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Maximization of quality jute seed production in India

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CRIJAF, Barrackpore
March, 2013

(Sitangshu Sarkar)
Principal Investigator
TMJ-MM 1.4

CONTENTS

1. Introduction

Jute (*Corchorus sp.*), a bast fibre self-pollinated (predominantly) crop is a natural inhabitant of the tropical and subtropical region of the world. However, commercial cultivation is restricted to India, Bangladesh, China, Myanmar, Thailand and Nepal. India happens to be the global leader both in acreage and production of jute and allied fibres accounting for 62% of the world's production. The importance of jute in the economy of Eastern India, particularly of West Bengal needs no emphasis. Its products being biodegradable and eco-friendly in contrast to synthetic substitutes, a renewed interest in this natural fibre has been generated in the recent past throughout the world. Around 5000 tonnes of quality seed is required for sowing about 0.8 million hectare of jute area now under cultivation in India while the annual seed production of certified seeds is only to the tune of 1500 to 2000 tonnes and it can cover only around 35% of total jute acreage in India. Besides, the production of certified jute seeds is mainly undertaken for *olitorius* jute (cv.JRO-524 in particular) as the demand for *capsularis* jute seed has drastically been reduced over the years. Majority of the jute seed requirement of Bangladesh (around 3000 tonnes annually to cover an area of around 0.5 million ha) are also met by Indian seed traders thereby aggravating the crisis of timely availability of quality jute seed locally. Since the objective of growing both fibre and seed crop is entirely different, separate management strategies regarding the improved commercial production of quality seed are warranted. The production of fibre is primarily governed by plant height and its diameter, while seed crop demands a short statured, strong and stout plant to sustain increasing number of pod bearing axillary branches to accommodate enhanced quantum of well-developed seed per plant. Quality of the seed used is the most vital component for undertaking maximisation programme of any crop. This has not been adequately dealt with in jute fibre production as the jute seed sector is yet to be geared up fully to meet up timely supply of quality certified seed to the farmers. Moreover, the seed crop in India is grown mostly as a rainfed crop and is dependent on timely monsoon rains. Any late rains or inclement weather has a major impact on seed harvest, and this in turn impacts on seed availability. Jute seed growers both in India and Bangladesh hardly follow the management standards resulting in poor seed productivity and quality. The four basic components of seed quality are its purity, viability, vigour and health. Being predominantly a self-pollinated crop, jute seed purity can be maintained more conveniently and does not pose appreciable problems if adequate isolation, timely rouging of off-types and management of weeds prior to their seed formation can be ensured. Seed viability (germinability) though plays a decisive role in the quality production of large

seeded crops while in case of small seeded crop like jute, it has been observed that the smaller seeds with around 100% germinability fails to emerge under field conditions due to poor vigour. Jute seed quality has, however, been observed to be directly related with its vigour (planting value) and this can conveniently and readily be gauzed from its size. Increase in seed size has been found to be associated with concomitant increase in other associated seed vigour parameters like test weight, nutrient capital, emergence, emergence rate index, seedling dry matter, seedling vigour index and cumulative growth of the crop. The primary exercise in improving seed quality of jute, therefore, should be directed to increase the proportion of bolder seeds in the seed-lot produced. Appropriate prophylactic measures need to be ensured to discourage the infection of seed borne pathogens. Proper care, therefore, needs to be taken to produce disease -free healthy seeds.

The present endeavour is aimed at providing a comprehensive package of management practices to attain maximized production of quality jute seed under different agro-ecological situations of India.

2. Standardized package of practices for achieving higher jute seed productivity

Package of practices for jute seed production for different agro-climatic conditions of India differed mainly in respect to sowing time, time of topping, date of harvesting, crop duration etc. However, other factors like seed rate, method of sowing, weeding, nutrient and water management, crop protection measures have little differences among the areas studied for jute seed production. Therefore, the common factors of seed production technology were described in one place for all the locations and the differing production factors depicted under each location individually.

A. General package of practices

Before sowing, jute seeds were properly treated with fungicide like bavistin @ 2 g/kg or captan @ 5 g/kg of seed. Sowing in line following spacing of 45 x 10 cm was recommended which reached the optimum plant density of 2.2 lakh/ha. Usually 3 kg seed was required to cover one hectare of land.

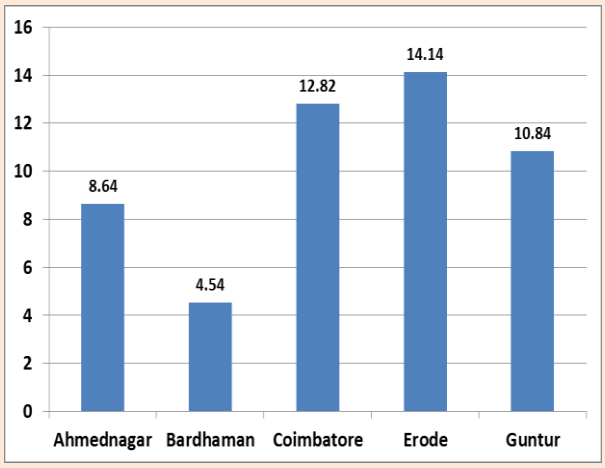
Two weeding was recommended, the first one at 14 days after sowing (DAS) and the second weeding was at 28 DAS. However, it may vary from place to place and accordingly weeding time need to be ascertained. For some typical red soil type and in time of lesser rainfall, only one weeding at 28 DAS was sufficient. Manual weeding is always highly cost adding to the total production cost. Therefore, mechanical weeding by 'CRIJAF Nail Weeder' was recommended in between the rows. Few weeds that left untouched by the 'CRIJAF Nail Weeder', along the line of

jute plants were removed manually, if pose serious problem. To get the desired plant population, thinning or removals of the extra jute plants (if any) were required and the operation was done along with the weeding.

Spacing of 40 cm x 10 cm were maintained for desired plant density

Weeding was crucial for raising jute seed crop

Very fertile land where more remunerative crops such as vegetables and other more economic crops are grown were not spared for jute seed production. Instead lands with medium and low fertility level were used for jute seed production. These types of soils were generally low in organic carbon content (0.3 to 0.5%) and low to medium in other nutrients including nitrogen.



Effect of FYM on % increase in seed yield in jute at different locations

Therefore, it was found from the present study that addition of organic matter (such as FYM @ 3.75 t/ha) had beneficial effect on jute seed production. Although, it is a matter of concern that day by day, availability of FYM even in the remotest of the villages is diminishing and if available, the cost of such input surpasses the economic benefit gained from increased quality & productivity.

Applications of nitrogen, phosphate and potash @ 60:60:60 kg/ha to the jute seed crop enhanced the seed productivity. Nitrogen as basal was not recommended for jute seed crop. In basal, with final land preparation full amount of phosphate (60 kg/ha) and potash (60 kg) were applied. If FYM was applied, the rate was 3.75 t/ha for achieving better soil condition. It was found that nitrogen in 3 split doses was superior to other method of application. Nitrogenous fertilizer splited as 20 kg N as urea (soil application) after final weeding and thinning (at 28 DAS), 20 kg N just after topping (42 DAS) and the remaining 20 kg N coinciding with the active branching (60-65 DAS).

Apical pruning of jute plant (topping) encourages growth of lateral branches and thereby increased numbers of pods per plant were achieved. From the result of the multi-location trials, it was established that topping at 42 ± 5 DAS, in general was appropriate for all the locations depending on the local situation and the stage of vegetative growth of the jute plants. A general thumb rule was that if the jute plants reached the 'knee height' stage, topping was done. It was found that the actual time of topping was 42 DAS for Bardhaman, 44-50 DAS for Paschim Medinipur, 42-48 DAS for Guntur, 42 DAS for Ahmednagar and 38-42 DAS for Coimbatore and Erode. Only the apical bud was removed manually by clipping it with the nails of thumb and the index finger. Heavy topping (like pruning) and very early stage of topping was detrimental for the seed crop of jute.

Even after sufficient care, weeds and off-type plants other than the desired variety of the crop were present in the seed production plots. Therefore, periodical and timely removal of 'Off type' plants from the jute seed plots were necessary. The process is called 'Roguing'. Roguing was done at stages like early growth phase, flowering, pod formation and seed maturity stages. The distinguishable phenotypic characters such as growth habit, leaf shape, size and leaf colour, pigmentation, branching behaviour, early flowering, late flowering, dehiscence of mature fruit etc were taken into consideration during the rouging process.

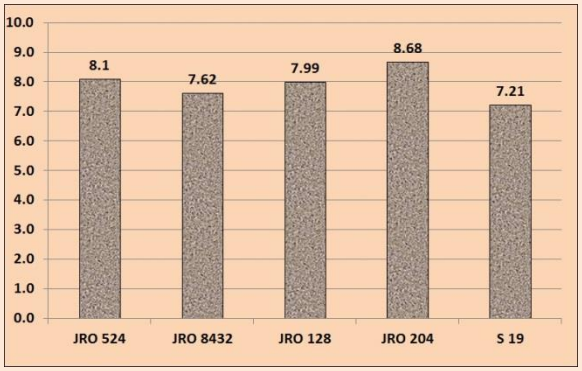
For getting higher seed yield, irrigation was given to the jute seed crop when soil was dry. In general jute crop required 2-3 irrigations. From the study, it was observed that in normal rainfall year with even distribution, jute seed production at Jhargram area of Paschim Medinipur was possible with no irrigation. Although seed yield was comparatively low (3.0 - 4.5 q/ha) might be due to poor native soil fertility including lower organic carbon content. If sudden rainfall was occurred, excess water was drained out of the plots as soon as possible.

As the jute seed crop was grown at the later part of the active monsoon rain, the attack of insect pest was less as compared to jute fibre crop. Incidence of insect attack causing economic damage was given timely application of insecticides.

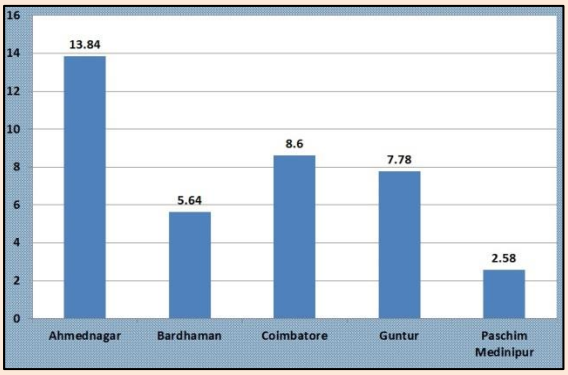
Incidence of some disease was noticed in the jute seed crops and the same was treated. To protect the jute seed crop from fungal diseases, spraying of carbendazim (12%) + mancozeb (63% WP) at 15 days interval @ 2 g/litre of water during pod formation stage was followed and proved beneficial.

Olitorius varieties produce non-shattering pods and all the varieties were harvested when majority of the pods were ripe. The whole jute plants along with the pods were harvested close to the ground level by sharp sickle during the morning hours.

The harvested jute plants were kept on the threshing floor under shade for 2-3 days to get all pods dried. During this time it was not kept in a heap. After 2-3 days, the plants were placed under the sun for drying. During the night it was covered by tarpaulin when the jute plants were cool enough. In the next morning again the tarpaulin was removed and the jute plants (along with the pods) were exposed to sunlight for drying. The process was continued for few days for proper drying. Then the pods were beaten by light weight wooden logs to separate the seeds from the pods. The seeds so collected were cleaned by winnowing. The clean seeds sun dried for few more days. The moisture content of jute seed was 8-9% at that time. After sunning the seed was allowed to cool before storing.



Varietal differences in jute seed yield



Seed yield of olitorius jute over locations

Gunny bags lined with polythene sheet was used for storing the produced jute seed. For smaller quantity of seeds as sample, air-tight pouch was used. On the bag or pouch, proper label indicating the variety, date of harvest, quantity, germination percentage etc were affixed.

B. Other jute seed production factors that differed over locations

WEST BENGAL

Bardhaman

Different types of soil are avilable in different topographical, biological and hydrological as well as geological condition within the Bardhaman district. This soil is of reddish colour, medium to coarse in texture, acidic in reaction, low in nitrogen, calcium, phosphate and other plant nutrients. Water holding capacity of this soil increases with depth as well as with the increase of clay proportions. The actual location of the field experiment was at Central Seed Research Station for Jute and Allied Fibre Crops, Bud Bud and also in the farmer's field at Bhasapur village in Galsi-II block of Bardhaman (http://www.bardhaman.gov.in/).

Based on field experimentation in the institute farms (Budbud) and on farmer's field (Galsi-II) for several years the package of practices for jute seed production in Bardhaman district had been standardized for higher jute seed productivity.

Seed crop of jute at Budbud, Bardhaman

Topping in time encouraged more branches and supported more seed yield

For Bardhaman district, the appropriate time of sowing for jute seed was 7th – 21st August depending on the intensity of monsoon rainfall in a particular year over the area. Early sowing decreased crop stand due to water stagnation in comparatively clay containing soil, increased weed infestation and several other associated crop management difficulties. Delayed sowing was decreased seed yield and the seed crop suffered from moisture stress at the later phase of crop growth.

Other crop management practices for seed production of jute at Bardhaman were discussed in the 'general package of practices' chapter.

Table 1. Seed yield performance of different *olitorius* jute varieties at Budbud

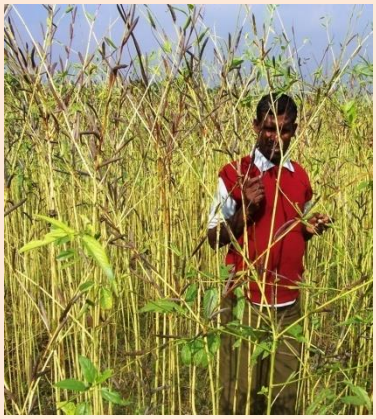
Varieties	Plant height (cm) at harvest	No. of branches /plant	No. of pods /plant	No. of seeds /pod	1000 seed weight (g)	Seed yield (q/ha)
JRO 524	313.8	6.08	33.04	200.72	1.890	4.64
JRO 8432	315.9	7.40	34.70	204.86	1.983	6.07
JRO 128	307.9	6.50	31.80	206.86	2.087	4.46
JRO 204	324.2	7.52	44.36	206.38	2.080	6.07
S 19	325.7	7.24	35.61	176.92	2.023	5.01

Seed crops of jute in Bardhaman were harvested between 7th and 15th December at 115-120 days crop age. The average jute seed yield at Budbud was 5.25 q/ha with a maximum of 6.07 q/ha each for JRO 204 and JRO 8432 variety. Whereas, the average seed yield in farmer's field at Galsi-II (Bardhaman) was 6.13 q/ha and the highest seed productivity was 6.86 q/ha for JRO 8432.

Table 2. Performance of different *olitorius* jute varieties for seed production at Galsi

Variety	No. of Branches/plant	No. of pods/ plant	No. of seeds/ pod	1000 seed weight (g)	Seed yield (q/ha)
JRO 524	4	15	237	2.42	5.23
JRO 8432	5	21	249	2.32	6.86
JRO 128	5	15	254	2.31	6.17
JRO 204	5	18	254	2.29	6.25

Jute seed crop at Galsi, Bardhaman



Farmer of Galsi got rich harvest of jute seed crop

The average 1000 seed weight of jute seed produced at Bardhaman was 2.013 g for Budbud and 2.335 g for Galsi-II. The highest Test weight of 2.087 g was recoded in JRO 128 at Budbud.

Paschim Medinipur

Paschim Medinipur is also considered as one of the drier districts of West Bengal and therefore tried for jute seed production. North and north-west region of this district is a part of Chhotonagpur plateau in its eastern end and covered with hard laterite stone (http://www.paschimmedinipur.gov.in). The field used for jute seed production was at Regional Research Station (Red & Laterite Zone), Bidhan Chnadra krishi Viswavidyalaya, Jhargram, Paschim Medinipur, West Bengal (situated at 22.5^{0}N latitude and 87.0 ^{0} E longitude and at an elevation of 78.77 m above MSL). The land were upland where the soils are coarse textured and strongly acidic (pH 4.2) and poor in organic matter (0.22 %), available nitrogen (175 kg/ha), phosphorus (22 kg/ha), potassium (130 kg/ha) and highly susceptible to erosion hazards. The annual precipitation varied between 1100 mm and 1300 mm; about 80% of which are usually precipitated between June and September i.e. during active monsoon period.

For Jhargram area of Paschim Medinipur, the appropriate time of sowing for jute seed crop was 7th – 15th July, with the sufficient monsoon rains. The seed crop was topped at 42 DAS.

Table 3. Seed yield performance of different *olitorius* jute varieties at Jhargram

Jute varieties	Plant height (cm)	No. of branches/plant	No. of pods/plant	No. of seeds/pod	1000 seed weight (g)	Seed yield (q/ha)
JRO 524	261.0	8.6	42.6	255.7	1.76	1.25*
JRO 8432	270.2	9.6	52.0	268.3	1.60	1.44*
JRO 128	281.0	11.2	58.2	270.7	1.70	3.34
JRO 204	315.6	12.4	61.0	295.4	1.95	4.81
S 19	265.2	7.6	47.0	245.0	1.65	2.06

**plant population was less in the field as compared to other varieties*

The right harvesting time for jute seed crop at Jhargram area of Paschim Medinipur was 7th to 10th November at 120-125 days after sowing. The average seed productivity was only 2.58 q/ha whereas, the highest seed productivity was 4.81 q/ha for JRO 204. The average test weight of jute seed produced at Jhargram was 1.73 g with the highest 1000 seed weight of 1.95 g for JRO 204.

ANDHRA PRADESH

Guntur

In Andhra Pradesh, Guntur area was chosen for jute seed production studies as the area is conventionally jute seed producing district. The normal rainfall of the district is 851 mm. The climate is generally warm in summer and winter is mild. The Krishna is the most important river in the district. The soils in general are very fertile and they are broadly classified as Black cotton, Red loamy and sandy loamy (http://guntur.nic.in/).

The appropriate sowing time for jute seed crop was between 28th July and 15th August coinciding with the availability of sufficient monsoon rain.

Table 4. Seed yield Performance of different *olitorius* jute varieties at Guntur

Jute varieties	Plant height (cm)	No. of branches/plant	No. of pods/plant	No. of seeds/pod	1000 seed weight (g)	Seed yield (q/ha)
JRO 524	167	16.4	98.0	213.2	2.22	6.20
JRO 8432	156	13.0	84.6	238.6	2.18	5.70
JRO 128	190	12.2	89.8	211.2	2.08	10.40
JRO 204	206	11.6	194.2	226.2	2.36	10.30
S 19	160	14.4	173.4	177.6	2.26	6.30

The seed crop was harvested during 7th – 21st December at 130 days after sowing. The average jute seed productivity was 7.78 q/ha with the highest productivity of 10.4 q/ha for JRO 128 and 10.3 q/ha for JRO 204. The seeds were bold and the average 1000 seed weight was 2.22 g with the highest value of 2.36 g for JRO 204.

MAHARASHTRA

Admednagar

In Maharashtra, the jute seed crop was grown at Rahuri area of Ahmednagar district. The district is located between 19°23′N & 74°39′E and 19.38°N & 74.65°E at an average elevation of 511 m (http://ahmednagar.gov.in/). The nutrient content of the jute seed plots were 198 kg N, 9.04 kg P and 520 kg K and the organic carbon content was 0.61%.

Jute seed field at Ahmednagar

Healthy growth of jute seed crop (JRO 204) at Ahmednagar

The suitable date of sowing for jute seed crop at Ahmednagar was 28th June to 15th July. Being very fertile soil of Agmednagar, especially at Rahuri, the general growth of the jute seed crop was remarkable. Two irrigations at 28th June and 3rd August were required. The seed crop was harvested during 1st – 28th November at 125 to 135 DAS during the period of study.

Table 5. Seed yield performance of different *olitorius* jute varieties at Rahuri

varieties	No. of plants /m²	Plant height (cm)	No. of branches /plant	No. of pods /plant	No. of seeds /pod	1000 seed weight (g)	Seed yield (q/ha)
JRO 524	27.6	254.9	18.44	51.04	203.94	2.237	15.68
JRO 8432	28.0	254.4	22.28	53.64	231.86	2.423	16.20
JRO 128	29.4	249.7	17.74	48.84	255.06	2.383	11.90
JRO 204	27.4	264.5	20.88	47.80	204.60	2.197	12.80
S 19	30.6	255.0	17.68	62.56	210.32	2.597	12.64

The average jute seed yield was 13.84 q/ha. The highest seed yield of 16.20 q/ha was obtained with JRO 8432 variety. The seeds were bold and the average 1000 seed weight was 2.37 g and the highest test weight was 2.59 g for S 19 and 2.42 g for JRO 8432.

TAMIL NADU

Coimbatore

The Coimbatore district of Tamil Nadu was selected for jute seed maximization programme. The mean maximum temperature was 25.3° C (in April) and mean minimum temperature was 18.7° C (in December). The total annual rainfall was 694.4 mm of which 327 mm rain occurs with north-east monsoon. The soil was sandy clay loam with pH 8.04. The available N, P and K contents were medium in values (http://coimbatore.nic.in/).

Field of jute seed crop at Coimbatore

Jute seed crop at Erode

The suitable sowing time for jute seed crop at Coimbatore was 21st June to 7th July and the crop required topping at 38-42 DAS. The seed crop was harvested on 31st October at 130-135 DAS.

Table 6. Seed yield performance of different *olitorius* jute varieties at Coimbatore

Jute varieties	No. of plants/m²	Days to 50% flowering	No. of branches/plant	No. of pods/plant	Seed yield (q/ha)
JRO 524	18	50	11.8	89.6	10.21
JRO 8432	17	47	12.6	70.5	7.82
JRO 128	15	52	11.2	67.6	8.23
JRO 204	18	54	11.3	61.4	8.54
S 19	17	52	9.9	69.9	8.16

At Coimbatore, infestation of mealy bug in the jute seed crop at the early stage of the crop growth was also recorded. Little leaf symptoms as formed in case of mycoplasma disease were also observed in some plots of jute seed crops at Coimbatore.

Little leaf symptoms in jute seed crops were observed at Coimbatore

Infestation of mealy bug was also observed in jute seed crop at Tamil Nadu

The average seed yield was 8.60 q/ha at Coimbatore. The highest seed yielder was JRO 524 (10.21 q/ha) followed by JRO 204 (8.54 q/ha). The average 1000 seed weight was 1.95 g. The highest 1000 seed weight of 1.98 g was recorded for JRO 524 followed by 1.96 for JRO 128.

Table 7. Test weight of jute seeds over locations

Location	State	1000 seed weight (g)	Variety
Budbud, Bardhaman	West Bengal	2.08	JRO 128
Galsi, Bardhaman	West Bengal	2.42	JRO 524
Jhargram, Paschim Medinipur	West Bengal	1.95	JRO 204
Jangamaheswarapuram, Guntur	Andhra Pradesh	2.36	JRO 204
Rahuri, Ahmednagar	Maharashtra	2.59	S 19
TNAU Farm, Coimbatore	Tamil Nadu	1.98	JRO 524
Bhavanisagar, Erode	Tamil Nadu	1.96	JRO 524

Bold seeds showed better field emergence and higher vigour index

It was observed that the boldest seed was produced at Ahmednagar district of Maharashtra. The seed produced at Bardhaman is also of good quality. The test weight of seeds produced at Paschim Medinipur is quite low due to poor soil fertility resulting reduced general growth of the seed crop.

3. Seed quality parameters

The jute seeds produced at different agro-climatic conditions of India were undergone standard quality testing at the Seed Centre, Tamil Nadu Agricultural University, Coimbatore.

Table 8 . Effect of provenance on seed quality parameters of *olitorius* jute seed

Quality parameters of jute seed	Provenance/ geographical source of seed				
	(C_1) CBE	(C_2) BWN	(C_3) MDN	(C_4) GTN	(C_5) ANG
Moisture content (%)	11.12	11.36	11.30	10.94	11.32
Recovery (%)	97.6	96.1	96.3	96.1	97.4
Germination (%)	76.7	81.4	76.1	81.7	76.7
Speed of germination	18.12	18.76	18.54	19.06	18.28
Root length (cm)	4.53	4.68	4.19	4.57	4.26
Shoot length (cm)	5.54	6.01	5.28	5.94	4.82
Vigour index	775	870	721	859	696
Dry matter production (mg/20 seedlings)	0.578	0.574	0.514	0.611	0.486
Field emergence (%)	68.9	71.2	67.8	73.5	68.2
Electrical conductivity (dSm^{-1}) of seed leachate	0.187	0.153	0.157	0.143	0.174
Oil content (%)	10.44	9.52	11.28	9.66	11.66
Seed infection (%)	0.040	0.020	0.144	0.054	0.226

CBE: Coimbatore; BWN: Bardhaman; MDN: Midnapore (West); GTN: Guntur; ANG: Ahmednagar

Moisture Content (%)

The effect of provenance/origin among *olitorius* jute seeds produced under this project showed significant differences in moisture content at harvest. Among the five provenances, C_4 or Guntur recorded the minimum moisture content (10.94%) followed by the moisture content of C_1 or Coimbatore seeds (11.12%).

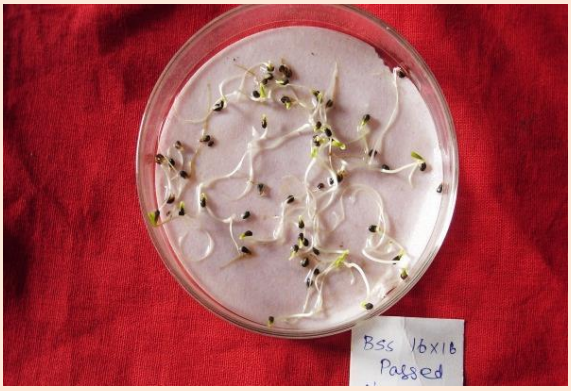
Seed Recovery (%)

The seed recovery % for *olitorius* jute seeds with respect to different provenances showed significant differences. Seed recovery percentage was found to be the highest in case of Coimbatore seeds (97.64%). Similarly, the lowest percentage was registered by Bardhaman (96.05%) followed by Guntur (96.06%) which was at par with each other.

Germination (%)

The effect of different source/ provenances on germination of jute seed was studied. Among the provenances, seeds of Guntur exhibited maximum germination (81.7%) which was at par with Bardhaman seeds in respect to germination (81.4%).

BSS 16 x16 Retained seeds



BSS 16 x 16 Passed seeds

Germination of size graded seeds using BSS 16 X 16 sieve in *olitorius* jute

Speed of germination

Speed of germination of *olitorius* jute seed was observed to be significant due to provenances. The speed of germination was observed to be the maximum in the provenance of Guntur (19.06) followed by Bardhaman (18.76).

Root length (cm)

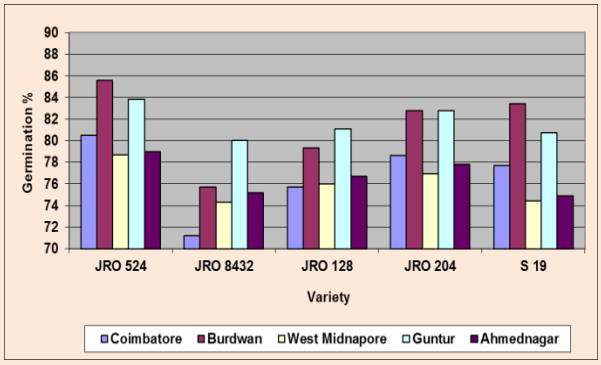
Regarding root length, significant differences were noticed for jute seeds produced at different provenances. The provenance C_2 (Bardhaman) exhibited the lengthiest roots (4.68 cm) followed by Guntur (4.57 cm) which was on par with Coimbatore (4.53 cm).

Shoot length (cm)

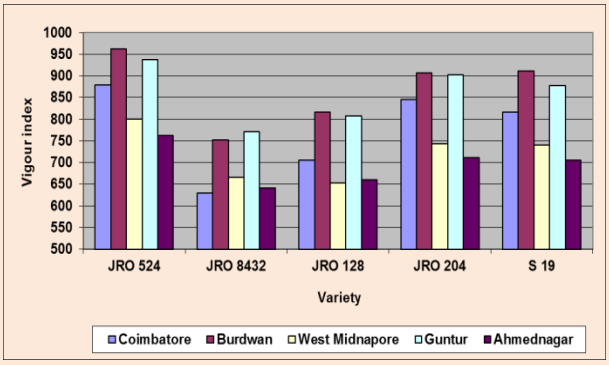
Significant differences in shoot length were observed for *olitorius* jute seeds due to different provenances. Between the provenances C_2 (Bardhaman) registered the maximum shoot length of 6.01 cm and the lowest shoot length was recorded in case of Ahmednagar seeds (4.82 cm).

Vigour index

The vigour indices derived for the jute seeds produced under this project showed significant differences due to provenances. Among the provenances considered, Bardhaman seeds showed maximum vigour index (870) and Ahmednagar seeds recorded the minimum vigour index (696).



Germination % of jute seed of different varieties produced at different locations of the project



Vigour index of jute seed of different varieties produced at different locations of the project

Dry matter production (mg/20 seedlings)

The dry matter production of jute seeds due to different provenances showed significant variations. Among the provenances, C_4 (Guntur) recorded the highest dry matter production (0.611 g/20 sdl) and the lowest DMP was recorded for Ahmednagar (0.486 g/20 sdl).

Field emergence (%)

Significant differences were observed in field emergence of jute seeds due to different provenances. The highest field emergence was obtained in Guntur seeds (73.5%) followed by Bardhaman seeds (71.2%).

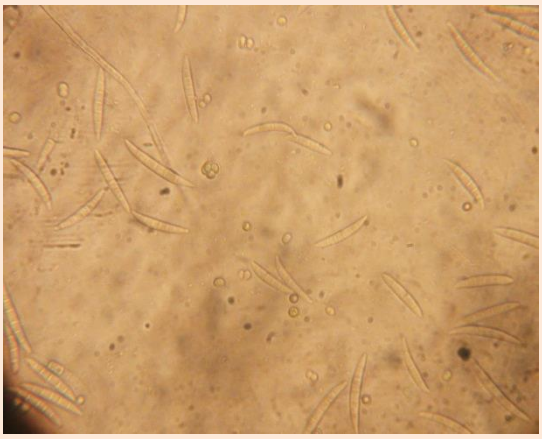
Electrical conductivity (dSm^{-1})

Membrane integrity is important for getting good vigour for seeds and jute seed is no exception. Electrical conductivity of jute seed leachates were noted as a measure of seed membrane integrity. Significant differences were observed for electrical conductivity for *olitorius* jute seeds due to different provenances. Among the provenances, the seed leachate was the maximum for Coimbatore seeds (0.187 dSm^{-1}) and the minimum electrical conductivity was in case of Guntur seeds (0.143 dSm^{-1}).

Oil Content (%)

It was reported that natives of some north-eastern parts of India extract and use jute seed oil for curing skin diseases. Earlier researcher opined that *olitorius* jute seed contains 8.3 (JRO 878) to 12.6 % (JRO 632) oil. The oil content of the jute seeds produced under this project varied between 9.78 and 11.38%. The oil content for the tested varieties were in the decreasing order of JRO 128 (11.38%) > JRO 204 (11.12%) > JRO 8432 (10.44%) > JRO 524 (9.84%) > S 19 (9.78%). The results of oil content showed significant differences for jute seeds in response to different provenances. The provenance C_5 (Ahmednagar) registered the highest oil content of 11.66% and the lowest in Bardhaman (9.52%) which was at par with the oil content of Guntur seeds (9.66%).

Pathogen observed in harvested jute seeds



***Fusarium** sp*

***Alternaria** sp*

Irrespective of locations, the seed infection for different varieties of *olitorius* jute seeds were in the ascending order of JRO 8432 (0.00%) > S 19 (0.07%) > JRO 128 (0.11%) > JRO 524 (0.15%) > JRO 204 (0.16%) The effect of different provenances or sources of seed on seed infection of *olitorius* jute seeds showed significant differences. The provenance C_2 (Bardhaman seed) recorded the minimum seed infection percentage of 0.020% whereas; Ahmednagar recorded the maximum seed infection of 0.226%.

4. Mass scale seed production and distribution

The Jangamaheswaram centre (at Guntur) of the project produced 500 kg seeds of JRO 204, JRO 8432, JRO 128 and S 19 in 2010 and handed over to Dr. D. Kumar, the then Nodal Officer (Seed) at Central Research Institute for Jute and Allied Fibres (CRIJAF), Barrackpore. The seeds were distributed on payment among the jute farmers of West Bengal. In the same year, another 500 kg jute seed of improved varieties was produced under direct supervision of the Principal Investigator. The same was transported to CRIJAF and it reached to the jute farmers well ahead of the sowing season of jute for fibre crop.

About 1000 kg of jute seed produced and distributed among the jute farmers

Dr. D. Kumar, Nodal Officer (Seed), CRIJAF inspecting the jute seed

5. Economics of jute seed production at different locations

From the jute seed production field trials conducted at various agro-climatic conditions, it was calculated that the average cost for jute seed production was ₹34,285 per hectare and the net income of ₹ 57,600 was obtained from a seed yield 8.0 q/ha sold for ₹ 7200/q. Therefore, from jute seed production activity, the Net return per rupee investment was 1.68.

6. Conclusion

The location specific improved production technology for achieving higher seed yield of *olitorius* jute were developed and refined through field experimentation for a period of 5 years (2007-08 to 2011-12) of the project for West Bengal (Bardhaman and Paschim Midnapore), Andhra Pradesh (Guntur), Maharashtra (Ahmednagar) and Tamil Nadu (Coimbatore and Bhavanisagar). It was observed that, location (districts) wise, the *olitorius* jute seed productivity were the highest in Ahmednagar, Maharashtra (12.33 q/ha), followed by Coimbatore (10.25 q/ha), Erode (9.93 q/ha), Guntur (9.64 q/ha), Bardhaman, West Bengal (6.13 q/ha) and West Midnapore (4.81 q/ha).

There are significant differences in respect to seed quality among the source or location of jute seed production (provenance). The overall quality performance of Jute seeds from different provenance revealed that irrespective of varieties, the seeds produced at Bardhaman of West Bengal and Guntur of Andhra Pradesh possessed the highest seed quality characters and the seeds produced at Ahmednagar (Maharashtra) found comparatively of poor quality characters.

7. Possibilities of jute seed production in other drier districts of West Bengal

A large area of Bankura and Purulia districts of West Bengal would be suitable for jute seed production because of comparatively congenial drier climatic condition, availability of marginal and uncultivated lands, and availability of rural work force. Gangajalghati, Chatna, Simlapal, Onda, Bishnupur (part) blocks of Bankura will be better suited for jute seed production. In Purulia, general cultivation is predominantly mono-cropped. About 60 % of the total cultivated land is upland. Out of the total agricultural holding about 73 % belongs to small and marginal farmers having scattered and fragmented smallholding. Therefore, Kashipur, Baghmundi, Balarampur and similar other areas in Purulia could suitably be utilized for jute seed production.