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Effect of Packaging Materials on Paddy (*Oryza sativa*) Seed Quality

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ABSTRACT Paddy (*Oryza sativa* L.) is the important staple cereal crop in India and its maintenance of seed quality during storage is an integral part of seed multiplication system. Seeds of five paddy cultivars from *kharif* 2007 were stored in 5 different types of packaging materials, for a period of 30 months at IARI Regional Station, Karnal, to study the effects of packaging materials on seed quality. Paddy cultivars registered significant differences in storability with respect to packaging materials. HDPE woven sacks were found better for paddy seeds. It was economical than cloth bag or hessian cloth bag. Paddy seeds could be safely stored in HDPE woven sack up to 30 months.

Key words: Packaging materials, seed quality, paddy, seed storability, germination, vigour

The harvested area of rice can be ranked second after wheat, but rice provides more calories per ha than any other cereal crop in the world. India is the largest grower of rice in terms of area (41.85 mha) with annual production of 89.13 m t (2009–2010) and it ranks second to China in terms of production [1]. About 3 billion people who rely on rice as their staple food today will increased to some 4.4 billion by the middle of this century. In order to meet the demand, it is essential to make available quality seed at the time of planting. Storage of seeds until the next sowing season is an essential segment of seed multiplication system. The seed deterioration begins immediately after physiological maturity and it is reflected in terms of loss in germination and vigour. Vigour of seeds is known to be regulated by variations in storage conditions, initial seed quality, packaging conditions, physio-chemical factors, *etc.* [2]. Among these, storage conditions and packaging materials are one of the most important factors influencing longevity of seeds in field crops. It has been reported that about 9 per cent of paddy is lost due to use of old and outdated methods adopted in post-harvest phase. It has been estimated that post-harvest losses of paddy at producers' level was about 2.71 per cent of total production.

A wide range of materials are available for packaging. Polyethylene (PE) bag/sack of different thickness, high density polyethylene (HDPE) woven bag (lined or unlined), poly-propylene (PP) non-woven bag, hessian cloth bag, cotton cloth bag, etc. are being used for packaging of paddy seeds. Selection of packaging materials is being done on the basis of cost, appearance, availability, handling ease. However, quality parameters of paddy seeds have been ignored. In light of above facts the present study had been undertaken to study the effects of packaging materials on paddy seed quality during storage.

MATERIALS AND METHODS

Seed material

Seeds of five popular varieties of paddy, *viz.* Pusa Basmati 1, Pusa Basmati 1121, Pusa 1460, Pusa 2511 and Pusa Rice Hybrid 10 grown at IARI Regional Station, Karnal, during *kharif* 2007 were taken for the study. The crop was harvested after attaining optimum maturity and threshability in the last week of October 2007. Seeds were processed using standard techniques. The processed seed was conditioned for moisture content of about 13 per cent (wb).

Packaging materials

Five packaging materials, *i.e.* cotton cloth, hessian cloth, HDPE woven, HDPE woven and poly lined and HDPE non woven were undertaken for the study. The specification of packaging materials is given in Table 1.

Table 1. Specification of packaging materials

Code	Kind	Specification	Cost/ unit (Rs)
P1	Cotton cloth	Closely woven	18
P2	Hessian cloth	Mesh–8, weight: 2kg/m^2	16
P3	HDPE woven	Weight: 90-110 GSM, mesh-11, heaming, seamless double stitching	10
P4	HDPE woven and polylined	Weight: 90-110 GSM, polylining (inside): 20 GSM, mesh-11, heaming, seamless double stitching	11
P5	HDPE non woven	Weight: 135-150 GSM, heaming, seamless double stitching	14

Storage condition

The seeds of each cultivar, in four replications, were packed in different packaging materials (P1 to P5). Each bag, containing 10 kg seed, was stored under ambient storage conditions. The major abiotic parameters, *i.e.* temperature (maximum and minimum) and relative humidity (maximum and minimum) during seed storage were recorded.

Sampling and analysis

First sample was drawn at the time of seed packaging, then onwards at an interval of every three months. The collected samples were subjected to seed quality evaluation, *i.e.* germination percentage and vigour index. The germination test was conducted as per ISTA rules [2], whereas ten normal seedlings from each replication were drawn at random to estimate vigour index (VI). The seedlings were dried at 104°C in oven for 8 hr to get seedling dry weight. The vigour index was obtained by multiplying germination (%) with seedling dry weight.

RESULTS AND DISCUSSION

Storage temperature and relative humidity are major abiotic parameters for longevity of cereal seed [3]. Monthly average of maximum, minimum temperature and relative humidity of storage location is depicted (Fig. 1). The maximum temperature varied between 16°C and 40°C, whereas minimum temperature varied between 5°C and 26°C. The minimum temperature trend was smooth. However, maximum temperature was abrupt. The maximum relative humidity was also found to be varying from 53 to 98 per cent and that of minimum relative humidity from 16 to 76 per cent. However, relative humidity fluctuated from least to highest or vice versa within three months period. Steady change in minimum relative humidity was observed, but variation of maximum relative humidity was abrupt in nature. It signified that ambient condition of storage was changing frequently.

Seed germination percentage of all cultivars was 95 per cent except for Pusa Rice Hybrid 10 (88%) at the start of seed storage. Seed germination reduced to about 80 per cent (Indian Minimum Certification Standards) after 30 months from start of seed storage, irrespective of packaging materials in all the cultivars except Pusa Rice Hybrid 10. The Pusa Rice Hybrid 10 attained the same level within 15 months from the starting of seed storage. It may be due to initial lower quality of seed and varietal characteristics. The reduction rate was significantly different for different packaging materials used.

Seed quality, *viz.* germination and vigour index were found significantly affected by packaging materials during storage. Among all five packaging materials; HDPE woven sack was

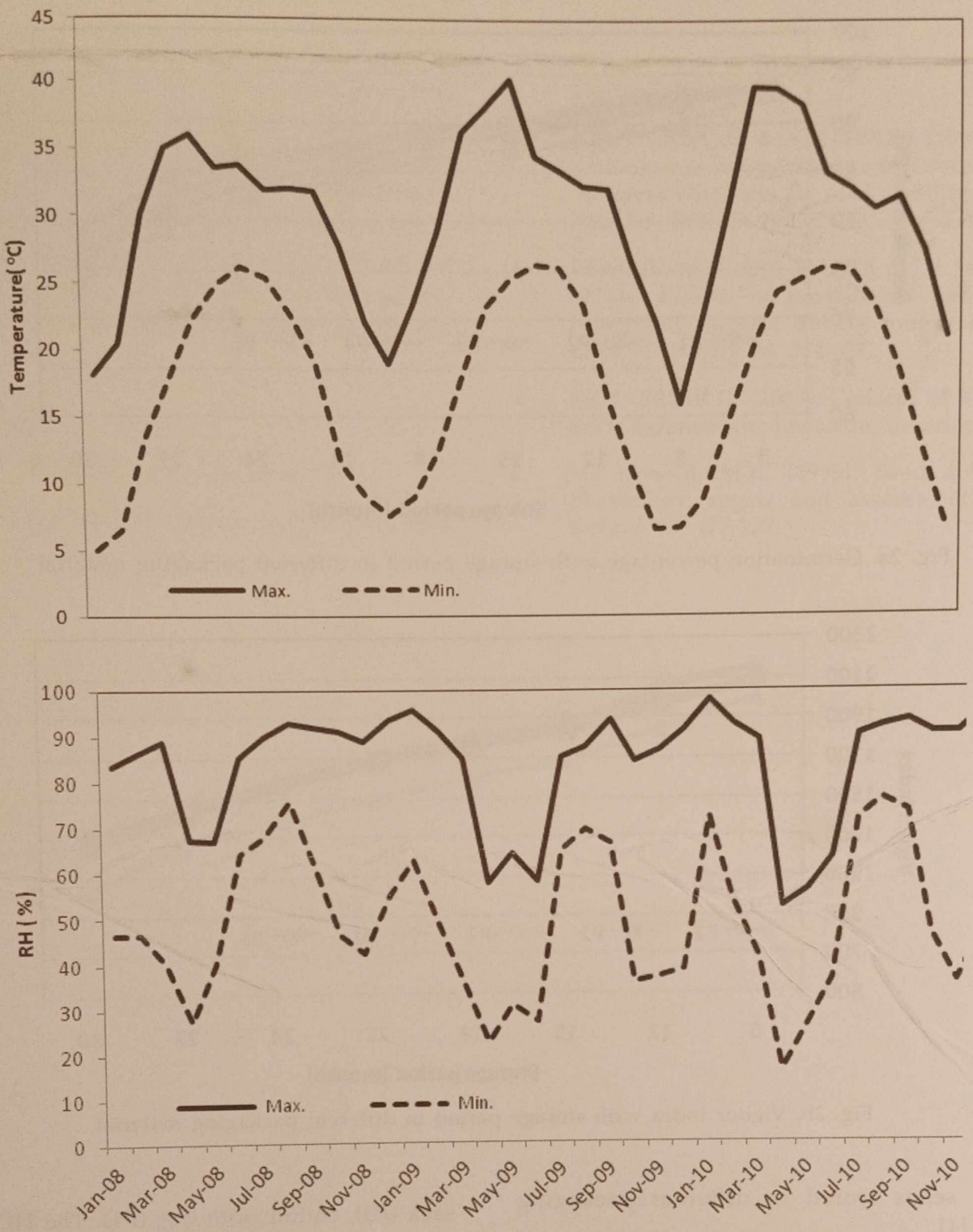

Fig. 1. Monthly maximum and minimum temperature and relative humidity of study location

found to be the best with regard to seed germination percentage. However, HDPE woven polylined sack was least suitable, followed by polypropylene non-woven, as germination of seed was affected maximum. The HDPE woven sack (P3) was found at par with hessian cloth (P2) and cotton cloth (P1) with respect to germination of seed. All the packaging materials were significantly different from each other with respect to vigour index. The hessian cloth was the best followed by cotton cloth, HDPE woven, polypropylene non woven and HDPE woven and lined. It might be attributed to differences in the rate of respiration, oxidation and enzyme activity

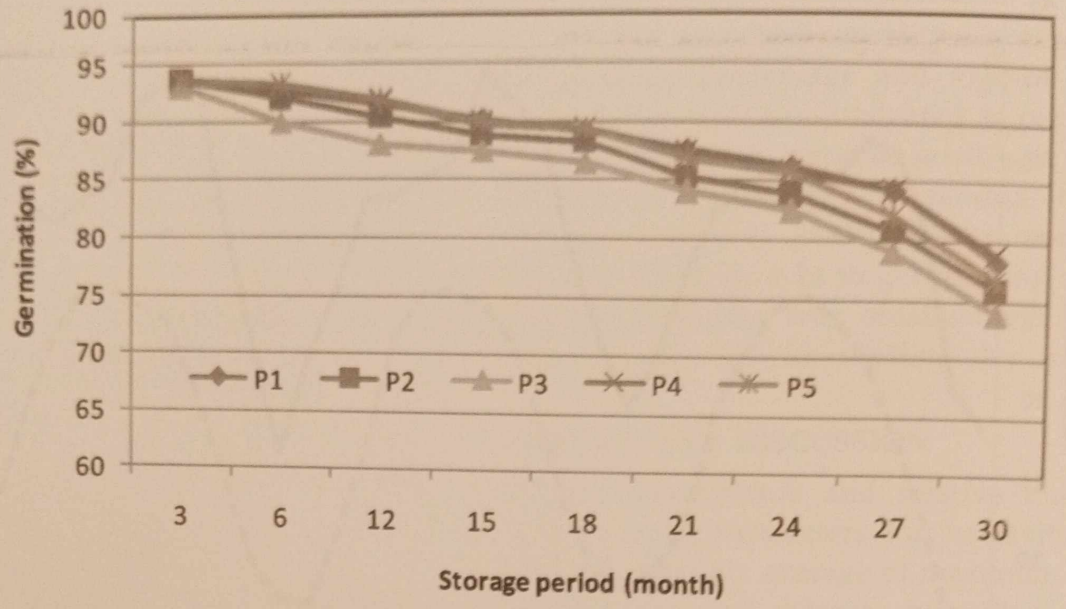

Fig. 2a. Germination percentage with storage period in different packaging material

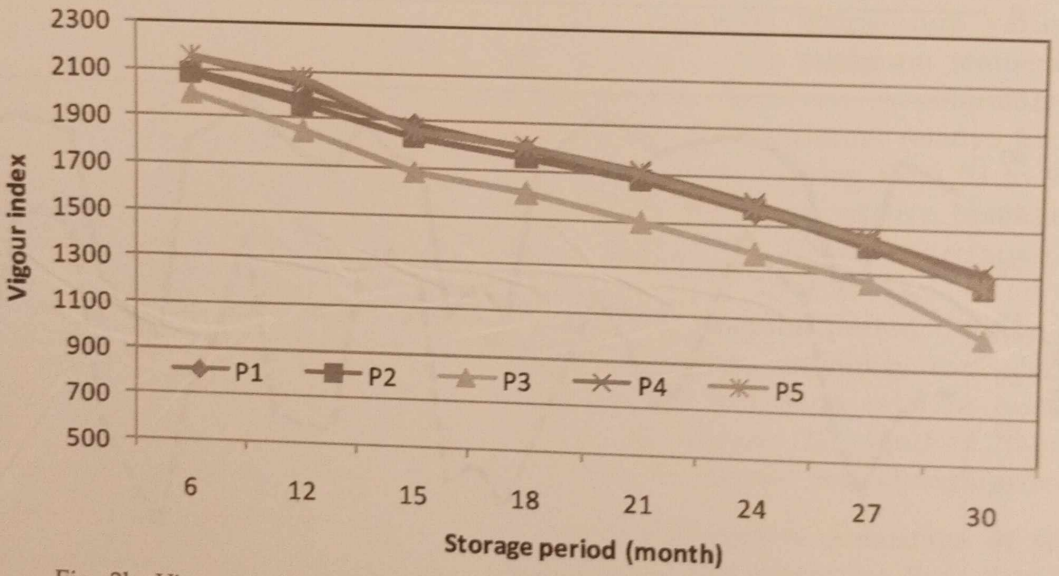

Fig. 2b. Vigour index with storage period in different packaging material

in paddy seeds stored in different packaging materials [4].

Storability of paddy seed has been found to be highly influenced by packaging material (Table 2). It may be due to change in chemical composition of seed. Mutters [5] reported that the chemical composition altered during storage at high temperature (>15°C); primarily protein was decreased and free fatty acid was increased. Germination of seed declined with increasing storage period in all the packaging materials. The decline was maximum with HDPE woven & lined sack (P4) followed by polypropylene non woven sack (P5), cotton cloth bag (P1). The HDPE woven sack (P3) and Hessian cloth bag (P2) were found at par in terms of declining germination (Fig. 2a). The decline of germination was steep after 30 month from start of seed storage.

The seed vigour index was also reduced with the advancement of storage period (Fig. 2b). However, reduction was maximum in cloth bag (P1), followed by polypropylene non woven sack (P5) and HDPE woven sack (P3). The decline in seed vigour index with increased storage was at par for P1 and P2. It was inferred that HDPE

woven sack is as good as Hessian cloth bag for storing paddy seeds. On the other hand the cloth bag, HDPE woven & lined sack and polypropylene non woven sack are inferior for packaging the paddy seeds. Higher concentration of cabondioxide also deteriorate the seed and that is why seed stored in HDPE polylined sacks deteriorated faster than HDPE unlined sacks. Similar observations had been reported by Mc Donald [6].

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