



## Seed Yield and Quality of Late Season Jute (*Corchorus olitorius* L.) Seed as Influenced by Plant Growth Regulators

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### Abstract

An experiment was conducted at Jute Research Regional Station (JRRS) of Bangladesh Jute Research Institute (BJRI), Kishoreganj during August 2009 to January 2010 to determine the effect of different plant growth regulators on seed yield and quality of olitorius jute using late jute seed production technique. The experiment was laid out in a randomized complete block design (RCBD) with four replications. Seven growth regulators with different brand names such as Bionik, Litosen, Okozim, Mirakulan, Planovit, Flora and Yield were used in the experiment. All the yield contributing characters increased due to the application of growth regulators over the control. The highest seed yield (2.91g/plant) was obtained with Bionik which was followed by Mirakulan> Okozim> Litosen> Planovit> Yield> Flora> control. The highest of 33.49% seed yield was found in Bionik over control. In terms of quality of seeds, the plant growth regulator 'Bionik' performed the best.

**Keywords:** Plant growth regulator (PGR), jute seed, yield, quality.

### 1. Introduction

Jute (*Corchorus* sp.) is the principal fiber crop of Bangladesh. It accounts for 6% of the foreign currency earnings from exports (Islam, 2009). Bangladesh is the largest supplier of jute and jute goods in the international markets meeting nearly 95% of world raw jute demand and about 60% of jute goods demand (Rahman, 2010). The green leaves of jute contain minerals and proteins, which are edible and are popular as leafy vegetable. Now a day's attempt is being made to popularize the jute plants also for making pulp in paper industries (Dastogeer *et al.*, 2011). Among the various factors related to good production, seed quality plays the pivotal role. Quality seed of an improved variety itself

can provide 20% additional jute yield (Hossain *et al.*, 1994). Normal sowing time of olitorius jute is in the month of April for fiber production and August-September is the sowing time for seed production of olitorius jute but seed production during August-December known as 'late season jute seed production technique'. Unfortunately the availability of good quality jute seed in our country is far below than the total requirement. Farmers of the country often have to depend on market seed having poor quality. Hence, the production and quality of healthy jute seed as well as its quality storage is highly essential to ensure the higher yield of quality fiber in order to meet the challenging need for natural fiber. Bangladesh requires 4000-4500 MT of jute seed annually where as

production in Bangladesh Agricultural Development Corporation (BADC) is only 800-1000 MT. The farmers produce 400-600 MT. Rest of the demand is met up by importing mostly from India (Pulok *et al.*, 2014). Nevertheless, the country has to largely rely on the farmers' seed and it faces acute scarcity of quality jute seed every year.

Plant Growth Regulators (PGRs) encompass a broad category of compounds that promote, inhibit, or otherwise modify plant physiological or morphological processes. Some PGRs are plant hormones or their analogues; others are simply metabolic regulators. PGRs are classified as organic compounds that alter the growth and development of plants. Plant growth regulators are used as stimulant in many crops to enhance the growth and yield of crops. Chemical PGRs have been widely used in cotton production in an attempt to adjust plant growth and to improve lint yield and fiber quality (Cothren and Oosterhuis, 2000). Now- a- days many growth regulators are available in our country. But the performances of growth regulators are not known for jute seed crops. From the above facts the experiment was designed to find out the effect of different plant growth regulators on seed yield and quality of olitorius jute under late jute seed production technique.

## 2. Materials and Methods

An experiment was conducted at the Bangladesh Jute Research Institute (BJRI), Regional Station, Kishoreganj, Bangladesh during the period from August to January 2009-2010. The site is located at 24°38' North latitude and 90°13' East longitudes and at an altitude of 18 m. The soil of the site belongs to Old Brahmaputra Floodplain Agro Ecological Zone, 'AEZ-9' (UNDP and FAO, 1988). The field was medium high land having well-drained silty loam soil with  $p^H$  6.75. The experimental field was prepared with three ploughings and cross ploughings followed by laddering. A randomized complete block design was used for this experiment with four replications. Seven growth regulators with

different brand name such as Bionik, Litosen, Okozim, Mirakulan, Planovit, Flora and Yield were used in the experiment along with a control plot. The tested jute seed variety was O-72. The unit plot size was 4m × 3m. The climatic condition was hot and humid with frequent rain during vegetative phase, and cold and dry during the reproductive and ripening phase (Table 1). The crop was sown on 20 August, 2009. Line to line spacing was 30cm and plant to plant spacing was 10cm. The crop was fertilized with urea, triple super phosphate, muriate of potash, gypsum and zinc sulphate @ 90 kg N, 20 kg P, 20 kg K, 18 kg S and 8 kg Zn ha<sup>-1</sup>, respectively. One third of urea and full amount of other fertilizers were applied as basal dose during final land preparation. The rest amount of urea was top dressed in two equal splits on 25 and 45 days after sowing (DAS). Plant growth regulators were applied at three different times of application *i.e.* vegetative at 70 DAS, flower initiation at 80 DAS and pod initiation stage at 90 DAS of the crop. The growth regulators were applied by spraying at ten days interval. Solution was prepared according to company recommendation (Bionik @ 4ml/1L, Litosen @ 10ml/10L, Okozim @ 5ml/10L, Mirakulan @ 5ml/10, Planovit @ 15-20ml/10 L, Flora @ 5ml/10L, Yield @ 1.5ml/10L of water). Spraying was done at the time of late afternoon.

All intercultural operations were done accordingly for off season seed production technique. Weeding was done by hand at 30 and 50 days after sowing (DAS). The crop plants were infested by caterpillar at vegetative stage. Insects were successfully controlled by spraying Ripcord 10 EC @ 2 ml L<sup>-1</sup> of water at an interval of 10 days. Removal of excessive rain water was done as and when necessary. The crop was harvested at maturity (when 80% capsules became brown). Plant height, base diameter, branch plant<sup>-1</sup>, pod plant<sup>-1</sup>, seed pod<sup>-1</sup> and seed yield plant<sup>-1</sup> and different quality parameters *i.e.* 1000-seed weight, germination%, vigor index, accelerated ageing and field emergence were recorded. Seed yield and other plant characters were recorded from 10 randomly selected plants

of each plot. The crop was harvested on 6-12 January in 2010. After harvest the crop was dried for three days and then threshed by beating with a stick. Seeds were cleaned and then dried for another five days in the sun to bring seed moisture content below 10% and stored properly in suitable air tight containers.

### 2.1 Laboratory germination test

The test was conducted on top of the paper method. The test was conducted on top of the paper method. One hundred seeds in four replications were placed on the moist paper (two fold of Bashundhara kitchen towel) in petridish (11 cm diameter). The petridishes were kept in the germinator maintain temperature at  $30 \pm 1^{\circ}\text{C}$ . Daily counting of the germinating seedlings were done up to 8 days of seed setting. The number of normal seedling was counted at 8 DAS and the germination percentage of seed was measured with the following formula:

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

### 2.2 Vigour Index (VI)

The number of germinated seeds was counted daily from the germination test up to 8 days. The seed vigour index (VI) was then calculated by following formula (AOSA, 1983):

$$\text{VI} = \frac{\text{Number of germinated seed}}{\text{Days of first count} + \frac{\text{Number of germinated seed}}{\text{Days of final count}}}$$

### 2.3 Accelerated ageing (AA) test

The test was done using 15 g of seed in accelerated ageing chamber exposing to  $41^{\circ}\text{C}$  temperature and 100% RH for 72 hours. Following the laboratory germination test (ISTA, 1999).

### 2.4 1000-seed weight

1000-seed weight was measured by using electric balance according to (ISTA, 1999).

### 2.5 Field emergence (FE)

Field emergence was calculated according to Mollah (2014) by using following formula:

$$\text{Field emergence (\%)} = \frac{\text{Number of total seedling}}{\text{Number of seed sown}} \times 100$$

### 2.6 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 adjusted by Duncan's Multiple Range Test with the help of a computer based statistical package program MSTAT-C (Gomez and Gomez, 1984).

## 3. Results and Discussion

### 3.1 Plant height

Plant height is an important vegetative factor affecting seed yield. Plant growth regulators exerted significant effect on plant height over control. The tallest plant was recorded (96.67cm) in Litosen which was statistically identical with Bionik but significantly higher than others (Table 2). Plant height of Okozim, Planovit and Yield were statistically similar but significantly lower than Mirakulan and Flora. The shortest plant was recorded (80.63 cm) in control treatment. Similar beneficial effects of plant regulators have been reported by several workers i. e., Chauhan *et al.* (2009) in black gram and horse gram and Somayeh and Alireza (2015) in wheat, Copur *et al.* (2010) in cotton, Akter *et al.* (2007) in mustard.

### 3.2 Base diameter

Plant growth regulators exerted significant effect on plant base diameter over control. The highest base diameter was recorded (10.21 mm) in Bionik which was significantly higher than control (6.55 mm) and Planovit but identical with other treatments. The lowest base diameter was recorded (6.55mm) in control which was statistically similar with Planovit, Flora and Yield (Table 2).

**Table 1.** Meteorological data recorded at the experimental site during the study period

Month	Air temperature (%)		Rainfall (mm)	Relative Humidity (%)	Sunshine (hrs/day)	Cloudy (hrs/day)
	Max	Min				
August-2009	32.4	26.7	277	88.55	4.39	7.08
September-2009	32.4	26.9	154	86.70	4.77	6.18
October-2009	31.9	24.0	193	87.10	5.84	6.75
November-2009	28.4	18.6	2.39	84.22	7.15	4.48
December-2009	23.7	13.7	0.12	79.40	8.00	4.10
January-2010	24.1	12.9	0.00	77.19	4.10	8.06

**Table 2.** Effect of plant growth regulators on seed yield and yield contributing characters of olitorius jute variety O-72

Treatment (Growth regulator)	Plant height (cm)	Base diameter (mm)	Branches/plant (no.)	Capsules /plant (no.)	Seeds/capsule (no.)	Seed yield/plant (g)	% Yield increase over control
Control	80.63e	6.55b	2.65c	7.54f	144.40c	2.18e	-
Bionik	96.00a	10.21a	3.13ab	9.70b	170.13a	2.91a	33.49
Litosen	96.67a	9.89a	3.13ab	9.23c	173.00a	2.59bc	18.81
Okozim	82.97d	9.98a	2.71c	7.77f	162.60b	2.69b	23.39
Mirakulan	88.23b	10.14a	3.16a	10.16a	172.60a	2.74ab	25.69
Planovit	82.50d	8.24b	2.73c	8.20e	163.90b	2.46cd	12.84
Flora	85.63c	8.96ab	2.83c	8.15e	147.53c	2.22e	1.83
Yield	82.53d	8.16ab	2.90bc	8.63d	162.07b	2.36de	8.26
CV(%)	1.21	19.46	5.50	2.01	1.48	5.49	-
LSD (0.05)	1.54	2.52	0.24	0.25	3.54	0.20	-
Level of sig.	**	**	**	**	**	**	

**Table 3.** Effect of plant growth regulators on the seed quality of olitorius jute variety O-72

Treatment (Growth regulator)	1000-seed wt. (g)	Germination (%)	Vigor Index (%)	Accelerated ageing germination (%)	Field emergence (%)
Control	1.894bcd	86.50ab	80.57cd	72.00ab	84.50ab
Bionik	2.008a	89.75a	85.23a	75.00a	87.00a
Litosen	1.980abc	88.25ab	84.58ab	74.00ab	86.00a
Okozim	1.891bcd	85.50ab	82.26abcd	73.00ab	83.75ab
Mirakulan	1.986ab	89.50a	83.12abc	74.00ab	85.75a
Planovit	1.867cd	84.75ab	81.88bcd	73.00ab	83.00ab
Flora	1.821d	85.50ab	79.89d	70.00b	81.25b
Yield	1.872bcd	83.25b	82.24abcd	71.00ab	83.50ab
CV(%)	3.80	3.83	2.32	3.59	3.03
LSD (0.05)	0.104	4.874	2.817	3.841	3.761
Level of sig.	**	*	**	*	**

Note: CV= Coefficient of variation, \*\*= Significant at 1% level,\*= Significant at 5% level. In a column, figures having similar letter(s) do not differ significantly at 5% level as per DMRT

### 3.3 Branches per plant

Plant growth regulators exerted significant effect on the number of branches per plant over control. The highest number of branches per plant was recorded (3.16) in Mirakulan which was identical with Bionic and Litosen but significantly higher than others (Table 2). The lowest number of branches per plant was recorded (2.65) in control and it was statistically similar with Okozim, Planovit and Flora. Similar result was reported by Gare *et al.* (2017) in chilli.

### 3.4 Capsules per plant

Number of capsules per plant is an important seed yield contributing character. Plant growth regulators exerted significant effect on number of capsules per plant over control. The highest number of capsules per plant was recorded (10.16) in Mirakulan which was significantly higher than all other treatments (Table 2). The second highest number of capsules per plant was recorded in Bionic and it was significantly higher than others. Moderate number of capsules per plant was observed in Planovit and Flora, and the lowest number of capsule per plant was recorded (7.54) in control which was identical with Okozim (7.77). Similar results have been reported by several workers i.e., Copur *et al.* (2010) in cotton, Akter *et al.* (2007) in mustard.

### 3.5 Seeds per capsule

Number of seeds per capsule is another important seed yield contributing character. Plant growth regulators exerted significant effect on number of seeds per capsule over control. The highest number of seeds per capsule was recorded (173.00) in Litosen which was identical with Bionic and Mirakulan but significantly higher than other treatments. Seeds per capsules of Planovit, Okoimim and Yield were statistically identical which produces moderate number of seeds per capsules (Table 2). The lowest number of seeds per capsule was recorded (144.40) in control which was identical with Flora (147.53). Similar result was reported by Akter *et al.* (2007) in mustard.

### 3.6 Seed yield per plant

Plant growth regulators exerted significant effect on seed yield per plant over control. The highest seed yield per plant was recorded (2.91 g) in Bionik which was identical with Mirakulan but significantly higher than other treatments (Table 2). Seed yield of Mirakulan, Okozim and Litosen were identical. Again seed yield of Planovit and Litosen was identical. The lowest seed yield per plant was recorded (2.18 g) in control which was identical with Flora (2.22 g) and Yield (2.36 g). This might result from increased photosynthetic activity and the increased dry matter accumulation by the plant growth regulator, depending on the increase of photosynthetic pigments (Wu *et al.*, 1994). Pan *et al.*, (2013) reported that plant growth regulator spray has considerable effects on seed yield and quality. The present findings are in agreement with Ekamber and Kumar, (2007); Rajendra and Jones, (2009) in wheat, and Akter *et al.* (2007) in mustard.

### 3.7 Yield increase

Result revealed that commercial growth regulators have significant effect on seed yield and yield attributes of late jute seed production over control. The highest seed yield increase (33.49%) over control was recorded by using Bionik which was followed (25.69%) by using Mirakulam (Table 2). In terms of seed yield, the plant growth regulator 'Bionik' performed the best among the seven plant growth regulators used in this experiment.

### 3.8 1000-seed weight

1000-seed weight is considered both for yield and quality parameter of jute seed. Plant growth regulators exerted significant effect on 1000-seed weight. The thousand seed weight ranged from 1.82 g to 2.00 g (Table 3). The highest 1000-seed weight was recorded (2.008 g) in Bionik which was identical with Mirakulan (1.986g) and Litosen (1.980g) but significantly higher than other treatment. Moderate 1000-seed weight was recorded in control and Okozim. The lowest 1000-seed weight was recorded (1.821g)

in Flora which was statistically identical with Yield and Planovt.

### 3.9 Germination percentage

Plant growth regulators exerted significant effect on seed germination percentage. The highest germination percentage was recorded (89.75%) in Bionik which was statistically identical with Mirakulan (89.50%) but significantly higher than Litosen (88.25%), Control (86.50%) and Okozim and Flora (85.50%). The lowest germination percent was recorded in Yield (83.25%) which was statistically lowest than others (Table 3). Similar result was reported by Tzortzakakis (2009).

### 3.10 Vigor index (VI)

Plant growth regulators exerted significant effect on vigor index. The highest vigor index was recorded (85.23) in Bionik which was statistically identical with Litosen (84.58), Mirakulan (83.12), Okozim (82.26) and Yield (82.24). The lowest vigor index was recorded (79.89) in Flora which was statistically identical with control (80.57) but significantly lowest than others (Table 3).

### 3.11 Accelerated ageing

Plant growth regulators exerted significant effect on accelerated ageing. The highest accelerated ageing was recorded (75.00) in Bionik which was statistically identical but significantly highest than Mirakulan & Litosen (74.00); Okozim & Planovit (73.00); control (72.00) and Yield (71.00). The lowest was recorded (70.00) in Flora which was statistically lowest than others (Table 3). Moori and Eisvand (2017) reported that, pre-treatment of the non-aged and aged seeds by gibberellin improved the physiological quality of the seed and seedling.

### 3.12 Field emergence

Plant growth regulators also exerted significant effect on field emergence. The highest field emergence was recorded (87.00) in Bionik which was statistically identical with Litosen (86.00) and Mirakulan (85.75). The lowest was recorded (81.25) in Flora which was significantly lowest

than others (Table 3). Similar result was reported by Tzortzakakis (2009).

## 4. Conclusions

All the yield attributes increased significantly over the control due to the application of growth regulators. The highest seed yield (2.91 g/plant) was obtained with Bionik which was followed by Mirakulan > Okozim > Litosen > Planovit > Yield > Flora > control. Commercial plant growth regulators are not detrimental for seed quality and most of the growth regulators significantly increased seed quality of jute. Among the growth regulators, 'Bionik' performed the best in terms of increasing seed quality.

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