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Effect of three different storage containers on the Moisture Content in four different varieties of Soybean seeds under tropical storage conditions

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Abstract

The soybean seed germination and vigour is found to be high at physiological maturity. High seed moisture level increases seed mycoflora, which play an important role in deterioration of soybean seed quality and viability during storage.The effect of storage containers on the seed quality of soybean seeds is always an important research aspect to study for the researcher. In the present study three different bags Polythene bag (C1), Cloth bag (C2) and Jute bag (C3) of dimensions 20 cm x 30 cm were used for the storage of soybean seed of four different varieties JS-335 (V1), AMS-99-33 (V2), TAMS-38 (V3) and TAMS-98-21under ambient temperature and relative humidity for a period of 18 months. The observations of moisture content of seeds from each container were recorded after 3 months (90 days).The least amount of moisture increase (9.1 %) was found in seeds stored in Polyethylene bag as compared to Cloth bag and Jute bag at the end of 540 days of storage. The corresponding moisture content values of soybean varieties JS-335, AMS-99-33, TAMS-38 and TAMS-98-21 when stored in Polyethylene, Cloth and Jute bags were different. Variety JS-335 seeds recorded lower moisture content (9.1 %) as compared to AMS-99-33, TAMS-38 and TAMS-98-21.

Keywords*: Soybean, Storage containers, Physiological studies, Moisture content, Soybean seed varieties.*

1. Introduction:

An important aspect in any agricultural improvement programme is the maintenance of quality in the storage of seeds. High temperature and high humidity conditions which are the common ambient feature of subtropical and tropical areas, induced deterioration of seed quality. Although several reviews are available on the loss of seed viability during storage and its assessment has been standardized. Soybean; the raw materials for vegetable oils, occupy a significant place in India's national economy. India is the world's biggest oilseed growing country and, paradoxically, the world's biggest important of edible oils as well, the main reason for this can be traced to low productivity per hector.

In Vidarbha region of Maharashtra State, soybean crop are harvested in October-November. The seeds of soybean crops are stored for 7-8 months prior to sowing. Through sun drying after harvest, followed by storage, has been found to reduce the problem of loss of viability. Even keeping the seeds under ambient conditions in ordinary gunny bags, would result in significant loss of viability (Charjan and Tarar; 1992). However, seed is not dried to a relatively safe moisture content after harvest, its storability will be reduced (Gadewar*et. al.*, 2009).

The demand for seed is fluctuating and very often there are large surplus stock of seed which need to be preserved till the time of next sowing. Such left-over seed experience in the hot and humid mansoon months, would significantly decline germinability. By the time of next sowing in June-July, the loss in vigour and viability of carry over seeds, may adversely affect field emergence and productivity (Basu, *et. al.*; 1978, Charjan and Tarar; 1992, and Abdullah M. Alhamdan*et. al.*; 2011). The oil seeds are poor storer and loose its viability very fast in adverse conditions of temperature and humidity.

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Razzaket. al., (2013) studied effect of storage containers on the seed quality attributes of tossa jute and found that Moisture content of the seeds of tin container increased significantly to 12.9% from initial moisture content 12.2%. Seed moisture content of polythene bag and gunny bag also increased very significantly from 12.2 to 13.2% and 12.2 to 14.5%, respectively.*Khan et. al., (2018)* observed the correlation between container and seed moisture level, the highest germination and lowest seed-borne fungal infection was recorded in seeds stored in aluminum foil bag with 7% moisture content. *Mainaet. al., (2017)* found that seeds stored in clay pots, brown paper bags, plastic transparent jars and freezer had higher seed quality than those stored in polythene bags. *Rani et. al., (2013)* suggested that the seeds at higher moisture contents (16, 18, and 20%) must be dried to lower levels before 8, 5, and 3 weeks, respectively for prolonged storage.*Tiwari and Gupta, (1981)* investigated that the moisture content of sunflower seed increase or decrease with the increase or decrease relative humidity of the environment. *Babuet. al., (1982)* reported that moisture exhibited greater fluctuation when stored in cloth and jute bags than when stored in polyethylene and polycoated bags. *Gregg, (1982)* observed that soybean seeds do not store well at high seed moisture content and storage temperature but they can store satisfactory under low temperature and low moisture content.

Arulnandhyet. al., (1984) revealed that the most important factor affecting soybean seed viability in storage is the moisture content. *Usberti, (1984)* reported that increase in moisture content of seeds stored in cloth bag due to its moisture pervious nature.*Verma and. Verma,(2014)* observed that cloth bag is not perfect for soybean seed storage for long time as compared to tin container and polyethylene bag; because the rate of moisture absorbance was higher in bag than in container and polythene bag.*Islam et. al., (2018)* revealed that in maintaining seed quality higher moisture content in the seed stored in air leaked container, over a longer storage period, accelerated the respiration rate and infestation of microorganisms, consequently the germination potential of seeds reduced.

2. Material and Methods:

Seeds of the following kinds and varieties i.e.JS-335, AMS-99-33, TAMS-38 and TAMS-98-21, (Denoted by V1, V2, V3 and V4 respectively) were obtained from "All India Co-ordinate Oil Seed project, College of Agriculture, Nagpur.

The seed samples were packed in the respective containers Polyethylene bag 700 gauge (moisture vapour proof), Cloth bag (moisture pervious) and Jute bag (moisture pervious). Polyethylene bag, Cloth bag and Jute bag, are denotes by C1, C2 and C3 respectively.

All the three bags will be of 20 cm x 30 cm. The seeds were closed by stitching in fresh jute and cloth bags, whereas it was heat sealed in case of polyethylene bags. The respective containers were then stored in wire mesh almirah in mesonary building having cemented walls, roof and floor under ambient temperature and relative humidity for a period of 18 months. Portion of the seeds from each container were removed after 3 months (90 days) and examined for Physiological, Biochemical and Mycological observations.

0 Days, 90 Days, 180 Days, 270 Days, 360 Days, 450 Days, and 540 Days intervals are denoted by T1, T2, T3, T4, T5, T6 and T7 respectively.

The soybean seeds finely ground was used for moisture determination. 5 gm of sample was weighed directly into the container. After weighing, the container with seeds (lid kept separately) was placed in the oven which has already been heated to the drying temperature. In this experiment the "low constant temperature method" was followed involving drying at 103 °C for 17 hours. The oven drops in temperature when the sample is placed in it and hence the drying period was counted from the moment only when oven regained the required temperature. At the end of drying period the container along with the lid was allowed to cool 30 to 45 minutes in desiccator and then it was weighed again. The moisture content (M) in percentage was calculated as follow

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$$M = \frac{(M2-M3)}{(M2-M1)} * 100$$ (Nema, 1986)

Where, M1=Weight of empty container with lid

M2=Weight of container with lid and seed before drying

M3= Weight of container with lid and seed after drying and cooling

Statistical analysis: The data obtained from the experiments were statistically analyzed by using factorial CRD. (Complete Randomized Design), Using Web Portal of CCS Hariyana Agricultural University, Hisar: http://14.139.232.166/opstat/default.asp. The critical differences between the parameters like Soybean seed Varieties, containers and storage period were worked out at five per cent significance.

3. Results and Discussion:

Results:

The effect of container and storage period on Moisture Content in all four varieties V1, V2, V3 and V4 is presented in **Table 1**.

Table 1: Effect of Varieties (V), Storage Containers (C) and Storage Periods (T) and three factor interaction on Moisture Content (%) of soybean seeds during storage.

VxCxT	V1			V2			V3			V4		
	C1	C2	C3	C1	C2	C3	C1	C2	C3	C1	C2	C3
T1	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0
T2	9.0	8.9	9.0	9.1	8.8	9.2	9.0	9.0	9.1	9.1	8.9	9.2
T3	9.2	10.8	11.2	9.1	11.0	11.4	9.2	10.8	11.4	9.0	11.1	11.5
T4	9.1	10.2	10.4	9.0	10.4	10.5	9.1	10.1	10.6	9.0	10.3	10.6
T5	9.0	10.1	10.2	9.0	10.2	9.9	9.1	10.2	10.4	9.0	10.3	9.8
T6	9.0	9.3	9.4	9.0	9.5	9.5	9.0	9.6	9.8	9.0	9.4	9.6
T7	9.1	11.2	11.6	9.1	11.4	11.8	9.2	11.1	11.7	9.1	11.3	11.9
Mean	9.1	9.9	10.1	9.0	10.0	10.2	9.1	10.0	10.3	9.0	10.0	10.2
SE (m)	0.193											
CD(P=5%)	NS											

*NS-Non Significant

a) Variety (V) Effect on Moisture content:

In variety JS-335 (V1), Polyethylene bag (C1), Cloth bag (C2) and Jute bag (C3) showed fluctuations in moisture content of seeds during storage according to temperature and relative humidity of the atmosphere. A significant minimum fluctuation of moisture content was observed in Polyethylene bag (C1). Seed stored in Polyethylene bag (C1) showed significantly lower moisture content (9.0 %) as compared to those stored in Cloth bag (C2) (11.2 %) and Jute bag (C3) (11.6 %) up to 540 days (T7) days of the storage. Among the containers Polyethylene bag (C1) showed significantly lower mean moisture content (9.1 %) as compared to Cloth bag (C2) (9.9 %) and Jute bag (C3) (10.1 %) throughout the storage period.

In variety AMS-99-33 (V2), Polyethylene bag (C1), Cloth bag (C2) and Jute bag (C3) showed fluctuations in moisture content of seeds during storage according to temperature and relative humidity of the atmosphere. A significant minimum fluctuation of moisture content was observed in Polyethylene bag (C1). Seed stored in Polyethylene bag (C1) showed significantly lower moisture content (9.0 %) as compared to those stored in Cloth bag (C2) (11.4 %) and Jute bag (C3) (11.8 %) up to 540 days (T7) days of the storage. Among the containers Polyethylene bag (C1) showed

significantly lower mean moisture content (9.1 %) as compared to Cloth bag (C2) (10.00 %) and Jute bag (C3) (10.2 %) throughout the storage period.

In variety TAMS-38 (V3), Polyethylene bag (C1), Cloth bag (C2) and Jute bag (C3) showed fluctuations in moisture content of seeds during storage according to temperature and relative humidity of the atmosphere. A significant minimum fluctuation of moisture content was observed in Polyethylene bag (C1). Seed stored in Polyethylene bag (C1) showed significantly lower moisture content (9.2 %) as compared to those stored in Cloth bag (C2) (11.1 %) and Jute bag (C3) (11.7 %) up to 540 days (T7) days of the storage. Among the containers Polyethylene bag (C1) showed significantly lower mean moisture content (9.1 %) as compared to Cloth bag (C2) (10.00 %) and Jute bag (C3) (10.3 %) throughout the storage period.

Similarly in variety TAMS-98-21 (V4), Polyethylene bag (C1), Cloth bag (C2) and Jute bag (C3) showed fluctuations in moisture content of seeds during storage according to temperature and relative humidity of the atmosphere. A significant minimum fluctuation of moisture content was observed in Polyethylene bag (C1). Seed stored in Polyethylene bag (C1) showed significantly lower moisture content (9.1 %) as compared to those stored in Cloth bag (C2) (11.3 %) and Jute bag (C3) (11.9 %) up to 540 days (T7) days of the storage. Among the containers Polyethylene bag (C1) showed significantly lower mean moisture content (9.0 %) as compared to Cloth bag (C2) (10.00 %) and Jute bag (C3) (10.2 %) throughout the storage period.

b) Container (C) Effect on Moisture content:

Table 4.39 shows that, in four varieties of soybean, seeds stored in Polyethylene bag (C1) exhibited significantly lower moisture content as compared to Cloth bag (C2) and Jute bag (C3). The variety JS-335 (V1) exhibited significantly lowest moisture content (9.7 %) as compared to AMS-99-33 (V2) (9.8 %), TAMS-38 (V3) (9.8 %) and TAMS-98-21 (V4) (9.8 %), irrespective of storage containers and storage period.

Two factor interaction for Moisture content

c) Variety x Container (VxC)

The two factor interaction between Varieties and Containers (VxC) on moisture content is presented in **Table 2.** The effect for two factor interaction V×C was non significant during all the periods of storage T1 to T7.

Table 2: Two factor interaction between Varieties and Containers (VxC) on Moisture Content (%).

VxC	C1	C2	C3	Mean V
V1	9.1	9.9	10.1	9.7
V2	9.0	10.0	10.2	9.8
V3	9.1	10.0	10.3	9.8
V4	9.0	10.0	10.2	9.8
Mean C	9.1	10.0	10.2	
SE (m)	0.073			
CD(P=5%)	NS			

. *NS-Non Significant

The interaction between Variety x Container for moisture content was non significant throughout the storage period. V2C1 had maintained lowest moisture content throughout the storage period. At the end of storage, lowest moisture content was found in V2C1 (9.0 %), and highest moisture content was found in V3C3 (10.3 %).

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d) Variety x Storage Period (VxT)

The two factor interaction between Varieties and Storage Period (VxT) on moisture content is presented in **Table 2**.

The interaction between Varieties and Storage Period for moisture content was non-significant for all three containers. During 90 days of storage. V1T2 recorded lowest moisture content (9.0 %). At the end of storage, V4T7 had recorded highest moisture content (10.8 %).

Table 3: Two factor interaction between Varieties and Storage Period (VxT) on Moisture Content (%).

VxT	T1	T2	T3	T4	T5	T6	T7	Mean V
V1	9.0	9.0	10.4	9.9	9.8	9.2	10.6	9.7
V2	9.0	9.0	10.5	10.0	9.7	9.3	10.8	9.8
V3	9.0	9.0	10.5	9.9	9.9	9.5	10.7	9.8
V4	9.0	9.1	10.5	10.0	9.7	9.3	10.8	9.8
Mean T	9.0	9.0	10.5	9.9	9.8	9.3	10.7	
SE (m)	0.111							
CD(P=5%)	NS							

*NS-Non Significant

e) Container x Storage Period (CxT)

The two factor interaction between Container x Storage Period (CxT) on moisture content is presented in **Table 4**.

The interactions among Container x Storage period for moisture content was significant for all the four varieties, during storage period T2 of storage, C2T2 recorded lowest moisture content (8.9 %). And higher moisture content was recorded in C3T7 (11.8 %).

Table 4: Two factor interaction between Container x Storage Period (CxT) on Moisture Content (%).

VxT	T1	T2	T3	T4	T5	T6	T7	Mean C
C1	9.0	9.1	9.1	9.1	9.0	9.0	9.1	9.1
C2	9.0	8.9	10.9	10.3	10.2	9.5	11.3	10.0
C3	9.0	9.1	11.4	10.5	10.1	9.6	11.8	10.2
Mean T	9.0	9.0	10.5	9.9	9.8	9.3	10.7	
SE (m)	0.096							
CD(P=5%)	0.269							

4. Discussion

In the present investigation (**Table 1**), the moisture content of the seeds does not adopt any trend either of decrease or rise continuously with the increase of storage period in all four varieties of soybean. The moisture content of seeds increased or decreased according to the atmospheric relative humidity and temperature. The moisture content of seeds was directly related to the relative humidity of the atmosphere (*Delouche et. al., 1973*).

It was also found that when seeds were stored in Cloth (C2) and Jute (C3) bags, it showed higher moisture content than those stored in Polyethylene bags (C1). The least amount of moisture increase was found in seeds stored in Polyethylene bag (C1) during storage. This increase in moisture content of seeds stored in Cloth (C2) and Jute (C3) bags may be due to moisture pervious nature.

While in Polyethylene bag it is primarily due to resistance to moisture penetration. *Naharet. al. (2009)* investigated that, Cloth and Jute sacks offer no resistance to moisture penetration. The moisture content of seeds stored in open weave, cotton or Jute sacks will eventually reach a value which is in equilibrium with the atmospheric relative humidity in the store. *Ali et. al., (2014)* reported that seed stored in Polyethylene packets is considered to be the best because humidity cannot pass through it.

In the present investigation, the corresponding moisture content values of soybean varieties JS-335 (V1), AMS-99-33 (V2), TAMS-38 (V3) and TAMS-98-21 (V4) when stored in Polyethylene (C1), Cloth (C2) and Jute (C3) bags were different. The seeds of soybean varieties absorb more moisture comparatively. This may be due to bulk protein constitution of soybean seeds. The present findings are in agreement with those of *Snow, (1944)* and*Allerup, (1958).*

Wang et, al., (2010) reported high moisture holding capacity of proteineous legume seeds. Significant varietal differences in soybean crop were not found in regard to moisture content of seeds during storage.

The results obtained from determination of moisture content have been illustrated graphically in **Figure 1.**

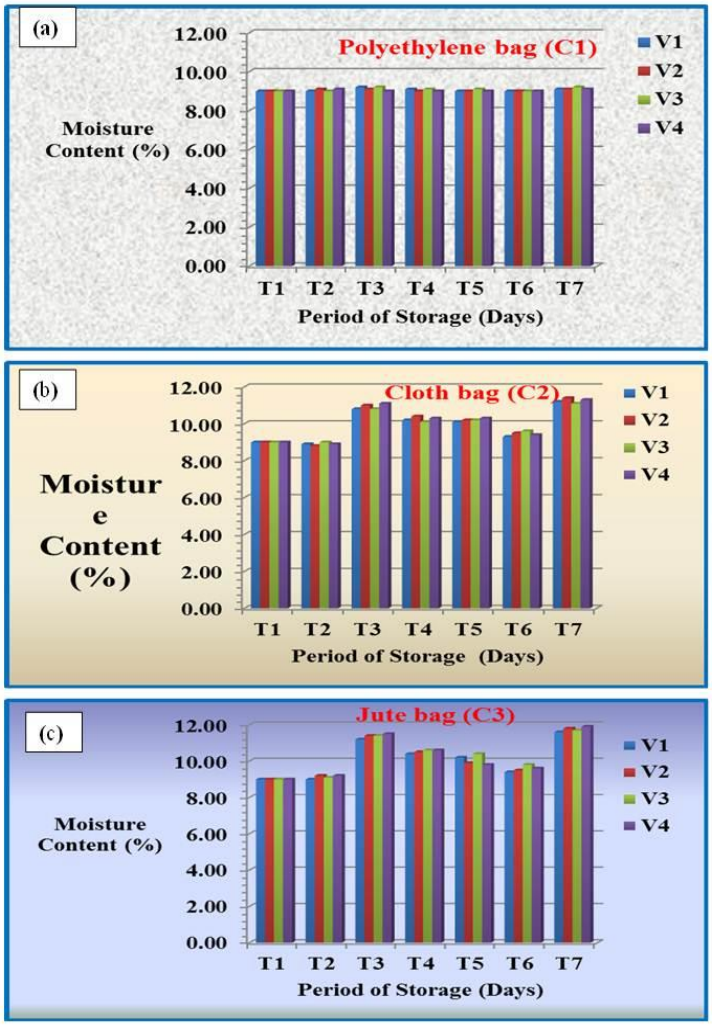

Figure 1: Effect of storage containers on Moisture Content (%) in Soybean seed varieties. (a) Polyethylene bag (C1), (b) Cloth bag (C2) and (c) Jute bag (C3).

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5. Conclusion:

The moisture content of seeds increased or decreased according to the atmospheric relative humidity and temperature. The moisture content of seeds was directly related to the relative humidity of the atmosphere. It was also found that when seeds were stored in Cloth and Jute bags, it showed higher moisture content than those stored in Polyethylene bags. The least amount of moisture increase (9.1 %) was found in seeds stored in Polyethylene bag at the end of 540 days of storage.
In the present investigation, the corresponding moisture content values of soybean varieties JS-335, AMS-99-33, TAMS-38 and TAMS-98-21 when stored in Polyethylene, Cloth and Jute bags were different. Variety JS-335 seeds recorded lower moisture content (9.1 %) as compared to AMS-99-33, TAMS-38 and TAMS-98-21.

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