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Effect of Seed Treatments and Packing Materials on Seed Quality Parameters of Maize (*Zea mays* L.) during Storage

KEYWORDS: Maize(*Zea mays* L.), Seed treatments – Castor oil, Captan, Vitavex, Packing materials, Moisture content, germination %, Vigour index.

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ABSTRACT *The cultivated species "Zea mays L." belongs to family poaceae (Graminae). Poaceae is the fifth largest family consisting of 10,000 species and at least 600 genera, unquestionably the most important family providing majority of food. Maize (Zea mays L.) is one of the most nutritional crops and proper storage of seeds continues to be a challenge for farmers.*

In the present study, a storage experiment was conducted to understand the effect of different seed treatments, Packing materials and different storage periods on seed quality parameters of maize at Govt. Madhav Science PG College Ujjain (M.P). Freshly harvested Maize seeds of variety "JM-216" were collected from Krishi Vigyan Kendra Ujjain. The seeds were treated with Castor oil (5ml/kg), Captan (3g/kg), Vitavex (3g/kg) and Control (Untreated) stored in Cloth bags and Polybags for 3-9 months under ambient conditions at MVM Ujjain. The results revealed that the seeds treated with Captan recorded higher germination (80%) and for packing materials, Cloth bags recorded higher germination (75.5%), Vigour index(2161). For moisture content, Polybags recorded higher moisture content (8.7 %) at the end of 9-month storage.

INTRODUCTION

Maize (*Zea mays* L.) is important as a source of energy and protein in the human diet throughout the world (**Rehman, 2006**). Maize together with rice and wheat provides at least 30% of the food calories 2 more than 4.5 billion people in 94 developing countries, where maize is the preferred stapleThe production of maize in the world has been increasing continuously. At global level, India ranks 4th in area and 7th in production of maize. The area, production and productivity of maize in India are 8.6mha, 20.5mt and 2.4t/ha, respectively in 2010-11 (Annual Report Directorate of Maize Research 2011-12).

The storage of food grains is practiced from the era of the beginning of civilization. It is an important problem because the production of grain crops is seasonal and location specific (**Sawant, 1994**).Proper crop storage plays an integral part in ensuring domestic food supply (**Thamaga- chitja et al., 2004**) and that seed quality and vigor is maintained (**Joao Abba and Lovato, 1999**). Fluctuations in temperature, humidity and prolonged storage results in considerable nutrient losses (**Shah et al., 2002**).

Seeds are required to be kept in safe storage since they are harvested. Despite significant advances in food storage methods, many communities still rely on traditional storage methods for seeds to be used as food and fodder (**Olakojo and Akinlosotu, 2004**). During storage, seed quality remain high at the initial level or decline to a level that may make the seed unacceptable for planting purpose what is related to many determinants: environmental conditions during seed production, pests, seed moisture content, grain characteristics, packing materials, storage periods, fungicidal seed treatments etc. Insect pests are one of the major organisms that are responsible for the decline in quantity, quality and germination potential of maize seeds in storage (**Jayas and white, 2003**).

According to **Joao Abba and Lovato, 1999**; proper and safe storage conditions are those that maintain seed quality without loss of vigour for three years. The loss of quality of maize seeds stored in different packing materials is not only visually observed by the poor condition of the seeds but also by the performance of this seed when it is planted for the next season (**Bellon, 2001**).

Seeds cannot retain their viability indefinitely and after a period of time, the seeds deteriorate. Prolonged storage period with high seed moisture percentage also causes reduction in germination, seedling vigour, and increases germination period and decreases chlorophyll content. **Tekrony et al., (2005**) studied the effect of storage of maize on germination and vigour in an "uncontrolled" warehouse and in a controlled environment, where the temperature and humidity were monitored. Their results showed that all seed lots had 87-99% germination prior to storage. After eight months storage in the "uncontrolled" warehouse, the germination declined to 50-80%.

The productivity of a crop primarily depends on the availability of quality seeds. To maintain the quality of seeds during storage the standardization of suitable seed treatment and packing material is most important because seed treatment is the basic measure to assure an adequately health of crops at emergence and during further growth of plants.

Good storage is a basic requirement in seed production program as the maintenance of high seed viability and vigour from the harvest to planting is of utmost important in a seed production program. In storage, the seeds are to be protected against the pests and pathogens. The seeds can be treated with different fungicides to prevent the growth of micro-organisms and insect infestation. Seed treatments with fungicides not only controls seed-borne diseases but also improve seed heath, plant stand, germination and crop yield (**Tanweer 1982**).

Fungicide treatments are required for seeds to be stored

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for several months and stability of fungicides effects without affecting the seed health adversely. Keeping in view these facts, the aim of the present study was to determine the effect of different seed treatments and packing materials on germination, moisture content, chlorophyll content and vigour index during different storage periods(3-9) months.

MATERIALS AND METHODS

COLLECTION OF SAMPLE

Samples of freshly harvested grains of Maize variety JM-216(JAWAHAR MAIZE) were obtained from Krishi Vigyan Kendra (KVK) Ujjain (M.P.).

SEED TREATMENTS

Freshly harvested grains of Maize were treated with Captan T_1(3g/kg), Castor oil T_2(5ml/kg), Vitavex T_3(3g/kg) and Control T_4 packed in different packing materials like Cloth bags(C_1) and Polybags(C_2) stored for 9 month storage period under ambient condition at KVK Ujjain. Observations on various parameters were taken at an interval of three months.

SEED MOISTURE CONTENT

The moisture content of seed samples were determined by using low constant oven method following the guidelines of International Seed Testing Association (ISTA). The moisture was measured just after collection of seed from the KVK Ujjain. For each treatment 15 g seed was taken into a crucible and weighed. Then the crucible was kept in an electric oven maintained at a temperature of 75^{0}C for a period of 24 hours for proper drying of the seed sample. After cooling the weight of the seeds were taken. Then the moisture content of the seed sample was calculated with the help of the following formula

Seed moisture content =

$$\frac{M1 - M2}{M1} \quad X \quad 100$$

Where,

M1 = Fresh weight of the Seeds

M2 = Dry weight of the Seeds

GERMINATION TEST

For germination test, it was done on field performance evaluation procedure i.e. plastic trays were filled with compost and coco-pit and about 100 seeds were planted at 1cm depth at an equal spacing. They were arranged in a randomized design (RBD) with three replicates for each treatment. No other fertilizers were added but adequately moisture was maintained.

VIGOUR INDEX (VI)

Vigour index was calculated as per Abdul-baki and Anderson by using the formula;

VI = Germination percentage (%) x Total seedling length (cm)

DATA ANALYSIS

The mean values of data obtained were statistically analyzed by two way ANOVA using RBD design for parameters like moisture content, germination percentage and vigour index.

RESULT AND DISCUSSION

The results of the moisture content, germination percentage and vigour index of seeds of maize during 3,6 and 9 months of storage as influenced by various seed treatments and different packing materials are presented in tables 1 to 4.

MOISTURE CONTENT

The results of the present study indicates that the moisture content of maize seeds during storage differed significantly among packing materials at 3-9 months of storage period(Table 1. Fig.1.). The results indicated that the seeds stored in Polybags (**C_2**) recorded highest moisture content (**8.71%)** at the end of 9-month storage period as compared to seeds stored in cloth bags (**C_1**) which shows lower moisture content (**8.31**%). Differences in moisture content due to seed treatments and their interaction were significant during the entire storage period from 3-9 months as shown in the table 1. Significant higher moisture content was found in seeds stored in poly bags as compared to seeds stored in cloth bags at the end of 9-month storage may be due to presence of dry atmospheric conditions and high temperature. This indicates that seeds stored in Polybags shows higher moisture content because Polybags acts as temperature impervious containers while cloth bags acts as temperature pervious containers during dry atmospheric conditions and high temperatures.

GERMINATION PERCENTAGE

The seed treatments and packing materials shows significant influence on germination percentage at the end of 9-month storage period. The result of the present study indicates that maximum germination (82.50%) was recorded in Captan (**T_2**) treated seeds followed by seeds treated with Vitavex **T_3** (72.883%). Whereas germination was minimum in seeds treated with Castor oil **T_1** (64.68%) at the end of 9-month storage period as shown in (Table 2. Fig. 2.). A significantly higher germination was recorded in seeds treated with Captan **T_2** (82.50%) which may be due to effective control of storage diseases and insect pests, wherein the chemicals acted as antioxidants to counteract the release of free radicals during the storage period. On the other hand minimum seed germination was observed seeds treated with Castor oil (**T_1**) (64.68%) may be due to deleterious effect on seeds and also it is clear that Castor oil forms a thin film over seeds and due to this processes like respiration and other metabolic activities gets inhibited which affects on seed germination process.

It has also been evident from the results of the present investigation that the packing material also influences on germination. The results shows that maximum germination (75.5%) was recorded in seeds stored in cloth bags **C_1** and minimum seed germination (73.01%) was recorded in Polybags at the end of 9-month storage period. A significant higher quality parameters like seed germination percentage recorded in seeds stored in cloth bags **C_1** (75.5%) may be due to presence of lower moisture content and also due to presence of dry and hot atmospheric conditions at the end of 9-month storage period. Similar results were reported by **Clements (1988)**. Interaction of seed treatments and packing materials shows significant difference at the end of 9-month storage period.

VIGOUR INDEX (VI)

Seed treatment and packing materials shows significant influence on vigour index at the end of 3-9 month storage periods (Table 3. Fig.3.).The data obtained at the end of 3-month storage period shows that highest vigour index (2773) was recorded in Vitavex T_3 treated seeds followed by Captan T_2 (2384). And lower vigour index was recorded in Castor oil T_1 (1857). Results also shows that seeds stored in Polybags shows highest vigour index (2584) and seeds stored in cloth bags shows lower vigour index (2075).

The data obtained at the end of 6-month storage period shows that highest vigour index (3784) was recorded in Vitavex T_3 treated seeds. And lower vigour index was recorded in untreated seeds T_4 (3011). Results also shows that seeds stored in cloth bags shows highest vigour index (3509) and seeds stored in Polybags shows lower vigour index (3190). Interactions of packing materials and seed treatments shows significant differences in vigour index. The highest vigour index recorded in cloth bags C_1 may be due to dry atmospheric conditions due to which it reduces the moisture content from

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cloth bags quite easily as compared to ploy bags because Polybags acts as vapour proof.

And for 9-month storage period, the data shows that that highest vigour index (2679) was recorded in Castor oil (T_1) treated seeds. And lower vigour index was recorded in Captan T_2 (1415). Results also shows that packing materials also produced significant influence on vigour index. Highest vigour index was recorded in cloth bags C_1 (2161) and lower vigour index was recorded in poly bags C_2 (1951). Interactions of seed treatments and packing materials showed non-significant difference at the end of 9-months storage period.

Table 1. Influence of seed treatment and packing materials on moisture content (%) in Maize during storage

Treatment (T)	Storage Period								
	3 Month			6 Month			9 Month		
	C_1	C_2	**Mean**	C_1	C_2	**Mean**	C_1	C_2	**Mean**
T_1	5.2	4.7	4.9	8.6	8.3	8.44	7.8	9.6	8.7
T_2	4.5	5.2	4.8	8.1	8.2	8.20	8.5	8.1	8.3
T_3	5.3	6.4	5.8	8.8	9.2	9.01	8.7	8.8	8.7
T_4	5.3	4.3	4.8	8.6	8.3	8.46	8.2	8.3	8.2
Mean	5.07	5.15	5.1	8.5	8.50	8.5	8.3	8.7	8.47

For comparing	S.Em ±	C.D	S.Em ±	C.D	S.Em ±	C.D
C	0.021	0.064	0.016	0.048	0.026	0.080
T	0.015	0.046	0.011	0.034	0.019	0.057
C x T	0.030	0.091	0.022	0.067	0.037	0.114

Where;

C_1 = Cloth bag; C_2 = Polybags; C = Packing material
T_1 = Castor oil (5ml/kg); T2 = Captan (3g/kg); T_3 = Vitavex (3g/kg); T_4 = Control
T = Treatment;

Table 2. Influence of seed treatment and packing materials on germination (%) in Maize during storage

Treatment (T)	Storage Period								
	3 Month			6 Month			9 Month		
	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
T_1	82.46	81.03	81.75	78	75.76	76.88	68.23	61.13	64.68
T_2	82.63	82.63	82.63	81.56	81.70	81.63	78.6	81.9	80.25
T_3	82.66	81.4	82.06	81.13	81.30	81.21	77.46	68.3	72.88
T_4	82.03	81.30	81.66	80.60	81.16	80.88	77.7	80.73	79.21
Mean	82.45	81.60	82.02	80.32	79.98	80.15	75.5	73.01	74.25

For comparing	**S.Em ±**	**C.D**	**S.Em ±**		**C.D**	**S.Em ±**	**C.D**
C	0.414	NA	0.902	2.763	1.089	3.334	
T	0.293	NA	0.638	N/A	0.770	2.358	
C x T	0.586	NA	1.276	N/A	1.540	4.716	

Where;
C_1= Cloth bag; C_2 = Polybags; C = Packing material
T_1= Castor oil (5ml/kg); T2 =Captan (3g/kg) T_3 =Vitavex (3g/kg); T_4 =Control;
T= Treatment;

Table 3. Influence of seed treatment and packing materials on vigour index in Maize during storage

Treatment (T)	Storage Period								
	3 Month			6 Month			9 Month		
	C_1	C_2	Mean	C_1	C_2	Mean	C_1	C_2	Mean
T_1	1613	2110	1857	3921	2896	3409	2553	2806	2679
T_2	1918	2850	2384	3426	2963	3194	1619	1210	1415
T_3	2548	2998	2773	3854	3713	3784	2442	1917	2179
T_4	2223	2388	2306	2835	3187	3011	2030	1872	1951
Mean	2075	2584		3509	3190		2161	1951	

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For comparing	S.Em ±	C.D	S.Em ±	C.D	S.Em	C.D
C	0.021	0.064	0.016	0.048	0.026	0.080
T	0.015	0.046	0.011	0.034	0.019	0.057
C x T	0.030	0.091	0.022	0.067	0.037	0.114

Where, C_1= Cloth bag; C_2 = Polybags; C = Packing material

T_1= Castor oil (5ml/kg) T_2 =Captan (3g/kg); T_3 =Vitavex (3g/kg; T_4 =Control; T = Treatment; N/A = Non analyze

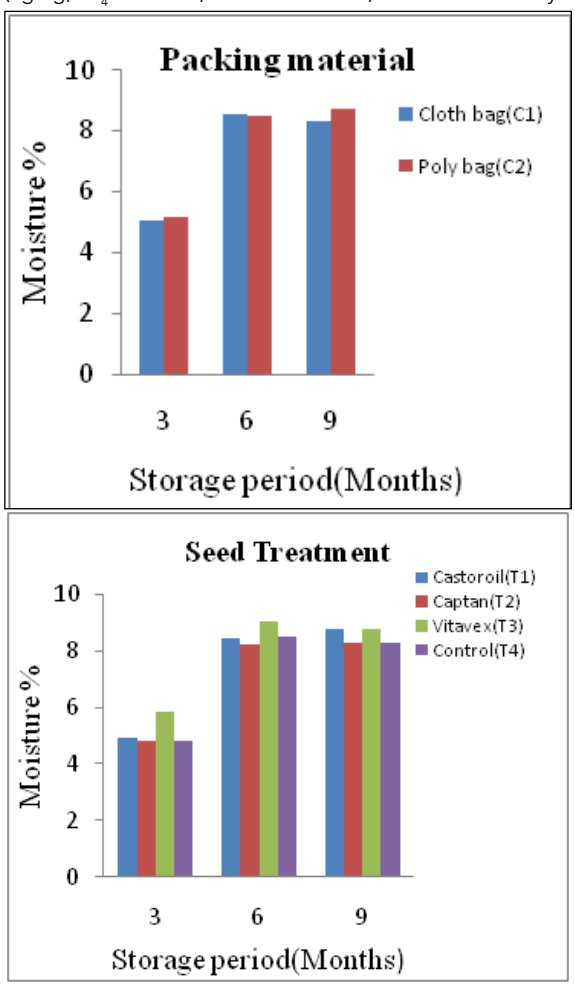
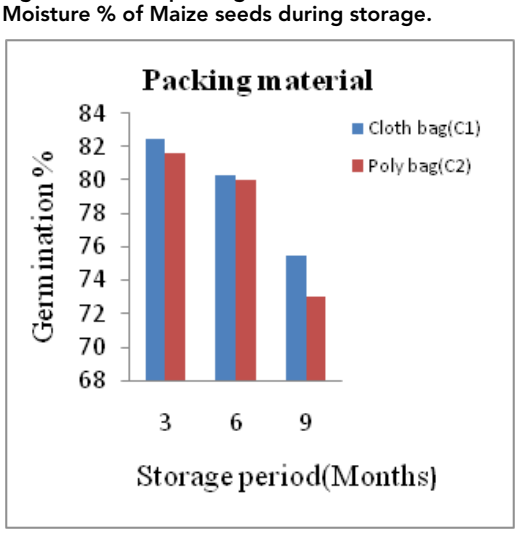


Fig. 1: Effect of packing material and seed treatment on Moisture % of Maize seeds during storage.



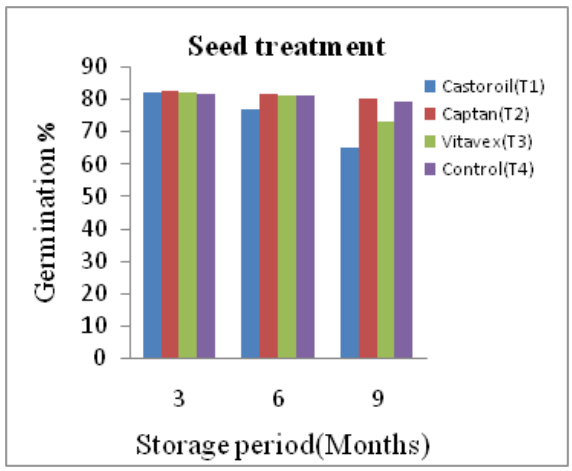
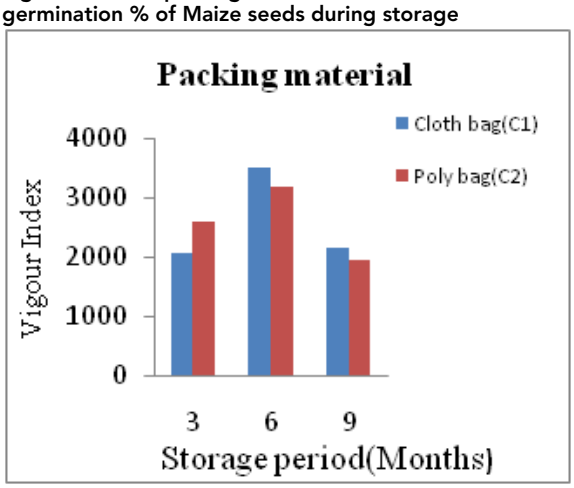


Fig. 2:Effect of packing material and seed treatment on germination % of Maize seeds during storage



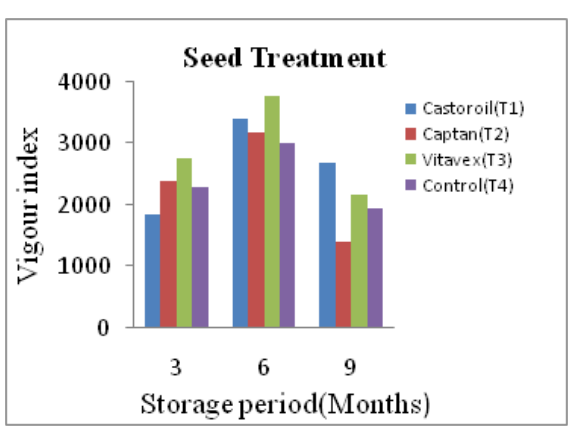


Fig. 3: Effect of packing material and seed treatment on Vigour index of Maize seeds during storage.

CONCLUSION

The present study reiterated the importance of proper storage techniques and their impact on seed quality parameters of maize seeds. Apart from correct storage, the original condition of the seeds needs to be taken into account before they are stored as insect damage could aggravate the

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problem. Seed treatments have a major role in protecting the seed during storage and can also play an important role in achieving uniform seedling emergence under certain conditions. This study confirms that germination capacity of the stored grains decreased in all types of seed treatments and packing materials with the process of storage period. The seeds treated with Castor oil & Vitavex stored in Polybags lost their viability more as compared to seeds treated with Captan and stored in Cloth bags due to more toxic effects and due to low air movements.

Overall results shows that seeds of maize were treated with Captan (3g/kg) and packed in Cloth bags stored for 9-months storage period under ambient conditions maintained maximum seed quality.

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