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Influence of packaging materials on germination and seed vigour characters of rice (*Oryza sativa* L.) during storage

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Abstract
A storage experiment was conducted to understand the influence of packaging material on germination and seed vigour characters of rice (*Oryza sativa* L.) during the period of 12 months of storage at Seed Testing Laboratory, SHIATS Allahabad for 18 months during 2013-15. The seeds rice variety (Sahbhagi) was taken from the Directorate of seed and farm, SHIATS, Allahabad and were stored in Polythene bags (700 gauge) (P_1) and jute bags (P_2) for 12 months. The data were recorded on characters *Viz:* germination percentage, root length, shoot length, and electrical conductivity of seed leachete after 3 months of duration for 12 months of storage. The effect of packaging materials on genotypes was significant on all characters after 12 months of storage. Mean comparison showed that the seeds packed in polythene bags recorded significantly higher germination percentage (85.33%), root length (13.97cm), shoot length (7.78cm) and lower electrical conductivity of seed leachete (0.521ds/m^{-1}) fallowed by jute bags after 12 months of storage. The result indicates that the seeds packed in polythene bags were good in all seed quality characters.

Keywords: Polythene bag, packaging, storage, germination, paddy

Introduction
The germination of paddy varieties in storage does not suffer much as compared to other cereals (Paderes, *et al*., 1997) [10]. However, paddy seed stored for long- term is invariably exposed to climatic adversities e.g. extreme summer, winter and monsoons and requires a great deal of effort to safeguard it. There is hardly any recommendation available to maintain seed quality during storage. Seed vigour is an important aspect of quality, which controls field stand, establishment ability and performance. The problems associated with establishing vigorously growing seedlings are often related to poor seed quality. High quality seeds have the capacity to provide vigorous seedlings over a wide range of environments. Deterioration of high quality seed, can render seed worthless for planting although its germination per cent remains relatively high (Christiansen and Presley, 1967) [2]. Seed deterioration is a progressive process from the time of physiological maturity until the seed is dead. (Delouche, 1963) [3]. Rudrapal and Basu (1981) [12] reported that chlorine, bromine and iodine in their vapour form reduce physiological deterioration of seeds. Tappel (1973) [15] indicated that the loss of membrane functions might be one of the basic reasons. Schnathorst and Presley (1963) [14] found that the increased cell permeability of deteriorated cotton seed allowed large quantities of cellular components to diffuse out when seed were placed in water. Accelerated ageing is a test for predicting the storability of seed lots. It is assumed that the process of deterioration under accelerated ageing enormously increased (Delouche, 1971; Deslouche and Baskin, 1973) [4, 5]. The seed is said to be in storage at all the stages between harvest to sowing. These stages are considered actually part of storage process. The extent of storability influenced by type of packaging material. In general seed stored in moisture impervious sealed containers provide suitable environment for storage, offer protection against contamination and also acts as a barrier against the escape of seed treatment chemicals than in moisture pervious containers. The package which is moisture proof or moisture resistant would be more valuable in prolonging germination and vigour. (Harrington 1973) [8] Hence, the present study was carried out to study the influence of packaging material on germination and seed vigour characters of rice (*Oryza sativa* L.) during storage.

Materials and methods
Rice Seeds of Variety (Sahbhagi), were obtained from the Directorate of seed and farm, SHIATS Allahabad. The required quantities of seeds were packed in polythene bags and jute bags at different quantities and were stored for 12 months. The data were recorded on characters *Viz:* germination percentage, root length, shoot length and electrical conductivity of seed leachete after 3 months of duration for 12 months of storage.

Germination percentage
One hundred seeds in four replications were taken from each bag and the germination test was conducted using between paper methods as per ISTA Rules. The rolled paper towels were placed in the germinator in slanting position at a constant temperature of 25+10C and 95+1 per cent relative humidity. The number of normal seedlings was counted at the end of 14th day of the test; the count of germination was expressed in percentage.

Root length
Final count was observed on 14th day after every storage interval (3 months up to 12 months) and 5 normal seedlings were selected randomly and measured the root length of them. The root length was measured from the tip of primary root to base of the hypocotyls and the mean root length was expressed in centimeters.

Shoot length (cm)

The same five normal seedlings selected randomly for measurement of root length were used to record the shoot length. The shoot length was measured from the base of primary leaf to the base of hypocotyls and the mean shoot length was expressed in centimeters.

Electrical conductivity of seed leached (dSm-1)

Five grams of seeds from each bag in four replications were taken and soaked in acetone for half a minute and thoroughly washed in distilled water for five times. Then the seeds were soaked in 25 ml distilled water and kept in an incubator maintained at 25+10C for 12 hours. The seed leachate was collected and volume was made up to 25 ml by adding distilled water. The electrical conductivity of the seed leachate was measured in the digital conductivity bridge with a cell constant of 1.0 and the mean values were expressed in desi Simons per meter (dSm-1).

Statistical analysis

The analysis of variance was worked out to test the significant differences among packaging materials by F- test and critical difference between rice variety and packaging materials. Fisher and Yates (1936).

Result and Discussion

Viability and vigour of the seed varied from source to source as the locality factors influenced the storability of seed. The seeds from different sources possess different quality values, physical structures and chemical composition. These factors determine the longevity of seed in the storage. The seeds packed in polythene bags recorded significantly higher germination percentage (85.33%), root length (13.97cm), shoot length (7.78cm) and lower electrical conductivity of seed leachete (0.521ds/m^{-1}) fallowed by jute bags after 12 months of storage. Seeds packed in jute bag (P_2) recorded lower viability and seed vigour as compared to polythene bag (P_1).

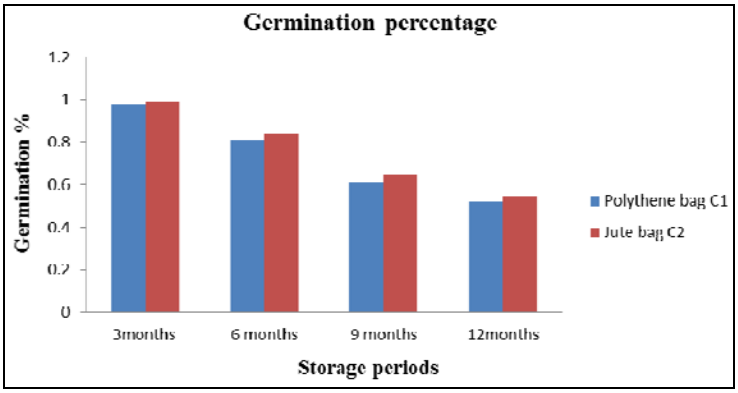
Table 1: Effect of packaging materials on germination percentage and root length of rice during the different intervals of storage period

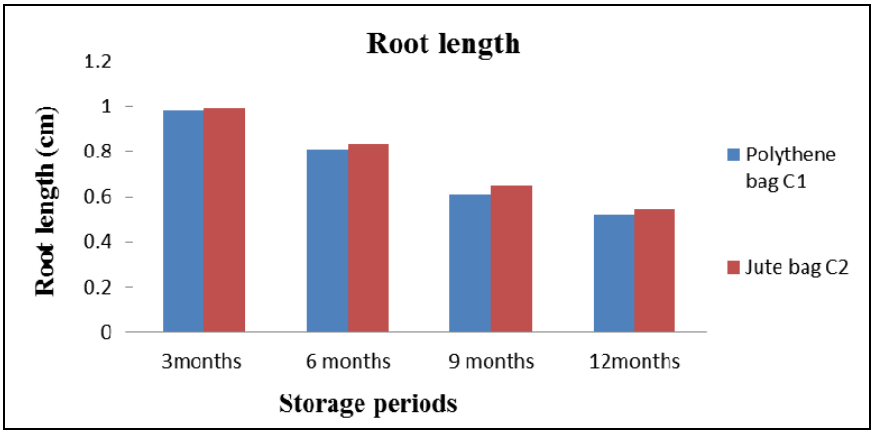
Packaging materials	Germination percentage				Root length			
	3months	6 months	9 months	12months	3months	6 months	9 months	12months
Polythene bag C_1	91.33	90.02	87.21	85.33	18.86	17.69	15.44	13.97
Jute bag C_2	90.63	88.25	85.44	83.63	18.43	17.01	15.41	13.45
F- test	S	S	S	S	S	S	S	S
S.Ed. (±)	0.22	0.23	0.23	0.28	0.18	0.18	0.18	0.14
C.D. at 5%	0.43	0.47	0.47	0.55	0.37	0.37	0.37	0.28

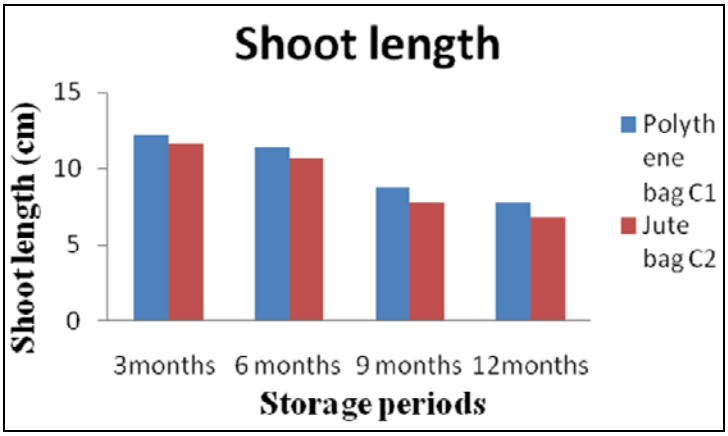
Table 2: Effect of packaging materials on Shoot length and Electrical conductivity of rice during the different intervals of storage period

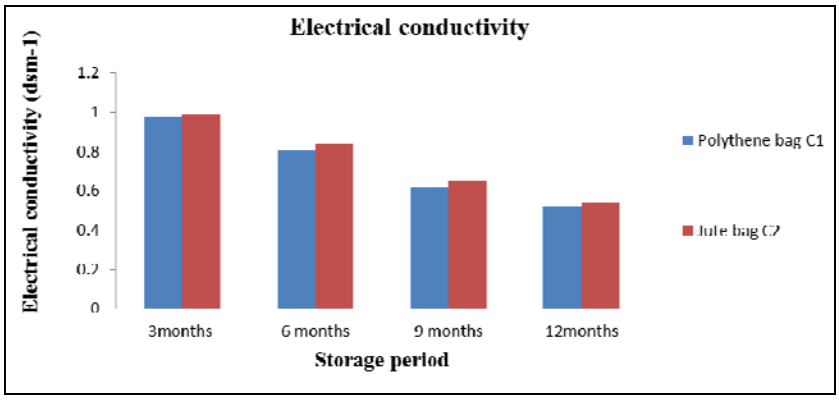
Packaging materials	Shoot length				Electrical conductivity			
	3months	6 months	9 months	12months	3months	6 months	9 months	12months
Polythene bag C_1	12.22	11.38	8.74	7.78	0.978	0.807	0.612	0.521
Jute bag C_2	11.66	10.72	7.78	6.75	0.990	0.835	0.648	0.544
F- test	S	S	S	S	S	S	S	S
S.Ed. (±)	0.16	0.16	0.12	0.10	0.002	0.001	0.001	0.002
C.D. at 5%	0.32	0.32	0.24	0.20	0.004	0.002	0.003	0.004

The polythene bag played significant role in preventing vapour entry from the surrounding air. This becomes effective strategy in regulating lower moisture content in the seeds using vapour impervious containers. Lower respiration rate and metabolic activity are governed by lower moisture content and temperature during the storage period**.** (Muangkaeo *et al.*, 2005) [9]**.** The seeds packed in polythene bags (P_1) exhibited higher germination, seedling length, seedling dry weight, and lower electrical conductivity as reported by Doijode (1995) [6]. Similar observations have been reported by Padma and Reddy (2002) [11] in maize and green gram. Seeds packed in polythene bag and acted as vapour proof barrier in regulating lower moisture content in the seeds. Lower electrical conductivity during the storage period is an indication of higher vigour. This is in accordance with the findings of Azad *et al.*, (2014) [1] who have observed higher vigour when wheat seeds dried to 12 per cent moisture content and preserved in polythene bags stored for nine months. Similar findings have been reported by Saxena *et al.*, (1987) [13] in cereals.









Conclusion

Finally, it can be concluded based on above discussions that the storage of seeds in polythene bags and under controlled conditions was recorded superior as compared to storage of seeds in jute bags and under ambient conditions respectively. Polythene bag 700 gauges were proved to be better packaging material in preserving the seed quality of rice seeds.

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