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Review Article

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Seed Storability and Quality of Oil Seed Crops during Storage: A Review

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ABSTRACT

The option of a packaging material for any agricultural produce differs with the type of markets in which the products are distributed. In developing countries, this choice is largely determined by the cost and availability of packaging materials. Seed storage is an integral part of seed production programme. Seeds of many field crops are produced with greater care and cost. Hence, a good storage is essential to keep them alive and vigorous until required for subsequent sowing season. Seed is said to be in storage in various stages from harvest to sowing. Seed storability and quality is affected during pre and post harvest periods. The seed of various crops reaches their maximum potential for germination and vigour at physiological maturity. The germination potential (viability) is very short lived in oil seeds crops as compared to other agricultural crops and is often reduced prior to planting time. This loss of germination is much more acute under tropical conditions like India. These environmental conditions make very difficult to maintain oil seeds crops viability during storage. Such deteriorated seed is one of the basic reasons for low productivity in all the oil seeds crops cultivated in developing country like India. Further, the oil seeds crops are highly susceptible to mechanical injury and damage occurring during post harvest handling, which affect the viability and vigour of oil seeds crops during storage. Besides these, large number of pathogens is also associated with oil seeds crops which lead to the reduction in germination and storability of the seed. However, the seed quality and viability during storage depend upon the initial quality of seed and the manner in which these are stored. The rapid seed deterioration of oil seeds crops are thought to be due to lipid peroxidation, subsequently resulting in loss of seed viability. The research on these aspects of oil seeds crops seed deterioration during storage has been reviewed in this article.

Key words: *Oil seeds, Seed quality, Seed storability and Storage containers*

INTRODUCTION

Storage seeds are an important problem from the time mankind learnt to grow crops. Million tons of seeds are either damaged or lost due to inadequacy of scientific methods of storage. Post harvest losses of seeds in storage are very substantial and such losses thwart our attempt to boost agricultural production and maintain self-sufficiency in seeds.

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The primary cause leading to loss in quality and quantity of agricultural produce during its storage is due to presence of higher moisture content in the stocks at the time of storage cause sprouting, molding and heating. Insects and rodents apart from eating away the produce pollute it by contamination with their urine, excreta and carcass. Insects and mites eat away the germ portion of the seeds rendering it unfit for germination and impart objectionable odor. These losses can be avoided by using modern techniques based on scientific storage[2]. The present survey was deals with seed deterioration during storage and the vacuum packaging is a good approach to avoid the same.

Storage of seeds till the next sowing season is an essential segment of seed industry. The knowledge of seed storability is also essential to avoid the huge financial losses due to non selling of the seeds and to carry over the seed stock for use in next season. Storage is a critical operation for rice, representing between 4 to 6 per cent of total post-harvest losses. In rice, upon storage, many enzymatic changes, oxidation and respiration occur. Thus, its nutritive value is lost because of chemical changes in starch, protein and lipid contents. If the viability and vigour is not maintained properly during storage period, it will be difficult to sell it as a seed material for the next season. Post harvest storage life of rice largely depends on the genotypes, production conditions, mechanical injury to the seed, initial seed quality, seed treatment, packaging material and storage conditions. Seed storage is an essential segment of seed industry. In storage, viability and vigour of the seeds is regulated by many physico-chemical factors like moisture content of the seed, atmospheric humidity, temperature, initial seed quality, physical and chemical composition of seed, gaseous exchange, storage structure and packaging materials. As the seed is hygroscopic in nature, seed quality is affected by variation in moisture content, relative humidity and temperature. To combat these factors, it is better to store the seeds in moisture vapor proof containers like vacuum packaging bags, polythene bags, aluminium foil, tin or any sealed container to maintain the quality for longer period**.**

Seed quality is a limiting factor affecting, not only germination capacity but also emergence potential, field stand and uniformity, seedling growth and finally crop productivity. The significance of seed quality is more pronounced under adverse seed sowing conditions. Seed quality (seed viability and vigor) has a profound effect on seed performance, stand establishment and ultimately economical yield. Seed vigor refers to the ability and strength of a seed to germinate successfully and produce normal seedling and optimum field stand under both optimum and suboptimal soil conditions and therefore, to maximize yield. Seed vigor is gradually acquired as the seed develops on the parent plant reaches maximum at the physiological maturity stage. Conditions inhibiting normal plant growth, seed development and maturation can reduce the maximum attainable vigor. Following physiological maturity, seed vigor is readily declined till being seeded in the growing season or as seed deterioration progress by means of physical, physiological and pathogenic deteriorative processes[7].

Seed quality (seed viability and seed vigor) is a limiting factor affecting, not only germination capacity but also emergence potential, field stand , uniformity, seedling growth and finally crop productivity. The significance of seed quality is more pronounced under adverse seed sowing conditions. Seed vigor refers to the ability and strength of a seed to germinate successfully and produce normal seedling and optimum field stand under both optimum and suboptimal soil conditions and therefore, to maximize yield. Seed vigor is gradually acquired as the seed develops on the parent plant reaches maximum at the physiological maturity stage. Conditions inhibiting normal plant growth, seed development and maturation can reduce the maximum attainable vigor. The various seed quality related

findings of researchers have been suggested High quality seed that provides adequate plant stands is the basis for profitable production and expansion of oil seed crops. In order to increase the production of oil seed crops, a source of high quality, disease free seed must be established and maintained. Loss of viability and vigour under high temperature and RH conditions is a common phenomenon in many crop seeds but it is well marked in oil seed crops which are reviewed in this article and some of them are listed in the following Table.

Sl. No.	Name of the Researchers	Crops	Seed quality parameters
			a) Moisture content
1.	Harrington[12]	Seeds	Found that a package which is moisture proof or moisture resistant would be more valuable in prolonging germination and seedling vigour
2.	Bhattacharya and Raha[6]	Soybean	Seeds stored at moisture levels of 14.0 and 9.7 %, respectively. They observed decrease in percent of germination and seedling vigour in soybean and maize during the storage period. The percentage of germination in soybean and corn after 10 and12 months was zero and 4 %, respectively..
3.	Osuna-Garcia *et al*[18].	Ground paprika	Observed that moisture contents and water activity changed during the storage period. Under an ambient average relative humidity of 33 %, paprika samples with low initial moisture content were found to absorb water to reach an equilibrium water activity of 0.22.
4.	Dadlani and Veena[8]	Soybean	Showed that the storability of soybean seeds at 10.6 % moisture content maintained better in 500 gauge polythene bag and superbag (Seed Proc. Inc.TM) than cloth bag under ambient condition upto 12 months.
5.	Gurmit Singh and Hari Singh[11]	Soybean	Reported that soybean seeds with 10 per cent moisture content could be stored for 6 months in gunny bags without loss of viability.
6.	Monira *et al*[15].	Soybean	Reported that higher moisture in seeds enhances seed deterioration, which ultimately reduces the planting value of seeds in the field. The initial moisture content of different containers' seeds was similar (around 12 %) but it was increased with increasing storage time. The increasing rate was higher in seeds of cloth bag.
7.	Rahman and Rahman[21]	Soybean	Found that the highest germination and lowest prevalence of fungi was recorded in

			the seeds stored in tin followed by polythene bag and cloth bag with polythene.
8.	Davidson *et al*[9].	Groundnut	Good quality shelled peanuts of acceptable varieties can be stored for at least 1 year at temperatures of 1 - 5 ^{o}C and moisture content of 7 % or lower, and from 2 to 10 years at 6 % moisture content and -18^{o}C without significant loss in quality.
9.	Moholkar *et al.*	Sunflower	Concluded that the seeds of sunflower cv. 6 D-1 maintained above MSCS upto 20 months by drying the seeds to 8 per cent moisture content kept in 700 gauge polythene bags, while it was only10 months in cloth bags. Moisture content differed significantly from fourth month to end of the storage period due to containers
10.	Rajendraprasad *et al*[22].	Groundnut	Observed significant differences in seed germination and moisture content in kernels stored in jute and cloth bags as per the minimum seed certification standards (70 %) for three months only, while upto 15 months in polythene bags (700 guage).
11.	Patra *et al*[19].	Groundnut	Seeds stored in gunny bags lost viability with advancement of storage period and became nil after 9 months of storage compared to seeds stored in polythene bag.
12.	Huda[13]	Groundnut	Seeds kept in metal container had the lowest moisture content followed by seed kept in polythene bag, earthen pot, jute bag and bamboobin sealed partially or completely. **b) Germination and Seedling Vigour**
13.	Ankaiah *et al*[1].	Sunflower	Germination and seedling vigour were significantly higher in seed stored in moisture impervious containers when compared to moisture pervious containers throughout the storage period.
14.	Radhakrishna *et al*[20].	Soybean	Seeds stored in airtight glass containers maintained 40 per cent germination during 4th month's storage, while in gunny or polyethylene bags maintained viability for only 2 months.
15.	Vanangamudi[28]	Soybean	seeds stored in paper, aluminium foil and polythene laminated pouches showed higher viability and vigour than seeds stored in cloth bags upto 10 months of storage It was observed that germination rate was

16.	Monira *et al*[15].	Soybean	almost similar at initial stage but it decreased with increase of storage period. After storage, the germination rate was better in seeds of tin (87.3 %) and polythene bag (84.7 %) as compared to that of cloth bag (68.5 %).
17.	Baskin *et al*[5].	Soybean	Polythene bag was superior in preserving viability, quality and extending storage life of seeds over other types of storage containers (paper, cloth and jute bags).
18.	Nataraj *et al*[17].	Sunflower	Sunflower hybrid seeds stored in polythene bag (700gauge) recorded higher germination (80 %) and seedling vigour index (1869) as compared to cloth bags upto 12 months of storage.
19.	Singh and Dadlani[27]	Soybean	Stored soybean seeds in cloth and polythene bags (700 gauge) and reported high germination per cent (94 %) in JS-71-05 and 84 % in (PK-327) in seeds maintained for 14 months packed in polythene bags whereas, it fell down to 3 and 1 per cent, respectively in seeds packed in cloth bag after 8 months of storage.
20.	Sharma *et al*[26].	Soybean	Quality of soybean seeds and recorded lower seedling vigour and 60 per cent germination of soybean seeds when stored in gunny bags while higher seedling vigour and 74.3 per cent germination in polythene lined gunny bags after 5 months of storage.
21.	Aurellia Tatipata[3]	Soybean	The germination of seeds stored at 12 % moisture content using gunny bag for 6 months was low (87.75 %), followed by that seeds stored using polyethylene plastic bag (89.25 %) and aluminium foil bag (90.75 %).
22.	Gladys *et al*[10].	Soybean	Seed viability remained high throughout the study for seeds stored in cold storage (> 92 %) and moderate in the warm storage (>78 %), but decreased to almost 0% after 20 months in the ware house (WH).
23.	Rao *et al*[23].	Groundnut	They concluded that under all storage conditions, deterioration was slow in pods than in shelled seeds. Reported that groundnut pods stored in high density polythene bags retained germination above the minimum seed certification standards (>70 %) for 15 months with higher vigour index (958),
24.	Krishnappa *et al*[14].	Groundnut	while cloth bag retained for 10 months with lower vigour index (541). Groundnut pods stored for 16 months in cloth bag recorded significantly lower per

			cent germination and vigour index as compared to the pods stored in the polythene bag (700guage) with both the groundnut cultivars JL-24 and TMV-2.
25.	Narayanaswamy *et al*[16].	Groundnut	Theyreported higher germination (94%) in JS-71-05, followed by PK-327 upto14 months for the seeds packed in polythene bags but it fell down up to 3 % and 1 % per cent, respectively when kept in cloth bags after 8 months of storage.
26.	Singh and Dadlani[27]	Soybean	The effect of packaging materials on delinted cotton seeds (cv. MCU-7) stored in polythene bags maintained germination and seedling vigour at a higher levels as compared to seed stored in cloth bags at the end of storage period of 12 months.
27.	Selvaraj[24]	Cotton	Reported that both fuzzy and delinted cotton seeds were stored in paper, aluminium foil and polythene pouches performed better than those stored in cloth bags.
28.	Kumaresan	Cotton	The cotton seeds stored in polythene bags significantly enhanced the storage life and better performance than stored in cloth bags.
29.	Ramkumar and Chhabra,	Cotton	Concluded that cotton seeds stored in paper, aluminum foil and polythene pouches maintained higher seed quality compared to the seeds stored in cloth bags. The reduction in germination values was lower in delinted cotton seeds stored in jute bags for 12 months.
30.	Surendranath Reddy	Cotton	**c) Seedling length and dry weight**
31.	Monira *et al*[15].	Soybean	Reported that the initial root and shoot length of seeds in tin container, polythene and cloth bags were 15.04 cm & 13.3 cm, 10.95 cm & 12.60 cm and 8.24 cm & 11.15 cm, respectively; but it decreased with increasing storage time**.** The decreasing rate was higher in seeds of cloth bag compared to tin container and polythene bag.
32.	Narayanaswamy *et al*[16].	Groundnut	Reported that groundnut pods stored for 16 months in cloth bag recorded significantly lower hypocotyls length and more fluctuation in moisture content compared to the pods stored in the polythene bags (700guage) with both the groundnut cultivars JL-24 and TMV-2. Storing the seeds in moisture vapour proof containers like polythene bag, aluminium foil or any sealed container is found to be

			more useful in maintaining the desired seed quality for longer period unlike non moisture proof containers like cloth bags.
33.	Gurmit Singh and Hari Singh[11]	Soybean	The storability in sunflower seeds dried to eight per cent moisture content and stored in cloth bags under ambient condition for 20 months. The root, shoot, seedling length and seedling dry matter remained high upto ten months and there after decreased with an increase in storage period.
34.	Balamurugan et *al*[4].	Sunflower	Reported that hybrid cotton seeds. **d) Electrical conductivity**
35.	Shanmugavel *et al*[25].	Soybean	Soybean seeds stored in muslin bag at 70 per cent relative humidity and 35 °C temperature for one to five weeks resulted faster decline in germination, seedling vigour, phospholipid content and higher values of seed electrolytes leakage in all the soybean genotypes throughout the storage period Revealed that sunflower hybrid seeds stored in polythene bag (700 gauge) recorded lower electric conductivity of seeds leachates (194.53d Sm^{-1}) as compared to cloth bags upto 12 months of storage.
36.	Nataraj *et al*[17].	Sunflower	Conducted a study on groundnut cultivars JL-24 and TMV-2 and reported that pods stored for 16 months show less storability in cloth bag compared to the pods stored in the polythene bag (700 guage) with cloth bag recording significantly higher electrical conductivity. .
37.	Narayanaswamy *et al*[16].	Groundnut	

CONCLUSION

The seeds of oil seeds crops are generally deteriorated with storage and deterioration were particularly strong for seeds stored in cloth bag. High temperature, high relative humidity, and moisture in the storage environment are the principal factors involved in deterioration of seeds of oil seeds crops quality during storage. Loss of germination capacity was the final manifestation of seed deterioration. When seed moisture content was increasing the rate of germination percentage was decreased. The deterioration rate was also the highest in seeds of cloth bag. The electrical conductivity was increased with increasing storage time, but the increasing rate was higher in seeds of cloth bag. The shoot and root length of seedling and seedling vigour was the lowest in cloth bag at the end of storage period. Dry weight per plant of seeds of oil seeds crops decreased in all cases but the rate of deterioration was also the highest in cloth bag. It may be concluded that the conventional practices of seeds of oil seeds crops storage in cloth bags are not suitable because there is a possibility of moisture gain and pests attack, which play important role in deterioration of seeds of oil seeds crops quality and viability during storage. Air tight tin container will be the best means for seeds of oil seeds crops storage for long time. Seeds of oil seeds crops germination and vigour are high at physiological maturity. High seed moisture level increases seed mycoflora, which play an important role in deterioration of seeds of oil seeds crops quality and viability during storage.

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