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Effect of Different Packaging Materials on the Quality of Soybean Seeds

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ABSTRACT: Seeds of Soybean (Glycine max (L.) Merr.), cultivar Pb – 1, dried to 6.0 ± 0.5% and 7.25 ± 0.5% initial seed moisture were stored for 12 months at two locations having different ambient conditions. Polyethylene – gauge 800, Polyethylene – gauge 500 and Woven polypropylene (polysack) were used as packaging materials for storage. The germination of seed stored in woven polypropylene material declined below 75% at Pelvehera and Rahangala after 6 and 9 months, respectively. The viability of seeds contained in polyethylene packs remained above 70% over the entire storage period at both locations. Significant variation in seed quality was evident between the initial moisture contents only after 9 months in storage. Tetrazolium test and the seedling emergence rate test results indicated the loss of vigour of seeds stored in woven polypropylene packs, due to the permeability of the material.

INTRODUCTION

Packaging is essential for storage and distribution of any seed material in units of safe and convenient size. The most important function of a seed package is protection against climatic factors and mechanical and physical hazards during storage, transport and distribution (Harrington, 1973). The kind of packaging material to be used is dependent upon several inter – related factors such as kind and quantity of seed handled, type and size of packs, intended storage duration, storage environment and the geographical location of storage (Justice and Bass, 1978).

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The physical properties and storage potential of seeds are influenced by moisture content which is controlled by the relative humidity of the surrounding atmosphere. Seeds being hygroscopic in nature, tend to absorb or lose moisture until the vapor pressures of seed moisture and air reach equilibrium. Therefore, when dried seeds are stored in warehouses, water vapor will move into seeds through container material resulting in gradual seed deterioration. These deteriorative losses can be rapid especially in soybean due to its relatively high oil and protein content. Thus, in tropical areas where humid conditions prevail, moisture proof or resistant containers need to be used in order to retain seed viability and vigour for a desired period under uncontrolled storage environments.

The objectives of this study are the identification of the most suited packaging material (among the tested) for the storage of Soybean seeds under two varying ambient conditions and the investigation of any relative advantage of packaging Soybean seeds with moisture contents lower than that are currently used.

MATERIALS AND METHODS

Soybean seeds, cultivar Pb – 1, were obtained from a certified crop produced in *Maha*, 1988 – 89 season at Maha Illuppallama. Seed lot was dried to 6.0 $\pm$ 0.5% and 7.25 $\pm$ 0.5% initial moisture content by sun drying and then using hot air sack – drier at a temperature of 38 $\pm$ 2 C. Polyethylene – gauge 800, Polyethylene – gauge 500 and Woven polypropylene were used as the three packaging materials. Accordingly, the following six treatment combinations were applied in the experiment: –

M1P1 = 6.0% Moisture x Polyethylene G.800. (M1 G800)
M1P2 = 6.0% Moisture x Polyethylene G.500 (M1 G500)
M1P3 = 6.0% Moisture x Woven polypropylene (M1 POLY)
M2P1 = 7.25% Moisture x Polyethylene G.800 (M2 G800)
M2P2 = 7.25% Moisture x Polyethylene G.500 (M2 G500)
M2P3 = 7.25% Moisture x Woven polypropylene (M2 POLY)

The package size used was 37.5 x 25 cm in all materials. Eighty (80) bags were prepared each filled with 5kg of above conditioned seed for each of the treatment combinations. Woven polypropylene bags were

closed using a hand – held electric stitching machine and the polyethylene packs were heat sealed. The treatments arranged in a randomized complete block design (RCBD) were replicated four times and repeated at two locations (*viz.* Pelvehara – L1 and Rahangala – L2). The ambient temperature and relative humidity of the storage atmosphere at the two locations were recorded over the period of study.

The initial seed quality (moisture content, percentage germination, tetrazolium viability and seedling emergence rate) was determined. The rules of International Seed Testing Association (1976) were applied for moisture and germination tests, and the tetrazolium test was conducted as per methods described in the Seed Vigour Testing Hand Book (1983) of the Association of Official Seed Analysts. The seedling emergence rate was computed according to the methods suggested by Maguire (1962) using the following formula modified by Arulnandhy and Senanayake (1988).

Sampling of seeds was done at one month intervals and tested to determine moisture content, viability and the seed vigour using the methods as above. The data sets obtained at 0, 3, 6, 9 and 12 months were used for standard analysis of variance.

RESULTS AND DISCUSSION

Two initial moisture levels, 6.0 % and 7.25 % included in the experiment were relatively lower than the currently applied level (*viz.* 9.0%) in Sri Lanka for Soybean seed storage under ambient conditions. A steady moisture uptake by the seed stored in woven polypropylene containers was observed over the storage period at both locations (Figures 1 and 2). However, the moisture up – take rate of seed in polyethylene packs was slow and did not reach beyond 8.7% by the end of 12 months storage period indicating the moisture resistant property of 800 and 500 gauge polyethylene material.

These results are in consistence with the reports of Warham (1986) and Grabe and Isely (1965). In Warham's investigation, the six packaging materials tested were ranked in the following descending order of Water Vapor Transmission Rate (WVTR) expressed in g/m2/day: Jute, Woven polypropylene, 4 ply kraft, polyvinyl chloride, polyethylene

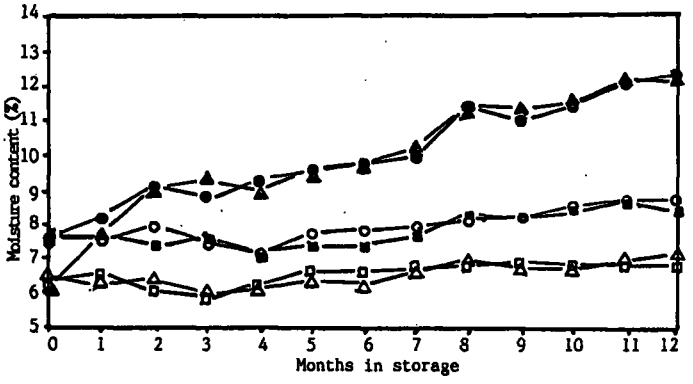

Fig. 1. Mean seed moisture content % during storage at Pelwehera.

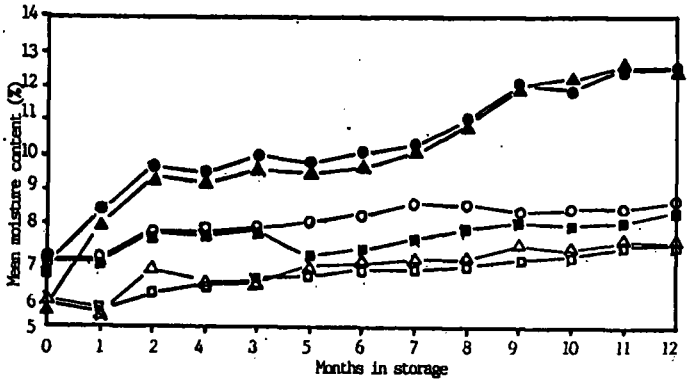

Fig. 2. Mean seed moisture content (%) during storage at Rahangala.

coated kraft and low density polyethylene. Grabe and Isely also reported the relatively better moisture resistant property of polyethylene material.

The influence of the quality of packaging material on the germination of soybean seeds stored at the two locations is shown in Table 1. A dramatic decline in germination of seed contained in woven polypropylene packs at Pelvehera was observed at 9 months' stage onwards while the trend at Rahangala has been slow.

Seeds in polyethylene material (gauge 800 and 500) remained viable above 75 % over the entire storage period at both locations. On examining the ambient conditions for the entire storage period at the two locations (Figure 3), it is evident that the difference in temperature has caused more influence than the relative humidity on the seed quality changes. The results are in agreement with Harrington's (1972) rules of thumb. The mean daily temperature during storage period at Rahangala has been 23.2 C and that of Pelvehera was 29.2 C. The moisture resistance offered by the thick polyethylene material has contributed to the retention of seed viability.

Poor resistance to moisture transmission associated with woven polypropylene has caused the steady rise in seed moisture content at the two locations. However, the seed deterioration has been rapid and more pronounced at Pelvehera evidently due to ambient temperatures favoring decline in physiological activity in seeds. This effect was illustrated in the seed vigour changes shown by the tetrazolium test and seedling emergence rate results (Figures 4, 5, 6 and 7). Dorworth and Christensen (1968) showed that the temperatures of 20, 25 and 30 C have influenced mould growth on soybean seeds of 12.1 % moisture content up to 73 %, 100 % and 98% respectively after storage for 20 weeks. Seeds stored in woven polypropylene packs at Pelvehera entirely lost viability at 12 months in storage.

Effects of the difference in two initial seed moisture levels were evident in germination results only after nine months in storage. Relatively low moisture contents of the tested seed lots have delayed their deteriorative process remarkably. This effect was also seen in the TZ test and seedling emergence rate tests. Arom Sripichitt *et al.*, (1988) reported similar advantages of low initial seed moisture in the region of 6 – 9 % for the storage of soybean seeds. Arulnandhy and Senanayake (1988), however found in their study, that the rate of deterioration of

Table 1. Mean germination % of seeds stored in different packaging materials at the two locations.

Packaging material	Pelvehera months in storage					Rahangala months in storage				
	0	3	6	9	12	0	3	6	9	12
Polyethylene gauge 800	91.3	93.4	83.1	84.8	78.0	90.4	92.9	86.4	85.5	83.5
Polyethylene gauge 500	90.6	94.6	81.9	80.4	76.8	89.1	92.5	83.6	84.0	78.5
Woven polypropylene	90.5	93.8	80.4	46.6	00.0	87.6	92.9	82.0	75.9	60.6
L.S.D. (P=0.05)	NS[1]	NS[1]	NS[1]	3.48	3.31	NS[1]	NS[1]	3.48	3.48	3.31

NS[1] = Not significant

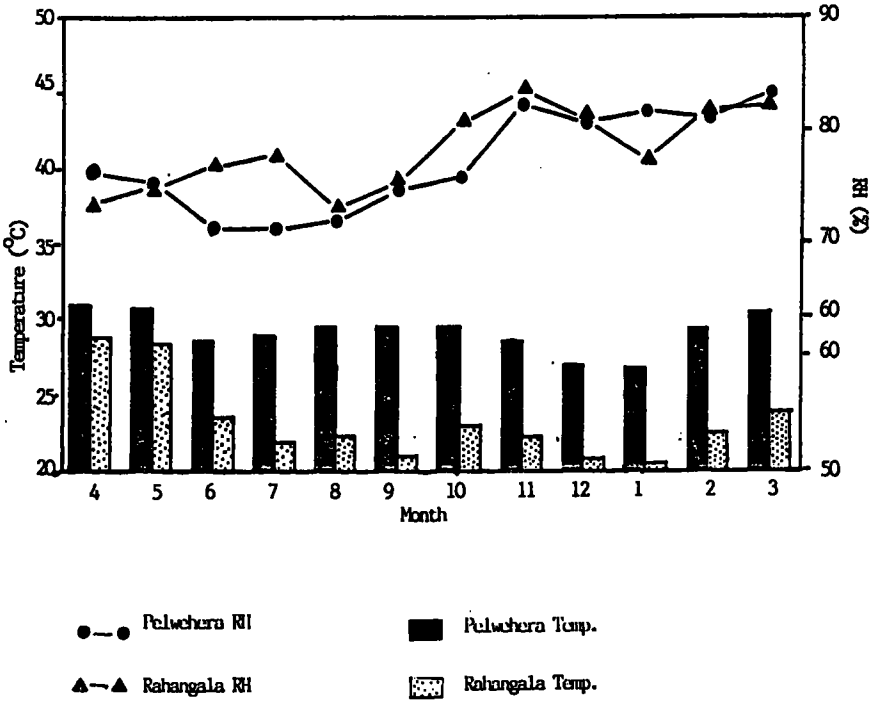

Fig. 3. Ambient conditions at the two locations (1989/90)

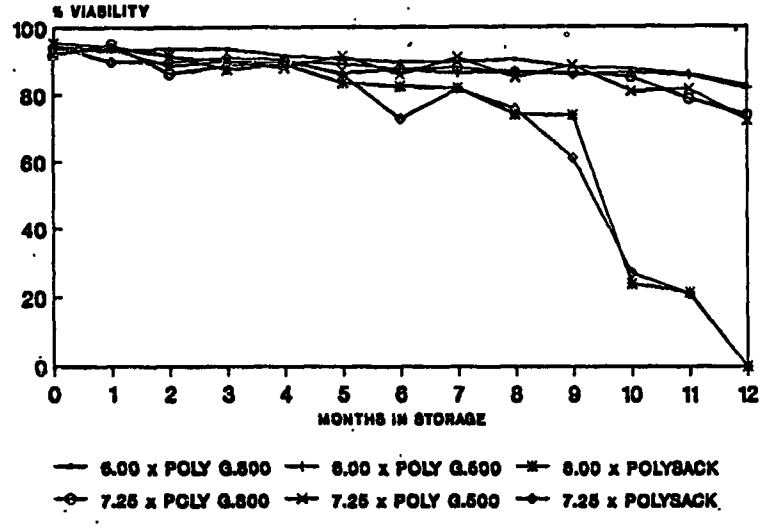

Fig.4. Mean TZ viability (%) during storage at Pelwehera.

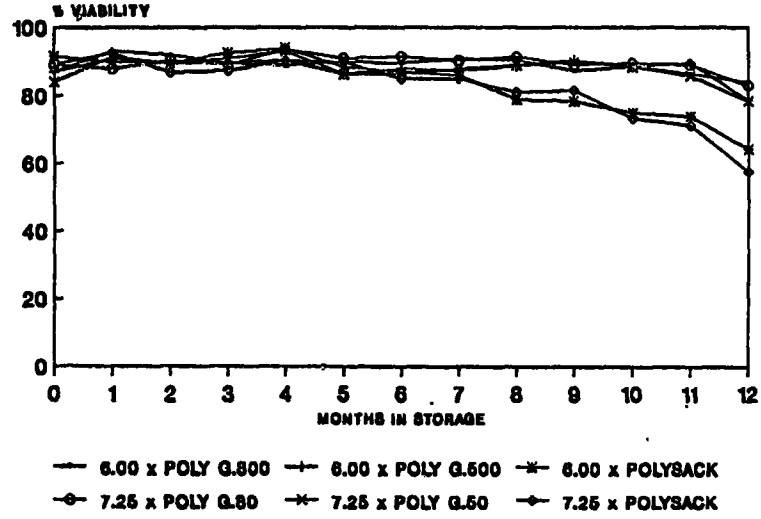

Fig.5. Mean TZ viability (%) during storage at Rahangala.

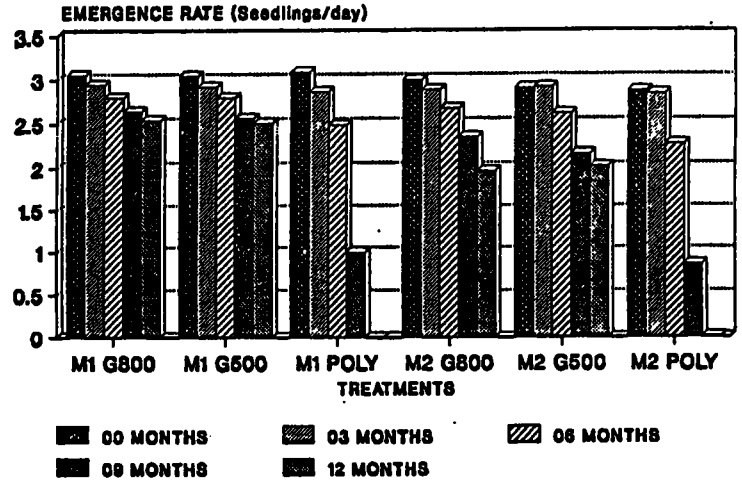

Fig.6. Seedling emergence rate at Pelwehera.

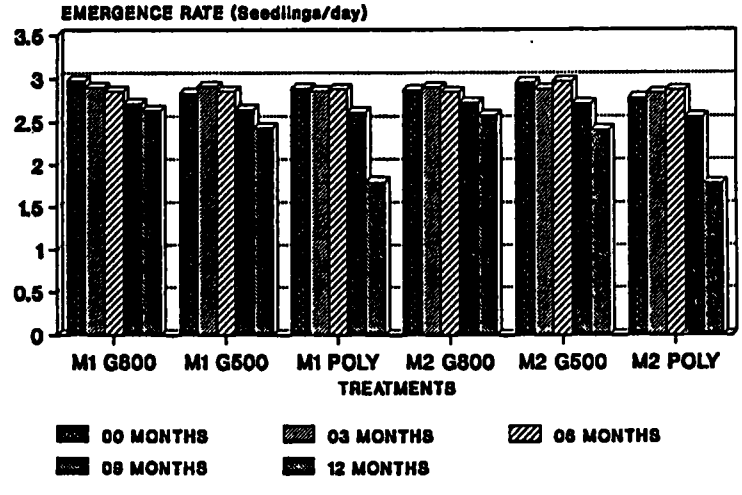

Fig.7. Seedling emergence rate at Rahangala.

soybean seeds dried to 8.5 % moisture was higher than that of seeds dried to 11.5 % moisture upon storage under ambient conditions for 9 months.

The data obtained in the present study strongly suggest that the woven polypropylene material cannot be used for soybean seed storage for periods beyond six months in viable state under ambient conditions. Polyethylene (gauge 800 and 500) retains the seed viability of Soybean seeds of 6 – 7% initial moisture content at least for one year. Rahangala is shown to be a better location than Pelvehera for seed storage.

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