

Effect of Packaging Material and Storage Place on Storability of Seeds-A Simulation Study

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ABSTRACT The adequately tested simulation model was used to compare the storability of pea and onion seeds in different packaging material under the climatic conditions of Leh, Srinagar, Barmer, Poona and Vishakapatnam. The study suggested that Leh and Srinagar were good places for storing onion seed in any type of packaging material. Vishakapatnam was not congenial place for seed storage because of high temperature and high humidity combination. Special protection to seeds from moisture absorption during monsoon was required at Barmer and Poona in order to maintain minimum certification standards. The study indicated that there was an effect of storage place, packaging material, duration of storage and kind of seed on the viability during storage. The model could be effectively used for storing different types of seeds under varying agro-climatic conditions.

Keywords: Packaging, storage place, simulation

Proper storage of seed is an important sequel to the production of seed. It is of no use to produce good quality seed if it becomes worthless before it can be planted. Therefore, the purpose of good storage is to preserve high germination and vigour of the seed from harvest to planting time.

Seeds have maximum potential viability at physiological maturity and then the viability starts declining. The rate of deterioration largely depends on genetic factors, treatment, storage conditions and period. All stages between physiological maturity in the field to subsequent planting are actually a part of the storage. Proper storage environments would slow down the ageing process and enhance the longevity of seeds.

Broad guidelines for safe storage in terms of storage temperature, relative humidity, and seed moisture content for a wide range of seed types in tropics and sub-tropics were provided [1]. Effect of packaging material was studied [2] and found that materials containing foil provided good moisture and germination protection. In order to minimize the loss of viability during storage [3], the need to select a proper place for bulk seed storage was emphasized. The difference in relative storability of

seed of ten species under ambient conditions was shown [4].

Experimental studies to see the effect of so many factors-moisture content, temperature, relative humidity, packaging materials, kind of seed, storage place on seed viability at different places are costly procedure in terms of time and manpower expended. It necessitates the development of a mathematical model to help in optimum selection of various factors and to see the effects of these parameters on seed viability in order to maintain desired seed certification levels during storage.

MATERIALS AND METHODS

The detailed experiment was conducted at IARI, New Delhi. A computer based simulation model [5] was developed to predict the moisture content and viability of seeds packed in the different packaging materials. The experimental results were then validated with that of the results obtained from simulation study. A close agreement between the results was obtained. The model was used for making predictions under different operating conditions. The purpose of the simulation study was to demonstrate

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Table 1. Mean annual variation of temperature (°C) and relative humidity(%) for different sites

Site	Temperature		Relative humidity	
	Max.	Min.	Max.	Min.
Barmer	34.4 (May)	17.5 (Jan)	71 (Aug)	39 (April)
Vishakapatnam	30.9 (May)	22.6 (Jan)	90 (Jan)	78 (Nov)
Leh	17.5 (July)	-8.4 (Jan)	62 (Jan)	38 (June)
Srinagar	24.6 (July)	1.1 (Jan)	85 (Jan)	64 (June)
Poona	29.9 (May)	21.1 (Dec)	80 (July & Aug)	39 (March)

Table 2. Input parameters considered for the simulation study

Parameter	Values	
Seeds	Pea	Onion
Surface area of the packet (sqm)	0.0261	0.0261
Thickness (gauge)	350	350
Initial germination	96%	96%
Date of packing	1 st June	1 st June
Quantity of seeds packed(g)	50	5
Initial moisture content	9%	7%
Water vapour permeability (g mil/sq m day mm Hg)	Three levels (0.40,0.10,0.02)	Three levels (0.10,0.02,0.01)

the applicability and utility of the moisture content and viability prediction models in designing better seed storage systems.

Germination test was conducted by using 50 seeds in three replications at 20°C by the Between Paper method in a seed germinator. At the end of 8 days for pea and 12 days for onion, the number of normal seedlings was counted and the percentage of germination calculated.

Depending on the climatic data, five different sites in India were selected. These were Barmer (warm and dry); Vishakapatnam (warm and humid); Leh (cool and dry); Srinagar (cool and humid); and Poona (normal). Sixty years' average monthly data for temperature and relative humidity were available for these locations [6]. This data was taken from CROPWAT, Irrigation and Drainage Paper No. 44, FAO, Rome. The data is from 1925 to 1985. The mean annual temperature and relative humidity variations for the selected sites are presented in Table 1. The

climatic data, mean monthly for each station, was approximated by fitting sixth order polynomial to the sixty year data for the five locations.

The input parameters required for the simulation study were initial moisture content, water vapour transmission rate of packaging material, hygroscopic behaviour of seeds, environmental conditions, initial germination and duration of storage. The simulation study was conducted for onion and pea seeds. The seeds were selected keeping in view their storability. The values of the input parameters selected for the simulation study are presented in Table 2.

Only high quality seed, i.e., with high initial germination percentage, was considered for storage. Pea and onion are harvested in the month of April. Thus, for simulation study, June 1 was taken as the date of packaging. The water vapour permeability values obtained through the process of calibration during the present study for selected packaging material were used. Three different types of

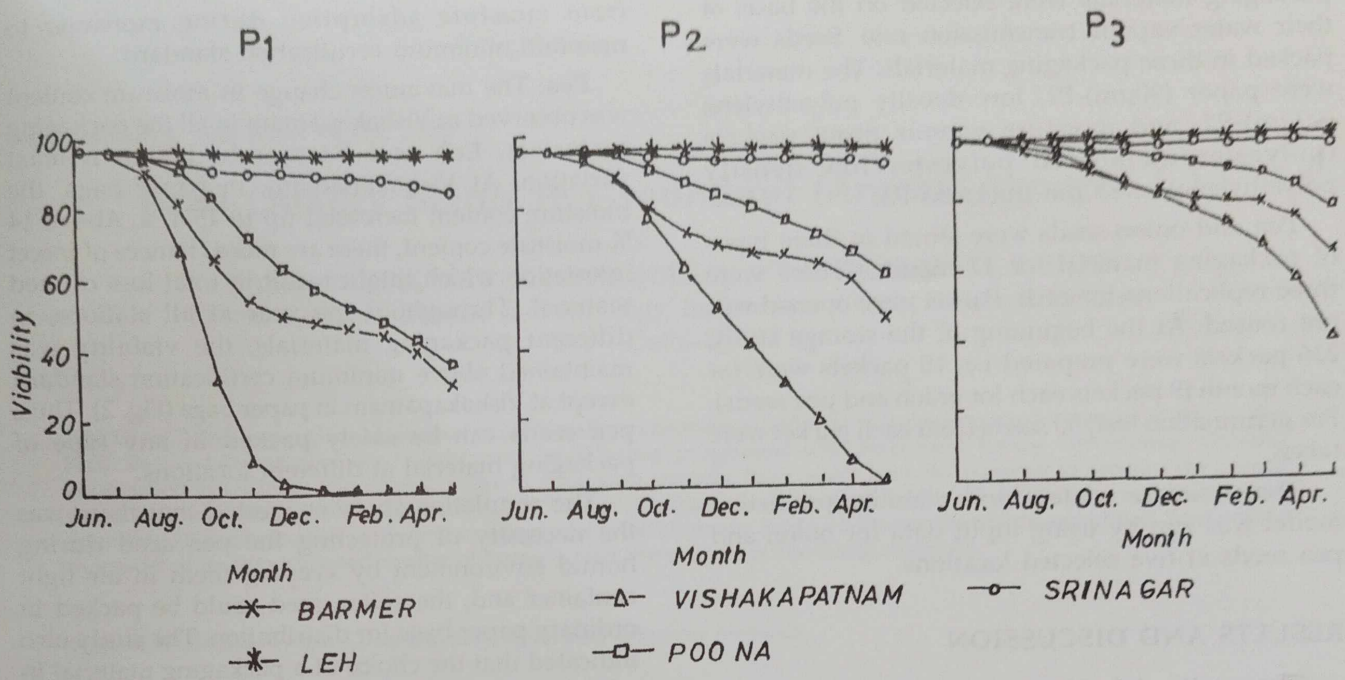


Fig. 1 Effect of packaging material (P₁, P₂, P₃) and storage place on the viability of onion seeds

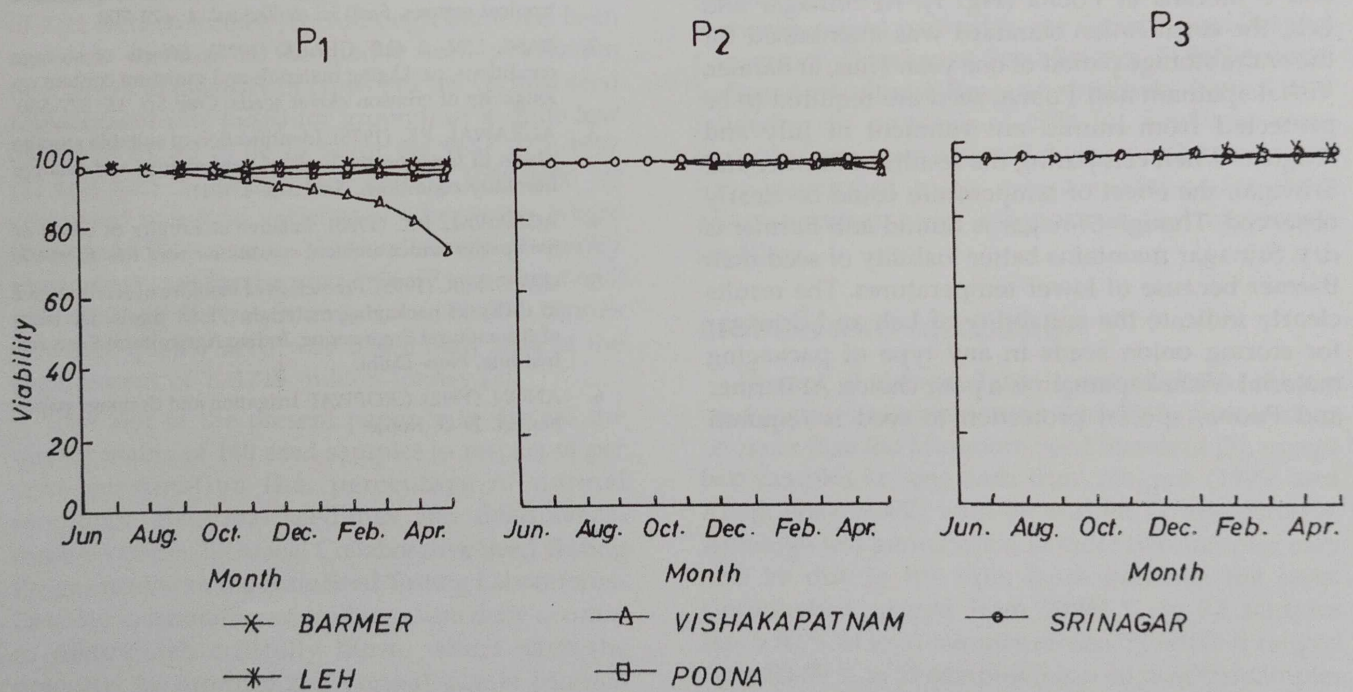


Fig. 2 Effect of packaging material (P₁, P₂, P₃) and storage place on the viability of pea seeds

packaging materials were selected on the basis of their water vapour transmission rate. Seeds were packed in these packaging materials. The materials were paper (90µm)-P1, low density polyethylene (90µm)-P2, and moisture vapour proof packets (polyester/metallized polyester/low density polyethylene) of 83 µm thickness-P3.

Pea and onion seeds were stored in three types of packaging material for 12 months. There were three replications for each. Packet once opened was not reused. At the beginning of the storage study, 216 packets were prepared i.e. 18 packets were for each month (9 packets each for onion and pea seeds). For germination test, 50 seeds from each packet were taken.

The moisture content and viability prediction model was run by using input data for onion and pea seeds at five selected locations.

RESULTS AND DISCUSSION

The results of the simulation study are presented in Figure 1 for both onion and pea seeds.

Onion: The relative humidity was maximum at Vishakapatnam and minimum at Leh (Table 1). The paper bag could maintain certification standard only for 3 months at Barmer; 2 months at Vishakapatnam and 5 months at Poona (Fig. 1). At Srinagar and Leh, the certification standard was maintained for the entire storage period of one year. Thus, at Barmer, Vishakapatnam and Poona, seed are required to be protected from humid environment of July and August. When comparing the results of Barmer and Srinagar, the effect of temperature could be clearly observed. Though Srinagar is humid and Barmer is dry, Srinagar maintains better viability of seed than Barmer because of lower temperatures. The results clearly indicate the suitability of Leh and Srinagar for storing onion seeds in any type of packaging material. Vishakapatnam is a poor choice. At Barmer and Poona, special protection to seed is required

from moisture adsorption during monsoon to maintain minimum certification standard.

Pea: The maximum change in moisture content was observed at Vishakapatnam in all the packaging materials. Leh and Barmer had shown least variation. At Vishakapatnam, in paper bags, the moisture content increased up to 15.8 %. Above 14 % moisture content, there are more chances of insect infestation which might result in total loss of seed material. Throughout the year at all stations, in different packaging materials, the viability was maintained above minimum certification standard except at Vishakapatnam in paper bags (Fig. 2). Thus, pea seeds can be safely packed in any type of packaging material at different locations.

The simulation study suggested that there was the necessity of protecting the pea seed during humid environment by keeping them in air tight container and, thereafter, seed could be packed in ordinary paper bags for distribution. The study also indicated that the choice of a packaging material in a given climatic condition would depend upon kind of seed and the duration of storage.

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