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Impact of Various Desiccants on Extending Groundnut Pod Storability

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ABSTRACT: Storability of seeds generally depend upon the moisture content, which need to be brought down even at high temperatures. During the storage of groundnut pods, for reduction of moisture content, use of suitable desiccants will be useful rather than going for the practice of pod drying methods, which will be useful for reduction as well as maintenance of low moisture content of pods for extending the storability. The study on the effect of storability of groundnut pods cv. VRI 8 with different desiccants *viz*., anhydrous calcium chloride (14 g kg^{-1}), silica gel (8.5 g kg^{-1}) and zeolite beads (300 g kg^{-1}) in poly lined gunny bag under ambient condition were carried out in Department of Seed Science and Technology, TNAU, Coimbatore. The result revealed that the performance of stored seed was decreased with advancement in storage period. Among all the treatments, storage of pods with zeolite beads (300 g kg^{-1}) was found to be supreme in maintaining low moisture content of 6.24% after six months of storage followed by silica gel (8.5 g kg^{-1}) and anhydrous calcium chloride (14 g kg^{-1}). The pods stored with zeolite beads (300 g kg^{-1}) recorded higher germination per cent (78 per cent) and vigour index (2480), insect infestation (8 %) and pathogen infection (5 %). Hence, storage of groundnut pods with zeolite beads (300 g kg^{-1}) can be practiced to extend the storability with minimum deterioration.

Keywords: Groundnut pod, desiccants, poly lined gunny bag, extended, seed viability

Groundnut (*Arachis hypogaea* L.) is an essential oilseed crop also called as monkey nut, peanut and goober. It is the 13th most important food crop in the world and first crucial oilseed crop in India. It is a major source of edible oil and vegetable protein hence it is often known as King of oilseeds [1]. The obstacle in attaining the sound yield in groundnut is owing to unavailability of quality seeds, improper storage practices and poor mechanization in cultivation. The utmost issue in groundnut is the rapid decline in seed viability during storage, since the groundnut kernels are very sensitive to deterioration because of its chemical composition (high fat and protein content). In addition to that, the longevity of seeds is mostly influenced by storage conditions viz., seed moisture content, storage temperature and relative humidity. However, the longevity of seeds can be increased, when they are stored with low moisture content in cool temperature [2]. But maintaining the cold storage unit for low temperature storage is expensive and difficult to adopt at farm level. Keeping these above vistas, storing of groundnut seeds for medium to long term, a low-cost input technology should be developed to maintain seed quality under ambient storage condition rather than outlaying on cold storage system.

MATERIALS AND METHODS

The present experiment was carried out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu during November, 2018 to April, 2019. The genetically pure groundnut pods of cv. VRI 8 was stored in poly lined gunny bag along with following desiccants under ambient condition (27.4ºC and 48% Relative humidity) for six months. The groundnut pods without any desiccants served as control. The treatments are as follows: T_1 - Control, T_2 - Anhydrous CaCl, @ 14 g kg^{-1}, T_3 - Silica gel @ 8.5 g kg^{-1}, T_4 - Zeolite beads @ 300 g kg^{-1}. Initially, the moisture content was reduced to 8.15 per cent. Since anhydrous calcium chloride (14 g kg^{-1} of pods) is a liquid desiccator, it was tied in a muslin cloth and hung from the lid inside a small perforated plastic container using a nylon twine and positioned vertically in the core of the poly lined gunny bag. The silica gel (8.5 g kg^{-1} of pods) and zeolite beads (300 g kg^{-1} of pods) were packed in a muslin cloth and placed in the hub of the packaging material (Figure 1). The samples were drawn at monthly intervals and evaluated for the following physical, physiological and biochemical parameters for kernels under laboratory condition.

Calcium chloride

Silica gel

Zeolite beads

Figure 1. Desiccants used for groundnut pod storage

Moisture content

Five grams of kernel was ground and transferred to a weighed moisture bottle and placed in a hot air oven maintained at temperature of 103 ± 2°C for 16 ± 1 hr. Then it was cooled in a desiccator for 30 minutes and weighed. The weight of ground samples along with moisture bottle before and after drying was noted. The moisture content was computed using the following formula and the mean value was indicated in percentage.

$$\text{Moisture content \%} = \frac{M_2 - M_3}{M_2 - M_1} 100$$

where, M_1 – Weight of moisture bottle alone (g)

M_2 – Weight of moisture bottle + ground seed sample before drying (g)

M_3 – Weight of moisture bottle + ground seed sample after drying (g)

Electrical conductivity of seed leachate

Twenty-five kernels from each treatment were soaked in 50 ml of distilled water for 8 hours at room temperature after initial washing. The seed steep water was mentioned as seed leachate. The electrical conductivity of the seed leachate was measured using electrical conductivity meter and was indicated in dSm^{-1}.

Germination (%)

The germination test was performed with 25 pods in each replication using sand medium in a germination tray. The trays were placed in a germination room sustaining a temperature of 25 ± 2°C and a relative humidity of 90 ± 3%. As the seeds were sown without shelling, it required more time to germinate. Hence the seedling evaluation was carried out on fourteenth day of sowing. On fourteenth day of sowing, the number of normal seedlings in each replication of treatment was enumerated. The mean values were calculated and denoted in percentage.

Vigour index I

Vigour index was calculated using the following formula and the mean values were indicated in whole number.

Vigour index I= Germination (%) x Seedling length (cm)

Insect infestation

A number of 4 x 100 seeds from each replication were taken at random and number of infested seeds by insects was counted. The mean value was indicated in percentage.

Pathogen infection

Seed health experiment for stored seeds was carried out using 2, 4 - D blotter method to identify fungal infection.

Totally 400 kernels of from each replication were placed at equidistance on three layered blotter paper soaked in 0.2% 2,4 - D solution in petri plates under sterile condition and incubated at 20 ± 2 °C for seven days with alternate series of 12 hrs in ultraviolet light and 12 hrs in dark. The seeds were analyzed for the presence of fungal infection after seventh day. The number of infected seeds was counted and the mean value was indicated in percentage.

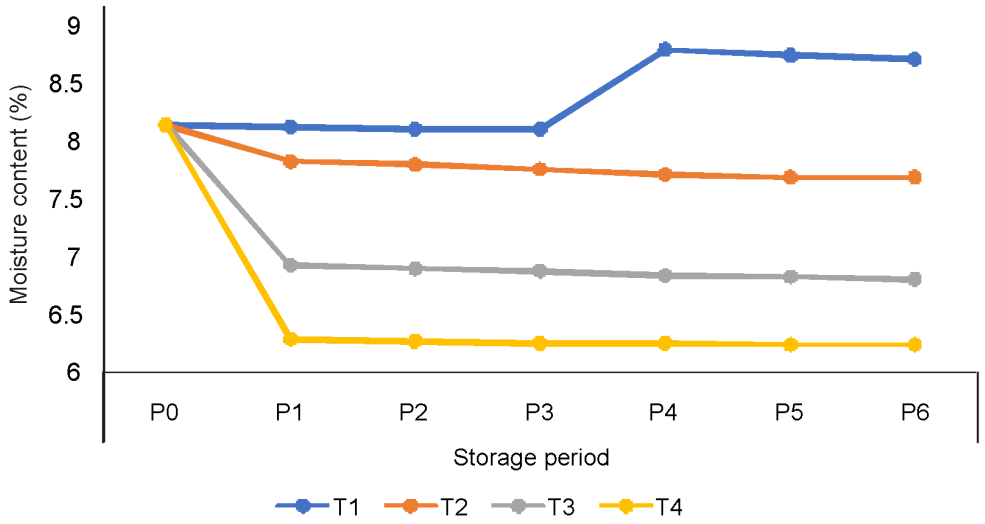
Statistical analysis

The experiments were laid out in Factorial Complete Randomised Design with four replicates. The data obtained from different experiments were statistically analyzed using the procedure given by [3]. The per cent values were analyzed after transforming into angular (arcsine) and square root values at appropriate place. The critical differences (CD) were calculated at 5 per cent probability level and the data were tested for statistical significance. If the F test is non-significant, it was denoted by NS.

RESULTS AND DISCUSSION

In the present study storage of groundnut pods with different desiccants, a declining trend in seed moisture content was perceived as the storage period extends except control *i.e.,* pod stored without desiccant. There was a sudden decrease of moisture content after first month of storage which was maintained for six months in the treatments stored with desiccants. A maximum decrease in moisture content was observed in pods stored with zeolite beads (6.24%) than any other desiccants (Figure 2). This high adsorption capacity of zeolite beads is due to their micropores with high internal surface area. The similar result was reported by [4] in storage of green gram seeds with different desiccants. Champathi Gunathilake et al. [5, 6] also observed the reduction of seed moisture content during storage period under ambient condition in soy bean.

The initial germination of groundnut was 58%. The low germination per cent might be due to the occurrence of fresh seed dormancy which is present in almost all groundnut cultivars whether they are dormant or non-dormant during the initial period of storage immediately after harvest. However, after one month of storage more than 90% of germination per cent was recorded in all the treatments including control due to the release of fresh seed dormancy in this groundnut cv. VRI 8 which is basically a non- dormant one. The experimental result spotted that the groundnut pods stored with zeolite beads retained their germination (78%) upto six months of storage period, whereas pods stored without desiccants (control) had recorded 68% (Table 1). The percentage increase was 14%. The above-mentioned results are in agreement with. [7] in tomato seeds and [8] in paddy. The high germination per cent in pods stored with zeolite beads was due to low moisture content (6.24%) which maintained the lower respiration rate and retained vigour and viability during the storage period. The same trend was also observed in vigour index I (Table 2) Physiological



T_1 - Control, T_2 -Anhydrous calcium chloride (14 g kg^{-1}), T_3 - Silica gel (8.5 g kg^{-1}), T_4 - Zeolite beads (300 g kg^{-1})

Figure 2. Effect of different desiccants on moisture content (%) of groundnut cv. VRI 8 during storage

Table 1. Effect of different desiccants on germination (%) of groundnut cv. VRI 8 during storage

Treatments	Period of storage							
	P_0	P_1	P_2	P_3	P_4	P_5	P_6	Mean
T_1	58	90	87	80	76	72	68	76
	(49.6)	(71.54)	(68.86)	(63.43)	(60.66)	(58.05)	(55.55)	(60.66)
T_2	58	91	86	83	79	75	72	78
	(49.6)	(72.54)	(68.02)	(65.65)	(62.72)	(60.00)	(58.05)	(62.02)
T_3	58	91	88	84	80	76	73	79
	(49.6)	(72.54)	(69.73)	(66.42)	(63.43)	(60.66)	(58.69)	(62.72)
T_4	58	93	90	86	83	80	78	81
	(49.6)	(74.66)	(71.56)	(68.02)	(65.65)	(63.43)	(62.02)	(64.15)
Mean	58	91	88	83	80	76	73	78
	(49.6)	(72.54)	(69.73)	(65.65)	(63.43)	(60.66)	(58.69)	(62.02)

	T	P	TxP
SEd	0.52	0.68	1.37
CD (P=0.05)	1.04	1.37	NS

(Figure in parenthesis indicate arcsine values)

T_1 - Control, T_2 -Anhydrous calcium chloride (14 g kg^{-1}), T_3 - Silica gel (8.5 g kg^{-1}), T_4 - Zeolite beads (300 g kg^{-1})

Table 2. Effect of different desiccants on vigour index I of groundnut cv. VRI 8 during storage

Treatments	Period of storage							
	P_0	P_1	P_2	P_3	P_4	P_5	P_6	Mean
T_1	1682	3087	2945	2559	2402	2210	1951	2405
T_2	1682	3167	2965	2778	2583	2360	2131	2524
T_3	1682	3194	3034	2850	2664	2470	2234	2590
T_4	1682	3339	3168	2982	2813	2640	2480	2729
Mean	1682	3197	3028	2792	2616	2420	2199	2562

	T	P	TxP
SEd	24.01	31.77	63.5
CD (P=0.05)	48.11	63.65	127.3

(Figure in parenthesis indicate arcsine values)

parameters of groundnut pods stored with various desiccants resulted with good quality which was supported with the soy bean seeds stored with different storage containers maintained the seed viability for prolonged period as quoted by [9]. Also, similar result was observed in groundnut seeds reported by [10, 11].

In the present study, the insect infestation was minimum in pods stored with desiccants *i.e.,* 9%, 6% and 4% in anhydrous calcium chloride, silica gel and zeolite beads respectively at end of the storage period (Table 3). This might be due to the maintenance of low moisture content and relative humidity in the poly lined gunny bag which made unfavourable condition for insect growth. However, in pods stored without desiccants exhibited higher activity of insect (11%) due to the prevalence of high moisture content (above 8%) which provided suitable hospitability for insects. In addition to that, zeolite beads effectively controlled the insect activity by adsorbing the moisture from epicuticular lipids which paves to desiccation of insects The occurrence of storage fungi is usually accompanied with insect infestation The evaluation of seed pathogen test in the current study disclosed that there was continuous rise in infection with *Aspergillus niger, A. flavus and Rhizopus spp*. The infection pattern of fungi was in accordance with the insect infestation. The least infection was noticed in pods stored with zeolite beads (5%) because of low moisture content which had become unfavourable environment for growth of fungal colonies (Table 4).

Table 3. Effect of different desiccants on insect infestation (%) of groundnut cv. VRI 8 during storage

Treatments	Period of storage							
	P_0	P_1	P_2	P_3	P_4	P_5	P_6	Mean
T_1	0.00	0.00	3.00	5.00	7.00	8.00	11.00	5.00
	(0.71)	(0.71)	(1.87)	(2.35)	(2.74)	(2.92)	(3.39)	(2.35)
T_2	0.00	0.00	3.00	3.00	5.00	7.00	9.00	4.00
	(0.71)	(0.71)	(1.87)	(1.87)	(2.35)	(2.74)	(3.08)	(2.12)
T_3	0.00	0.00	0.00	2.00	3.00	4.00	6.00	2.00
	(0.71)	(0.71)	(0.71)	(1.58)	(1.87)	(2.12)	(2.55)	(1.58)
T_4	0.00	0.00	0.00	0.00	2.00	3.00	4.00	1.00
	(0.71)	(0.71)	(0.71)	(0.71)	(1.58)	(1.87)	(2.12)	(1.22)
Mean	0.00	0.00	2.00	3.00	4.00	6.00	8.00	3.00
	(0.71)	(0.71)	(1.58)	(1.87)	(2.12)	(2.55)	(2.92)	(1.87)
	T		P		TxP			
SEd	0.091		0.132		0.301			
CD (P=0.05)	0.183		0.264		0.603			

(Figure in parenthesis indicate arcsine values)

Table 4. Effect of different desiccants on pathogen infection (%) of groundnut cv. VRI 8 during storage

Treatments	Period of storage							
	P_0	P_1	P_2	P_3	P_4	P_5	P_6	Mean
T_1	0.00	0.00	5.00	9.00	10.00	11.00	13.00	7.00
	(0.71)	(0.71)	(2.35)	(3.08)	(3.24)	(3.39)	(3.67)	(2.74)
T_2	0.00	0.00	0.00	3.00	5.00	6.00	10.00	4.00
	(0.71)	(0.71)	(0.71)	(1.87)	(2.35)	(2.55)	(3.24)	(2.12)
T_3	0.00	0.00	0.00	0.00	3.00	4.00	7.00	2.00
	(0.71)	(0.71)	(0.71)	(0.71)	(1.87)	(2.12)	(2.74)	(1.58)
T_4	0.00	0.00	0.00	0.00	2.00	2.00	5.00	1.00
	(0.71)	(0.71)	(0.71)	(0.71)	(1.58)	(1.58)	(2.35)	(1.22)
Mean	0.00	0.00	1.00	3.00	5.00	6.00	9.00	3.00
	(0.71)	(0.71)	(1.22)	(1.87)	(2.35)	(2.55)	(3.08)	(1.87)
	T		P		TxP			
SEd	0.087		0.116		0.232			
CD (P=0.05)	0.176		0.232		0.465			

(Figure in parenthesis indicate arcsine values)

CONCLUSION

The study on storage of groundnut pods showed its superiority of storage potential in pods stored with different desiccants (silica gel, calcium chloride and zeolite beads) than control. However, among the desiccants used, groundnut pods stored with zeolite beads (300 g kg^{-1}) can be practiced to extend the storability with minimum deterioration.

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