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CHANGES OF JUTE SEED QUALITIES UNDER AMBIENT STORAGE CONDITION

A. T. M. M. Alam[1]*, M. M. Haque[2], M. G. Rasul[3], M. A. A. Khan[4] and M. A. Karim[2]

Abstract

Experiment was conducted to determine the changes of jute seed qualities under ambient storage condition over one year period. Jute seed produced from three genotypes (O-72, O-3820 and Acc.4311) sown on three dates (31 July, 15 August and 30 August) over four locations (Manikganj, Cumilla, Dinajpur and Jashore) and preserved in plastic containers at ambient condition. Seed qualities were assessed in the laboratory for every six months of storage. Results showed that fresh jute seed maintained 94 to 98% germination which declined with the advent of storage period. Irrespective of genotype, sowing date and location, germination capacity of jute seed remained more than 80% up to 6 months of storage at ambient condition. Afterwards, seed harvested from genotype Acc.4311 sown on 15 August at Manikganj maintained the highest germination (86%) after 12 months of storage. Seedling dry weight of all the genotypes also decreased over the storage period. However, rate of reduction of seedling dry weight was lower in seed harvested from the crop sown on 15 August which indicates that seed obtained from this time can maintain better seedling dry weight even after 12 months of storage. Contrary, electrical conductivity of seed electrolytes increased with the increase of storage period although it was the lowest (285 μ Scm^{-1}) in seed of genotype Acc.4311 harvested from 15 August sowing at Manikganj. Considering different qualities of stored jute seed, the genotype Acc.4311 supposed to be promising for producing good quality seed sown on mid-August at Manikganj environment.

Keywords: Germination, dry matter, electrical conductivity.

Introduction

Seed attains maximum viability at its physiological maturity and then starts to deteriorate slowly or quickly depending upon the storage environment (Donald and Jacobs, 1999). The environment in which seed is stored is an important factor determining the period it can be stored and acceptable level of viability can be maintained. Storability may be improved by controlling the storage environment, particularly the maintenance of low temperature and relative humidity within the storage area (Marshal and Lewis, 2004). Generally, during the storage period the seed has to face unfavourable environmental conditions, especially in humid tropic like Bangladesh which is characterized by high

[1]Bangladesh Jute Research Institute, Manik Mia Avenue, Dhaka 1207, Bangladesh. [2]Department of Agronomy, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh. [3]Department of Genetics and Plant Breeding, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh. [4]Department of Plant Pathology, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur 1706, Bangladesh. *Corresponding author: morshedbjri@ gmail.com

temperature and high relative humidity which is conductive to rapid seed deterioration during storage. In storage, high temperature and relative humidity cause faster deterioration of seed. Moisture content of seed can also affect its storage potential. The storage life of seed is doubled for each 1% reduction in its moisture content down to an optimum percentage (McDonald, 1999).

Seed deterioration is a natural phenomenon that occurs in all seeds leading to gradual decline in seed viability during storage. During storage, the biochemical properties like amino acid, lipid, oil content, carbohydrate, soluble sugar and enzymatic activities are changed. The process of seed deterioration is most pronounced in oil-rich seeds because of high susceptibility to peroxidation of poly-unsaturated fatty acids present in these seeds (Priestly and Leopold, 1983; Sung, 1996; Freitas *et al.*, 2006). In carbohydrate rich seeds, the processes are described by the degree of concentration of soluble sugar (Likhatchev *et al.,* 1984). Generally, it is known that soluble carbohydrate declines with seed ageing (Petruzelli and Taranto, 1989). Protein containing seeds deteriorate in ageing accompanying a rise in the level of amino acids (Kalpana and Rao, 1997; Alam *et al.,* 2009). The processes associated to deterioration of jute seed in storing have not sufficiently investigated. Further information relating physiological process associated with jute seed deterioration in storage and their relationship yet to be determined. Therefore, the present study was undertaken to determine the physiological changes of seed during ageing process under ambient storage condition over time and to establish relationship between the physiological changes occurred in seed during storage.

Materials and Methods

Initially, field experiment was conducted at four locations of Bangladesh during late sown jute growing season of 2011. The locations were Jute Agriculture Experimental Station, Manikgonj (23°83′ N latitude and 90°02′ E longitude); Jute Research Regional Station, Chandina, Cumilla (23°49′ N latitude and 90°97′ E longitude); Jute Seed Production and Research Station, Noshipur, Dinajpur (25°37′ N latitude and 88°39′ E longitude) and Jute Research Sub Station, Monirampur, Jashore (23°02′ N latitude and 89°23′ E longitude). Seed produced from three genotypes (O-72, O-3820 and Acc.4311) at three sowing dates (31 July, 15 August and 30 August of 2011) over four locations were collected and dried in the sun on the gunny sack at around 8 to 9% moisture content. The dried seed was stored in airtight plastic container under ambient condition for 12 months for assessing its qualitative parameters. The storage experiment was set on 01 March 2012 at the Crop Management Laboratory, Agronomy Division, Bangladesh Jute Research Institute. The containers were kept on the wooden table of the laboratory beside the wall. The windows of the laboratory remained open during day time of every working day and closed during night time and in the off days throughout the storage period.

Seed quality attributes were tested in the Physiology Laboratory of Bangladesh Jute Research Institute, Dhaka. Seed samples were collected from each selected treatment for every 6 months interval up to 12 months and the seeds were subjected to perform different tests of seed quality attributes such as germination percentage, seedling dry weight, seedling vigour index and electrical conductivity test following the procedures.

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^{0}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 as the seed coat ruptured and radical came out up to 2 mm length as per ISTA (2006) rules.

Germination percentage was calculated using the following formula (Krishnasamy and Seshu, 1990).

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

Seedling dry weight

Seedlings obtained from standard germination test were used for seedling evaluation. Normal or abnormal seedlings were classified according to the rules of the Association of Official Seed Analysts (AOSA, 1981). Ten plant samples from each Petri dish were harvested on the 5th day of the germination test and dried at 70°C for 72 hours for dry matter yield. Dry weights of those samples were measured.

Electrical conductivity test

For electrical conductivity test, 2 g 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). Four replicates of measurements were made for each sample of seed. Data were then subjected to statistical analysis by analysis of variance (ANOVA). Microsoft Excel and MSTAT-C software were used wherever appropriate. Functional relationships among the parameters were established through correlation and regression analysis (Gomez and Gomez, 1984).

Results and Discussion

Seed germination

Main objective of storage system is to maintain germination capacity of stored seed over a specific period (Ellis *et al*., 1998). In present study, irrespective of genotypes and location, germination of fresh jute seed showed 94 to 98% which declined gradually over storage period (Fig. 1). Seed germination however, remained more than 80% up to 6 months which indicated that jute seed may be stored safely in air tight plastic container for 6 months under ambient storage condition. After 12 months of storage, germination of jute seed obtained from three genotypes sown on 30 August were 70 to 72% at Manikganj, 67 to 70% at Cumilla, 67 to 72% at Dinajpur and 70 to 72% at Jashore. The minimal decrease (8%) in germination was observed in the seed obtained from the crop sown on 15 August. While, the maximum decrease (21%) was recorded from the seed obtained from the crop sown on 30 August in all the genotypes at all the locations. Among the genotypes, seed harvested from genotype

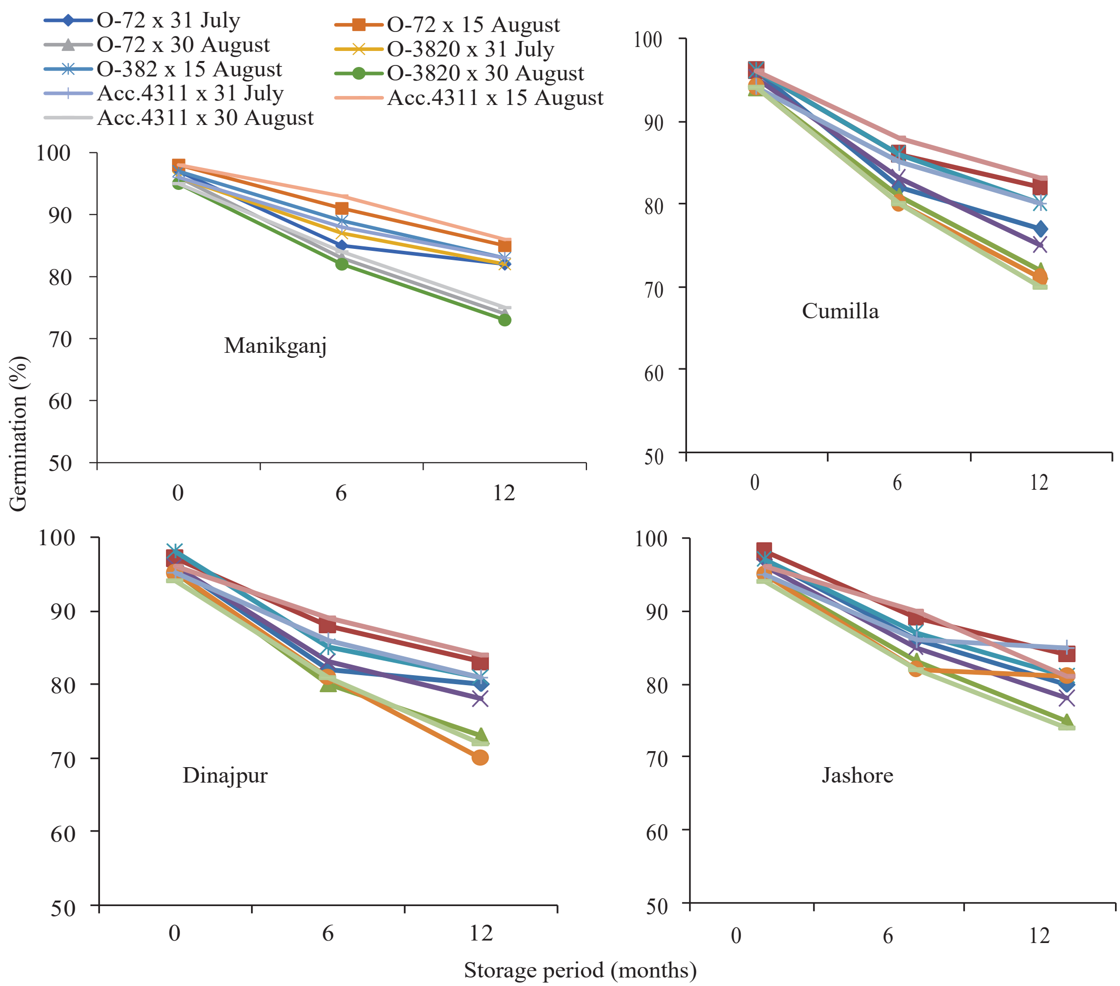

Fig. 1. Changes in germination of stored jute seed at ambient condition which obtained from three sowing dates and four locations.

Acc.4311 sown on 15 August at Manikganj resulted the highest germination (86%) at the end of storage period. These results agree with the findings of Basu *et al*. (1978) in jute seed. The results indicated that genotype and sowing date might have an impact on seed moisture relationship which determined the variability in germination of jute seed stored for longer period. Higher relative humidity along with higher storage temperature at ambient storage condition might loosed the viability as well as germination capacity of stored seed (Barton, 1985).

Seedling dry weight

Seedling dry weight decreased differently over the storage period and the treatment combinations (Table 1). Decrease in seedling dry weight was more profound in the seed obtained from the crop sown on 30 August. Genotypes also differed significantly in seedling dry weight where it was higher in

Table 1. Interaction effect of genotype and sowing dates on seedling dry weight (mg plant^{-1}) of stored jute seed at ambient condition

All locations	Genotypes	Sowing dates	Changes in seedling dry weight over storage period		
			Storage period (months)		
			0	6	12
Manikganj	O-72	31 July	0.8990 c	0.7878 d	0.7414 c
		15 August	0.9710 ab	0.8917 b	0.8223 ab
		30 August	0.8490 d	0.7340 e	0.6367 d
	O-3820	31 July	0.8950 c	0.8110 c	0.7365 c
		15 August	0.9584 b	0.8793 b	0.8102 b
		30 August	0.8504 d	0.7417 e	0.6332 d
	Acc.4311	31 July	0.8880 c	0.8140 c	0.7492 c
		15 August	0.9750 a	0.9253 a	0.8357 a
		30 August	0.8418 d	0.7522 e	0.6291d
LSD (0.05)		-	0.0145	0.0219	0.0169
Cumilla	O-72	31 July	0.8505 c	0.7265 e	0.6644 d
		15 August	0.9030 a	0.8089 b	0.7525 a
		30 August	0.8070 e	0.6955 e	0.6010 f
	O-3820	31 July	0.8550 bc	0.7470 d	0.6480 e
		15 August	0.9040 a	0.8098 b	0.7345 b
		30 August	0.8130 d	0.6920 e	0.5881 g
	Acc.4311	31 July	0.8570 b	0.7750 c	0.6929 c
		15 August	0.9060 a	0.8305 a	0.7456 a
		30 August	0.8120 d	0.6911 e	0.5788 g
LSD (0.05)		-	0.0045	0.0088	0.0069
Dinajpur	O-72	31 July	0.9150 c	0.8301 b	0.7567 b
		15 August	0.8650 e	0.7388 d	0.7134 d
		30 August	0.8110 g	0.6830 f	0.6146 f
	O-3820	31 July	0.9320 b	0.8084 c	0.7393 c
		15 August	0.9000 d	0.7781 d	0.6948 e
		30 August	0.8140 fg	0.6940 e	0.5983 f
	Acc.4311	31 July	0.9500 a	0.8807 a	0.7800 a
		15 August	0.8750 e	0.7921 cd	0.7474 bc
		30 August	0.8270 f	0.7126 e	0.6212 f
LSD (0.05)		-	0.0145	0.0215	0.0164
Jashore	O-72	31 July	0.8670 b	0.7687 cd	0.7159 de
		15 August	0.9270 a	0.8419 b	0.7734 b
		30 August	0.8190 c	0.7155 e	0.6207 f
	O-3820	31 July	0.8620 b	0.7632 d	0.7017 e
		15 August	0.9350 a	0.8386 b	0.7593 c
		30 August	0.8120 c	0.7009 e	0.6278 f
	Acc.4311	31 July	0.8700 b	0.7876 c	0.7250 d
		15 August	0.9420 a	0.8831 a	0.8046 a
		30 August	0.8220 c	0.7171 e	0.6252 f
LSD (0.05)		-	0.0145	0.0217	0.0166

Means in a column followed by same letter did not differ significantly at 0.05 level.

O-3820 as compared to Acc.4311 and O-72. Results showed that the highest seedling dry weight (0.8357 mg plant^{-1}) was recorded in seed obtained from the crop sown on 15 August in Acc.4311 genotype at Manikganj and the lowest seedling dry weight (0.5788 mg plant^{-1}) was registered with the seed obtained from the crop of same genotype at same location sown on 30 August. Table 1 clearly indicates that better seedling dry weight may be maintained even after 12 months storage at ambient condition if the seed crop is sown on 15 August. It is evident that the seed crop of genotype Acc.4311 sown on 15 August reduced only 14.28% seedling dry weight after 12 months storage.

Electrical conductivity

Irrespective of location, genotype and the sowing date, the leaching of solutes from the imbibed seed increased with the increase of storage period as it is exhibited by the increase

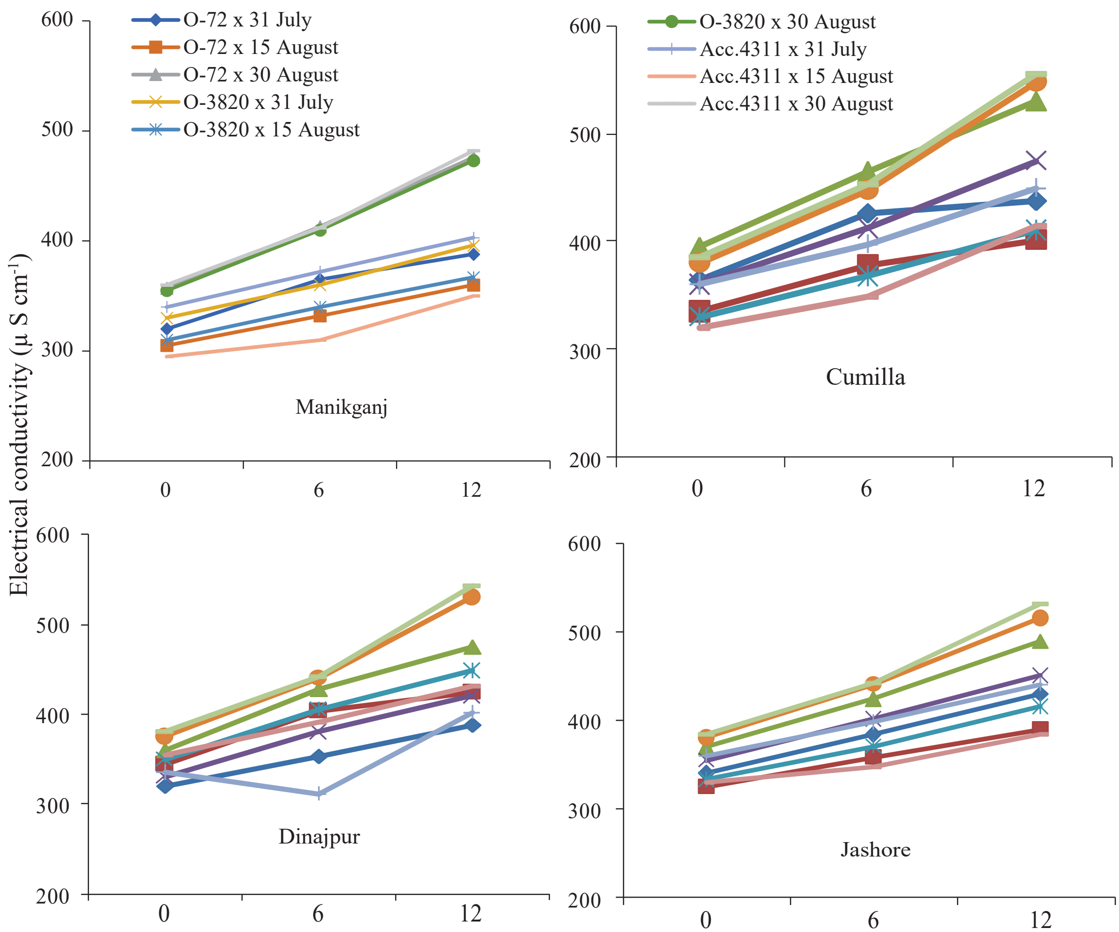

Fig. 2. Changes in electrical conductivity of jute seed produced at three sowing dates and four locations stored at ambient condition.

of electrical conductivity of seed electrolytes (Fig. 2). This is a common indication of seed deterioration with passing of storage period. The pattern of leachate conductivity differed widely due to the genotype, sowing date and storage period. Jute seed harvested from the genotype Acc.4311 sown on 30 August at Cumilla showed higher levels of electrical conductivity (555.0 µ S cm^{-1}) after 12 months of storage. This might be ascribed due to production of smaller sized seed obtained from the crop sown on 30 August. This means that smaller is the seed size higher is the electrical conductivity. Tao (1978) explained the phenomenon as the small seed having a greater surface area per unit weight and induced higher rate of leakage out of cell and enhanced electrical conductivity of seed.

Unlike 30 August sowing, the electrical conductivity of seeds produced from genotype sown on 15 August and 31 July showed lower electrical conductivity after 12 months of storage. It might be due to induce of cell wall synthesis (Sutcliffe and Baker,

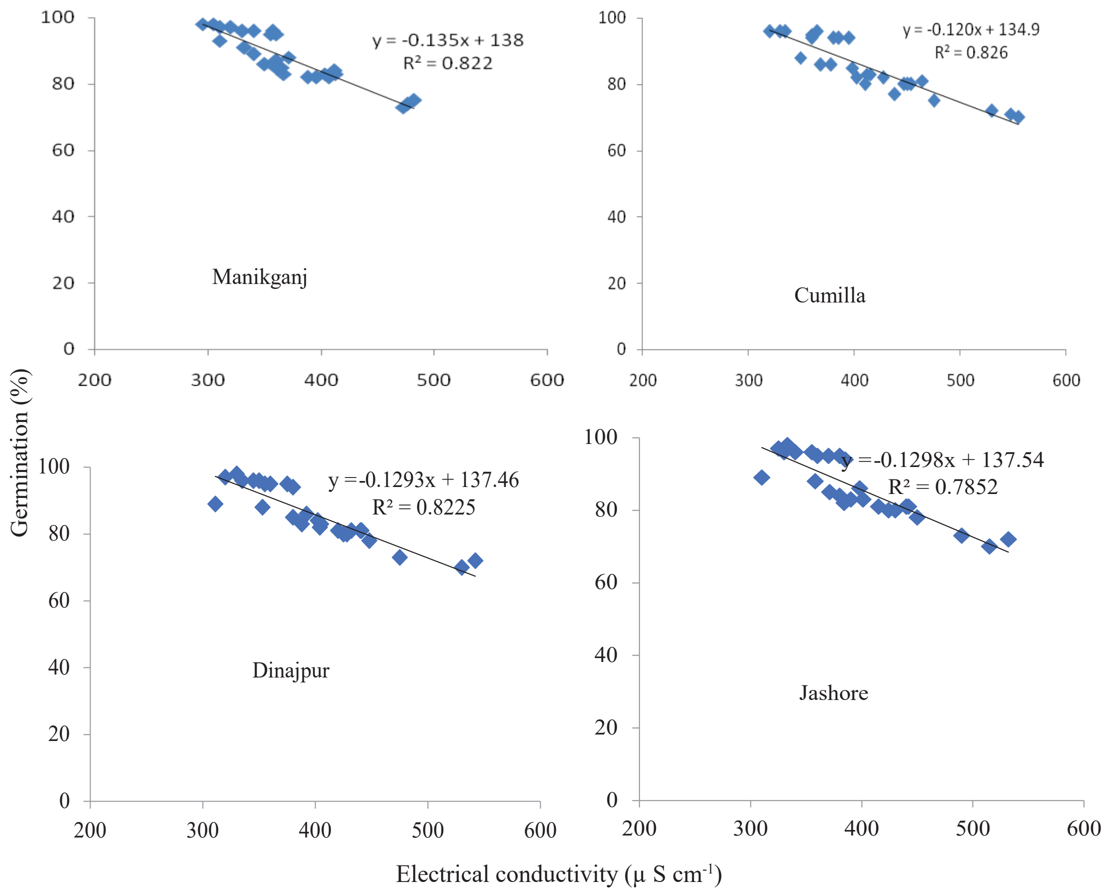

Fig. 3. Relationship between electrical conductivity and germination of jute seed produced in four locations and stored at ambient condition.

1981; Whittington, 1957) and maintaining better membrane integrity (Parr and Louhgman, 1983) which ultimately reduces seed leachate leakage and resulted lower electrical conductivity. The result of electrical conductivity test has been considered as efficient for seed vigour evaluation where increase in electrical conductivity indicates decrease of germination capacity of seed. The present study further revealed that leaching of electrolytes from seed produced in four different locations and stored under ambient condition was negatively correlated with seed germination (Fig. 3). This result corresponded well to finding of Agrawal (1980) who reported seed deterioration of okra, carrot and onion accompanied with leakage of electrolytes, increase in electrical conductivity and decrease of germination over storage period.

Conclusion

From the results it may be concluded that sowing of jute seed in the first fortnight of August is more favourable environment for production of quality seed of new promising jute genotypes. Jute seed harvested from genotype Acc.4311 sown on 15 August showed better performance in terms of physiological seed quality and maintained longer life span under ambient storage condition.

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