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SEED QUALITY OF SELECTED JUTE GENOTYPES PRODUCED AT DIFFERENT SOWING TIMES OVER LOCATIONS

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ABSTRACT

Laboratory experiment was conducted to determine physiological qualities of jute seed produced at different sowing dates and locations. The jute seeds were obtained from three genotypes (O-72, O-3820, Acc.4311) and sown at three dates (31 July, 15 August, 30 August) over four locations (Manikgonj, Cumilla, Dinajpur, Joshore) of Bangladesh. Seed quality of freshly harvested jute seed was assessed by germination test, mean germination time, vigour index and electrical conductivity test. Germination percentage of fresh jute seed was not profoundly influenced by the interaction effect of genotype and sowing date over the locations, where all the genotypes showed more than 94% seed germination. However, mean germination time was significantly influenced by the various genotypes and different sowing dates. The highest mean germination time (1.370 days) was found from the seed of genotype Acc.4311 sown on 30 August at Cumilla, while the lowest mean germination time (1.011 days) was recorded from the seed of genotype O-72 harvested from the crop sown on 15 August at Manikgonj. The highest vigour indices were observed in genotype Acc. 4311 from seed harvested from different locations. Significant variation was also observed in electrical conductivity of seed leachate, where the highest electrical conductivity of seed leachate (395 $\mu S\ cm^{-1}$) was found from the seed of O-72 sown on 30 August at Cumilla. Contrary, the lowest electrical conductivity of seed leachate (295 $\mu S\ cm^{-1}$) was recorded from the seed of Acc. 4311 sown on 15 August at Manikgonj. Among the genotypes, Acc. 4311 sown on 15 August in different locations showed better physiological seed qualities and may be considered as a promising line for variety development and quality seed production.

Keywords: Genotype, sowing date, seed quality, late jute

Introduction

Jute is the prime fibre crop in Bangladesh although its productivity is much low due to varied reasons. One of the key reasons is to use of poor quality seed (Hossain *et al.* 2008). Quality seed is the cheapest input in modern agriculture. Availability of viable and vigorous seeds at sowing time is very important for achieving the targeted fibre yield of jute.

High quality jute seed can be produced by sowing the crop in optimum time. Sowing time is one of the important production components and sowing before or after optimum date produces lower yield with poor seed quality. Sowing time is specifically important for late sown jute as it is short day photoperiod sensitive (Husain 1977). The critical photoperiod of *Corchorus olitorius* L. is 12.5 hours although it may vary over the genotypes and other environmental parameters prevailing during whole growing season. Due to extreme late sowing, the crop is exposed to short photoperiod, that hastens flowering, reduces seed maturation period and provides adverse effect upon seed quality. Temperature below 15°C usually causes flower bud injury, restricts its number and affects pod formation (Johansen *et al*. 1985). Further, high temperature convergently hastens maturity of seeds, pods turn brown and dry quickly before seeds attain proper physiological maturity. These plants produced more unfilled seeds with smaller seed size and low germination percentage (Hossain *et al*. 1999). At extreme early sowing, there is every possibility to damage seed crop by natural hazards during rainy season (Talukder and Akanda 1994, Islam 2010, Islam and Uddin 2019).

Seed quality of jute further depends on harvesting stage of the crop which is related to sowing date. Harvesting the crop at an early stage makes relative losses due to threshing and produces enormous unfilled seeds. Besides, mature seeds can be stared longer than the immature seeds. Harvesting at a late stage may result in increased weather damage and losses due to shattering of seeds. Pre-harvest field environment seldom favours in proper seed maturation. As the seeds continue to decrease in moisture content during or after maturation, they become drier under the influence of field environment. The factors that have the most detrimental effect on seed quality are temperature, relative humidity and precipitation. Frequent and prolonged precipitation, high relative humidity and temperature of the humid tropics can result in rapid and severe deterioration of seed quality before harvest. Diseases of various sorts have ample time to become established with the seeds during maturity stages.

Although prevalence of weather damage is frequent in early planted crop, persistent foggy weather affects late jute seed crop and often contains pathogens that deteriorates health status of seed (Islam *et al*. 2007). As sowing time regulates appropriate stage of seed maturity, the present study was undertaken to determine physiological qualities of jute seed of different genotypes produced at different sowing dates in late season at different locations of Bangladesh.

Materials and Methods

Laboratory experiment was conducted at Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur to determine physiological quality of jute seed produced at different sowing dates in late season at different locations of Bangladesh during 2012-13. The Jute seeds were obtained from three genotypes (O-72, O-3820, Acc. 4311) and sown at three dates (31 July, 15 August, 30 August) over four locations (Manikgonj, Cumilla, Dinajpur, Joshore) of Bangladesh. Experimental design in the field was randomized complete block design with three replications. Seed quality of freshly harvested jute seed was assessed in the laboratory by germination test, mean germination time, vigour index and electrical conductivity test as per following procedures.

For germination test, one hundred pure seeds of each treatment combination were placed in petridish containing filter paper soaked with distilled water. For each test, four petridishes were used. The petridishes were placed in germinator at 30°C in 12/12 hours alternative dark and light for 5 days. Seedlings were counted every day up to the completion of germination at fifth day. A seed was considered to be germinated where the seed coat ruptured and radical came out up to 2 mm length. Germination percentage was calculated using the following formula (Krishnasamy and Seshu 1990).

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds tested}} \times 100$$

Mean days to germination was calculated as per Bewley and Black (1994) according to the following formula.

$$\text{Mean germination time} = \frac{100}{\text{Co-efficient of germination}}$$

Seedlings obtained from standard germination test were used for seedling vigor index. Ten plant samples from each Petri dish were harvested on the 5th day of the germination test and dried at 70^{0}C for 72 hours for dry matter yield. Dry weights of those samples were measured for calculation of vigor index. Seedling vigour index was calculated according to the following formula (Bedi *et al.* 2006).

Seedling vigor index = % germination x total seedling dry matter

For electrical conductivity test, 2g seeds of each sample were taken in a conical flask containing 50 ml de-ionized water and were incubated at 20^{0}C for 20 hours as per Ali *et al.* (2004). After 20 hours, water of the beaker containing seeds was decanted in order to separate the seeds. The electrical conductivity of the decanted water containing seed leachate was measured with a conductivity meter (Model-CM- 30ET). All data were subjected to statistical analysis by analysis of variance (ANOVA). Microsoft EXCEL and MSTAT software programs were used wherever appropriate and the means were compared according to Duncan's Multiple Range Test (Gomez and Gomez 1984).

Results and Discussion

Germination percentage of fresh jute seed was not profoundly influenced by the interaction effect of genotype and sowing date as all the genotypes showed more than 94% germination (Table 1). The highest germination (98.0%) was found in seeds obtained from genotype O-72 sown on 15 August at Manikgonj and Joshore, Acc.4311 at Manikgonj and O-3820 at Dinajpur. The lowest germination (94.0%) was found in seeds obtained from genotype Acc.4311 sown on 30 August grown at all the locations except Manikgonj which was similar with the seeds obtained from genotypes O-72 and O-3820 sown on 30 August grown at Cumilla. The seeds obtained from all the genotypes sown on 31 July at all the locations showed

Table 1. Germination percentage of *Corchorus olitorius* jute seeds as influenced by genotype and sowing date at four different locations

Genotype	Date of sowing	Locations			
		Manikgonj	Cumilla	Dinajpur	Joshore
O-72	31 July	97.0 abA	96.0 aA	97.0 bcA	97.0 abA
	15 August	98.0 aA	96.0 bB	96.0 abAB	98.0 aA
	30 August	96.0 bcA	94.0 bB	95.0 cdAB	95.0 cdAB
O-3820	31 July	96.0 bcA	95.0 abA	98.0 bcA	96.0 bcA
	15 August	97.0 abAB	96.0 aB	96.0 aA	97.0 abAB
	30 August	95.0 cdA	94.0 bA	95.0 cdA	95.0 cdA
Acc.4311	31 July	96.0 bcA	96.0 aA	96.0 cdA	96.0 abA
	15 August	98.0 aA	94.0 bC	95.0 bcB	97.0 bcAB
	30 August	95.0 cdA	94.0 bA	94.0 dA	95.0 cdA

Means in a column followed by same small letters and in a row by same capital letters did not differ significantly by DMRT at 0.05 level.

medium germination (95.0 to 97.0%) which was very close to the highest germination percentage. The present results confirmed with those of Bhattacharjee *et al*. (2000) who observed the germination of freshly harvested jute seeds at maximum level.

Mean germination time was significantly influenced by the interaction effect of genotype and sowing date (Table 2). The highest mean germination time (1.370 days) was found from the seeds of genotype Acc.4311 sown on 30 August at Cumilla. There was a decreasing trend in mean days to germination with the seeds of earlier sowing dates. The lowest mean germination time (1.011 days) was recorded from the seeds of genotype O-72 harvested from the crops sown on 15 August at Manikgonj followed by the seeds harvested from the crops of genotype Acc.4311 and O-3820 sown on the same sowing date. Thus it is indicated that the faster germination from the seeds of the genotypes O-72, Acc.4311 and O-3820 harvested from the crops sown on 15 August was attributed as a consequence of improvement of seed vigour. Faster germination is the prime concern as it determines the success of crop in the field (Yamauchi and Winn 1996).

Basically seed vigour is the potential for growth and the ability to sustain life. High vigour seed lots have significantly higher emergence than low vigour seed lots (Akeson and Widner 1980, Steiner 1990). However, the advantage to be gained from planting high vigour seed is expected to improve stands but not necessarily increase yields (Tekrony and Egli 1991). The interaction effect of genotype and sowing date also resulted in seedling vigour index in the present study (Table 3). The highest vigour index was observed in genotype Acc. 4311 in seed of all the locations which might be due to linked with the improvement in chemical composition of seed (Mugnisjah and Nakamura 1986) as well as better translocation of assimilates from leaf to seed.

The electrical conductivity test is acknowledged as one of the best tests for the evaluation of the loss of cell membrane integrity by the concentration of electrolytes released by seeds during imbibitions. Cell membrane integrity is considered as one of the primary physiological events of seed deterioration process (Delouche 1976). Consequently, lower vigour seed lots exhibit higher intensity of cellular constituent losses, such as inorganic

Table 2. Effect of genotype and sowing date on mean germination time (days) of *Corchorus olitorius* jute seed grown at four different locations

Genotype	Date of sowing	Locations			
		Manikgonj	Cumilla	Dinajpur	Joshore
O-72	31 July	1.025 bC	1.239 deA	1.158 fB	1.030 cC
	15 August	1.011 cC	1.182 gB	1.233 dA	1.015 dC
	30 August	1.065 aB	1.338 bA	1.334 aA	1.068 bB
O-3820	31 July	1.026 bC	1.234 eA	1.181 eB	1.028 cC
	15 August	1.012 cC	1.165 hB	1.236 cdA	1.016 dC
	30 August	1.066 aB	1.317 cA	1.324 abA	1.071 abB
Acc.4311	31 July	1.027 bC	1.253 dA	1.186 eB	1.032 cC
	15 August	1.012 cC	1.202 fB	1.247 cA	1.017 dC
	30 August	1.068 aC	1.370 aA	1.313 bB	1.073 aC

Means in a column followed by same small letters and in a row by same capital letters did not differ significantly by DMRT at 0.05 level.

Table 3. Effect of genotype and sowing date on vigour index of *Corchorus olitorius* jute seed grown at four different locations

Genotype	Date of sowing	Locations			
		Manikgonj	Cumilla	Dinajpur	Joshore
O-72	31 July	87.20 cA	81.65 bC	88.76 bA	84.10 bB
	15 August	95.16 aA	86.69 aC	83.04 dD	90.85 aB
	30 August	81.50 eA	75.86 cB	77.05 eB	77.81 cB
O-3820	31 July	85.92 cdB	81.23 bC	91.33 aA	82.75 bC
	15 August	92.96 bA	86.78 aC	86.40 cC	90.70 aB
	30 August	79.94 eA	76.42 cB	77.33 eB	77.14 cB
Acc.4311	31 July	85.25 dB	80.55 bC	91.20 aA	82.65 bC
	15 August	95.55 aA	86.98 aC	89.13 aD	90.43 aB
	30 August	79.97 eA	76.33 cB	77.74 eB	77.27 cB

Means in a column followed by same small letters and in a row by same capital letters did not differ significantly by DMRT at 0.05 level.

Table 4. Effect of genotype and sowing date on electrical conductivity (µ S cm^{-1}) of *Corchorus olitorius* jute seed grown at four different locations

Genotype	Date of sowing	Locations			
		Manikgonj	Cumilla	Dinajpur	Joshore
O-72	31 July	320.0 dC	365.0 cA	320.0 dB	340.0 dB
	15 August	305.0 eC	335.0 dA	345.0 fB	325.0 fB
	30 August	357.0 aC	395.0 aA	360.0 bC	370.0 bB
O-3820	31 July	330.0 cC	360.0 cA	330.0 cdB	355.0 cAB
	15 August	310.0 eB	330.0 dA	350.0 eA	333.0 eA
	30 August	355.0 aB	380.0 bA	375.0 aA	380.0 aA
Acc.4311	31 July	340.0 bB	360.0 cA	335.0 bcA	360.0 cA
	15 August	295.0 fC	320.0 eB	355.0 eA	330.0 efA
	30 August	360.0 aB	385.0 bA	380.0 aA	385.0 aA

Means in a column followed by same small letters and in a row by same capital letters did not differ significantly by DMRT at 0.05 level.

ions. Electrical conductivity is related to deterioration process of seeds as related to degradation of cell membranes and leakage out of cells (Delouche and Baskin 1973). In present study, electrical conductivity differed significantly in tossa jute seeds found from different genotypes and sowing dates grown at different locations of Bangladesh (Table 4). The highest electrical conductivity of seed leachate (395 µS cm^{-1}) was found from the seeds of O-72 sown on 30 August at Cumilla followed by the seeds of Acc.4311 sown on 30 August at Cumilla and Joshore(380 µS cm^{-1}). On the contrary, the lowest electrical conductivity of seed leachate (295 µS cm^{-1}) was recorded from the seeds of Acc.4311 sown on 15 August at Manikgonj which was statistically different with the seeds of other genotypes sown on 15 August at the same location. Higher electrical conductivity found in seeds obtained from the crops of O-72 and Acc.4311 sown on 30 August might be associated with its smaller sized seeds produced at Cumilla and Joshore. There is every possibility of having under developed seeds with weak membrane structure in smaller sized seeds which facilitated leachate leakage from the seeds. Different authors (Tao 1978, Mugnisjah and Nakamura 1986) explained the phenomenon in different way that small seeds having a greater surface area per unit weight and induced higher rate of leakage out of cell which increased electrical conductivity of small seeds than that of bolder ones.

From the results it may be concluded that sowing of jute seeds in the first fortnight of August is the favourable environment for production of high quality jute seed. Among the genotypes, Acc.4311 sown on 15 August showed better physiological quality attributes in all the locations and may be considered as promising line for variety development and quality seed production.

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