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Competitive Research Grant

Sub-Project Completion Report

on

Enhancement of Productivity of Kenaf in Char Areas

Project Duration

May 2017 to September 2018

Bangladesh Jute Research Institute
Regional Station, Rangpur

Submitted to
Project Implementation Unit-BARC, NATP 2
Bangladesh Agricultural Research Council
Farmgate, Dhaka-1215

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Acronyms

AA	:	Accelerated ageing
AEZ	:	Agro-ecological zone
BADC	:	Bangladesh Agricultural Development corporationl
BARC	:	Bangladesh Agricultural Research Council
BARI	:	Bangladesh Agricultural Research Institute
BBS	:	Bangladesh Bureau of Statistics
BCR	:	Benefit cost ratio
BJRI	:	Bangladesh Jute Research Institute
BRRI	:	Bangladesh Rice Research Institute
CP	:	Cropping pattern
DAE	:	Department of Agriculture Extension
DAS	:	Days after sowing
FP		Farmers practice
GM	:	Gross margin
GR	:	Gross return
MBCR		Marginal benefit cost ratio
NGO	:	Non government organization
NATP	:	National Agricultural Technology Program
RH	:	Relative humidity
RCBD	:	Randomized complete block design
SRDI	:	Soil Resource Development Institute
TVC	:	Total variable cost
UAO	:	Upazila Agriculture Officer

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Executive Summary

Kenaf can be grown in char areas competently by minimal cultural management with less labour and lower cost compare to jute. This creats opportunity to enhance kenaf productivity by introducing kenaf either in fallow land or replacing jute in char areas of Bangladesh. Therefore the present study was conducted at two selected char areas namely Char Bazra under Ulipur upazila of Kurigram district and Razar Char under Sundarganj upazila of Gaibandha district involving 20 farmers selecting 10 from each location. The study comprised of varietal trail, cropping pattern trail, seed production potential and method of threshing and drying of kenaf seed. In first experiment, five kenaf varieties viz. HC-2, HC-95, BJRI kenaf-3, BJRI kenaf-4 and local were tested in farmers' field where significant yield difference was observed among the varieties over the locations. The highest fibre and stick yield were recorded as 3.90 and 8.24 tha^{-1} in BJRI kenaf 3 at all the locations. In cropping pattern testing, alternative cropping pattern potato-kenaf-T. aman was designed and tested against traditional cropping pattern potato-jute-T.aman in both the locations. In alternate cropping pattern yield of Kenaf was 3.52 and 3.42 t ha^{-1} at Kurigram and Gaibandha, respectively, whereas in existing pattern yield of Jute was 2.35 and 2.55 t ha^{-1} at Kurigram and Gaibandha, respectively. In terms of economic performance, kenaf obtained higher benefit cost ratio 1.99 at Kurigram and 1.98 at Gaibandha in alternate cropping pattern which were higher in compare to jute of farmers' cropping pattern. Benefit cost ratio of jute was 1.40 at Kurigram and 1.60 at Gaibandha.

Seed production potential of five kenaf varieties (HC-2, HC-95, BJRI kenaf-3, BJRI kenaf-4, local) was evaluated in late season condition. Significant difference was observed among the varieties in relation to seed production potential. The highest seed yield was recorded in BJRI kenaf 3 which was 1029 kg at Kurigram and 1043 kgha-1 at Gaibandha district. Another experiment, yield and seed quality was assessed by drying period of harvested plant and method of threshing of kenaf seed. Three drying period of harvested plant (threshing without drying of harvested plant, threshing after 7 days drying of harvested plant, threshing after 14 days drying of harvested plant) and two method of threshing (traditional method of threshing, mechanical method of threshing) were used as experimental variables. The highest kenaf seed was obtained from mechanical method of threshing in all the drying period with minimum time required for threshing. Irrespective of threshing method, the best quality seed was obtained by threshing without drying of harvested kenaf plant.

CRG Sub-Project Completion Report (PCR)

A. Sub-project Description

1. Title of the CRG sub-project: **Enhancement of Productivity of Kenaf in Char Areas**
2. Implementing organization: Bangladesh Jute Research Institute
3. Name and full address with phone, cell and E-mail of PI/Co-PI (s):

Principal Investigator: Dr. Md. Abul Fazal Mollah

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Principal Scientific Officer
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Bangladesh Jute research Institute, Dhaka-1207
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4. Sub-project budget (Tk):

   4.1 Total : Tk.15,56,000 (Fifteen Lac and fifty six thousand Taka only)

   4.2 Revised (if any):

5. Duration of the sub-project:

   5.1 Start date (based on LoA signed): 11 May 2017

   5.2 End date: 30 September 2018

6. Justification of undertaking the sub-project: Kenaf is a commercially important fiber crop next to cotton and jute. Kenaf accounts for about 10 percent of total raw fibre production in Bangladesh (Deb and Bairagi, 2008). In Bangladesh, around 0.04 million hectares of land is now devoted to kenaf cultivation producing 0.08 – 0.09 million tons per annum with an average yields of 2.0 - 2.5 t ha^{-1} (Mostofa, 2012). Kenaf can be grown in the char lands more profitability with minimum care than jute. Hiron *et al*. (2006) stated that kenaf can give high yield even in the marginal, fallow and char lands with less care. In char land, kenaf cultivation is profitable than jute because it can be produced at minimal management practices with less labour and lower cost. The prices of jute and kenaf fibres are almost same, and as a consequence, kenaf can replace jute in the char areas very easily.

Different kinds of products can be derived from kenaf. According to Sinha and Day (2008), kenaf has the capacity to produce huge amount of biomass, eventually bio-fuel, and it is considered as the main renewable source of raw materials for paper pulp production in many countries. It also functions as an industrial material for making bags, towels, jeans, fabric, computer parts, carpets, plane parts, geo-textile, non oven neat, and furniture which makes its potential value higher (Abbas Ali and Islam, 2006). Moreover, its dried stick is used in fencing and as house construction materials either directly or with mill processed hardboard, and climbing sticks of betel leaf and some vegetable crops, cattle shed and other domestic purposes. Kenaf seed oil is consumed as cooking oil, salad oil, margarine, lubricant, as well as input in production of soap, linoleum, paints and varnishes (Duke, 2003). The commercial success of kenaf has important potential economic and environmental benefits in the areas of soil remediation, toxic waste cleanup, removal of oil spills on water, reduced chemical and energy use for paper production, greater recycled paper quality, reduced soil erosion due to wind and water, replacement or reduced use of fibre glass in industrial products, and the increased use of recycled plastics (Webber and Bledsoe, 2002). In terms of environmental impact, kenaf can absorb CO_2 and NO_2 3-5 times faster than forests, and its deep roots can improve the soil. It can clean the environment efficiently (Lam, 2000). Therefore, kenaf cultivation should be expanded for better utilization of the char lands of the country and also to achieve more economic and environmental benefits.

Sandy medium high to low land is not suitable for jute production because stem rot, die back and other similar diseases occurs severely in jute field in those field conditions. Whereas kenaf can be grown easily this type of land because kenaf is resistance to such type of diseases. A vast area of char lands present in northern different districts like Kurigram and Gaibandha which are remain fallow during jute growing season. Farmers cannot grow jute due to infection of different diseases. They can cultivate easily kenaf as alternate of jute crop. By introducing kenaf in char land, farmers can utilize their fallow land to increase fibre production and economic return.

In Kurigram and Gaibandha district about 63455 and 57389 hectares land is under char which is 10.91% and 10.47% respectively of the total cultivated area of these two districts (BBS, 2013). The productivity of char land is very poor. The productivity can be increased by inclusion of high value crops in the existing system. Potato-Jute-T.aman rice cropping pattern

is practiced in char land of Kurigram and Gaibandha district. The yield potential of jute is stagnated. They can cultivate easily kenaf as alternate of jute crop.

Being an annual crop, kenaf is grown from seed. A large quantity of seed supply is needed for continuous cultivation of kenaf. Currently availability of kenaf seed is very limited. Under this circumstances, there is need to produce kenef seed at farmers level to fulfill local requirement. Conventional method of seed production successfully replaced by off or late season jute seed production technology. Bangladesh Agricultural Development Corporation and many farmers are now producing jute seed following this technology. Until now, research reports relating to late season seed production technology in kenaf is highly unavailable. Since, kenaf is a short day plant like jute and therefore, it is expected to produce kenaf seed following late season seed production technology. Seed production of kenaf in late season may be done by direct seeding or transplanting of seedling or planting of top cut like jute.

Collection of kenaf seeds by manual threshing (traditional method) is very labour intensive and costly. Further, harvesting of kenaf seed is another major constraint as bristles from kenaf capsules can cause extreme itchiness and irritation to human skin. So, farmers face an acute problem of threshing kenaf seed. In traditional method, some amount of kenaf seed losses due to inefficient threshing practices. Therefore, mechanical threshing needs to be developed for efficient and economic threshing.

For the above agronomical, environmental and economic perspective, strategic research was undertaken for development of sustainable technology to enhance kenaf production and to impose farmers' livelihood in char areas of Bangladesh.

7. **Sub-project goal:** Introduce kenaf in char land towards poverty alleviation and environmental enrichment
8. **Sub-project objective (s):**
   i) To develop find out alternate cropping patterns with higher productivity in char areas of Bangladesh.
   ii) To identify kenaf varieties and seed production technique for mitigating seed crisis at farm level.
   iii) To disseminate and popularize the BJRI developed kenaf varieties in char areas.
9. **Implementing location (s):** Char Bazra of Ulipur Upazila in Kurigram district and Razar char of Sundarganj Upazila in Gaibandha district.

10. Methodology in brief:

Char Bazra of Ulipur Upazila in Kurigram district and Razar char of Sundarganj Upazila in Gaibandha district were selected as the trial locations for the project. The study consisted of four experiments of which under varietal trial, 5 varieties of kenaf (BJRI varieties-4 and local variety-1) were planted using a RCB design with 6 (dispersed) replications where unit plot size was 30 decimal. Likewise in the experiment of alternate cropping pattern trials, experiment was laid out in RCB design with 4 dispersed replications and unit plot size was 5 decimal. Under late season kenaf seed production at farmer's field five kenaf varieties viz. HC-2, HC-95, BJRI kenaf-3, BJRI kenaf-4 and local were planted in both locations using a RCB design with 10 (dispersed) replicates. Unit plot size was 10 decimal in each location. The experiment of drying and threshing was comprised with three drying period of harvested plant (threshing without drying of harvested plant, threshing after 7 days drying of harvested plant and threshing after 14 days drying of harvested plant) and two method of threshing (Traditional method of threshing and mechanical method of threshing) in a randomized complete block design with four replications. Necessary data were recorded as per requirement of specific experiment. Detail methodology is given in each experiment separately.

11. Results and discussion:

Experiment 1

Yield Performance of Kenaf Varieties in Char Areas of Bangladesh

Abstract

The experiment was carried out at Kurigram and Gaibandha districts during kharif-1 season of 2017. The aim of the experiment was to evaluate yield performances of some BJRI kenaf varieties in comparison to local variety (Dumka-2). The BJRI released varieties were HC-2, HC-95, BJRI kenaf-3 and BJRI kenaf-4. The experiment was laid out in a randomized complete block design with six dispersed replications. Significant yield difference was observed among the varieties in two different locations. Results revealed that the highest fibre and stick yield were recorded as 3.90 and 8.24 t ha^{-1} in BJRI kenaf 3 from Ulipur of Kurigram and Sundarganj of Gaibandha district.

Introduction

Kenaf (*Hibiscus cannabinus* L.), an one of the important fiber crops next to cotton and jute belonging to the family Malvaceae, is cultivated for its core and bast fibres. Recently, the interest in growing kenaf has been increased throughout the world for its elevated fiber content (Alexopoulou *et al*., 2000). Kenaf is traditionally grown in east-central Africa, west Asia and in several southern states of America for fiber and oil seed (20% oil content) production; whereas it comprises an excellent forage crop containing 18-30% crude leaf protein and stalk protein 5.8-12.1% (Phillips *et al*., 1989). Kenaf is also an important source of textile fibres for the manufacture of twines, ropes, burlap bags and carpet backings using traditional retting ponds in Africa, Asia and Latin America (Boulanger, 1990). The residual core fraction can be used as biomass for energy production (Danalatos and Archon toulis, 2005). It is being used as a raw material alternative to wood in pulp production and the newspaper industries (Ardente *et al*., 2008). Kenaf accounts for about 10 percent of total fibre production in Bangladesh (Deb and Bairagi, 2008). In Bangladesh, around 0.04 million hectares of land is now under kenaf cultivation producing 0.08–0.09 million tons per annum with an average yield of 2.0-2.5 t ha-1 (Mostofa, 2012). Kenaf can be grown in the char lands more profitability with minimum care than jute. It can give high yield even in the marginal, fallow and char lands with less care (Hiron *et al*., 2006). Kenaf cultivation is profitable than jute because it can be produced at minimal management practices with less labour and lower cost in char land. The prices of jute and kenaf fibres are almost same, and as a consequence, kenaf can replace jute in the char areas very easily. Sandy medium high to low land is not suitable for jute production because of occurring severity of stem rot, die back and other similar diseases, whereas kenaf can be grown easily those type of land due to its resistance to diseases. A lot of char lands present in northern districts like Kurigram and Gaibandha are remain fallow during jute growing season. Farmers cannot grow jute due to infection of different diseases. They can cultivate easily kenaf as alternate of jute crop. By introducing kenaf in char land farmers can utilize their fallow land for maximizing economic return. However, before introducing kenaf in char land, it is imperative to identify the variety which is best adopted to specific location. The present study was therefore to select suitable kenaf variety for achieving better fibre yield in char area of Bangladesh.

Materials and Methods

The experiment was carried out at two project sites at Char Bajra at Kurigram (Latitude: $25^0$38.955 N, Longitude: $089^0$36.108E and Altitude: 22m) belongs to Tista Meander Floodplain under the Agro-Ecological Zone (AEZ-03) and Razar char at Gaibandha (Latitude: $25^0$10.918' N, Longitude: $089^0$23.862' E and Altitude: 18m) districts during kharif-1 season of 2017. Main objective was to

evaluate the BJRI developed varieties of kenaf in comparison to local variety in respect of fibre yield and yield contributing characters in char areas. Four kenaf varieties of BJRI viz. HC-2, HC-95, BJRI kenaf-3, BJRI kenaf-4 and one local (Indian) variety was selected as control in the experiment. The experiments were laid out in randomized complete block design with 6 dispersed replications having unit plot size of 30 decimal in each location. Seeds were sown from 13 April to 25 April. Recommended dose of fertilizers was applied and intercultural operations were done as and when necessary. Harvesting was done at field duration of 120 days of each plot as per experimental specification. At the time of harvesting ten sample plants were collected from each plot at random. Harvested plants of each plot were separately bundled, tagged and to leave in a heap in dry field for four days for defoliation. Plants were allowed in retting, fibre extraction and dried. The data collected on different parameters were statistically analyzed using ANOVA technique the MSTAT-C computer package program. The mean differences among the treatments were compared by Duncan's Multiple Rang Test (Gomez and Gomez, 1984).

Results and Discussion

Plant population: Plant populations of different kenaf varieties were significantly different. The highest plant population was found in 'HC-95' and 'BJRI kenaf-4'; and the lowest was in local (Dumka-2) variety both in Ulipur and Sundarganj sites (Table 1.1).

Plant height: Plant height is an important yield contributing character of kenaf. Plant heights of different kenaf varieties are significantly different. The highest plant height was found in 'BJRI kenaf-3' (2.84m and 3.11m) both Ulipur and Sundarganj sites, respectively which are statistically identical with HC-2 and BJRI kenaf-4 varieties and the lowest was in local (Dumka-2) variety (2.57m & 2.86m) both Ulipur and Sundarganj sites, respectively.

Base diameter: Base diameters of different kenaf varieties were significantly different. The highest base diameter was found in 'BJRI kenaf-3' (19.56mm & 21.18mm) both Ulipur and Sundarganj sites, respectively which are statistically identical with HC-2, HC-95 and BJRI kenaf-4 varieties and the lowest was from local (Dumka-2) variety (18.37mm & 19.33mm) both Ulipur and Sundarganj sites, respectively.

Table 1.1: Yield and yield contributing characters at Ulipur and Sundarganj sites.

Variety	Plant Population (m^{-2})			Plant height (m)			Base diameter (mm)		
	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.
HC-2	28b	18b	23.0	2.78a	3.10a	2.94	19.44ab	20.45a	19.95
HC-95	32a	19ab	25.5	2.82a	3.00b	2.91	19.30ab	20.86a	20.08
BJRI Kenaf-3	28bc	19ab	23.5	2.84a	3.11a	2.975	19.56a	21.18a	20.37
BJRI Kenaf-4	31a	20a	25.5	2.89a	3.06ab	2.98	19.18ab	20.67a	19.93
Local	26c	18b	22.0	2.57b	2.86c	2.72	18.37	19.33b	18.85
LSD (5%)	1.87	1.17	-	0.198	0.005	-	0.996	1.058	-
CV (%)	5.33	5.16	-	5.89	2.35	-	4.31	4.29	-

Green weight with leaves: Green weight with leaves is an important yield contributing character of kenaf. Green weights with leaves of different kenaf varieties were significantly different. The highest green weight with leaves was found in 'BJRI kenaf-3' (7.28 & 6.93, t ha-1) both Ulipur and Sundarganj sites, respectively which were statistically identical with HC-2 and BJRI kenaf-4 varieties and the lowest was from local variety (6.51 & 6.17, t ha^{-1}) both Ulipur and Sundarganj sites, respectively (Table 1.2).

Green weight without leaves: Green weight without leaves is an important yield contributing character of kenaf. Green weights without leaves of different kenaf varieties are significantly different. The highest green weight without leaves was found in 'BJRI kenaf-3' (6.30 & 5.98, tha^{-1}) both Ulipur and Sundarganj sites, respectively which were statistically identical with HC-95 (6.22 & 5.79, tha^{-1}) and the lowest was in local variety (6.51 & 6.17, t ha^{-1}) both Ulipur and Sundarganj sites, respectively (Table 1.2).

Fibre yield: Fibre yield is the most important yield contributing character of kenaf. Fibre yields of different kenaf varieties were significantly different. The highest fibre yield was found in 'BJRI kenaf-3' (3.99 and 3.81 t ha^{-1}) and the lowest was in local variety (3.03 t & 2.84t ha^{-1}) both Ulipur and Sundarganj sites, respectively. Fibre yield of HC-2, HC-95 and BJRI kenaf-4 were intermediate both in Ulipur and Sundarganj sites (Table 1.2).

Stick yield: Stick yield is also an important yield contributing character of kenaf. Stick yields of different kenaf varieties were significantly different. The highest stick yield was found in 'BJRI kenaf-3' (8.07 and 8.41, t ha-1) and the lowest was from local variety (6.99 & 6.58, t ha-1) both Ulipur and Sundarganj sites, respectively. Intermediate yields were observed in HC-95 and BJRI kenaf-4 and HC-2 remain in both Ulipur and Sundarganj sites (Table1.2).

Table 1.2: Yield and yield contributing characters of kenaf varieties in comparison with control variety at Ulipur and Sundarganj sites.

Variety	Green weight (t ha^{-1}) with leaves			Green weight (t ha^{-1}) without leaves			Fibre yield (t ha^{-1})			Stick yield (t ha^{-1})		
	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.
HC-2	6.86b	6.54ab	6.70	5.80b	5.47bc	5.64	3.28b	3.32ab	3.30	7.27b	7.48b	7.38
HC-95	7.13ab	6.81a	6.97	6.22a	5.79ab	6.01	3.34b	3.81a	3.58	7.32b	8.27a	7.80
BJRI Kenaf-3	7.28a	6.93a	7.11	6.30a	5.98a	6.14	3.99a	3.81a	3.90	8.07a	8.41a	8.24
BJRI Kenaf-4	6.91b	6.60ab	6.76	5.85b	5.55b	5.70	3.36b	3.37a	3.37	7.42b	7.80b	7.61
Local (Dumka -2)	6.51c	6.17b	6.34	5.48c	5.14c	5.31	3.03b	2.84b	2.94	6.99b	6.58c	6.79
LSD (5%)	0.2875	0.4649	-	0.2285	0.3653	-	0.3385	0.4772	-	0.4275	0.3789	-
CV(%)	3.45	5.84	-	3.19	5.42	-	8.30	11.54	-	4.78	4.08	-

Conclusion

The above results revealed that growth and yield of kenaf varied due to varieties. It may be concluded that the BJRI varieties have the potentiality to out yield the local (Indian) variety. Among these varieties BJRI Kenaf 3 is the best for fibre production in char areas of Bangladesh.

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Experiment 2

Development of Alternate Cropping Pattern Potato-Kenaf-T.aman Rice against Potato-Jute-T.aman Rice Cropping Pattern at Char Land

Abstract

A field trail was conducted in farmer's field at two project sites of Kurigram and Gaibandha during 2017 to develop alternate cropping pattern Potato-Kenaf-T.aman Rice against Potato-Jute-T.aman Rice cropping pattern at char land for increasing productive and farm income. In the alternate cropping pattern, yield of potato, kenaf and T.aman were 24.32 t ha^{-1}, 3.52 t ha^{-1} and 4.43 t ha^{-1}, respectively at Kurigram site and 23.65 tha^{-1}, 3.42 tha^{-1} and 4.55 tha^{-1}, respectively at Gaibandha site. In the existing cropping pattern, yield of potato, jute and T.aman rice were 14.80 t ha^{-1}, 2.35 t ha^{-1} and 4.13 t ha^{-1}, respectively at kurigram site and 19.76 t ha^{-1}, 2.55 t ha^{-1} and 4.30 t ha^{-1}, respectively at Gaibandha site. Gross return and gross margin were also much higher in alternate cropping pattern over the existing cropping pattern.

Introduction

Char farmers follow wide variants of cropping patterns across areas and time, given the high incidence of natural calamities and the different necessities that arise. Unlike farmers from other parts of the country, char farmers cannot cultivate crops round the year for floods that inundate their lands almost half the year. Consequently, some of them are engaged in relay cropping and/or mixed cropping as subsistence farming system. Farmers generally arrange the cultivation of their crops according to the patterns, based on their respective necessity and demands, and the experience, skills and knowledge level, in addition to other factors like technical feasibility. Similar to other parts of the country, cropping systems in char areas are predominantly rice based and where aman rice in the most commonly cultivated. Although Bangladesh is nearly self-sufficient in rice production, but studies exposed that continuous rice cultivation reduces production of non-rice

crops, erodes biodiversity and creates nutritional imbalance in the soil (Hussain *et al*, 2001, Rahman, 2010). After harvesting potato, jute is usually grown by farmers in the char areas during kharif 1 season. However, it is observed that during jute growing season, a vast area of land in char areas remain fallow due to unsuitability of land for jute production. Because stem rot, die back and other similar diseases occurs severely in jute field. Hence kenaf can be grown easily because it is resistance to those diseases. So farmers can cultivate kenaf easily as alternate of jute crop. Furthermore, kenaf cultivation enhances soil siltation and fertility as well. Char lands can provide high value crops like potato that can be harvested before sowing of kenaf. Inclusion of high value crops in the existing system, the productivity of char land can be increased. With this consequence and on the basis of farmers existing cropping pattern and farmers choice, a promising alternative cropping pattern Potato-Kenaf-T.Aman was designed and tested against Potato-Jute-T.Aman traditional cropping pattern in char areas of Kurigram and Gaibandha districts of Bangladesh.

Materials and methods

The experiment was conducted at the farmers' fields of Kurigram (Latitude: $25^0$38.955 N, Longitude: $089^0$36.108E and Altitude: 22m) belongs to Tista Meander Floodplain under the Agro-Ecological Zone (AEZ-03) and Gaibandha (Latitude: $25^0$10.918' N, Longitude: $089^0$23.862' E and Altitude:18m) district. The experiment was laid out in randomized complete block design with four dispersed replications. The unit area for each field was 200 m^2. Existing patterns data were recorded from potato, Kenaf, Jute and T.aman rice planted under alternate and farmers cropping patterns in both char areas of Kurigram and Gaibandha. Cost and return of rice, potato, kenaf and jute were calculated on the basis of prevailing local market price of the commodities. Crop management practices for alternate and farmers cropping patterns have been presented in Table 2.1 and Table 2.2.

Result and discussion

Product yield: In alternate cropping pattern, yield of potato, kenaf and T.aman were 24.32 t ha^{-1}, 3.52 t ha^{-1} and 4.43 t ha^{-1}, respectively at kurigram site and 23.65 tha^{-1}, 3.42 t ha^{-1} and 4.55 t ha^{-1}, respectively at Gaibandha site. In the existing cropping pattern, yield of potato, jute and T.aman rice were 14.80 t ha^{-1}, 2.35 t ha^{-1} and 4.13 t ha^{-1}, respectively at kurigram site and 19.76 tha^{-1}, 2.55 tha^{-1} and 4.30 t ha^{-1}, respectively at Gaibandha site.

Cost and return analysis: At Kurigram, total gross return and gross margin of alternative pattern were Tk. 4,95,510/- ha^{-1} and Tk. 2,36,856/-ha^{-1} respectively whereas in farmers pattern these were Tk. 3,44,815/- ha^{-1} and Tk. 1,05,685/- ha^{-1} respectively (Table 2.1). Similarly at Gaibandha, total gross

return and gross margin of alternative pattern were Tk. 5,01,060/- ha^{-1} and Tk. 2,44,486/-ha^{-1} respectively whereas in farmers pattern these were Tk. 4,15,320/- ha^{-1} and Tk. 1,55,050/-ha^{-1} respectively (Table 2.2). In both study areas, the whole pattern benefit cost ratio 2.1 at Kurigram and 2.07 at Gaibandha in alternate cropping pattern and 1.59 at Kurigram and 1.83 at Gaibandha in farmers cropping pattern which indicated that kenaf based cropping pattern is more profitable than Jute based under farmers cropping pattern.

Table 2.1. Performance of alternate cropping pattern potato-kenaf-T.aman against the existing pattern potato-jute-T. aman at Char Bazra, Ulipur, Kurigram

Observation	Alternate cropping pattern			Farmers cropping pattern		
Crop	Potato	Kenaf	T.aman	Potato	Jute	T.aman
Varieties	Asterix	HC-95	BRRI dhan49	Cardinal	JRO-524/ O-9897	Swarna
Spacing (cm)	60 × 25	Broadcast	20 ×15	60 × 25	Broadcast	20 ×15
Fertilizer dose (N-P-K- S-Zn-B Kg ha^{-1})	120-50-110 -22-8-1	90-15-30-10-0-0	115-0-40-15-0-2-0	120-50-110-22-8-1	120-15-30-10-0-0	100-0-0-15-0-0
Sowing/ transplanting	Dec.17(7-13)	May 17(2-4)	Aug.17(10-13)	Dec.17(12-16)	April(14-22)	July.17 (24)
No. of weeding /thinning	-	1	2	-	3	2
No. of irrigation	3	-	4	3		5
Harvesting date	Mar.18(4-7)	Aug.17(5-8)	Nov.17(27-29)	Mar.18(2-6)	July17(10-15)	Nov.17(27-30)
Field duration	114-117	120-123	106-107	110-113	105-111	123-126
Main product Yield (t ha^{-1})	24.32	3.52	4.43	14.80	2.35	4.13
By-product yield (t ha^{-1})	-	7.58	4.00	-	4.92	3.60
Total variable cost (Tk. ha^{-1})	146560/-	68,254/-	43,840/-	120630/-	76,580/-	41,920/-
Gross return (Tk. ha^{-1})	243210/-	1,35,920/-	116380/-	148000/-	1,06,850/-	89965/-
Whole pattern GR(Tk. ha^{-1})	4,95,510/-			3,44,815		
Gross margin (Tk. ha^{-1})	96650/-	67,666/-	72,540/-	27370/-	30,270/-	48,045/-
Whole pattern GM(Tk. ha^{-1})	2,36,856/-			1,05,685/-		
Benefit cost ratio (BCR)	1.66	1.99	2.65	1.23	1.40	2.15
BCR (Whole pattern)	2.1			1.59		

Price (Tk. Kg^{-1}): Urea-16, TSP-22, MP-15, Gypsum-10, Zinc Sulphate-150, Boric acid-160, Rice grain-16.50, Rice straw-01, Jute fibre-33, Jute stick-5 and Potato-10

Table 2.2. Performance of alternative cropping pattern Potato-Kenaf-T.aman against the existing pattern Potato-Jute-T. aman at Razar Char, Sundarganj, Gaibandha.

Observation	Alternate cropping pattern			Farmers cropping pattern		
Crop	Potato	Kenaf	T.aman	Potato	Jute	T.aman
Varieties	Asterix	HC-95	BRRI dhan49	Cardinal	JRO-524/O-9897	BR11
Spacing(cm)	60 × 25	Broadcast	20 ×15	60 × 25	Broadcast	20 ×15
Fertilizer dose (N-P-K- S-Zn-B Kg ha^{-1})	120-50-110-22-8-1	90-15-30-10-0-0	115-0-40-15-0-2-0	120-50-110-22-8-1	120-15-30-10-0-0	100-0-0-15-0-0
Sowing/ transplanting	Dec.17(7-10)	May 17(4-6)	Aug.17(13-16)	Dec.17(10-15)	April(15-25)	July.17 (24)
No. of weeding /thinning	-	1	2	-	2-3	2
No. of irrigation	3	-	3	3	-	4
Harvesting date	Mar.18(6-10)	Aug.17(6-9)	Dec.17(2-4)	Mar.18(4-7)	July17(10-15)	Nov.17(25-29)
Field duration	83-90	119-122	108-110	82-83	110-115	121-125
Main product Yield (t ha^{-1})	23.65	3.42	4.55	19.76	2.55	4.30
By-product yield (t ha^{-1})	-	7.35	5.00	-	5.32	4.40
Total variable cost (Tk. ha^{-1})	145350/-	66,474/-	44,750/-	145050/-	72,240/-	42,980/-
Gross return (Tk. ha^{-1})	225440/-	1,32,000/-	143620/-	186680/-	1,15,850/-	112790/-
Whole pattern GR(Tk. ha^{-1})	5,01,060/-			4,15,320/-		
Gross margin (Tk. ha^{-1})	80090/-	65,526/-	98,870/-	41630/-	43,610/-	69,810/-
Whole pattern GM(Tk. ha^{-1})	2,44,486/-			1,55,050/-		
Benefit cost ratio (BCR)	1.55	1.98	2.67	1.28	1.60	2.62
BCR (Whole pattern)	2.07			1.83		

Price (Tk. Kg^{-1}): Urea-16, TSP-22, MP-15, Gypsum-10, Zinc Sulphate-150, Boric acid-160, Rice grain-16.50, Rice straw-01, Jute fibre-33, Jute stick-5 and Potato-10

Conclusion

From the above result it is clear that of Kenaf based alternative cropping pattern is more productive and profitable than Jute based existing pattern in both char areas. Thus introduction of kenaf in cropping pattern with improved management would help to increase total production, farmers' income as well as improve soil health at char areas o Bangladesh.

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Experiment 3

Seed Production Potential and seed quality of late sown kenaf varieties in Char area

Abstract

The experiment was carried out at two project sites at Kurigram and Gaibandha during kharif II season of 2017 to evaluate the yield performances of some BJRI kenaf varieties in comparison to local variety. BJRI varieties (HC-2, HC-95, BJRI kenaf-3 and BJRI kenaf-4) were tested against local variety (Dumka-2) as control. The experiment was laid out in a randomized complete block design with ten dispersed replications. Significant seed yield difference was observed among the varieties and over the locations. Results revealed that the highest seed yield was recorded as 1029.33 and 1043.00 kgha-1 from BJRI Kenaf 3 in Ulipur and Sundarganj sites, respectively. The highest seed germination percent was recorded also from BJRI Kenaf 3 (85.33% and 87.50% at Ulipur and Sundarganj sites, respectively). The other quality parameters (seed vigor index and field emergence) did not differ significantly among the studied varieties.

Introduction

Seed is the most vital input for crop production. In Bangladesh, around 0.4 million hectares of land is now under kenaf cultivation producing 0.08 – 0.09 million tons per annum with an average yields of 2.0-2.5 tons ha^{-1} (Mostofa, 2012). The annual requirement of Kenaf seed in Bangladesh is estimated to be approximately 480 tons (Mollah *et al*, 2015). But only a few tons of quality seed are produced in organized way and the rest are supplied by indigenous sources. In response to increasing farmer demand for better varieties and quality seed, more than 5 improved varieties of kenaf crop with high yield potential were released by BJRI, but these varieties are not extensively cultivated in various parts of the country mainly due to non-availability of seed. The seeds supplying through informal sources is not recognized as quality seeds because in this system seeds are not produced by following the proper steps of seed technology. Use of such poor quality seed is one of the major factors responsible for lower yield of kenaf. So supply of quality seed to the farmers may be the most essential concern in prioritizing different issues on development of agriculture, For increasing quality

seed supply to the farmers and to meet farmers own demand an initiative was taken to produce seed at farm level involving farmers in production process of quality seed. However seed production potential of BJRI released kenaf varieties yet not determined. The present study therefore, undertaken to identify kenaf variety suitable for quality seed production in late sown condition.

Materials and methods

The experiment was carried out at 2 project sites at Ulipur at Kurigram and Sundarganj at Gaibandha districts. The field was medium high land having well-drained silty loam soil. Four kenaf varieties of BJRI (HC-2, HC-95, BJRI kenaf-3 and BJRI kenaf-4) one local Indian variety (Dumka-2) were tested using a RCB design with 10 (dispersed) replications. Unit plot size was 10 decimal in each location. The data collected on different parameters were statistically analyzed using ANOVA technique the MSTAT-C computer package program. The mean differences among the treatments were compared by Duncan's Multiple Rang Test (Gomez and Gomez, 1984).

Result and discussion

Number of pods per plant: Number of pod per plant is an important seed yield contributing character of kenaf. Numbers of pods per plant of different kenaf varieties are significantly different. The highest numbers of pods per plant were found in 'BJRI kenaf-3' (16.06 & 20.74) and the lowest were found in local (Dumka-2) variety (13.90 & 15.04) both at Ulipur and Sundarganj sites, respectively. HC-95, HC-2 and BJRI kenaf-4 varieties are remain in the middle position (Tables 3.2).

Number of seeds per pod: Number of seeds per pod is an important seed yield contributing character of kenaf. Numbers of seeds per pod of different kenaf varieties were significantly different. The highest numbers of seeds per pod was found in 'BJRI kenaf-3' (18.77 & 19.30) and the lowest was in local (Dumka-2) variety (14.00 & 15.10) both at Ulipur and Sundarganj sites, respectively. HC-95, HC-2 and BJRI kenaf-4 varieties showed intermediate number of seeds per pod(Table 3.1).

1000-seed weight: 1000-seed weight is an important seed yield contributing character of kenaf. 1000-seed weights of different kenaf varieties were significantly different. The highest 1000-seed weight was found in 'BJRI kenaf-3' (24.65g & 24.61g) and the lowest was local (Dumka-2) variety (23.71g & 23.75g) both at Ulipur and Sundarganj sites, respectively. HC-95, HC-2 and BJRI kenaf-4 varieties were remain in the middle position (Table 3.1).

Seed yield: Seed yield is the most important yield contributing character of kenaf. Seed yield of different kenaf varieties were significantly different. The highest seed yield was found in 'BJRI kenaf-3' (1029.33 & 1043.00 $kgha^{-1}$) and the lowest was found in local (Dumka-2) variety (865.67 & 863.90

kgha^{-1}) both at Ulipur and Sundarganj sites, respectively. HC-95, HC-2 and BJRI kenaf-4 varieties maintained intermediate yield.

Germination: Seed germination percent is the most important seed quality parameter of kenaf. At Ulipur site there is no significant difference found of seed germination percent of different kenaf varieties. At Sundarganj site significant difference was found of seed germination percent of different kenaf varieties. The highest seed germination percent was found in 'BJRI kenaf-3' (87.50%) followed by HC-95 (86.00%) and the lowest was found in local (Dumka-2) variety (84.10%) at Sundarganj site. HC-2 and BJRI kenaf-4 varieties are remain in the middle position (Table 3.2).

Vigor index: Seed vigor index is an important seed quality parameter of kenaf. No significant difference found in seed vigor index of different kenaf varieties of both Ulipur and Sundarganj sites (Table 3.2).

Field emergence: No significant difference found in field emergence of different kenaf varieties of both Ulipur and Sundarganj sites (Table 3.2).

Table 3.1: Yield and yield contributing characters of kenaf varieties in at Ulipur and Sundarganj sites.

Variety	Number of Podsplant^{-1}			Number of seeds Pod^{-1}			1000-seed weight (g)			Seed yield (kgha^{-1})		
	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.
HC-2	15.33b	18.58b	16.96	16.33abc	17.44b	16.89	24.11ab	24.18b	24.15	937.17b	948.90bc	943.04
HC-95	15.38b	18.71b	17.05	17.42ab	19.20a	18.31	24.13ab	24.11bc	24.36	961.33b	960.30b	960.82
BJRI Kenaf-3	16.06a	20.74a	18.40	18.77a	19.30a	19.04	24.65a	24.61a	24.63	1029.33a	1043.00a	1036.17
BJRI Kenaf-4	15.24b	18.04b	16.64	15.35bc	16.39bc	15.87	23.77b	23.82bc	23.80	915.67bc	909.30c	912.49
Local (Dumka-2)	13.90c	15.04c	14.47	14.00c	15.10c	14.55	23.71b	23.75c	23.73	865.67c	863.90d	864.79
LSD (5%)	0.5009	1.018	-	2.98	1.637	-	0.585	0.382	-	58.02	40.32	-
CV(%)	2.74	6.10	-	15.13	10.32	-	2.02	1.70	-	5.12	4.70	-

Table 3.2: Seed germination, seed vigour index and field emergence of kenaf varieties at Ulipur and Sundarganj sites.

Variety	Germination (%)			Seed vigour Index			Field emergence (%)		
	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.	Ulipur	Sundar ganj	Avg.
HC-2	84.83	85.60bc	85.22	45.50	45.50	45.50	83.50	84.60	84.05
HC-95	84.67	86.00ab	85.34	44.00	46.40	45.20	83.33	84.90	84.12
BJRI Kenaf-3	85.33	87.50a	86.42	44.83	47.10	45.97	84.00	85.10	84.55
BJRI Kenaf-4	84.17	85.20bc	85.69	44.17	45.00	44.59	82.83	84.00	83.42
Local (Dumka-2)	84.50	84.10c	84.30	43.67	45.00	44.34	83.17	83.80	83.49
LSD (5%)	NS	1.609	-	NS	NS	-	NS	NS	-
CV (%)	2.75	2.07	-	7.29	5.84	-	2.79	2.47	-

Conclusion

The above results revealed that seed yield and seed quality of kenaf varied due to varieties. It may be concluded that the BJRI varieties have the potentiality to out seed yield than the local (Dumka-2) variety. Among these kenaf varieties BJRI Kenaf 3 is the best for seed yield and quality.

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Experiment 4

Effect of drying period of harvested plant and method of threshing on yield and seed quality of kenaf

Abstract

An experiment was conducted at project sites at Kurigram during kharif II season of 2017 to develop economically feasibility kenaf seed threshing technique for getting more seed yield and quality. The trial consisted of three drying period of harvested plant (threshing without drying of harvested plant, threshing after 7 days drying of harvested plant, threshing after 14 days drying of harvested plant) and two method of threshing (traditional method of threshing, mechanical method of threshing) in a randomized complete block design with four replications. The highest kenaf seed yield was obtained from mechanical method of threshing in all the drying period with minimum time for threshing. Irrespective threshing method the best quality seed was obtained at threshing without drying of harvested plant.

Introduction

Kenaf is a commercially important fiber crop next to cotton and jute. Kenaf accounts for about 10 percent of total raw fibre production in Bangladesh (Deb and Bairagi, 2008). In Bangladesh around 0.04 million hectares of land is now devoted to kenaf cultivation producing 0.08-0.09 tons per annum with an average yields of 2.0-2.5 tonsha^{-1} (Mostofa, 2012). The expansion of kenaf cultivation in Bangladesh has been limited by shortage of quality seed. Very few amounts of kenaf seed are produced in Bangladesh, but there is no statistics about kenaf seed production (Khan et al., 2014). In adequate supply of quality seed is the major barrier to the expansion of kenaf. The quality of kenaf seeds depends on many pre and post harvest factors, such as time of cultivation and method, time of seed maturity and harvest, threshing, processing, and drying operation and storage condition. Mechanical damage is one of the major factors which reduce the seed quality. In traditional method, some amount of kenaf seed losses due to inefficient harvesting and threshing practices. Manual threshing methods are labour intensive as compared to mechanical threshing. However, harvest of kenaf seed is another major problem as bristles from kenaf capsules can cause extreme itchiness and irritation to human skin and farmers face an acute problem of threshing kenaf seed. The seed injuries are caused from the weathering, fungi, insects, artificial drying and mechanical damage during harvest, handling, threshing and storage (Henning *et al*., 2006). From the above facts the experiment was designed to develop economically feasibility kenaf seed threshing technique for getting more seed yield and quality.

Materials and methods

An experiment was conducted at Kurigram during kharif II season of 2017 to develop economically feasible kenaf seed threshing technique with suitable drying operation and different threshing methods for getting more seed yield and quality. The experiment comprised three drying period of harvested plant (threshing without drying of harvested plant, threshing after 7 days drying of harvested plant and threshing after 14 days drying of harvested plant) and two method of threshing (traditional method of threshing and mechanical method of threshing) with crop grown in a randomized complete block design with four replications. The unit plot size was 8 m × 5 m. Kenaf variety HC-95 was used as test crop. The experimental plots were fertilized with urea, triple super phosphate (TSP), murate of potash (MoP) and gypsum @ 180-50-20-50 kg ha^{-1}, respectively. All fertilizers except urea were applied during final land preparation. Urea was top dressed in three equal splits at 15, 30 and 45 days after sowing. The seed was sown @ 12 kg ha^{-1} on 25 August in 2017

in line sowing. Weeding was done by hand at 30 days after sowing (DAS). Thinning was done to maintain plant to plant distances of about 15 cm along with the weeding operation. The crop was infested by mealy bug and white fly at the vegetative stage which were successfully controlled by spraying Ripcord 10 EC @ 2mlL^{-1} of water for two times at an interval of 10 days. No irrigation was needed while drainage of excess water was done as and when necessary.

The crop was hand harvested at maturity (i.e. when 80% of the capsules became brown in color). Drying period of harvested plant and threshing was done as per experimental specification. Paddy thresher machine was use as mechanical threshing. Initial seed moisture content was measure at threshing time. Then seeds were sun dried on jute mat kept on cemented floor for 5-6 days to around 8% moisture content. After cleaning the seed was stored in thick polythene bags and kept in the laboratory until further use for quality tests. Prior to harvesting, ten plants from each plot were harvested to collect data on seed yield $plant^{-1}$, seed moisture content, percentage of unfilled and cracked seed. Standard laboratory germination accelerated ageing test and field emergence percentages were done to record on germination and vigour of seed. A brief description on different laboratory tests is given below.

Laboratory germination test:

The test was conducted on top of the paper method. The germination percentage of seed was measured by Mollah (2014) using the following formula:

$$\text{Germination (\%)} = \frac{\text{Number of normal seedling}}{\text{Number of seed sown}} \times 100$$

Accelerated ageing (AA) test

15 g seed in accelerated ageing chamber exposing to 41^0C temperature and 100% RH for 72 hours. Following the laboratory germination test (ISTA, 1999).

Statistical analysis of data:

The collected data on different yield related characters and seed quality parameters were subjected statistical analysis following ANOVA technique. Differences among treatment means were compared by Duncan's Multiple Range Test with the help of a computer based statistical package program MSTAT-C (Gomez and Gomez, 1984).

Results and discussions

Effect of drying period of harvested plant

Almost all the parameters were not found statistically significant in terms of drying period of harvested plant (Table 4.1- 4.2). Significantly the highest seed moisture content (20.62%) was obtained from the threshing without drying of harvested plant and lowest (14.17%) was found in threshing after 14 days drying of harvested plant (Table 4.1). The present study revealed that total unfilled and cracked seed (2.75%) was found in threshing after 14 days drying of harvested plant and the lowest (2.25%) was found in threshing after 7 days drying of harvested plant (Table 4.1). Best seed quality was obtained in threshing without drying of harvested plant. Significantly the highest germination (89.88%), accelerated ageing germination (71.63%) and field emergence (83.88%) were found in threshing without drying of harvested plant and the lowest in threshing after 14 days drying of harvested plant (Table 4.2).

Effect of method of threshing

Significantly the highest seed yield was obtained from mechanical threshing (808.03 kg ha^{-1}) with the lowest time required (11.91 man days/ha) than traditional method of harvesting (Table 4.1). The present study revealed that the highest unfilled and cracked seed (2.58%) was found in mechanical method of threshing (Table 4.1). However, there was no significant difference of seed quality between in mechanical and traditional method of threshing (Table 4.2).

Interaction effect of drying period and method of threshing

The highest seed yield was obtained from mechanical threshing method with the lowest time required in all the drying period than the harvesting of traditional method (Table 4.3). Seed moisture content (20.68% and 20.56%) was the highest in seed obtained from the threshing without drying of harvested plant in both the threshing method and the lowest (14.24% and 14.09 %) in threshing after 14 days drying of harvested plant in both the threshing method. The highest unfilled and cracked seed was found in mechanical method of threshing in all the drying period (Table 4.3). The highest germination percent after accelerated ageing and field emergence was found in seed threshing without drying of harvested plant in both the threshing method (Table 4.4).

Table 4.1. Effect of drying period and method of threshing on seed moisture content, percent unfilled and cracked seed, time required for threshing and seed yield of kenaf

Treatment	Time required for threshing (Man-days/ha)	Seed yield(kgha^{-1})	Unfilled and cracked seed (%)	Seed moisture content (%)
Drying period				
d_0	16.62	705.50	2.63	20.62
d_1	15.57	718.98	2.25	16.94
d_2	15.67	735.55	2.75	14.17
S $\overline{X}$	0.43	9.03	0.23	0.21
CV (%)	7.65	3.55	11.69	3.47
Level of sig..	NS	*	NS	**
Threshing method				
M_t	19.99	631.98	2.50	17.33
M_m	11.91	808.03	2.58	17.15
S $\overline{X}$	0.43	9.03	0.23	0.21
CV (%)	7.65	3.55	11.69	3.47
Level of sig..	*	*	*	**

Table 4.2. Seed germination (%), accelerated ageing germination (%) and field emergence (%) of kenaf seed as influenced by drying period and method of threshing

Drying period(days)	**Germination (%)**	**Germination percent after accelerated ageing**	**Field emergence (%)**
D_0	89.88	71.63	83.88
D_1	86.63	70.13	81.63
D_2	85.63	68.63	80.63
S $\overline{X}$	0.85	0.75	0.44
CV (%)	2.74	3.04	1.52
Level of sig..	**	*	**
M_t	87.17	69.75	81.75
M_m	87.58	70.50	82.33
S $\overline{X}$	0.85	0.75	0.44
CV (%)	2.74	3.04	1.52
Level of sig..	NS	NS	NS

Table 4.3. Interaction effect of drying period and method of threshing on seed moisture content, percent unfilled and cracked seed, time required for threshing and seed yield of kenaf

Drying period × method of threshing	Time required for threshing (Man-days/ha)	Seed yield(kgha^{-1})	Unfilled and cracked seed (%)	Seed moisture content (%)
$D_0 \times M_t$	21.14	588.00	2.50	20.68
$D_0 \times M_m$	12.11	823.00	2.75	20.56
$D_1 \times M_t$	19.30	630.70	2.25	17.07
$D_1 \times M_m$	11.83	807.25	2.50	16.81
$D_2 \times M_t$	19.53	677.25	2.75	14.24
$D_2 \times M_m$	11.80	793.85	3.00	14.09
S $\overline{X}$	0.61	12.77	0.32	0.30
CV (%)	7.65	3.55	11.69	3.47
L. Sig.	*	*	*	*

Table 4.4. Seed germination (%), accelerated ageing germination (%) and field emergence (%) of kenaf seed as influenced by drying period and method of threshing

Drying period × method of threshing	Germination (%)	Accelerated ageing germination (%)	Field emergence (%)
$D_0 \times M_t$	89.75	71.25	83.75
$D_0 \times M_m$	90.00	72.00	84.00
$D_1 \times M_t$	86.50	69.75	81.25
$D_1 \times M_m$	86.75	70.50	82.00
$D_2 \times M_t$	85.25	68.25	80.25
$D_2 \times M_m$	86.00	69.00	81.00
S $\overline{X}$	1.20	1.07	0.63
CV (%)	2.74	3.04	1.52
L. Sig.	*	*	

Conclusion

The result of the present study concludes that the highest kenaf seed was obtained from mechanical method of threshing in all the drying period with minimum time for threshing. The best quality seed was obtained at threshing without drying of harvested plant in both the threshing methods.

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12. Research highlight/findings :

- Yield performance of kenaf varieties were determined where the highest fibre yield (3.90 t ha^{1}) was found in BJRI kenaf 3 at Ulipur of Kurigram and Sundarganj of Gaibandha district.
- Developed alternate cropping pattern potato-kenaf-T.aman against existing cropping pattern potato-jute-T.aman in char areas which showed higher gross return and gross margin over existing cropping pattern.
- In case of late season kenaf seed production, BJRI Kenaf 3 produced maximum seed yield (1036 kg ha^{-1}) over the locations.
- Seed threshing through mechanical method was found more efficient than traditional method. The highest kenaf seed was obtained from mechanical method of threshing in all the drying period with minimum time for threshing.

B. Implementation Position

1. Procurement:

Description of equipment and capital items	PP Target		Achievement		Remarks
	Phy (#)	Fin (Tk)	Phy (#)	Fin (Tk)	
(a) Office equipment	Laptop (01), Lesser Jet printer (01)	80,000	Laptop (01), Lesser Jet printer (01)	80,000	100%
(b) Lab &field equipment	-	-	-	-	-
(c) Other capital items	-	-	-	-	-

2. **Establishment/renovation facilities:** Not applicable

Description of facilities	Newly established		Upgraded/refurbished		Remarks
	PP Target	Achievement	PP Target	Achievement	

3. Training/study tour/ seminar/workshop/conference organized:

Description	Number of participant			Duration (Days/weeks/ months)	Remarks
	Male	Female	Total		
(a) Training(2 in 2 locations)					
i. Training on "kenaf fibre and seed production in Char areas"	8	4	12	1 day	Char bazra, Ulipur, Kurigram 01/12/2017
ii. Training on "kenaf fibre and seed production in Char areas"	12	0	12	1 day	Razar char, Sundarganj, Gaibandha, 02/12/2017
(b) Workshop					Not applicable

C. Financial and physical progress

Figure in Taka

Items of expenditure/activities	Total approved budget	Fund received	Actual expenditure	Balance / unspent	Physical progress (%)	Reasons for deviation
A. Contractual staff salary	2,65,500	2,65,500	2,65,500	0	100	-
B. Field research/lab expenses and supplies	6,86,984	6,86,984	6,86,984	0	100	-
C. Operating expenses	1,80,000	1,72,424	1,70,292	2132	100	Tk. 2132 not expended, remain in Bank
D. Vehicle hire and fuel, oil & maintenance	1,50,000	1,45,500	1,45,500	0	100	Lack of GoB fund
E. Training/ workshop/seminar etc.	44,000	44,000	44,000	0	100	-
F. Publications and printing	70,000	0	0	0	0	Fund not released
G. Miscellaneous	79,516	67,975	67,975	0	100	Lack of GoB fund
H. Capital expenses	80,000	80,000	80,000	0	100	--
	15,56,000	14,62,383	14,60,251	0	100	

D. Achievement of Sub-project by objectives: (Tangible form)

Specific objectives of the sub-project	Major technical activities performed in respect of the set objectives	Output(i.e. product obtained, visible, measurable)	Outcome (short term effect of the research)
1. To compare yield performance and introduce kenaf as a fibre crop in char areas.	-Site and farmer selection. -Purchase and distribution of crop production inputs. -Experimental layout, seed sowing and intercultural operations. - Harvest and post harvest operations. -Data collection and analysis -Field Visit. -Secondary information collection from farmer, DAE and other NARS institutes.	- Location specific profitable and suitable crops kenaf varieties have been identified. -The BJRI varieties have the potentiality to out yield the local (Indian) variety	- Dissemination of improved kanaf varieties at Char areas. - Awareness has been created among the farmers to use suitable kenaf varieties for their cropping system.
2. To develop kenaf based alternative cropping pattern and increase production and expansion of kenaf in char land areas.	-Site and farmer selection. - Implementation of on-farm trials on varietal performance and alternative cropping pattern performance against farmers practice. - Monitoring, data collection and analysis	- Kenaf based cropping pattern Potato – Kenaf-T.aman have been developed at 2 char areas. - Farmers' income (gross margin) increased about 72-164% across the locations and cropping patterns. - Irrespective of the developed cropping patterns, the BCR were found 1.59-2.10, which ensure the increasing of farm efficiency.	-Increased crop productivity, farmer's income as well as improve soil health at char areas. -Proper land utilization and cropping intensity enhancement are possible by using developed cropping patterns. - Farmers of the 2 locations have also demanded to buy BJRI kenaf seeds for next year production and continuation of the improved cropping pattern.
3. To determine seed yield and quality of late season kenaf seed production at farm level in char areas.	Site and farmer selection. - Implementations of on-farm trials on varietal seed performance at 2 char areas. - Monitoring, data collection and analysis - Farmer training on kenaf and kenaf seed production technologies.	- The BJRI varieties have the potentiality to out yield the local (Indian) variety.	-Dissemination of improved late season kenaf seed production technology at char areas. -Farmers of the 2 locations have preserved a total of 300 kg kenaf (HC-2, HC-95, BJRI kenaf-3 and BJRI kenaf-4) seeds for next year production. -Farmers' capacity have been improved on kenaf and kenaf seed production through modern technology based training.
4. To develop economically feasible kenaf seed threshing technique with suitable drying operation and different threshing methods for getting more seed yield and quality.	-Site and farmer selection. -Purchase and distribution of crop production inputs. -Harvest and post harvest operations. -Data collection and analysis -Field Visit. .	-Adoption of drying operation and threshing method on seed yield and quality of kenaf	-The highest kenaf seed has been obtained from mechanical method of threshing in all the drying period and minimum requirement of time. -The best quality seed has been also obtained at threshing without drying of harvested plant in both the threshing methods.

E. Materials Development/Publication made under the Sub-project:

Publication	Number of publication		Remarks (e.g. paper title, name of journal, conference name, etc.)
	Under preparation	Completed and published	
Technology bulletin/ booklet/leaflet/flyer etc.	-	-	
Journal publication	-	3	1. Performances of some kenaf varieties in two selected char areas of Bangladesh. Bangladesh J. Environ.Sci.,Vol.35, 23-26, 2018. 2. Development of alternate cropping pattern incorporating kenaf at char land areas in two selected district of Bangladesh. Bangladesh J. Environ.Sci.,Vol.35, 39-42, 2018. 3. Seed yield and quality performances of some kenaf verities in char areas of Bangladesh. Bangladesh J. Environ.Sci.,Vol.35, 63-66, 2018.
Information development	-	-	
Other publications, if any	-	-	

F. Technology/Knowledge generation/Policy Support (as applied):

i. Generation of technology (Commodity & Non-commodity)

- Identified of improved kanaf varieties at char areas.
- Developed alternative cropping pattern potato-kenaf-T.aman rice for increase production and economic return.
- Late season kenaf seed production technology at char areas is established.
- Developed kenaf seed threshing technique with suitable drying period for maintaining better seed quality.

ii. Generation of new knowledge that help in developing more technology in future

Instead of Jute, cultivation of modern Kenaf varieties and Kenaf-based cropping patterns with improved package of technology developed specially for char areas increased production capabilities as well as spawn more income to farmers. Dissemination of improved late season kenaf seed production technology at char areas also helped to meet farmers' need of quality seed. Alongside higher seed production of Kenaf has been achieved from mechanical method of threshing in all the drying period with negligible use of time at farm level. These achievements justify implementation of further research for development of more technology in future in relation to crop production in Char areas of Bangladesh.

iii. Technology transferred that help increased agricultural productivity and farmers' income

Kenaf cultivation with inclusion of modern varieties attained better yield at farm level as compared to Jute in char areas. Moreover, improved Kenaf-based cropping pattern generated higher crop production as well as economic gains to the farmers.

iv. Policy Support

All char areas of Bangladesh need to bring under similar and intensive agricultural development programme by the Govt. with involvement of NGO's. Proper seed production programmes and facilities need to be extended at farm level with easy access of credit and marketing amenities.

G. Information regarding Desk and Field Monitoring

Desk Monitoring (description & output of consultation meeting, monitoring workshops/seminars etc.):

-Monitoring workshop: 15 May 2018

Output: Desk monitoring suggested that result need to be given in Table rather than Figure. In cropping pattern trial, detail information on crop management aspects, date of sowing and harvesting, crop duration and BCR may be given. Conclusion should be given considering cropping pattern. Very appropriate study for those farmers of char areas. Continuation of those studies is needed for these areas.

H. Information regarding Field Monitoring

Field Monitoring (time & No. of visit, Team visit and output):

- Duration of Field Visit: 20 March 2018
- Coverage of Monitoring Report: From May 2017 to March 2018
- Location(s) of the Program: Char Bazra of Ulipur Upazila in Kurigram district and Razar char of Sundarganj Upazila in Gaibandha district.
- Field Monitoring Members: 1. Md. Abdur Rahman and 2. Dipok Kumar, Monitoring Associate, PIU, BARC, Dhaka

  Output: Field monitoring viewed continuing the sub-project as per planned following standard methodology

I. Lesson Learned

-The project broadening the way of commercial kenaf seed cultivation in char areas to save precious foreign currency for importing kenaf seed. It also helps expansion of kenaf cultivation in Bangladesh.

J. Challenges (if any)

Natural calamities especially hail storm affected to crop. Damaged road communication also hampered monitoring programme partially during the flood and post-flood period. Banking facility and Agricultural loan system are very limited in char areas. Carrying and delivery of crop production inputs are very limited from main land to char area and need to be developed.

Signature of the Principal Investigator

Date …….
Seal

Counter signature of the Head of the organization/authorized representative

Date ……..
Seal

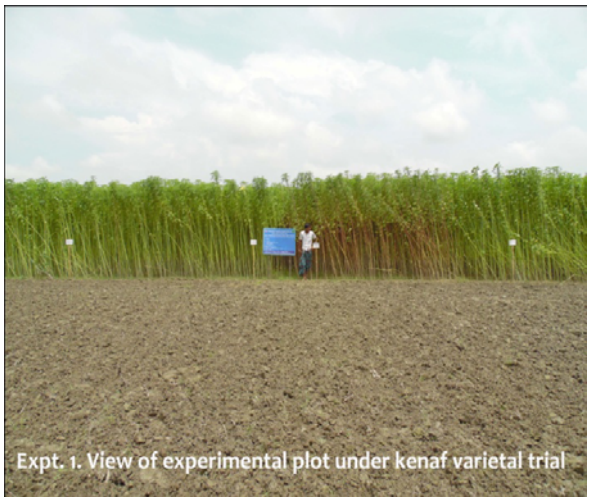
Appendix I: Pictorial view for Experiment number 1

Expt. 1. Distribution of inputs to farmer

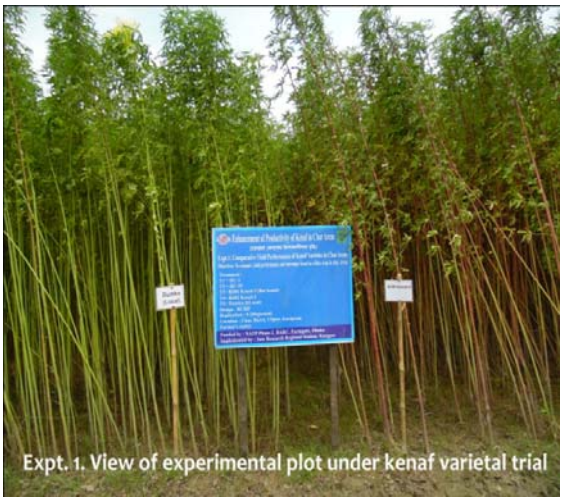
Expt. 1. Doing lay out after final preparation of land under experiment

Expt. 1. Scientist visit the experimental plot

Expt. 1. Farmer in front of the experimental plot



Expt. 1. View of experimental plot under kenaf varietal trial



Expt. 1. View of experimental plot under kenaf varietal trial


Enhancement of Productivity of Kenaf in Char Areas
Expt. 1. View of experimental plot


Enhancement of Productivity of Kenaf in Char Areas
HC-2
HC-95
Expt. 1. Woman farmer in front of the experimental plot


Dumka (Local)
Expt. 1. View of experimental plot under kenaf varietal trial


Enhancement of Productivity of Kenaf in Char Areas
Expt.1: Comparative Yield Performance of Kenaf Varieties in Char Areas
Objectives: To compare yield performance and introduce kenaf as a fibre crop in char areas.
Treatment :
T1 = HC-2
T2 = HC-95
T3= BJRI Kenaf-3 (Bot kenaf)
T4= BJRI Kenaf-4
T5= Dumka-2(Local)
Design : RCBD
Replication : 6 (Dispersed)
Location : Nazar Char, Sundarganj, Gaibandha
Farmer's name: Md. Nasrat Islam
Funded by : NATP Phase-2, BARC, Farmgate, Dhaka
Implemented by : Jute Research Regional Station, Rangpur
BJRI Kenaf-4
Dumka (Local)


Expt. 1. Harvesting of kenaf under experimental plot


Expt. 1. Harvesting of kenaf under experimental plot

Expt. 1. Counting of plant population of kenaf after harvest

Expt. 1. Data collection after harvest of kenaf

Appendix II : Pictorial view for Experiment number 2

Expt. 2. View of experimental plot under farmers cropping pattern

Expt. 2. View of experimental plot (farmers and improved patterns)

Expt. 2. View of experimental plot of kenaf under improved pattern

Expt. 2. Project PI with farmers in front of the experimental plot (right side: farmers pattern and left side: improved pattern)

Expt. 2. View of kenaf and jute plots under improved and farmers pattern

Expt.2. T.aman at vegetative stage under alternative cropping pattern Kenaf-T.aman-Potato at Charbazra, Ulipur, Kurigram

Expt. 2. T.aman experimental plot under development of alternate cropping pattern trial at Char bazra, Ulipur, Kurigram


Expt. 2. View of T.aman experimental plot at Rajar hat Char, Sundarganj, Gaibandha


Enhancement of Productivity of Kenaf in Char Areas
বারি আলু-২৫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Appendix III : Pictorial view under th Experiment number 3

Expt.3. Sowing seed in line for experimental plot at Charbazra, Ulipur, Kurigram


Enhancement of Productivity of Kenaf in Char Areas
Expt. 3 : Performance of Late Season Kenaf Seed Production at Farmer's Field In Char Area
Objectives : To Determine Seed Yield And Quality of Late Season Kenaf Seed Production.
Treatments :
Variety: HC-2, HC-95, BJRI Kenaf-3, BJRI Kenaf-4 & Local.
Design : RCBD.
Replication : 10 (dispersed)
Unit Plot size : 10 decimal
Location : Char Bazra, Ulipur, Kurigram.
Farmer's Name : Nahar Banu
Funded By : NATP Phase-2, BARC, Farmgate, Dhaka
Implemented By: Jute Research Regional Station, Rangpur
Expt. 3. Experimental plot under performance trial of late season kenaf seed production at Char bazra, Ulipur, Kurigram


HC-2
HC-95
Expt. 3. Experimental plot under performance trial of late season kenaf seed production at Char bazra, Ulipur, Kurigram


Enhancement of Productivity of Kenaf in Char Areas
Expt. 3 : Performance of Late Season Kenaf Seed Production at Farmer's Field In Char Area
Objectives : To Determine Seed Yield And Quality of Late Season Kenaf Seed Production.
Treatments :
Variety: HC-2, HC-95, BJRI Kenaf-3, BJRI Kenaf-4 & Local.
Design : RCBD.
Replication : 10 (dispersed)
Unit Plot size : 10 decimal
Location : Char Bazra, Ulipur, Kurigram.
Farmer's Name : Md. Shohidul
Funded By : NATP Phase-2, BARC, Farmgate, Dhaka
Implemented By: Jute Research Regional Station, Rangpur
HC-2
HC-95
Expt. 3. Experimental plot under performance trial of late season kenaf seed production at Char bazra, Ulipur, Kurigram


HC-95

Appendix IV : Pictorial view under th Experiment number 4

TRADITIONAL THRESHING

MECHANICAL THRESHING

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FARMERS CARRYING HARVESTED KENAF SEED PLANTS FOR MECHANICAL THRESHING

FARMERS USED KENAF WASTAGE AS FUEL

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Appendix V : Pictorial view for farmers training

Fig: Farmers Training on Kenaf and seed production program

Appendix VI : Field monitoring

Fig: Field monitoring

Appendix VII : Participant Farmers list

Participant Farmers list

1. Ulipur. Kurigram		
1	Md. Monaem	Char bazra, Ulipur. Kurigram
2	Mrs. Saleha Begum	Char bazra, Ulipur. Kurigram
3	Md. Badiuzzaman	Char bazra, Ulipur. Kurigram
4	Md. Sofiqul	Char bazra, Ulipur. Kurigram
5	Md. Sahidul	Char bazra, Ulipur. Kurigram
6	Mrs. Nehar Banu	Char bazra, Ulipur. Kurigram
7	Mrs. Champa Begum	Char bazra, Ulipur. Kurigram
8	Md. Saiful	Char bazra, Ulipur. Kurigram
9	Md. Chan Mia	Char bazra, Ulipur. Kurigram
10	Mrs. Sapna Begum	Char bazra, Ulipur. Kurigram

2. Sundarganj, Gaibandha		
1	Md. Monir Hossen	Razar char, Sundarganj, Gaibandha
2	Md. Azam Mia	Razar char, Sundarganj, Gaibandha
3	Md. Nazrul Mia	Razar char, Sundarganj, Gaibandha
4	Md. Haider	Razar char, Sundarganj, Gaibandha
5	Md. Mofijul	Razar char, Sundarganj, Gaibandha
6	Md. Manju Mia	Razar char, Sundarganj, Gaibandha
7	Md. Haidar Ali	Razar char, Sundarganj, Gaibandha
8	Md. Raza Mia	Razar char, Sundarganj, Gaibandha
9	Md. Gella Shekh	Razar char, Sundarganj, Gaibandha
10	Md. Mofijul	Razar char, Sundarganj, Gaibandha