Influence of polymer seed coating, biocides and packaging materials on storability of Wheat (*Triticum aestivum* L.)

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Abstract: This present study was elucidated that the effects of ageing (storage) in wheat seeds are treated with polymer, biocides and stored in different packaging materials. Genotypes of wheat were treated with the synthetic polymer and biocide. Then the poly-coated seeds shade dried and further treated with biocide (i.e. neem oil and castor oil) at recommended dosage and stored in types of packaging materials (normal polythene bag (700 gauges) (P_1), Vacuum polythene bag (P_2), jute bag(P_3), cloth bag (P_4) and normal plastic bag + jute bag (P_5)] in ambient condition in the Post Graduate Laboratory, Department of Genetics and Plant Breeding, SHIATS, Allahabad for two, four and six months. Observations shows that the treatment of polymer @ 8 ml/kg of seed stored in vacuum plastic bag for 6 months displayed significant higher percentage of seed viability, germination, seed vigour, root length, shoot length and seedling length as compared to other treated seeds were stored in vacuum plastic bag. Germination and vigour percentage decreased with the period of ageing. It is also found out that vacuum polythene bag could be the best options among normal plastic bag, cloth bag and plastic normal bag for seed packing in terms of maintaining the seed quality as reflected in the varied parameters of the seed quality assessment indicators. Seeds are stored in plastic bags were affected due to storage but the effects were more pronounced in the plastic bags as compared to jute bags.

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Keywords: polymer seed coating, biocides, packaging materials.

Introduction

Wheat (*Triticum aestivum* L.) is one of important leading cereal crop which ranks first among world food crops, measured either by cultivated area (211.06 m ha) or by the production (566.8mt.) achieved (Jagshoran *et al*. 2010). Wheat with its root ramifying into the depths of human culture has an evolutionary history parallel with history of human civilization itself. Even today, it decides the feast or famine for millions of people. Wheat attained its premier position by virtue of its unique protein gluten, which is responsible of bread making properties of wheat flour. It is highly nutritious cereal foodstuff and its amino acid yield per acre for exceeds that of animal products (Gillibrary and Basley, 1962 and Hegsted, 1965).

Seed are required to be kept in safe storage since they are harvested in the preceding season and usually used for sowing in the subsequent season often after a time gap of six months or longer. Thus proper storage is required to keep seeds in good condition. Some varieties needs air conditioned storage. Storage costs are also added in order to drive cost of seed. Seed is stored form the moment it attains physiological maturity on the plant until it is sown. The weathering agencies like high moisture, oxygen, sunlight, insects and diseases cause adverse effects on the seed before harvest. Improper and delayed harvesting as well as processing cause further injury to the seeds. Seeds are stored under optimal storage conditions (low temperature and low seed moisture content) to prolong the seed viability. Hence, present studies were undertaken to assess the effect of storage bags on prolonging/maintaining its longevity under ambient and control conditions of Allahabad.

Materials and Methods

The seeds of wheat were treated with the synthetic polymer and biocide. Then the poly-coated seeds were shade dried and further treated with biocide, *i.e.* neem oil and castor oil at recommended dosage. It were packed in normal polythene bag (700 gauges) (P_1), vacuum polythene bag (P_2), jute bag (P_3), cloth bag (P_4) and normal plastic bag + jute bag (P_5) and stored under ambient condition in the Post Graduate Laboratory, Department of Genetics and Plant Breeding, SHIATS, Allahabad for 2, 4 and 6 months.

For seedling characters, the germination test was conducted using four replications of 100 seeds from each sample in rolled towel papers as per procedure described by ISTA (1993). Seedling dry weight and vigour index I and II were determined by Baki and Anderson (1973).

Data analysis

In order to calculate the Germination (%), Vigour Index (I and II), Root and Shoot length and Seedling Dry Weight formula 1, formula 2, formula 3 and formula 4 were used:

Germination (%) =

$$\frac{\text{Number of normal seedlings}}{\text{Total seeds used for germination test}} \times 100 \quad (1)$$

V.I. (I) = Germination percentage (Normal seedling) X Seedling length (cm) (2)

V. I. (II) = Germination percentage (Normal seedling) x Dry weight of the seedling (gm)

Root and shoot length: Root and shoot length of five fresh seedlings was measured in centimeters up to one decimal. Total seedling length was calculated by adding root and shoot length. (3)

Seedling dry weight: The seedlings used for recording were dried in an oven at $103^0C \pm 1^0C$ for 12 hours. Measurement of dried samples was record on an electronic balance upto three decimals in mg. (4)

Results

The seeds treated with polymer and biocides showed significant superiority on seed quality parameters during storage. The treatments were observed significantly higher germination percentage (94.05%) with seed treated by polymer @ 8 ml per kg of seeds (T_4) and minimum (79.35 %) with control (T_0) at the end of 6^{th} months of storage period.

Effect of packaging materials were observed significantly higher germination percentage (86.05%) with vaccum plastic bag (P_2) and minimum (81.95%) with normal plastic bag (P_1) at the end of 6^{th} months of storage period.

Significantly higher shoot length was recorded (13.84) with seed treated by polymer @ 8 ml per kg of seeds (T_4) and minimum (10.17 cm) with Neem oil (10 ml/kg) (T_1) at the end of 6^{th} months of storage period. Significantly higher shoot length was recorded (11.66cm) with vaccum plastic bag (P_2) and minimum (10.94cm) with jute bag (P_3) at the end of 6^{th} months of storage period.

Effect of seed treatments was observed significantly higher root length (10.39cm) with seed treated by polymer @ 8 ml. per kg of seeds (T_4) and minimum was (8.94cm) with neem oil (10 ml/kg) (T_1) at the end of 6^{th} months of storage period. Significantly higher root length was recorded (9.83cm) with vaccum plastic bag (P_1) and minimum (9.20cm) with cloth bag (P_4) at the end of 6^{th} months of storage period.

Significantly higher seedling length was recorded (24.04cm) with seed treated by polymer @8 ml per kg of seeds (T_1) and minimum (19.09cm) with control (T_1) at the end of 6 months of storage period.

Effect of packaging materials were observed significantly higher seedling length (21.66cm) with vaccum plastic bag (P_2) and minimum (20.28cm) with normal plastic bag (P_1) at the end of 6^{th} months of storage period.

Effect of seed treatments were observed significantly higher fresh weight of seedlings (0.73gm) with seed treated by polymer @ 8 ml per kg of seeds (T_4) and minimum (0.62gm) with control (T_0) at the end of 6^{th} months of storage period.

Effect of packaging materials were observed significantly higher fresh weight of seedlings (0.69gm) with vaccum plastic bag (P_2) and minimum (0.62gm) with Jute + normal plastic bag (P_5) at the end of 6^{th} months of storage period.

Effect of seed treatments were observed significantly higher dry weight of seedlings (0.17gm) with seed treated by polymer @ 8 ml per kg of seeds (T_4) and minimum (0.12gm) with control (T_0) at the end of 6^{th} months of storage period.

Effect of packaging materials were observed significantly higher dry weight of seedlings (0.15gm) with vaccum plastic bag (P_2) and minimum (0.13gm) with jute bag (P_4) at the end of 6^{th} months of storage period.

Effect of seed treatments were observed significantly higher seedling vigour index (2258.29) with seed treated by polymer @ 8ml per kg of seeds (T_4) and minimum (1542.80) with control (T_0) at the end of 6^{th} months of storage period.

Effect of packaging materials were observed significantly higher seedling vigour index (1871.16) with vaccum plastic bag (P_2) and minimum (1676.11) with normal plastic bag (P_1) at the end of 6^{th} months of storage period.

Effect of seed treatments were observed significantly higher seed viability (85.33 %) with seed treated by polymer @ 8 ml. per kg. of seeds (T_4) and minimum (54.18%) with control (T_0) at the end of 6th months of storage period.

Effect of packaging materials were observed significantly higher seed viability (71.36%) with vaccum plastic bag (P_2) and minimum (64.67%) with normal plastic bag (P_1) at the end of 6th months of storage period.

Effect of seed treatments were observed significantly higher seed vigour percentage (84.55 %) with seed treated by polymer @ 8 ml per kg of seeds (T4) and minimum (56.60 %) with control (T_0) at the end of 6th months of storage period.

Effect of packaging materials were observed significantly higher seed vigour percentage (72.30 %) with vaccum plastic bag (P_2) and minimum (65.70 %) with normal plastic bag (P_1) at the end of 6th months of storage period.

Interaction effect due to different seed treatments and packaging materials were observed the seeds quality parameters were higher with T_4P_2 and lower with T_0P_1throughout storage period in most of the cases.

Discussion

The germination of wheat seeds declined progressively with increase in the period of storage in all the treatment combinations, which may be attributed to the phenomenon of ageing and depletion of food reserves and decline in synthetic activity of seed. At the end of storage period the germination was significantly higher (94.05) in seeds treated with polymer @ 8 ml per kg of seed (T_4), whereas the T_0 (control) recorded (79.35) percent germination at same period of storage. The decline in germination percentage may be attributed to ageing effect leading to depletion of food reserves and decline in synthetic activity of embryo apart from death of seed because fungal invasion, insect damage, fluctuating temperature, relative humidity and storage container in which seeds are stored. The polymer reduced the impact of ageing enzymes; this suggests that polymer protective agent against seed deterioration due to fungal invasion and physiological ageing as result of which the seed viability was maintained for a comparatively longer period of time. These findings are in agreement with results obtained by Duruigbo (2010) in Maize and Cowpea seeds.

The seeds stored in vacuum plastic bag (P_2) proved better than cloth bags and jute bag. The maximum seed germination (86.05%) was observed in vacuum plastic bags whereas minimum seed germination (81.95%) was found in normal plastic bags (P_1). Similar results reported by in Procházková *et al.,* (2008) and European beech (*Fagussylvatica* L.) seeds.

Theoretically, no oxidative processes should be supported under vacuum. To recall some facts, the term vacuum is defined as space without matter in it. Vacuum packaging literally vacuums the air out of the bags or storage containers and so slows down the process of deterioration. A perfect vacuum has never been accomplished. The best man made vacuum had less than 100,000 gas molecules per cc, compared to about 30 billion molecules for air at sea level (Anon., 2007 b). It has also been reviewed that it is not possible to evacuate all the air ~ 0.3 – 3% may remain after sealing) by way of vacuum packing. Oxygen supports the growth of aerobic microorganisms; thus, the removal of oxygen from the modified atmosphere will extend the microbial shelf life (Sanjeev and Ramesh, 2006).

The root length and shoot length of wheat seedling decreased gradually with advancement in storage period. However, significantly higher root length (10.39cm) was recorded in seed treated with polymer @ 8 ml per kg of seed (T_4), followed by polymer coating @ 6 ml per kg of seed (T_3) as compared to neem oil @ 10 ml/kg seeds (T_1) which recorded (8.94cm). Significantly higher shoot length of (13.84cm) was recorded in seeds treated with polymer @ 8 ml per kg of seed (T_4), followed by in polymer coating @ 6 ml per kg of seed (T_3) as compared to neem oil @10 ml/kg (T_1) which recorded lower shoot length of (10.17cm). The decline in root and shoot length may be attributed to age induced decline in germination. The damage caused by fungi and insects and also toxic metabolites which might have hindered the seedling growth and similar findings were also reported by Paul *et al.* (1996) in mungbean, Dadlani*et al.* (1992) in rice and Kumar and Rai (2006 & 2007) in maize. With reference to the packaging materials the shoot and root length found to be significantly superior in plastic bags to cloth bag and jute bag. Similar results reported by Saxena *et al*. (1987) in onion seeds and Kumar and Rai (2006 & 2007) in maize.

Fresh weight and dry weight of seedling decreased with increase in storage period. This may be due to ageing, which resulted in seed deterioration of seed, decrease in the germination percentage and seedling length. Among different treatment combinations the seeds coated with polymer coating@ 8 ml per kg of seeds (T_4) recorded higher.

Seedling fresh and dry weight (0.73gm) and (0.62gm), as compared to control (T_0). These results are in conformity with findings of In the present study, significantly higher seedling vigour index 2258.29 was recorded in seeds treated with polymer @ 8 ml. per kg of seed (T_4) as compared to control (T_0) 1542.80 at the end of six months of storage. It may be due to age induced decline in germination, decrease in dry matter accumulation in seedling and decrease in seedling length. Similar findings were reported by Savitri *et al.* (1994) in sorghum and Savitri *et al.* (1998) in groundnut. The seeds stored in plastic bags (P_1) proved better than cloth bags (P_2).

The decline in viability percentage may be attributed to ageing effect leading to depletion of food reserves and decline in synthetic activity of embryo apart from death of seed because fungal invasion, insect damage, fluctuating temperature, relative humidity and storage container in which seeds are stored. The polymer reduced the impact of ageing enzymes; this suggests that polymer protective agent against seed deterioration due to fungal invasion and physiological ageing as result of which the seed viability was maintained for a comparatively longer period of time. These findings are in agreement with results obtained by Duruigbo (2012) in maize and cowpea seeds. Significant differences in seed viability (%) due to seed treatments were observed throughout storage period. The polymer coated or seeds treated with Biocides recorded significantly higher seed viability (%) compared to untreated seeds. Significantly higher seed viability (%) was recorded with seeds treated with polymer @ 8 ml. per kg of seeds (T_4) at the end of storage period (85.33%). Significantly lower seed viability (%) was recorded throughout the storage period with control (T_0) (54.18%) at the end of 6^{th} months of storage.

Seeds stored in vacuum plastic bag (P_2) recorded significantly higher over non vacuum plastic bag, jute bag, cloth bag and plastic bag+jute bag throughout the storage period. The higher seed viability (%) recorded with vacuum plastic bag (P_2) and minimum with normal plastic bag (P_1) at the end of 6^{th}month of storage was (71.36%) and (64.67%), respectively. Similar report was finding by Kameswar et al., (2002) in vacuum storage and seed survival in pearl millet and sorghum.

Significant differences in seed vigour (%) due to seed treatments were observed throughout storage period. The polymer coated or seeds treated with Biocides recorded significantly higher seed vigour (%) compared to untreated seeds. Significantly higher seed vigour (%) was recorded with seeds treated with polymer @ 8 ml. per kg of seeds (T_4) at the end of storage period (84.55%). Significantly lower seed vigour (%) was recorded throughout the storage period with control (T_0) (56.00) at the end of 6^{th}months of storage.

The seed vigour (%) seeds stored in vacuum plastic bag (P_2) recorded significantly higher over non vacuum plastic bag, jute bag, cloth bag and plastic bag+jute bag throughout the storage period. The higher seed vigour (%) recorded with vacuum plastic bag (P_2) and minimum with normal plastic bag (P_1) at the end of 6^{th}month of storage was (72.30%) and (65.70), respectively.

Table 1. Influence of polymer coating, biocide and packaging materials on storability of wheat seeds

Treatment	Germination (%)	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Fresh weight (g)	Dry weight (g)	Seed vigour index	Seed viability (%)	Vigour test (%)
(T)									
2 months	95.4	14.53	11.02	25.51	0.75	0.17	2432.28	89.33	87.85
4 months	95.05	14.2	10.5	24.66	0.74	0.17	2343.15	87.33	83.3
6 months	94.05	13.84	10.39	24.04	0.73	0.17	2258.29	85.33	84.55
F-TEST	*	*	*	*	*	*	*	*	*
S.E. m±	1.045	0.229	0.196	0.318	0.013	0.043	34.933	1.917	1.36
C.D. (P =0.05)	2.14	0.469	0.401	0.651	0.027	0.0083	71.543	3.927	2.786
PACKAGING									
(P)									
2 months	87.2	12.71	10.43	23.24	0.71	0.15	2030.55	77.51	75.45
4 months	86.7	12	10.21	22.27	0.7	0.15	1934.88	73.49	73.4
6 months	86.05	12.66	9.83	21.66	0.69	0.15	1871.16	71.36	72.3
F-TEST	*	*	*	*	*	*	*	*	*
S.E. m±	1.79	0.229	0.196	0.318	0.013	0.043	34.933	1.917	1.36
C.D. (P =0.05)	2.14	0.469	0.401	0.651	0.027	0.0083	71.543	3.927	2.786
Int. (T x P)									
F-TEST	*	n.s.	*	n.s.	*	n.s.	n.s.	n.s.	*
S.E. m±	2.337	0.512	0.438	0.711	0.03	0.009	78.113	4.288	3.042
C.D. (P =0.05)	4.786	1.049	0.898	1.455	0.061	0.018	159.975	8.781	6.231
n.s.- Non signifi									

Conclusion

From the present investigation it is concluded that the treatment of Polymer @ 8 ml/kg of seed was superior as it retained seed germination (%), shoot length, root length, seedling length, vigour index, dry weight and fresh weight. The treatment of Polymer @ 8 ml/kg of seed, stored in vaccum plastic bag for 6 months showed significant higher percentage of seed viability, germination, seed vigour, root length, shoot length and seedling length as compared to other treated seeds were stored in vaccum plastic bag materials. It is also found out that vaccum polythene bag could be the best options among normal plastic bag, cloth bag and plastic normal bag for seed packing in terms of maintaining the seed quality as reflected in the varied parameters of the seed quality assessment indicators.

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