International Journal of Agriculture Sciences
ISSN: 0975-3710&E-ISSN: 0975-9107, Volume 9, Issue 42, 2017, pp.-4674-4678.
Available online at http://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

ASSESSMENT OF THE PATTERN OF LOSS OF VIABILITY AND VIGOUR OF GROUND NUT SEEDS STORED AS POD AND KERNEL IN AMBIENT AND MODIFIED ATMOSPHERIC STORAGE

VAKESWARAN V.*, SELVARAJU P. AND BHASKARAN M.

Seed Centre, Tamil Nadu Agricultural University, Coimbatore, 641 301, Tamil Nadu, India
*Corresponding Author: Email-vakeswaran@gmail.com

Received: May 18, 2017; Revised: September 08, 2017; Accepted: September 09, 2017; Published: September 12, 2017

Abstract- Seed viability and seed vigour are the most important factors affected during deterioration. However, viability and vigour are not affected at the same rate. In the present study attempt was made to assess the pattern of loss of vigour and viability of two groundnut varieties (CO 7 - Dormant variety and TMV 13 non dormant variety) when stored as kernel and pod in different storage environment *viz*. ambient storage, cold storage and atmosphere with 40% of CO_2 concentration.
The groundnut kernels were dried to 8 % moisture content with the care of not over drying and gradual reduction of moisture. Ten kg of ground nut kernel and pods (untreated), were packed in gunny bag (farmers practice - Moisture vapour pervious) and 700 gauge polyethylene container (Moisture vapour proof) and placed in ambient condition and also in cold storage (10^0 C + 40 % RH) with three replications. The same were kept in a container were 40 % CO_2 concentration was maintained throughout the study period. The CO_2 concentration was measured and maintained on weekly basis.
The results in the present study revealed that the pattern of vigour and viability loss was found to endorse the already established trend of decline in vigour and viability i.e., the decline in vigour occurs much more rapidly than the decline in viability.
At the same time, the pattern of loss in vigour and viability varies with the different patterns of seed handling in storage. Pods packed in 700 gauge polyethylene bag and stored at 10 ^{0} C + 40 % RH (storage environment) maintains better vigour and viablity for 12 months, 1224 and 76 % in TMV 13 and 1158 and 72% in CO7 respectively, compared to gunny bag storage under ambient condition, where a vigour and viability of 858 and 43 % in TMV 13 and 664 and 47 % in CO 6 was recorded. A kernel stored in 100 C in polyethylene bag was on par with pods stored in cold storage. After 12 months of storage it recorded a vigour and viability of 1218 and 75 % in TMV 13 and 1210 and 76 in CO7, respectively. The storage insect - Ground nut seed borer (*Carydon seratus*) - was observed under ambient storage alone, that too only in TMV 13 but not in CO7. The seeds and pods stored in a storage atmosphere comprising of 40 % of CO_2 concentration maintained a vigour and viability 1220 and 81 % in TMV 7 and 1196 and 78 % in CO7, respectively after 12 months of storage, which was a par with kernel or pod storage in cold storage.
Hence storing the pods or kernels of groundnut dried to the moisture content of 8 percent and stored either in the storage environment of 10^0 C + 40 % RH or 40 % CO_2 concentration can maintain the vigour and viability as per the Indian Minimum Seed Certification Standards upto 12 months of storage.

Keywords- Groundnut, Pod storage, Kernel storage, Ambient, Cold storage, Modified atmospheric storage.

Citation: Vakeswaran V., et al., (2017) Assessment of the Pattern of Loss of Viability and Vigour of Ground Nut Seeds Stored as Pod and Kernel in Ambient and Modified Atmospheric Storage. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 9, Issue 42, pp.-4674-4678.

Academic Editor / Reviewer: Jagannath Pathak

Introduction

Groundnut (*Arachis hypogaea* L.) is an important oilseed crop, widely cultivated and used in India. It is the king of oilseed crops and cultivated over an area of 5.25 million hectares, with a production of 9.47 million tonnes and productivity of 1804 kg ha^{-1}. Oil content ranges from 33.6 to 55.0 %. The major fatty acids present in the oil are oleic and linoleic acids which accounts for 78 % of the total fatty acids. The mean oleic/linoleic ratio is 1.14 to 3.66.

In groundnut several biochemical and physiological changes occur during storage due to the presence of high fat and protein contents. Biochemical changes include lipid peroxidation, leading to increased free fatty acid content, membrane damage, changes in level of antioxidant enzymes, electrical conductivity, protein content, alteration in transcription and translation process. These changes are evident as a reduction in percentage germination, produce weak seedlings, loss of vigor, become less viable and ultimately seed death and finally reduce the quality of seeds. In addition, the accumulation of reactive oxygen species (ROS) in seed tissues plays an important role in the loss of seed viability during storage.

Seeds attain their peak germination potential and vigour during field maturation when maximum dry eight is reached. This stage is known as physiological maturity. Once this peak is attained seeds automatically start degenerating quantitatively. Storage therefore produces germinable but low vigoured seedlings. However, viability and vigour are not affected at the same rate. Seeds usually decline in vigour at a much more rapid rate than they decline in viability.

Maintenance of vigour and viability of groundnut seeds is a serious problem in the hot and humid climate in many parts of our country. Maintaining the quality of these seeds in post-harvest environment is demanding and often very difficult task. Efforts were made to reduce loss of viability through storage studies. In general, 70 percent of the seed required for sowing is stored by farmer himself in normal gunny bag. It has been shown that storing in impervious container especially in polythene lined gunny bag (PLGB) shall prolong the longevity of seed. [3] revealed that percentage of cabbage seed germination was reduced rapidly in modified atmosphere storage, reduction being least in seeds stored in carbon dioxide after three years of storage. The studies suggest that storage of cabbage seeds especially in carbon dioxide is effective and inexpensive for short-term preservation of seed quality and would prove beneficial in absence of cold storage facility.

In the present study, attempts were made to store the pods and kernels, packed in gunny bag as well as polyethylene bags and exposing to different storage environments *viz.,* ambient, dehumidified cold storage and modified atmospheric storage, to assess the vigour and viability maintenance potential during the storage period.

Materials and Methods

Fresh groundnut pods of the varieties TMV13 and CO6 were collected and dried to the moisture content of 8 per cent. One portion of the pods was decorticated and kernels were separated. Care was taken during drying that ensured gradual reduction in moisture content.

The pods and kernels in 10 kg quantity were packed in gunny bags and 700 gauge polyethylene bags. These bags were placed in the ambient storage condition as well as in the dehumidified storage condition where the 10^0 C temperature was maintained with the relative humidity of 40 %. The mean temperature and relative humidity at ambient conditions ranging from 28.4 ^{0}c to 37.6 ^{0}c and 47.4 to 81.1 % respectively during storage period. Another set of 10 kg of pod and kernel were stored in two separate containers where 40% CO_2 concentration was maintained. The CO_2 concentration was observed on weekly interval and maintained.

The pods and kernels were collected on every 30 days interval and the following seed quality analysis *viz.,* laboratory seed germination (%), field emergence (%), vigour index and seedling dry weight (mg. seedling–1) was done. Germination test was carried out following [5], with four replicates of 100 seeds of each working sample. Final count (on tenth day) was taken based on number of normal seedlings in each replication and the germination was calculated and expressed in percentage, seedling dry weight was recorded (mg/seedling). The seedling length was measured from tip of shoot to root tip and the mean length was calculated and expressed as seedling length in centimeters from the ten normal seedlings selected randomly from each treatment on the day of final count. The seedling vigour index was computed using the formula suggested by [1] and expressed as whole number.

Results and Discussion

The germination percentage of the stored groundnut seeds declined as the aging progress, irrespective of the variety, kind of storage, type of containers and storage environment. The same as the case in all other seed quality parameters of seedling length, vigour index, seedling dry weight and electrical conductivity.

The variety TMV 13 recorded the initial germination of 94 percent declined to the lowest of 32 percent in the treatment, stored as kernel, packed in gunny bag and placed in ambient condition at the end of 360 days of storage. In this same storage condition, it could maintain the viability of 79 per cent upto 120 days of storage. but it goes below the Indian Minimum Seed Certification Standard at 150 days. Longevity of stored seed is affected by a number of environmental factors. The three major factors are seed moisture content (*mc*), temperature and oxygen concentration in the storage environment (Roberts 1972).In the present study, pods stored in modified atmospheric stioage with 40 % CO2 concentration maintained the viability of 86 percent after 150 days after the storage [Fig-1]. Major factors that determine the storability of seeds are seed moisture content, temperature, and relative humidity of the storage environment. Storing of groundnut pods in gunny bag is the general practice of farmers. Groundnut being an oilseed crop and hygroscopic, it absorbs moisture from surrounding storage environment and looses viability rapidly [8].

The same trend was observed in the viability loss in the variety CO 6 [Fig-2]. Kernels storage lose the viability more rapidly (32 %) than compare pod storage (43 %) after 12 months of storage. Pods and kernels packed in polyethylene bags and stored in dehumidified cold storage maintains the viability of 76 and 75 percent respectively even after 12 months storage. At the same time, pods stored in modified atmospheric storage of 40 % CO 2 concentration recorded the highest germination of (81 %) followed by kernels stored in MAS (76 %) [Fig-1]. Modified atmosphere storage of seeds devoid of oxygen showed retention of higher seed viability for an appreciable period. Both seed viability and vigour were well preserved with modified atmospheric storage particularly with carbon dioxide and vacuum conditions. The probable reason for differences in storability of seeds in the modified atmospheric storage condition might be due to the variation in the gas concentrations [9]. In general, ageing is manifested by the decrease of metabolic activity and an increase of catabolic processes [4]. An oxidative stress might be reduced in O2- free storage atmospheres [6]. It should be noted that seed deterioration during storage could result in marked changes in the content and activity of enzymes capable for regarding the stored reserves [7, 12 & 13].

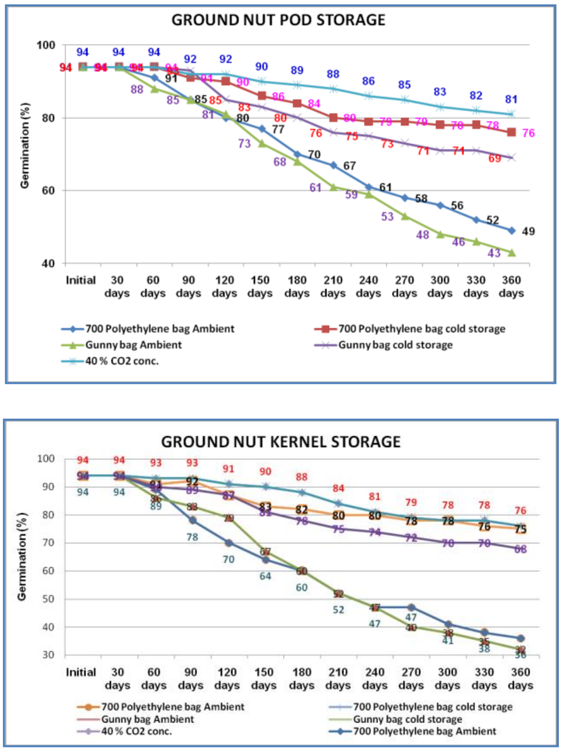

Fig-1 Effect of storage containers, storage chambers on pod and kernel storage on groundnut seed germination in TMV 13

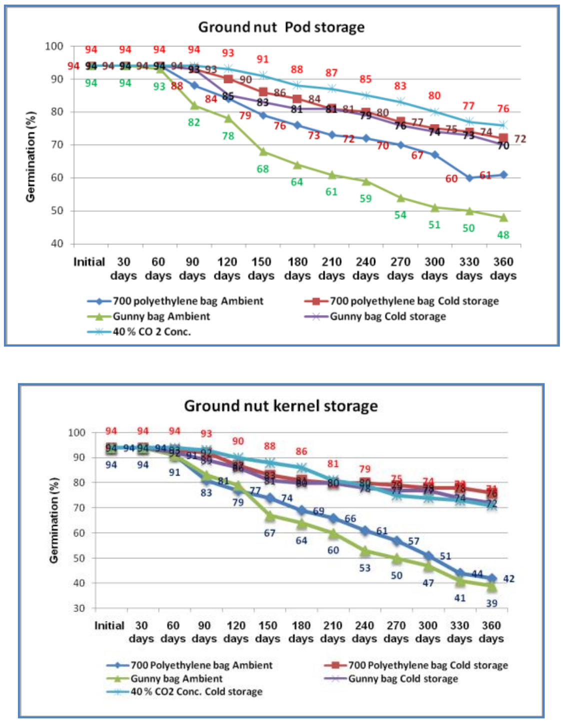

Fig-2 Effect of storage containers, storage chambers on pod and kernel storage on groundnut seed germination in CO6

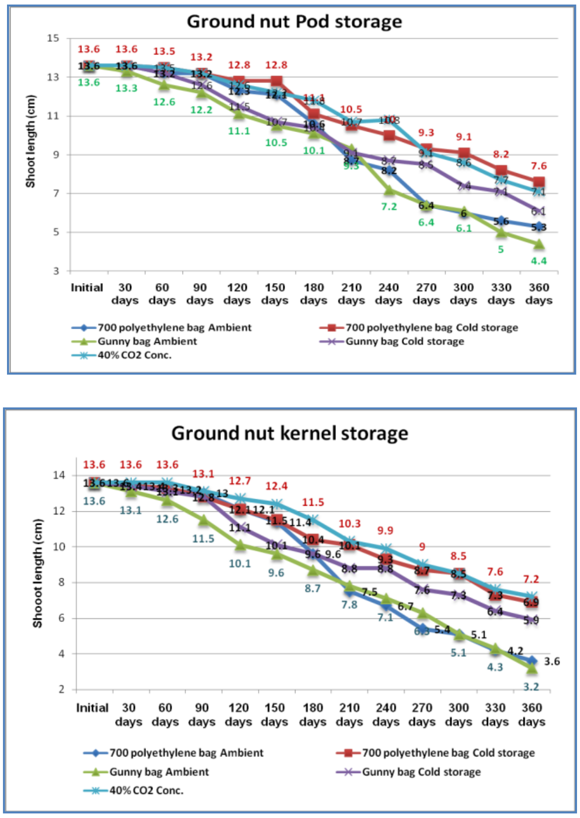

Fig-3 Effect of storage containers, storage chambers on pod and kernel storage on shoot length of groundnut seed germination in TMV 13

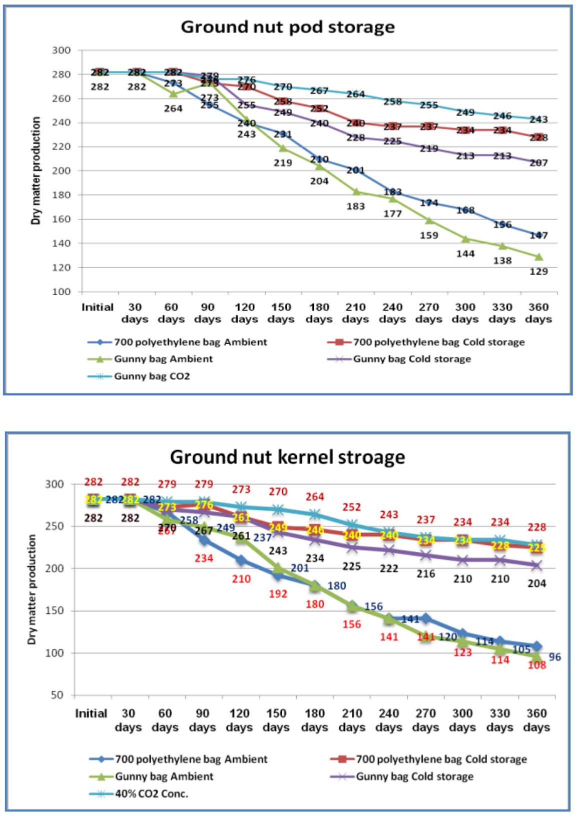

Fig-5 Effect of storage containers, storage chambers on pod and kernel storage on dry matter production of groundnut seed germination in TMV 13

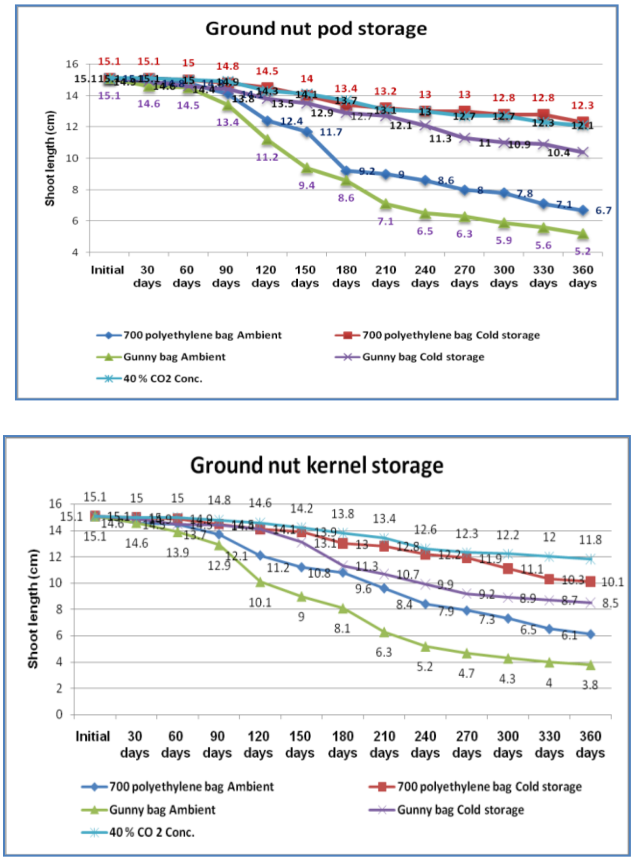

Fig-4 Effect of storage containers, storage chambers on pod and kernel storage on shoot length of groundnut seed germination in CO6

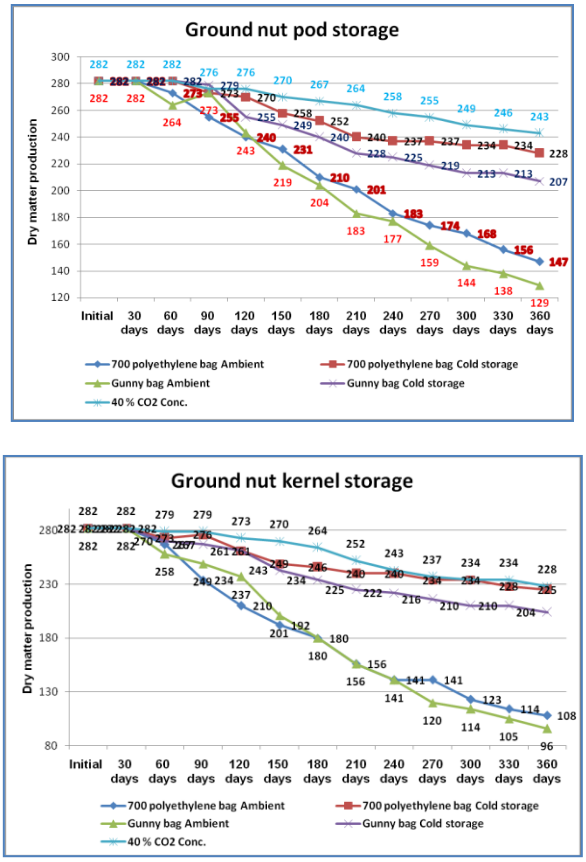

Fig-6 Effect of storage containers, storage chambers on pod and kernel storage on dry matter production (mg/ seedling) of groundnut seed germination in TMV 13

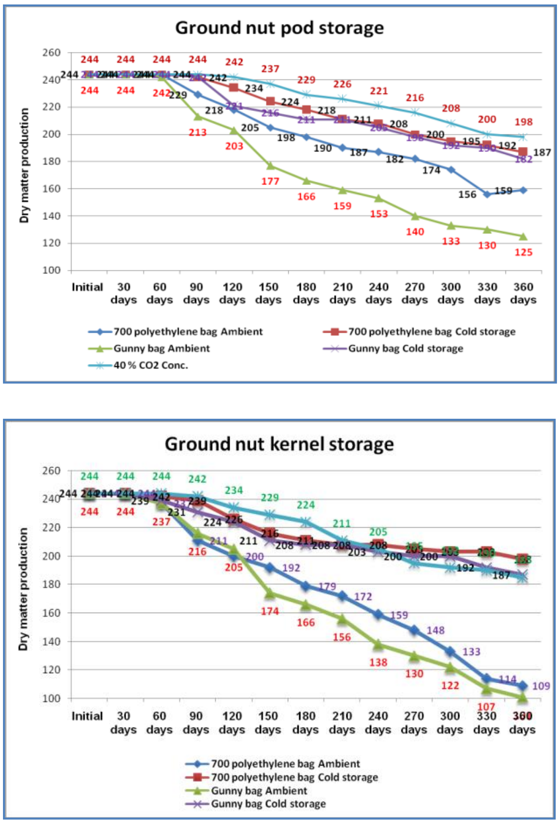

Fig-7 Effect of storage containers, storage chambers on pod and kernel storage on dry matter production (mg/ seedling) of groundnut seed germination in CO6

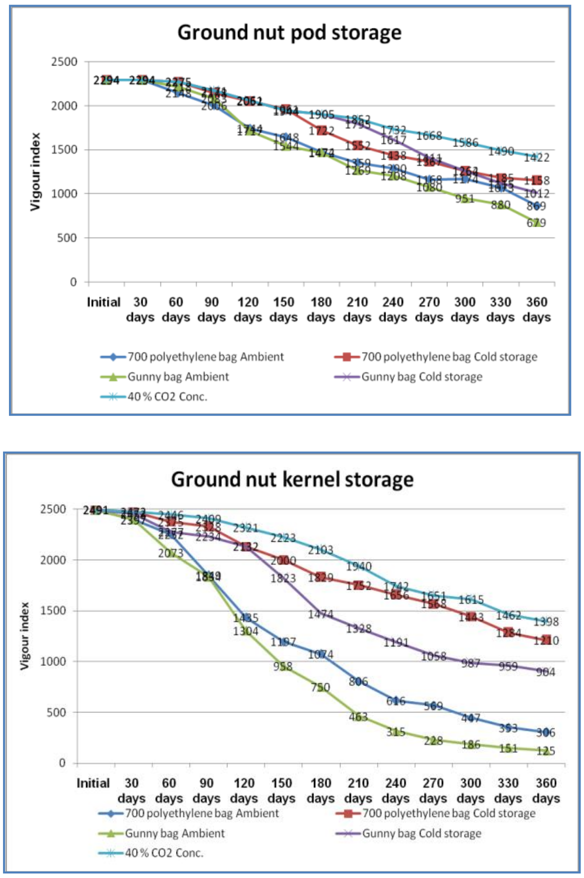

Fig-8 Effect of storage containers, storage chambers on pod and kernel storage on vigour index of groundnut seed germination in TMV13

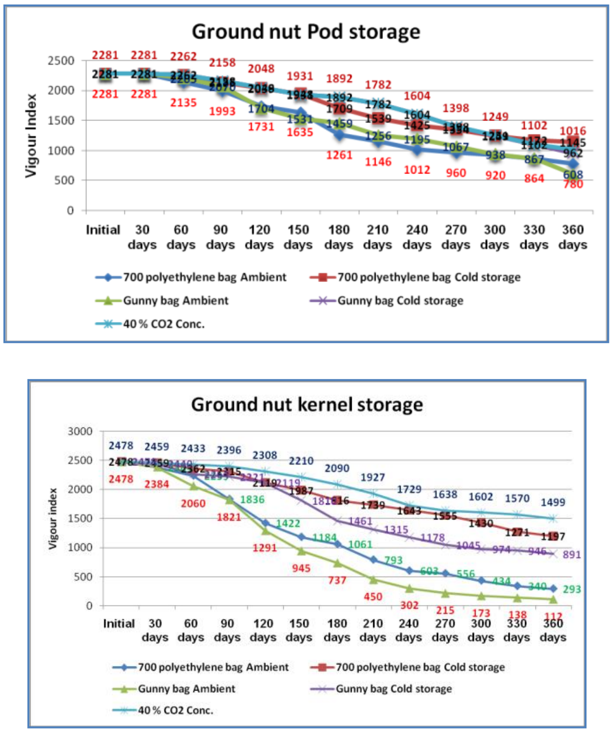

Fig-9 Effect of storage containers, storage chambers on pod and kernel storage on vigour index of groundnut seed germination in CO6

Vigour index of the stored groundnut seeds indicates the declining trend as storage period advances. The pattern of vigour deterioration varies with the pattern of seed handling. The vigour index groundnut pods stored as such and packed in polyethylene (869) and gunny bag (679) in ambient and 1158 and 1012, respectively when stored in cold storage after 360 days of storage, which declined from 2294 [Fig-9]. But the kernel of groundnut packed in polyethylene (306) and gunny bag (125) in ambient storage and 1210 and 904, respectively when stored in cold storage after 360 days of storage. The same trend exhibited in vigour reduction of variety CO6. It clearly reveals that that pod storage is advantageous in case of groundnut rather than kernel storage. It is evident that the kernels stored in polyethylene bag as well as gunny bag and ambient storage recorded the lowest vigour index compare to any other treatment. At the same time, the kernels stored in cold storage maintain comparatively higher vigour index. This is in line with the results of [11] who conducted experiment on modified atmospheric storage of groundnut seed kernels for 10 months and reported that seed kernals stored in gaseous combination of 40(%) CO2 and 60 (%) N2 showed better seed quality parameters at the end of the storage period. Hence the microclimate prevails inside the shells of groundnut pod acts as protective barrier in maintaining the vigour status of the kernels. The pods and kernels stored in modified atmospheric storage with 40 % CO_2 concentration recorded the vigour of 1422 and 1398 respectively after 12 months of storage. The decline of seed quality during storage is expressed first as a decrease in the growth rate of the germinating axis (vigor) and subsequently as a loss of actual germinability. Changes in the soluble carbohydrate contents could contribute to both the declines of vigor and of germinability of the seeds. It is known that soluble carbohydrates generally decline with seed aging, and this decline might result in limited availability of respiratory substrates for germination. Another possibility is that depletion of disaccharides may lessen the protective effects of sugars on structural integrity of membranes. Finally, the presence of reducing sugars may lead to deterioration of protein components through Amadori and Maillard reactions contributing to seed deterioration. Therefore, it is essential to preserve seeds in suitable storage environmental conditions which eliminate the deleterious effects of oxidative reactions which reduce the seed quality parameters with the progress in the storage period. Significantly, higher values for all the positive quality arameters were recorded in the seeds stored in higher carbon dioxide and lower oxygen percentages [2].

Conclusion

Storing the pods or kernels of groundnut dried to the moisture content of 8 percent and stored either in the storage environment of 10^0 C + 40 % RH or 40 % CO_2 concentration can maintain the vigour and viability as per the Indian Minimum Seed Certification Standards upto 12 months of storage.

Acknowledgement

Sincere thanks to Indian Council of Agricultural Research-All India Coordinate Research Project-National Seed Project (Crops)-Seed Technology Research Component, India for funding this research project.

Author Contributions

1. Vakeswaran V. is the Scientists incharge of the research project and conducted the experiment.
2. Selvaraju P. and Bhaskaran M. are the Nodal officers of this research project.

Conflict of interest: None Declared

References

[1] Abdul-Baki A.A. and Anderson J.D. (1973) *Crop Sci*., 13, 630-633.
[2] Alvindia D.G., Caliboso F.M., Sabio G.C. and Regpala A.R. (1992) *Proc. of the 6th International Working Conference on Stored-Product Protection-Volume1.* Food Protection Department, National Post Harvest Institute for Research and Extension, CLSU Compound, 3120, Nueva Ecija, Philippines.
[3] Doijode S.D. (2003) *Indian J. Plant Physiology,* **8**,186-188.
[4] Gorecki R.J., Kulka K. and Puchalski J. (1996) *Biochemical aspects of seed deterioration during storage. In: Proceedings of an international conference on crop germplasm conservation with special emphasis on rye, July 1996, Warsw, Poland, (Eds. T. Gass.W. Podyama, J. Puchalski and S. A. Eberhart), pp. 50-60, International Plant Genetic Resources Institute, Rome.*
[5] ISTA (1999) International Rules for Seed Testing, Seed Sci. Techol., 27,Supplement rules
[6] Justice O.L. and Bass L.N. (1978) Practices of seed storage. Agriculture Handbook, 506:57-77.
[7] Priestley DA (1986) Seed ageing*: Implication for seed storage and preservation in the soil*. Cornell University Press, Ithaca, New York.
[8] Ramamoorthy K. and Karivaratharaju T.V. (1986) *Indian Agric*, 30(2),101-106.
[9] Roberts E.H. and Abdalla F.H. (1968) *Annuals of Botony,* (N.S.) 32,97-117.
[10] Roberts E.H. (1972) Storage environment and the control of viability. Pages 14–58 *in* Viability of seeds (Roberts EH, ed.). London, UK: Chapman and Hall.
[11] Shrishail T. (2011) *Studies on effect of modified atmospheric storage conditions on storability of groundnut (Arachis hypogaea L.) seed kernels. M.Sc.(Agri) Thesis, Univ. of Agril. Sci.,Raichur, Karnataka (India).*
[12] Smith M.T. and Berjak P. (1995) *Deteriorative changes associated with the loss of viability of stored desiccation-tolerant and dessication-sensitive seeds. In: Seed development and germination, (Eds. J. Kigel and G. Galli), pp.701-746. Marcel Dekker Inc., New York.*
[13] Walters C. (1998) *Seed Sci. Res.,* 8, 223-244.