that are preserved for late season seed production programme to be sown in the month of August-September. Almost every year, there are enough unsold seeds remain with the seeds men and growers. As there is no other way of utilizing jute seeds but to destroy the entire quantity of unsold seeds, the country faces a huge wastage of national resources for want of a suitable method of long-term seed preservation. This problem warrants emphasis for the development of a suitable technology with the available materials to the farmers, which would help preserve seed viability and vigour at least for one year [3].

There evolved some less photo-sensitive varieties of both *C. capsularis* L. and *C. olitorius* L. species which have flexibility in sowing time and can easily be accommodated in three cropping patterns. Among the less photo-sensitive varieties, O-9897 of *C. olitorius* L., ranks at the top for its higher yield and better quality fibre. Farmers also prefer this variety for its early sowing characteristics. This variety exclusively produces better fibre yield but produces very poor seed yield when planted in March-April as fibre crop [6]. During the devastating flood of 1988 almost all of the jute seed crops were damaged. To recover that cataclysmic effect, jute seeds were planted in the month

of September where, O-9897 provided excellent results. Earlier evidences also offered favourable opinions that late planting technique produce higher seed yield [6, 10]. Choudhuri and Ali [11] suggestively stated that one of the devices to increase seed yield of jute was to check vegetative growth by late sowing. They further stated that jute crop should be planted in June or later so that plants remain stunted, induce early flowers and produce higher seed yield. Evidences also indicated that jute seeds could be sown even in the month of December for producing seeds of the following crop season [12, 13].

Above facts and findings thus indicated that photo-periodic effect rather brought beneficial effect to late-planted jute seed crop. Appropriate methods have been developed to produce jute seeds. Therefore, present review has evaluated the production methods, phenology, yield and cost of production of the off-season jute seed.

MATERIALS AND METHODS

The study was based on secondary data. The secondary data used were collected from different studies of the Library of Bangladesh Jute Research Institute, Dhaka during from August 2018 to till March, 2019. These secondary data were in BJRI annual reports, different thesis, Bangladesh Journal of Jute and Fibre Research of BJRI and other international journals.

FINDINGS

PRESENT STATUS: RESEARCH AND DEVELOPMENT ACTIVITIES

i. Jute and Allied Fibre Production in Bangladesh

Jute is the second most important vegetable fibre crop after cotton. In Bangladesh, last decade jute and allied fibres were cultivated about 0.70 to 0.80 millions hectares and total fibre production around 70-80 lac bales. The acreage and production of jute largely depends on market price of jute fibre at previous year and environment. The acreage and production of jute and allied fibre during last 10 years presented below.

Table-1: Acreage, production and yield of jute during last 10 years from 2008-09 to 2018-19

Year	Acreage (Lac ha.)	Production (Lac metric ton)	Production (Lac bales)	Yield (ton/ha)	Yield (bales/ha)
2009-10	4.56	8.89	48.99	1.95	10.74
2010-11	8.03	15.23	83.93	1.90	10.45
2011-12	7.60	14.41	79.41	1.90	10.45
2012-13	6.81	13.71	75.54	2.01	11.09
2013-14	6.66	13.57	74.78	2.04	11.23
2014-15	6.73	13.52	74.50	2.01	11.07
2015-16	7.25	13.74	75.71	1.90	10.44
2016-17	7.37	14.96	82.43	2.03	11.18
2017-18	7.90	14.54	80.10	1.84	10.14
2018-19	6.50	13.50	74.39	2.08	11.44

Source: BBS & DAE

ii. Status of Jute seed in Bangladesh

In BJRI, jute and allied fibre seed research activities is the main responsibility of breeder seed department of Genetic Resources and Seed Division. Besides breeder seed department other divisions like agronomy, pest management and jute faming systems division done some research work on jute and allied fibre seeds. At present, BADC is the major public sector of the country produce and distributes Jute and Allied Fibers (JAF) seeds to the growers. Generally BADC produces 700- 800 tons of seed both of deshi (*C. capsularis* L.) and tossa (*C. olitorius* L.) meeting only 8-10% of the total jute and allied fibers (JAF) seed requirements.

It is to be noted that the total need of deshi (*C. capsularis* L.) seeds is being met by the country itself through domestic source. In case of tossa (*C. olitorius* L.) seed, out of total requirement of 4500 tons, BADC is supplying only 450 tons. It appears that the remaining quantities of *C. olitorius* L. seeds are coming from the farmers own production (very little) and from both official and unofficial trade from a neighboring country. The unofficial source of jute seed has no guarantee of its quality and is often causes of lower yield. Due to lack of sufficient quantity of quality seed from the public sector farmers always opt for unofficial source of jute seeds.

With a view to overcoming this critical situation, Ministry of Agriculture (MOA), Bangladesh has directed to increase the production of quality seed both in the public and private sectors and for making best quality seeds available to the farmers on time with competitive price.

A look in to the public sector jute seed production reveals that Bangladesh Jute Research Institute (BJRI) produce nucleus seed to produce "Breeder seed" duly certified by Seed Certification Agency (SCA) with tag level. BJRI generally supplied 1000-1600kg Breeders Seed to BADC & NGOs every year for multiplication as Foundation and finally certified seed. Besides, BJRI also produces 8-10 tons of Truthfully Leveled Seed (TLS) in its different stations and supply to the farmers. Bangladesh Agricultural

Development Corporation (BADC) collects Breeder seeds from BJRI for producing Foundation seeds at its own seed multiplication farms. BADC then produces certified seeds through its contract growers. After collection, necessary processing and marketing of jute seed were done accordingly to reach to the hands of the farmers.

For production of certified jute seeds, there are six-contract growers zone under the management of BADC. The seeds are procured, processed and preserved in the seed processing centers and after packing, it is transported to distribution centers for selling to the farmers. Seeds are then distributed through private seed dealers with the consultation of DAE. In case of imported jute seed, distribution programme is taken themselves as of demand.

Recently, BJRI has taken up a programme of "Nizer beez nize kore" at farmers level to make the farmers self sufficient by providing seed and practical training. This programme has expanded widely with 2500 farmers training annually under "Develop & Dissemination of Agricultural Technologies of Jute & Allied Fibre Crops" project. Arrangement of fund through agricultural subsidy can help to overcome this situation of seed to a large extent. It may be mentioned here that jute seed crop alone is not profitable to the farmers. As jute is a short day plant, its production period covers Rabi season where lots of high value crops are there. So farmers of Bangladesh are reluctant to grow jute seed.

Table-2: Variety wise Breeder seed production in BJRI during 2013-2014 to 2017-2018

Name of varieties/ Year	2013-14	2014-15	2015-16	2016-17	2017-18
Deshi pat					
CVL-1	260	245	530	385	545
CVE-3	8	12	0	0	0
CC-45	0	30	0	0	0
BJRI Deshi Pat -5 (BJC-7370)	30	0	50	95	85
BJRI Deshi Pat -6 (BJC-83)	20	0	0	0	0
BJRI Deshi Pat -6 (BJC-2147)	8	0	0	0	0
BJRI Deshi Pat -8 (BJC-2197)	0	0	5	25	12
BJRI Deshi Pat Sak-1	0	0	0	13	6
Sub -total	326	287	585	518	648
Tossa pat					
O-9897	540	500	670	761	618
OM-1	3	0	0	0	0
BJRI Tossa Pat-4 (O-72)	51	30	55	60	26
BJRI Tossa Pat-5 (O-795)	46	90	40	99	75
BJRI Tossa Pat-6 (O-3820)	0	0	20	20	10
Sub -total	640	620	785	940	729
Kenaf					
HC-95	250	110	115	339	280
BJRI kenaf-3	0	0	0	18	15
Sub -total	250	110	115	357	295
Total amount of seed (kg)	1216	1017	1485	1815	1672

The Government of Bangladesh has given more thrust to promote the seed industry particularly by helping the private sector and Non Government Organizations (NGOs). About 50 companies are now in active seed business for different crops and different seed associations have grown up. It is the prime time to bring the private company to produce quality jute seed domestically to reduce the dependence on imported jute seed as well as to curb the unauthorized jute seed trade. BJRI has HYV jute varieties for the Bangladeshi farmers to get fibre and as well as jute seed profitably.

Table-3: Demand and supply of jute seed (*C. capsularis* L. & and *C. olitorius* L.) and kenaf seed in Bangladesh during last seven years from 2011-12 to 2017-18

Year	Demand (M.T)				Supply (M.T)			
	Deshi	Tossa	Kenaf	Total	Deshi	Tossa	Kenaf	Total
2011-12	465	4125	555	5145	446	4733	440	5619
2012-13	352	3770	465	4587	277	3723	498	4478
2013-14	345	3675	480	4500	447	4613	425	5285
2014-15	360	3690	510	4560	493	4049	448	4991
2015-16	337	4030	525	4892	500	4292	757	5549
2016-17	292	4223	707	5222	368	4899	1097	6364
2017-18	220	3463	627	4310	227	4102	909	5238

Source: DAE and BADC

Organizations (public) Involved in Jute Seed Sector of Bangladesh

Four components of jute seed industry in Bangladesh are controlled by several public and private sector organizations. These are:-

- *Variety/Seed Improvement*: The Bangladesh Jute Research Institute (BJRI) and The Bangladesh Institute of Nuclear Agriculture (BINA).
- *Seed production*: Bangladesh Agriculture Development Corporation (BADC), and Bangladesh Jute Research institute (BJRI)
- *Seed Marketing and Distribution*: BADC, BJRI, Department of Agriculture Extension (DAE), Department of Jute, Ministry of Textile and Jute, BINA and Private Seed Importers.
- *Controlling Institution*: Seed certification Agency (SCA) and seed Wing of Ministry of Agriculture.

iii. Bangladesh Jute Research Institute (BJRI)

Since its inception BJRI has developed 49 varieties of jute and allied fibre crops. Of which 20 are now cultivated at farmers level. Under Agriculture Research on Jute, BJRI produces breeder seeds of released varieties to supply to BADC for their Foundation as well as certified Seed production program. Besides BJRI also produces truthfully labeled seeds (TLS) in order to supply quality jute seeds at farmers level. Seed production programme of BJRI are as follows.

Table-4: Seed production programme of BJRI during last 5 years

Year	Breeder Seed (kg)	TLS (ton)
2013-14	1216	62.675
2014-15	1017	61.827
2015-16	1485	3.203
2016-17	1815	7.678
2017-18	1672	10.365

iv. Bangladesh Institute of Nuclear Agriculture (BINA)

Using radiation techniques the institute has already developed 97 improved mutant varieties of different crops and accordingly released by the National Seed Beard (NSB) for large scale cultivation in the farmer's field. Of the 97 varieties three were of jute out of which two for fibre production and one for vegetable purposes. Besides BJRI, they are the only Institute for variety development on jute. BINA supplies about 20 kg of breeder's seed of these varieties to BADC for foundation and subsequently certified seed production.

v. Department of Agricultural Extension (DAE)

The Department of Agriculture Extension is the largest public sector extension service provider in Bangladesh. Its mission is providing needs based extension services to all categories of farmers and enabling them to optimize their use of resources in order to promote sustainable Agriculture and socioeconomic development. The core functions of DAE include increasing agricultural productivity, human resources development and technology transfer. Of different Projects of DAE "Production, Storage and Distribution of quality Rice, Wheat and Jute Seed at Farmers Level" is one of the important, projects through which quality jute seeds are produced. Jute seed production and distribution of DAE are as follows.

Table-5: Jute seed production and distribution of DAE

Year	Seed production (M.T)
2013-14	15.0
2014-15	10.0
2015-16	33.0
2016-17	26.0
2017-18	11.0

Source: DAE

vi. Department of Jute, Ministry of Textile and Jute

Due to heavy shortage of jute seed in the country intrusion of inferior quality or non certified jute seed occurs causing deterioration in the quality o jute fibre and consequently has an adverse affect on the jute product. To save the country's jute industries from unwanted critical situation, it has been strongly recommended to go for distribution of quality seeds to the jute growers. As a pilot project named "Integrated jute production and Marketing" was launched funded by EC in 1994 and continued up to 1997. From 1997 another project was launched entitled "Production and Exchange Programme of HYV Jute Seeds at Farmers" and continued up to 2002. Later on "Integrated HYV Jute and Jute Seed production" project was undertaken in order to continue the programme of supporting quality jute seed distribution to the growers. Through this project jute growers are getting input programme.

The seed production programme (last 5 years) under these projects was as follows.

Table-6: Jute seed production and distribution of MoTJ

Year	Seed Production (m. ton)
2012-13	1150.00
2013-14	1095.00
2014-15	971.19
2015-16	1016.00
2016-17	1180.48

vii. Bangladesh Agricultural Development Corporation (BADC)

It is an autonomous corporate body under the Ministry of Agriculture serves to the whole of Bangladesh and has a nationwide network of outlying field offices down to the upazila/Farm level and at some places even below that level. The primary functions of BADC are: to make suitable arrangements throughout Bangladesh for the production, procurement, transport storage and distribution of essential agricultural inputs such as seed and fertilizers through utilization of surface and underground water to the farmers. It is the largest public institution for production and distribution of jute seeds in the country. Seed production and distribution of last five years are projected below.

Table-7: Jute seed production and distribution of BADC during last 5 years

Year	Production (M.T)			Distribution (M.T)		
	Deshi	Tossa	Total	Deshi	Tossa	Total
2013-14	317.5	473.1	790.6	315.7	454.5+199.6*	969.8
2014-15	564.8	479.0	1043.8	500.9	459.8	960.7
2015-16	521.8	371.2	893.0	520.0	297.5	817.5
2016-17	470.9	363.0	833.9	368.7	341.0	709.7
2017-18	234.2	545.0	779.2	227.3	0.3	227.6

Source: BADC *Imported seed (JRO-524)

viii. Seed Wing

The seed wing is the administrative authority of the seed sector in Bangladesh. The Wing plays an important role in monitoring seed production, import, distribution and utilization. It is responsible on testing breeder seed, certified seed, seed market, monitoring including an analysis on the demand and supply of seed in Bangladesh. Jute seed import situation are as follows.

Table-8: Jute seed import situation

Year	Tossa Jute (m.ton)	Kenaf (m.ton)	Total
2017-18	4102	909	5011
2016-17	4598	1097	5695
2015-16	4005	757	4762
2014-15	3598	640	4238
2013-14	3964	928	4891
2012-13	3980	550	4530
2011-12	4361	656	5017
2010-11	3617	772	4389
2009-10	3141	186	3327

ix. Seed Certification Agency (SCA)

The SCA is a regulatory agency of the ministry of Agriculture, responsible to certify and control the quality of all agriculture seeds of the recommended varieties since its establishment in 1974, SCA has been playing a vital role in quality seed production under an expanding seed industry development program in the country. The agency certifies and maintains seed quality through Field inspection, Seed Testing and Variety Testing as per decision of the NSB and regulations provided by the National Seed policy 1993. At present there are three classes of seeds (breeder, Foundation and Certified) under the Seed certification program in our country. SCA also monitored TLS through market monitoring system.

Table-9: List of varieties of jute and allied crops of Bangladesh

Sl No	Varieties	Released year	Pedigree
White jute (*C. capsularis* L.)			
1.	Oocarpus	1910	PLS
2.	Kakya Bombai	1910	PLS
3.	R-85	1916	PLS
4.	D-154	1919	PLS
5.	D-386	1931	PLS
6.	Funduk	1939	PLS
7.	C-212	1939	PLS
8.	C-13	1941	PLS
9.	C-412	1942	PLS
10.	C-1	1952	PLS
11.	C-2	1952	PLS
12.	C-3	1952	PLS
13.	C-4 (C-320)	1955	PLS
14.	C-5 (C-321)	1955	PLS
15.	D-154-2	1961	PLS
16.	C-6 (C-322)	1967	PLS
17.	CVL-1	1977	PLS
18.	CVE-3	1977	PLS
19.	CC-45	1979	PLS
20.	BJRI Deshi Pat-5 (BJC-7370)	1995	D-154 x CC-45
21.	BJRI Deshi Pat-6 (BJC-83)	1995	CVL-1 x Fuleshwari
22.	BJRI Deshi Pat-7 (BJC-2142)	2008	CC-45 x BJC-718
23.	BJRI Deshi Pat-8 (BJC-2197)	2013	CC-45 x FDR
24.	BJRI Deshi Pat Shak-1 (BJC-390)	2014	Cap dwarf red x BINA Pat Shak-1
25.	BJRI Deshi Pat-9 (BJC-5003)	2017	CVL-1 x Acc.1831
Tossa jute (C. olotorius L.)			
26.	Chinsura green (D-38)	1915	PLS
27.	R-26	1929	PLS
28.	R-27	1929	PLS
29.	O-620	1939	PLS
30.	O-632	1939	PLS
31.	O-753	1939	PLS
32.	O-1	1955	PLS
33.	O-2	1955	PLS
34.	O-3	1955	PLS
35.	O-4	1967	PLS
36.	O-5	1964	PLS
37.	O-9897	1987	O-5 x BZ-5
38.	OM-1	1995	PLS
39.	BJRI Tossa Pat-4 (O-72)	2002	O-9897 x O-2021 x O-9897
40.	BJRI Tossa Pat-5 (O-795)	2008	O-4 x Uganda Red
41.	BJRI Tossa Pat-6 (O-3820)	2013	PLS
42.	BJRI Tossa Pat-7 (MG-10)	2017	PLS

Source: Islam [7].

Table-10: Variety wise Breeder seed distribution to BADC and private seed companies in last 5 years

Name of varieties	2013-14	2014-15	2015-16	2016-17	2017-18
Deshi pat					
CVL-1	180.00	219.00	219.00	232.50	232.50
BJRI Deshi Pat -5 (BJC-7370)	12.00	21.00	21.00	27.00	12.00
BJRI Deshi Pat Sak-1	-	-	-	3.00	3.00
Sub -total	192.00	240.00	240.00	262.50	247.50
Tossa pat					
O-9897	350.00	365.00	531.00	509.34	266.25
BJRI Tossa Pat-4 (O-72)	12.00	23.00	28.00	25.83	13.18
BJRI Tossa Pat-5 (O-795)	12.00	19.00	14.00	42.92	-
BJRI Tossa Pat-6 (O-3820)	-	-	-	2.33	2.32
Sub -total	374.00	407.00	573.00	580.42	281.75
Kenaf					
HC-95	5.00	25.00	25.00	325	140.00
Total amount of seed (kg)	571.00	672.00	838.00	1167.92	669.25

STRATEGIES OF POPULARIZATION NEW VARIETIES AND TECHNOLOGIES

i. Supply of quality jute seed in time at doorstep of farmers

Due to short span of sowing time for jute, it is necessary to supply the jute seed well ahead of sowing time to the doorstep of farmers. Supply of jute seed should be distributed on the basis of demand and sowing time of the zone (early, late). Besides, jute seed marketing of public organizations need to be strengthened/modernized/competitive as well as private sectors need to be encouraged to produce seed in the country.

ii. Development of High Yielding Varieties (HYV) of jute

A single variety of tossa jute is mostly cultivated (80% of world jute area) over the jute growing areas of India and Bangladesh which is not desirable. Though productivity of jute has been increased to some extent but lot more need to be addressed to minimize cost of production with quality fiber and to withstand the competition thrown by cheaper synthetic fibers. Moreover, cultivation of jute is increasingly shifting to less productive land, thus creating challenges in dealing with new emerging production constraints. As an eco-friendly crop the demand of jute is increasing day by day. To meet up this demand variety development program should be strengthened to evolve HYV, having drought/flood/salinity tolerance and early maturity.

iii. Judicious import of jute seed

Different public organizations in Bangladesh are producing and distributing jute seed. Import quantity of jute seed is to be determined by considering the carryover seed and the production and marketing of the existing organizations on the corresponding year. It may be mentioned here that, to reduce the dependency on imported seed, gradual increase in seed production and distribution of public sector is necessary.

iv. Extension services need to be strengthened

Extension machinery needs to be activated for popularization of different varieties along with their potentialities. This will minimize the risk of dependence on single variety as well as will increase the production and productivity of jute through exploitation of newly developed varieties. It is noticed that even the results of research and development so far achieved have not been fully utilized for want of adequate extension facilities. This situation needs to be corrected by strengthening jute-specific extension services. Besides, BJRI developed "jute seed production technology" as well as "Nijer beez nije kori" programme should be disseminated with immediate priority.

v. Identification of new areas for production of jute seeds

Exclusive dependence on a few conventional jute seed production areas may affect the entire jute production in case of any large scale damage. Besides, developments of HYV of jute, identification of ideal seed production zones nearer to the marketing areas deserve much attention. If the jute growing areas produce at least some quantity of jute seed in the identified areas of their own, farmers may be benefited by availing the seed at an appropriate time and a moderate price.

vi. Kenaf-Mesta seed production and distribution should be undertaken by Public sectors

Kenaf varieties released by CRIJAF (India) are having the yield potentialities of 2.7-3.0 q/ha, whereas our farmers are getting 1.5-1.6 ton/ha. One of the major reasons for this yield gap is non-availability of seeds of improved varieties to the farmers. The kenaf production of Bangladesh is entirely dependent on Indian seeds. Organized/certified system of production of mesta-kenaf seed has to be taken up and this needs immediate attention.

vii. Following of seed multiplication chain in the production system of jute and kenaf-mesta seeds

After formal release and notification of a variety, the process of seed production and distribution is followed. Breeder, Foundation and Certified seed production is done for all notified varieties of jute in order to get quality seeds. The regeneration process from breeder to certified seed stage takes three years in jute and kenaf. This production cycle has to be ensured specially in India from where seeds are producing and distributing.

viii. Strengthening of monitoring system of Seed certification agency (SCA) of Bangladesh

Due to huge demand of jute seed, sometimes dishonest traders are taking the opportunity of introducing poor quality seeds in the market. They are mixing the new seed with old seed. India is the producer of 80% of jute seed of the world. In India only 30% seeds of the requirement is producing under public sector, the rests are under private sectors. Certification of kenaf seed in India is very limited. But the imported all kenaf seeds in Bangladesh are certified. In this context, certified seed production of jute and kenaf has to be increased and to be made available in time, and in adequate quantity at reasonable price.

ix. Buffer stock of jute and kenaf seeds

Natural calamities are a common phenomenon in Bangladesh. Excessive and continuous dependence on a few major production areas may affect seed availability and jute production due to any unforeseen large-scale damage. A conditioned seed storage facility with capacity of at least 25% of the requirement in jute growing areas is necessary.

x. R and D activities for alternate uses of jute and mesta-kenaf seeds along with their biomass

Jute and kenaf-mesta seeds' have no alternated uses other than as propagating materials. On the other hand reasonable quantities of these seeds remain unsold every year. Through value addition jute and mesta seeds may be marketed as important commodity other than propagating materials. Jute and mesta-kenaf seeds are reasonably rich in oil content and these oils may be used industrially. Profitable utilization of left over biomass especially fibrous stems of jute seed crops may be explored. Research interventions may yield useful result.

JUTE SEED PRODUCTION

Quality seed is the prerequisite to successful crop production. Yield of jute can be increased by 15-20% through good quality seeds alone. Generally jute seed crop is raised in two different methods. 1) Traditional method and 2) Improved method.

Methods of jute seed production

A portion of the fibre crop is kept at a corner of the main field for seed harvest. In traditional method, the most important intercultural operation was to rogue out off-type variety, diseased and insect infested plants. Other cultural operations are same as that followed in fibre crops. However, seed yield and quality were found to be very low in this method. On the contrary improved was found to be appropriate technology of jute seed production under varied conditions as it could be practiced through late planting to avoid flooding during monsoon as well as precipitation during seed maturation. Crop grown under improved method could also be harvested in dry months ensuring the high seed quality. In improved method, jute seed could be produced through three different methods i.e. i) Direct seeding method, ii) Stem/top cutting method and iii) Seedling transplanting method.

Direct seeding method

Studies revealed that the direct seeding method was observed to be the easiest and most profitable among the three methods of jute seed production technology. In this method seeds needed to be sown in July-August on medium high to high land with well drained soil where rain water or flood water did not accumulate or inundated the seed crop. The appropriate soil texture were sandy loam with pH value ranging 5.5-6.0 and the soil rich with organic matter was reported suitable for direct seeded jute seed crop. Cleaning weeds during land preparation was found to be effective to keep the land being less infested with more weeds during the subsequent period. Seeds sown on mid July to mid September were found to be productive. However, tossa jute seeds could be sown up to the last week of September.

Studies on seed rate showed that the rate depended on the soil condition, species and planting methods. In case of Deshi jute under line sowing it raged 4.0-4.5 while under broadcast sowing 5.0-5.5 kg/ha. But in case of Tossa jute under line sowing 3.0-3.5 and broadcast sowing 4.0-4.5 were found to be optimum. Treatment of 1 kg of jute seed with 4-5 gm of Provex-200 for 10 minutes in a tin/plastic pot prevent jute plants from soil pests.

Top/Stem cutting method

Top/Stem cuttings were to be transplanted during July-August, where strong and healthy stems, preferably of 120 days old were proved to be best. The optimum length of each cutting ranged 20-25 cm having 2-3 nodes which needed to plant in line with a spacing of 30 cm between the lines and 10 cm between the transplanted cuttings maintaining 5 cm depth at 45^0 angles inclined towards north-south direction.

Seedling transplanting method

On seedling transplanting method, sowing 50-100 gm seeds in a seed bed measuring 3m×1m using 50-100 g seed within mid July to mid August were proved to produce vigorous seedlings. 25-30 days old seedlings transplanted from mid August to last week of September in lines with a spacing of 30×10 cm and fertilizer with 60 Kg/ha Urea, 50 Kg/ha TSP, 20 Kg/ha

MP and 50 Kg/ha Gypsum were found to be produced higher seed yield. Besides this, two splits of urea for top dress in first split (60 Kg/ha) on 30-35 days after transplanting and second split (60 Kg/ha) before flowering were needed.

Studies on jute seed crop harvest data suggested being between mid-October to mid-December when 60-70% capsules/fruit of deshi jute became brown in color. However, in case of O-9897 the optimum harvest time was identified when 80% fruits turned brown in colour. Over maturity mainly in *C. olitorius* L. promoted shattering. Moist plant due to rain should be avoided for harvesting.

Traditional method

In traditional method the seed crop yielded about 150 to 250 kg/ha of seed. However, in improved direct seeding method it was observed to yielded 600 to 1000 kg/ha. Seed yield of 600 to 900 and 600 to 800 kg/ha were obtained in top/stem cutting and seedling transplanting method, respectively.

Studies revealed that the sowing time was very early in conventional and very late in improved method. Seed rate was recorded very high in conventional, on the other hand, in improved method the rate was very low and other types. A wide field duration of about 240 days was required in conventional, while in improved it was to be as low as 120 days (Table-12). As usually the pest and disease infestation was also found very high in conventional, but in improved method it was recorded to be very low among the seed production methods. In terms of survivability it was observed that probability was higher in direct seeding method, while medium in traditional and seedling transplanting methods (Table-12).

Table-12: Agronomic suitability of different methods of jute seed production

Agronomic parameters	Traditional method	Direct seeding	Top / stem cutting method	Transplanting Method
Land requirements	Land with fine tillage	Land with fine tillage	Land with fine tillage having available moisture	Land with fine tillage having high moisture
Optimum sowing time	April to May	Mid August to 1st week of September	Throughout the July	Mid August to September
Optimum seed rate	6-8 Kg/ ha	4-5 Kg/ha	It requires mother plants to collect top/stems	50-100 gm seed for a seed bed of (3x1)m^2 area
Field duration	About 240 days	About 120days	About 135 days	*About* 150 days
Infestation of pests and diseases	Very high	Very low	Very low	Low
Survivability	Medium	Higher	High	Medium

Source: Islam [7]

C. capsularis L. fruits

C. olitorius L. fruits

Response studies of *C. capsularis* L. in terms of pod/plant, seed pod, seed wt/ plant and 1000-seeds weight towards different seed production methods were also made. Results revealed that direct seeding was found to be superior over all other methods (Table-13). The highest seed yield (500-700 kg/ha) was recorded in direct seeding. In contrast the lowest (200-300 kg/ha) in conventional method of seed production (Table-13). Similar results were also observed in seed yield attributes of *C. olitorius* L. where the improved method, seed yield, were recorded to be as high as about 600-1000 kg/ha. Whereas, in conventional it was the lowest (150-250 kg/ha) (Table-14).

Table-13: Jute seed yield and yield attributing characters of *C. capsularis* L. under different production methods

Production methods	Branch /plant	Pod /plant	Seed /pod	Seed weight /plant (g)	1000 seed weight (g)	Seed yield (kg/ha)
Conventional	3-4	10-15	20-25	2.50-2.70	2.50-2.99	200-300
Improved method						
• Direct seeding	3-4	30-45	35-50	3.75-4.50	2.85-3.24	500-700
• Top/stem cutting transplantation		-	-	-	-	-
• Seedling transplantation	3-4	25-30	30-40	3.25-4.00	2.50-3.00	400-600

Source: Islam [7].

Table-14: Jute seed yield and yield attributing characters of *Corchorus olitorius* L. under different production methods

Production methods	Branch /plant	Pod /plant	Seed /pod	Seed weight /plant (g)	1000 seed weight (g)	Seed yield (kg/ha)
Conventional	4-5	20-25	50-120	3.00-3.15	1.80-2.00	150-250
Improved method						
• Direct seeding	4-5	45-50	150-220	3.40-3.70	2.00-2.35	600-1000
• Top/stem cutting transplantation	3-5	50-60	170-230	3.45-3.75	2.00-2.35	600-900
• Seedling transplantation	3-4	45-55	160-220	3.35-3.65	2.00-2.35	600-800

Source: Islam [7].

Different parameters in jute seed production

Average days to flowering

The attainment of average flowering ranged from first week of September in sowing from May15 to July15 in *C. capsularis* L., (D-154 and CVL-1). In September30 sowing in *C. capsularis* L., the average flowering ranged from first week of November. In *C. olitorius* L., (O-9897) it ranged from first week of September in sowing from May15 to June30 and in mid November in sowing of September30. It extended in O-4 up to last week of November in September30 sowing. In *C. capsularis* L. the average flowering days, pod maturation days and total field duration varied significantly due to planting dates. May15 and May30 sowing took longer period of 113 to 108.5 days, respectively for attainment of average flowering. It decreased gradually in latter dates of sowing. It was 44.5 days in September 15 sowing. In *C. olitorius* L. the

average flowering days, pod maturation days and total field duration also varied significantly due to the planting dates. The average flowering days consistently decreased from May15 sowing (123.5 days) to September 30 (41 days) in O-4 and O-9897.

Pod maturation

Pod maturation in all experimental materials was attained within 50 to 67 days. It was shorter in July **to August sowing. But longer in earlier and latter planting as compared to July and August sowing. In *C. capsularis* L. pod maturation days gradually decreased from May15 to September30. The duration was 65.5 days in May15 sowing and 60 days in September 30 sowing. In *C. olitorius* L. pod maturation days also decreased consistently from May15 to July15 and it increased from July 30 to September 30 sowing. Field duration also showed a consistent decrease from May15 to September 30.**

Seed washing and drying

Field duration

Field duration ranged from first week of November to first week of January in D-154, CVL-1 and O-9897. Whereas it ranged from first week of November to last week of December in O-4. May15 to July15 sowing required more than 6 to 8 months field duration in D-154, CVL-1 and O-4. July30 to September30 sowing required less than 4 months of field duration in D-154, CVL-1 and O-4. *C. olitorius* L. O-9897 required 5.6 months to 4 months field duration in May15 sowing through August30 sowing. It was less than 4 months in two September sowings. The days from sowing to flowering, sowing to pod maturation and sowing to harvest were counted and expressed in calendar days. In *C. capsularis* L. field duration decreased gradually from May15 to August30 sowing whereas, increased in September15 to September30 sowing. It was 178 days in May15, 102.5 days in August30 and 106.5 days in September30 sowing. In *C. olitorius* L. the field duration ranged from 103-201 days in O-9897 and from 93-182 days in O-4 from May15 to September 30 sowing. The marked difference in total field duration between O-9897 and O-4 supports the earlier report that O-9897 was less photosensitive (Figure 1, 2 & 3) [5].

Being less photosensitive O-9897 took longer field duration to get the pod matured than the D-154, CVL-1 and O-4. It may be postulated that the late varieties started flowering at day length of 12.30 hours. This might have happened due to decrease in sunshine hours from June to September (5.0 to 5.9 hours). The variety O-9897 responded to a low temperature, shorter sunshine hours and day length below 12 hours. Kar [14] indicated that a critical day length for both jute was 12 hours and suggested that low temperatures hastened the photoperiodic effect in *C. olitorius* L. and delayed the reproductive phase in *C. capsularis* L. He also reported days to flowering of both jute to be progressively shortened with the delayed planting from April to October. Plant height also decreased significantly in all the jute varieties from May15 to September30 sowing. It was taller in May15 and shorter in September30 sowing. *C. olitorius* L. attained higher plant height than *C. capsularis* L. [15, 16].

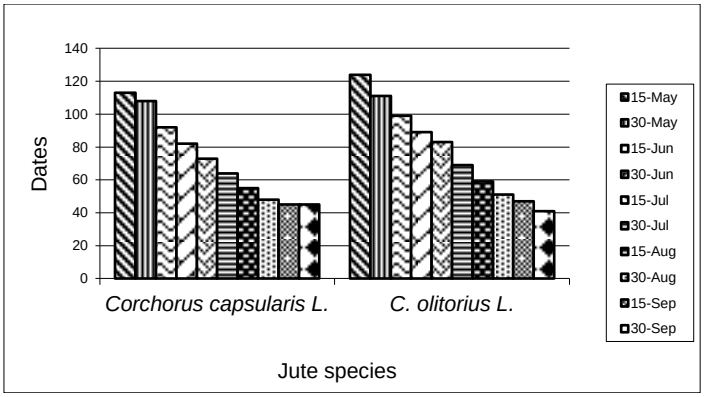

Fig-1: Average days to flowering of jute seed plants as affected by different dates of sowing
(Source: Islam [7])

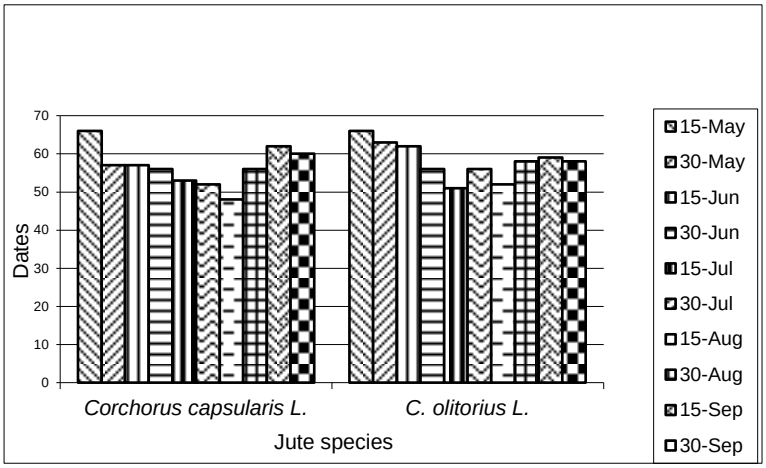

Fig-2: Days to pod maturation of jute seed plants as affected by different dates of sowing
(Source: Islam [7])

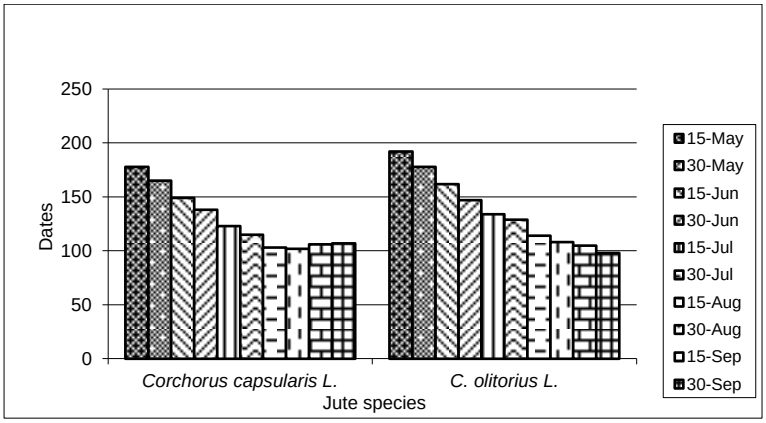

Fig-3: Field duration for jute seed production as affected by different dates of sowing
(Source: Islam [7])

C. olitorius L. and *C. capsularis* L. seeds and fruits

SEED TECHNOLOGY

i. Appropriate time of jute seed crop harvest

The crop becomes ready to harvest between mid October-mid December when 60-70% capsules become brown in color. This is the optimum time of harvesting the crop. Over maturity mainly in *C. olitonius* L. promotes shattering. Wetted plant due to rain should be avoided to harvest. Jute seeds are to be harvested in sunny day so that it can be dried immediately after harvest. It is also found that harvesting jute seed in sunny days before noon. As some fruits are burst due to over maturity and these fruits receive moisture from night dews and seeds get wet. If these seeds are harvested at an early hour before drying of seeds, this moisture certainly affects seed quality [9].

ii. Physiological maturity of jute seed

Maturity of a seed at the time of harvest is one of the important factor that contribute to quality seed production. The harvest stage of 194 days in *C. capsularis* L. and 178 days in *C. oitorius* L. coincide with 60% browning of fruits in *C. capsularis* L. and 70% browning of fruits in *C. olitoriu* L. Such stage of fruit browning confirm to physiological maturity i.e. optimum germinability, lowest moisture content, optimum seed dry weight for both the species and at the same time it appears maximum fruit bearing and highest seed yield. Seed should be collected at harvest stage of 194 and 178 days which coincide with 60% and 70% browning of fruits for *C. capsularis* L. and *C. olitorius* L., respectively [9]. Seed crop will be harvest when physiological maturity will come up.

iii. Suitable floor for jute seed drying at farmers level

Initial seed moisture content plays a vital role in the maintenance of seed quality in storage. The effect of floor types on the reduction of moisture during seed drying is very important. Seed drying on gunny bag or sacking was found very effective to reduce seed moisture without any damage of its embryo. Seeds will be dried just after harvest on gunny bag or sacking [9]. Gunny bag or sacking is more suitable for seed drying at farmers level then those of polythene sheet, cowdung plated floor and cemented floor.

iv. Easy viability test of jute seed at farm level

We know quality seed increase the production about 15 to 20 percent. We are facing the scares of quality seed at the sowing time of every crop in every year in our country. So is very important to test the viability of jute seed for quality before sowing. It is very easy and cost effective to test the viability of jute, kenaf or mesta seeds. Firstly one hundred seeds with four replications will be evenly distributed on the top of four bloating papers or news paper or old cloths placed in four soil made plates. The seeds and bloating or news paper or old clothes are kept moist through out the test period by adding water. Seeds that germinated will be counted and recorded daily till fifth day. A seed will be considered to be germinated as seed coat ruptured and radicle come out up to 0.2 cm or more length. Germination test will be carried out in room temperature. Above 80% of germinated seeds are considered as good quality seed. However below 70% viability are considered as bad as not to sow in the field for production purpose [9].

v. Seed treatment method of jute seed at farm level

In jute field the incidence of many diseases are found to occur from seedling stage to late stages. These are seedling die, seedling wilt, stem rot, black band, anthracnose and yellow mosaic. Any severe incidence may affect yield by 50%. As we all know prevention is better than cure. For this purpose, we can treat seeds before sowing. Seeds should be treated before sowing to prevent seed and soil born diseases and insect- pests infestations. For this, 1 kg of jute seed is to be treated mixing with 4-5 gm of Vitavex-200 for 10 minutes in a soil pot [9].

vi. Jute seed storage at small farm Level

Jute seeds are very delicate and it is slightly difficult to maintain its viability in storage condition. Before storing seed, it must be dried through 6-7 sundry. The dried seed then is stored in airtight tin or

plastic container. The sealed lamofoil is the best of all. If the quantity is more, it can be stored in airtight drum. Seeds will be dried through 6-7 sun dry, and then dried seed must be stored in air tight tin or plastic container or sealed lamofoil. If the quantity is more, airtight drum may be used for storing [9]. Sealed lamofoil is the best for seed storing followed by airtight plastic container, tin can and drum.

Cost of production per hectare of jute seed

Real differences were recorded in terms of comparative cost of production per hectare of jute seed production in direct seeding, top cutting and seedling transplanting methods. Results revealed that the highest variable cost was found in seedling transplanting (Tk. 84400/-) and the lowest (Tk. 75400/-) in direct seeding method of seed production (Table-15). Similar and higher gross return of Tk. 100000/- were observed in top cutting and direct seeding, however lower of Tk. 90000/- in seedling transplanting methods. The highest net return of Tk. 19600/- (BCR=1.25) obtained by calculating the data recorded from the method of direct seeding and the lowest in seedling transplanting (Tk. 5600/-, BCR=1.07) (Table-15) [5, 6].

Table-15: Comparative cost of seed production (Tk/ha) of jute in direct seeding, top cutting and seedling transplanting methods

Different operations	Unit cost	Direct seeding		Top/stem cutting		Seedling transplanting	
		No. of labour/ Amount required	Total cost	No. of labour/ amount required	Total cost	No. of labour/ amount required	Total cost
Land preparation (Ploughing and laddering)	450/-	25person	11250/-	25person	11250/-	25 person	11250/-
Seed	150/-	6 kg	900/-	-	-	3 kg	450/-
Seed sowing	450/-	4 person	1800/-	-	-	-	
Seed bed preparation	450/-	-	-	-	-	5 person	2250/-
Seedling uprooted & transplanting	-	-	-	-	-	20 person	9000/-
Plant cut from mother plant	450/-	-	-	5 person	2250/-	-	-
Cutting making & transplanting	-	-	-	25person	11250/-	-	-
Fertilizer	-	-	-	-	-	-	-
Urea	25/-	180 kg	4500/-	180 kg	4500/-	180 kg	4500/-
TSP	20/-	50 kg	1000/-	50 kg	1000/-	50 kg	1000/-
MP	30/-	20 kg	600/-	20 kg	600/-	20 kg	600/-
Other fertilizers (Gypsum)	10/-	50 kg	500/-	50 kg	500/-	50 kg	500/-
Fertilizer and manuring	450/-	3 person	1350/-	3 person	1350/-	3 person	1350/-
Intercultural operations (Weeding & thinning)	450/-	40person	18000/-	40person	18000/-	40person	18000/-
Fruit harvest & carrying	450/-	25person	11250/-	25person	11250/-	25person	11250/-
Seed processing	450/-	35person	15250/-	35person	15250/-	35person	15250/-
Seed drying & storing	450/-	20person	9000/-	20person	9000/-	20person	9000/-
Total no. of Labour (Person)	-	157	-	183	-	173	-
Total variable cost	-	-	75400/-	-	86200/-	-	84400/-
Seed yield (kg/ha)	-	-	450	-	500	-	450
By product yield (kg/ha)	-	-	5500	-	5000	-	4500
Gross Return (Tk)	-	-	95000/-	-	100000/-	-	90000/-
Sale price (Tk) Product/Byproduct	-	-	150/5(Tk/kg)	-	150/5(Tk/kg)	-	150/5(Tk/kg)
Net Return (Tk)	-	-	19600/-	-	13800/-	-	5600/-
BCR (%)	-	-	1.25	-	1.16	-	1.07

Source: Islam [7]

CONSTRAINTS

With limited resources the agriculture research of BJRI has many successes. In spite of its success BJRI has some constraints for producing quality jute and kenaf seed.

- Manpower shortage in seed management and research.
- Lands of different stations of BJRI are not suitable for seed production specially tossa jute.
- Lack of modern laboratory facilities in different regional and sub-stations.
- Storage facilities are very poor in different regional and sub-stations of BJRI.
- Inadequate training facilities.
- Unauthorized institution of inferior quality seeds from neighboring country.
- Sometimes traders take illegal opportunity due to high demand of jute seed in the market.

FUTURE RESEARCH THRUST

Bangladesh jute research institute is trying to meet up the national requirement of jute seed by producing breeder seed, Truthfully Labeled Seed (TLS) and technology transfer at farmers as well as different seed producing organizations. There are some future thrust of BJRI is given below:

- Development of HYV jute and kenaf.
- Development of short day and stress tolerant varieties.
- To meet up the seed shortage in Bangladesh identification of suitable seed growing areas.
- Seed production research in nontraditional areas.
- Location specific seed production technologies research.
- Alternate uses of jute seed.
- Fibre extraction from late jute seed plants.

CONCLUSION AND RECOMMENDATIONS

Bangladesh produces world's best quality jute. The agriculture climate of Bangladesh is very much suitable for quality fibre production. As a result supply of quality jute seed will ensure the fibre quality as well as quantity to a great extent. The government of Bangladesh has given more thrust to promote the jute seed industry by strengthening public sectors dealing with jute seed and also by sensitizing private sectors to reduce the dependence on imported jute seed. The activities of private sectors regarding jute seed are limited on seed import only. Bangladesh and India jointly produced 92% of total raw jute of the world and Bangladesh exports about 90% raw jute and 70% jute products in the world market. The major portion of the jute seed requirement of Bangladesh is meeting up through import from India. It was also observed that some of the introduced seed lots do not have the desired quality as required. Due to heavy demand of jute seed sometimes few unauthorized traders are taking the opportunity of introducing poor quality seeds in our country. From the above review, it may be concluded that among three improved methods of seed production, stem/top cutting and the seedling transplanting methods were found relatively complex, labour intensive and costly. On the other hand, direct seeding method was observed easier and less costly. The average flowering days, pod maturation days and total field duration also varied significantly due to the planting dates in *C. olitorius* L. and *C. capsularis* L. Pest and diseases infestation found higher in traditional method for its long field duration. Lower infestation was observed in improved method as this was practiced in dry and comparatively cool season. Net return as well as BCR was found to be higher in improved direct seeding method (1.25%), which was then followed by top/stem cutting (1.16%) and seedling transplanting method (1.07%). Therefore, it could be recommended that at farm level, the direct seeding method showed safer and appropriate for jute seed production in Bangladesh. On the other hand a strong and active coordination among public and private jute seed sectors of the country is necessary for a sound supply of quality jute seed in Bangladesh. An appropriate policy in this respect can mitigate the jute seed problem of the country.

REFERENCES

1. BBS. (2015). Yearbook of Agricultural Statistics of Bangladesh. Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh.
2. Ali, M. K. (1964). Pat-0-Patchash (in Bengali) East Pakistan Government Press, Dhaka. 14.
3. De, R. N. (1995). Jute and the Environment. International jute Organization, Banani, Dhaka, Bangladesh.
4. Husain, M. (1977). Studies on the effect of short day length of flower induction of some selected cultivars of jute. *Bangladesh J. Jute Fib. Res*, *2*(1), 73-77.
5. Johansen, C., Waseque, M., & Begum, S. (1985). Effect and interaction of photoperiod, temperature, water stress and nitrogen on flowering and growth in jute. *Field Crops Research*, *12*, 397-406.
6. Hossain, M. A., Haque, S., Sultana, K. S., Islam, M. M., & Khandakar, A. L. (1994). Research on late jute seed production. *Pub. Seed. Tech. Res. Bangladesh Jute Res. Inst., Dhaka*, 176-178.
7. Islam, M. M. (2009). Jute Seed Technology, Pub. M. Mahmudul Islam. 379, Middle Monipur, Mirpur, Dhaka-1207. Bangladesh. 165
8. Islam, M. M. (2010). Technological advances in off-season jute seed production. *J. Expt. Biosci*, *1*(1), 75-82.
9. Islam, M. M., & Rahman, M. M. (2008). Hand book on agricultural technologies of Jute, Kenaf and Mesta crops. *Bangladesh Jute Research Institute (BJRI). Dhaka*, *2*.

10. Khan, M. A., Samad, M. A., Hossain, M. A., Islam, M. M., & Rabbany, G. (1997). Effect of sowing date and variety on olitorius jute seed production. *Bangladesh J. Jute and Fib. Res*, *22*(1&2), 19-25.
11. Choudhuri, S. D., & Ali, M. K. (1963). Pat beezer utpadan-o-bister (a Bengali Booklet). East Pakistan Govt. Press, Dhaka.
12. Chang, H. S. (1960). Jute improvement in Taiwan. *Field Crop Abst*. 13(4): 300.
13. Kirby, R. H. (1963). Vegetable Fibres. First ed. Leonard Hill Pub., London. 62-100.
14. Kar, B. K. (1962). Investigation on the physiology of jute, Part VI. Assessment of flowering behaviour in different varieties of *Corchorus capsularis* L. and *Corchorus olitorius* L. *Proc., Nat. Inst. Sci., Ind.* part B. 28(1): 49-76.
15. Roy, B. (1968). Correlation between plant height and flowering time in jute (*Corchorus olitorius* L.). *Indian Agric.* 10(1): 59-63.
16. Mian, A. L., & Gani, M. O. (1971). Effect of time of planting on the yield of jute seed. *Indian Journal Agr Sci*, 41(11): 938-943.