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Seed Quality Deterioration in Groundnut Due to Fungi During Storage

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Abstract: Studies were conducted to evaluate the seed quality changes during storage due to fungal infection, at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore. The seed materials of groundnut variety VRI 2 collected from three different locations of Tamil Nadu viz., Vridhachalam (L₁), Thindivanam (L₂) and Villupuram (L₃) were subjected to experimentation. During storage, seed quality parameters such as germination and vigour index decreased from 84-79% and 2581-2005, respectively while moisture content increased from 7.1-8%. The investigation revealed that the seeds collected from Tindivanam showed better seed quality with 81% germination, 7.8% moisture content and vigour index of 2216, even after seven months of storage.

Key words: Ground nut, storage fungi, *Aspergillus flavus*, seed quality changes

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an annual legume which is also known as peanut, earthnut, monkey-nut and goobers. It is the thirteenth most important food crop and fourth most important oilseed crop of the world (Radha *et al.*, 2011). Groundnut crop is grown in more than 100 countries in the world. India, China, Nigeria, USA and Indonesia alone contribute to 74% of the total world production (Mehrotra, 2011). China is the largest producer of groundnut followed by India. India contributes 19% of world production. It occupies an area of 6.41 million ha with a production of 9.824 million tonnes and possesses an average yield of 1.6 tonnes.

Groundnut is usually harvested and stored dry in different storage facilities, traditional and modern. Being an oil seed, it losses its viability within a short period due to the irreversible phenomena of ageing. Under such storage conditions, seeds are also susceptible to attack by fungi, insects and other micro organisms. *Fusarium* spp., *Aspergillus* spp. and *Penicillium* spp. were the most abundant fungi encountered in groundnut seeds (McDonald, 1977).

Maintenance of seed quality until sowing is mandatory (Tunwar and Singh, 1988) as the irreversible degenerative changes would lead to loss of quality. Hence maintenance of seed quality during storage/carry over of seed is very much essential. Though the initial seed quality and storage environment are important to prolong the shelf life of seeds, the invasion of fungal pathogen also play a major role in decreasing the viability

of a seed lot. In this context, pathogens play a major role in determining the storage life of seed with their shorter life span especially in groundnut.

Therefore, production of disease free seeds for sustainable agriculture is the order of the day. Location of seed production is one of the important factors for occurrence of seed borne pathogens. The agro ecological conditions comprising of edaphic and environmental factors have more than one effect on the performance of the seed apart from its genetic make up (Nisha, 2007). Fungi like *Aspergillus niger*, *Aspergillus flavus*, *Alternaria dianthicola*, recorded discolouration, rotting, shrinking, seed necrosis, loss in germination capacity and toxification in oil seeds (Kakde and Chavan, 2011). A reduction in seed germinability of red gram, green gram and black gram was observed when the seeds were soaked in fungal filtrate of *Aspergillus* (Radha *et al.*, 2011). Thus the present study was taken up with the objectives of collection of groundnut variety VRI 2 from different locations and assessment of initial inoculum level of pathogen. The changes in the seed quality parameters during the course of storage were studied elaborately.

MATERIALS AND METHODS

The seed samples of groundnut variety VRI 2 collected from three different locations of Tamil Nadu viz., Vridhachalam, Tindivanam and Villupuram were used as base material for this study. The collected samples were hand sorted, cleaned thoroughly and tested for their initial quality including and seed health status based

on ISTA (International Seed Testing Association) recommendations. Seed samples were subjected to seed quality testing at monthly intervals.

About 5 g of seed was ground and transferred to a weighing bottle and placed in a hot air oven maintained at $103\pm 2^{\circ}\text{C}$ temperature for 16 ± 1 h. Then it was cooled in a desiccator for 30 min and weighed. The estimations were done in duplicate. The moisture content was calculated using the following equation and the mean was expressed as percentage:

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

M_1 = Weight of empty bottle

M_2 = Weight of the bottle+sample before drying

M_3 = Weight of the bottle+sample after drying

The germination test was conducted with 50 kernels in four replications in sand medium. The test conditions of $25\pm 2^{\circ}\text{C}$ and $95\pm 3\%$ RH were maintained in a germination room. At the end of tenth day, the number of normal seedlings was counted and the mean was expressed as percentage. Ten normal seedlings taken at random from standard germination test were used for the measurement of root length. Root length was measured from the collar region to the tip of the primary root. The mean value was calculated and expressed in cm. The seedlings used for the measurement of root length were measured for shoot length from the collar region to the growing tip of the shoot. The mean value was calculated and expressed in cm. Vigour index was computed by adopting an equation (Abdul-Baki and Anderson, 1973) and expressed as whole number:

$$\text{Vigour index} = \frac{\text{Germination percentage} \times \text{Seedling length in cm}}{\text{Seedling length in cm}}$$

Seed health testing for fungal infection was carried out using blotter technique for each sample. Ten kernels in ten replicates were placed equidistantly on three layered sterile blotter paper moistened with 0.2% 2,4-D solution in sterile petriplates under aseptic condition and incubated at $20\pm 2^{\circ}\text{C}$ for seven days with alternate cycles of 12 h in Near Ultraviolet Light (NUV) range and for the remaining 12 h in dark. On the eighth day, the seeds were examined for the presence of fungal infection. The number of infected seeds was counted and the mean value was expressed in percentage. The data pertaining to the observations recorded in the laboratory were analyzed using Completely Randomized Design (Panse and Sukhatme, 1967).

RESULTS AND DISCUSSION

Groundnut, being an oil seed, loses its viability within a short period due to the irreversible phenomena of ageing. The seeds collected from Tindivanam recorded more initial germination (86%), vigour (2881). But the seeds collected from Vridhachalam recorded less moisture content (6.9%) than other two locations and the seeds collected from Villupuram recorded the least initial germination (84%) and vigour index (2312) with more moisture content (7.2%). Initially, the incidence of *Aspergillus flavus* was not recorded in the seeds collected from three different locations (Fig. 1). Such a differential storability of genotypes of different place of origin within a species under ambient conditions has been reported in wheat (Nisha, 2007). Seed quality variation due to place of production was reported in groundnut (Reddy *et al.*, 2011).

During storage, seed quality parameters such as germination and vigour index decreased from 84-79% and 2581-2005, respectively and moisture content increased from 7.1-8%. There was no initial infection of

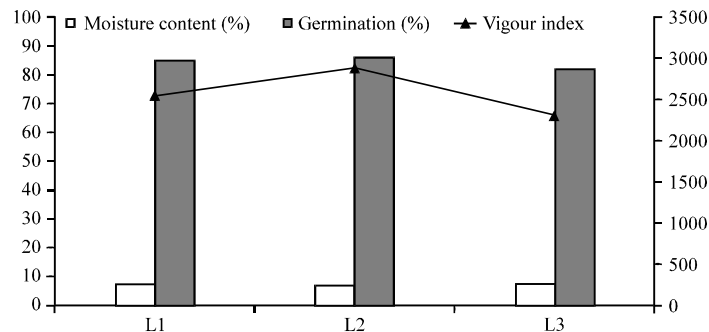


Fig. 1: Initial quality of groundnut seeds collected from three different location of Tamil Nadu

Aspergillus flavus found. But later on during storage the infection increased and reached 18.3% irrespective of locations. Similar results were obtained in groundnut (Tbiam and Egwu, 2011)(Table 1).

The increase in moisture content of the seeds noticed in the present study might be due to the absorption of moisture by the seeds and attainment of equilibrium with differential moisture content of the atmosphere (Gomathi, 2009).

Decline in germination is the last physiological phenomenon in the process of ageing. The reduction in germination might be due to the depletion of food reserves and decline in synthetic activity due to ageing (Heydecker, 1972). Storage fungi influenced the seed quality parameters and decreased the germination potential of the seeds during storage. In the present study, the decrease in seed germination percent might also be due to the presence of storage fungi. Similar results were obtained in soy bean (Haikal, 2008). Seedling growth is used as an index of seed vigour. In the present investigation the root length, shoot length and dry matter production of seedlings decreased as storage advanced. Similar results were reported in legumes (Cakmak *et al.*, 2010). The decline in shoot length, root length and dry matter production might be attributed to the lack of food mobilization in aged seeds. Vigour is essentially a physiological phenomenon influenced by the reserved metabolites, enzyme activities and growth regulators. Vigour index value which is the totality of germination and seedling growth has been regarded as a good index to measure the vigour of seeds (Basavegowda *et al.*, 2003). Loss of vigour precedes loss of viability. In the present study, the seed vigour index value decreased from 2581-2005 with an increase in storage period. Similar results were reported in groundnut also (Reddy and Biradarpatil, 2012).

Pathogen infection also severely affected the seedling vigour during storage. In the present investigation the seed lost its vigour quickly by the pathogen infection. This may be due to the utilization of food reserves by pathogens for their survival. Reduced germination and seedling length was reported in physic nut (Anjorin *et al.*, 2011). The seeds collected from Tindivanam showed better seed quality such as 81 germination, 7.8% moisture content, vigour index of 2216 and 15% *Aspergillus flavus* infection even after seven months of storage when the seeds collected from other locations recorded decreased germination (L1-71 and L3-69%) and vigour index (L1-1915 and L3-1833) with increased moisture content (L1-8.2 and L3-7.9%) and *Aspergillus flavus* infection (L1-9 and L2-8.8%) (Table 1). Location of seed production

Table 1. Seed quality changes during storage of seeds collected from three different location of Tamil Nadu

Period of storage	Moisture content (%)						Germination (%)						Vigour index						<i>Aspergillus flavus</i>								
	L1		L2		L3		L1		L2		L3		L1		L2		L3		L1		L2		L3		Mean		
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
P0	6.9	7.1	7.1	7.1	7.1	7.1	85(67.21)	86(68.02)	82(64.89)	84(66.42)	2550	2881	2312	2581	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)	0.0(0.00)
P1	6.9	7.1	7.2	7.1	7.2	7.1	83(65.65)	86(68.02)	82(64.89)	84(66.42)	2503	2868	2276	2549	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	3.3(0.51)
P2	7	7.2	7.2	7.1	7.2	7.1	80(63.43)	85(67.21)	82(64.89)	83(65.65)	2444	2775	2197	2472	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)
P3	7.2	7.4	7.3	7.3	7.3	7.3	81(64.15)	83(65.65)	78(62.02)	81(64.15)	2335	2665	2089	2363	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)	5.0(0.77)
P4	7.4	7.6	7.4	7.5	7.4	7.5	78(62.02)	81(64.15)	75(60.00)	79(62.72)	2278	2505	2088	2290	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	10.0(1.04)	8.3(0.95)
P5	7.6	7.6	7.7	7.6	7.7	7.6	76(60.66)	78(62.02)	73(58.69)	76(60.66)	2165	2434	2013	2204	12.0(1.11)	12.0(1.11)	12.0(1.11)	12.0(1.11)	12.0(1.11)	12.0(1.11)	12.0(1.11)	12.0(1.11)	12.0(1.11)	12.0(1.11)	12.0(1.11)	10.6(1.06)	
P6	7.9	7.7	7.8	7.8	7.8	7.8	73(58.69)	76(60.66)	71(57.41)	74(59.34)	2017	2315	1944	2092	15.0(1.20)	15.0(1.20)	15.0(1.20)	15.0(1.20)	15.0(1.20)	15.0(1.20)	15.0(1.20)	15.0(1.20)	15.0(1.20)	15.0(1.20)	15.0(1.20)	13.3(1.15)	
P7	8.2	7.8	7.9	8.0	7.9	8.0	71(57.41)	73(58.69)	69(56.16)	71(57.41)	1915	2216	1883	2005	20.0(1.32)	20.0(1.32)	20.0(1.32)	20.0(1.32)	20.0(1.32)	20.0(1.32)	20.0(1.32)	20.0(1.32)	20.0(1.32)	20.0(1.32)	20.0(1.32)	18.3(1.28)	
Mean	7.4	7.4	7.4	7.4	7.4	7.4	78(62.02)	81(64.15)	77(61.34)	79(62.72)	2276	2582	2100	2319	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	9.0(1.00)	8.8(0.98)
SED	0.01	0.01	0.02	0.19	0.31	0.55	LxP	LxP	L	LxP	L	L	LxP	L	LxP	L	LxP	L	LxP	L	LxP	L	LxP	L	LxP	L	LxP
CD p=0.5	0.02**	0.03**	0.05**	0.38**	0.63**	1.09**	0.63**	1.09**	1.91**	3.12**	3.44**	0.024**	0.039**	0.068**	0.024**	0.039**	0.068**	0.024**	0.039**	0.068**	0.024**	0.039**	0.068**	0.024**	0.039**	0.068**	0.024**

L₁: Seeds collected from Vridhachalam, L₂: Tindivanam, L₃: Villupuram

influenced the initial infection of seed borne pathogens. In the present investigation, the prevalence of fungi varied with respect to location. There was no initial infection of *Aspergillus flavus* infection on seeds collected from different locations but later on they showed various levels of infections of various pathogens during storage. The variation in pathogenic infection among locations in the present study was in conformity with the findings with previous findings (Basavegowda *et al.*, 2003). The reduction in germination due to storage fungi may be attributed to the production of aflatoxin in food grains interferes with protein synthesis by inhibiting the incorporation of amino acids into protein, resulting in non-germination of embryo. Aflatoxin affects the plants by inhibition of seed germination, elongation of hypocotyl or root of developing seeds.

The pathogen infection of 18.3% reduced the storage potential of seeds and reduced the germination to 71% and vigour index to 2005 at the end of storage period indicated that the storage fungal infection reduced the germinability and vigour of seeds by suppressing the expression of radicle through the secretion of toxic metabolites.

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