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Seed quality as affected under different temperature regimes using different packings in pigeonpea (*Cajanus cajan* (L.) Millsp.) during storage

Shaveta Kamboj, Manjeet Kaur, Geeta Bassi and Kamaljit Sidhu

Shaveta Kamboj
Department of Botany, Punjab Agricultural University, Ludhiana, Punjab, India

Manjeet Kaur
Department of Botany, Punjab Agricultural University, Ludhiana, Punjab, India

Geeta Bassi
Department of Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana, Pubjab, India

Kamaljit Sidhu
Department of Botany, Khalsa College for Women, Civil Lines Ludhiana, Punjab, India

Corresponding Author:
Shaveta Kamboj
Department of Botany, Punjab Agricultural University, Ludhiana, Punjab, India

Abstract
Maintenance of seed vigour and viability during storage is a matter of prime concern. Present research was formulated to store two different seed lots (fresh and revalidated) of pigeonpea *cv.* PAU 881 using four different packaging containers (cloth bag, cloth bag containing drying beads, only desiccator and desiccator containing drying beads) under two different temperature regimes *i.e.* ambient (~27.3 ^{0}C) and cold room temperature (~15.5 ^{0}C) to observe changes in seed quality. Viability of the stored seeds was tested by determining percent germination, speed of germination, emergence percent, vigour index I and vigour index II. The experiment results revealed that, the different temperature regimes showed significant effect on seed germination and other quality parameters in pigeonpea. Fresh seeds when stored under cold room temperature conditions maintained the Indian Minimum Seed Certification Standards (81.3% germination) for 12 months when packed at moisture content ~8.42% in desiccator containing drying beads with relative humidity ~55.5% whereas seed quality of revalidated lot was maintained (76% germination) for 10 months when stored under similar storage conditions. Maximum deterioration was observed in revalidated seed when stored under ambient temperature conditions in cloth bag.

Keywords: Drying beads, packaging materials, Pigeonpea (*Cajanus cajan* (L.) Millsp.), seed quality, storage temperature

Introduction

Pigeonpea (*Cajanus cajan* (L.) Millsp.) belongs to the family Fabaceae. It is most important *kharif* pulse crop of India contributing 3.96 m ha of area and 2.56 m tonnes of production with productivity of 646 kg/ha in 2015-16 (Anonymous, 2017) [4]. Seed being a living entity, deterioration in its quality is inevitable, irreversible and inexorable. But seed storability is important for maintaining seed quality from harvest till next sowing (Baiyeri and Mbah, 2006) [5]. The principle of storage is production of adequate amount of seeds which have ability to emerge uniformly and rapidly from seedbeds after sowing, so as to create a uniform stand of healthy and quickly growing seedlings. Storage of seed is influenced by the maintenance of viability and vigour of seeds such as initial physiological quality of seeds, climatic conditions at the time of maturation, relative humidity, seed storage temperature, action of microorganisms, type of packaging material and period of storage (Toledo *et al*., 2009) [16]. Seed moisture content and storage conditions are the important factors to control seed storability. The deteriorative reactions take place in the seed more readily when moisture content is higher and thus it imposes a threat to survival and longevity (Biabani *et al*., 2011; Amjad and Anjum, 2002) [6, 3]. Process of deterioration is associated with physiological changes as regular decrease in germinability, lower tolerance to adverse storage conditions. Seeds stored at high moisture content determine high rates of respiration and fungal attack which results in decline seed viability and vigour. Seeds at relatively high moisture level can be stored for longer periods at near freezing temperatures than at higher temperatures, while higher storage temperatures (30 ^{0}C) are less harmful when the moisture content of seed is low (Karanth, 2013) [9]. With decrease in germination percent, the speed of germination also decreases which causes loss of seed vigour resulting low of seed quality. Low quality seeds can potentially decrease percent germination and seedling emergence, leading to poor stand establishment in the field and therefore lead to yield loss. However, availability of an adequate supply of high quality seed is essential for a successful seed production programs and the maintenance of a viable and productive agriculture (Al-Maskri *et al*., 2002) [2]. Consequently, an experiment was planned to evaluate seed quality as affected under different temperature regimes using different packings in Pigeonpea (*Cajanus cajan* (L.) Millsp.) during storage.

Material and Methods

Fresh and revalidated seeds of pigeonpea *cv.* PAU 881 were used for conducting different seed quality test in Seed Technology Section of Department Plant Breeding and Genetics, Punjab Agricultural University, Ludhiana. Fresh seed (which was harvested during October 2015) and revalidated seed (harvested during October 2014) were procured from Pulses Section, Department of Plant Breeding and Genetics. Initial seed quality parameters for both lots were observed in terms of germination percent, speed of germination, emergence percent, vigour index I and vigour index II. Both seed lots were packed in four different packagings *viz*. cloth bag, cloth bag containing drying beads, desiccator only and desiccator containing drying beads and was stored under different temperature conditions *viz*. ambient temperature (~27.3^{0}C) and cold room temperature (~15.5^{0}C). The data was recorded till the seed germination fell below Indian Minimum Seed Certification Standards (IMSCS) (Ista, 2014) [8].

The extent and evaluation of seed quality was determined for each treatment using different laboratory tests: The germination was tested using "Between the Papers" method as per Rules of International Seed Testing Association (Abdul-Baki and Anderson, 1973) [1] in triplicate of 100 seeds each in a seed germinator at 25±1 ºC. The seeds were placed between two layers of moistened rolled germination paper which were then wrapped in wax paper to retain its moisture and put into transparent polyethylene bags. The bags were kept in a germinator in an upright position. After final count day *i.e.* after ten days, germination percent was computed as the percentage of normal seedlings. Seed moisture content (%) was determined as per Ista (2014) [8]. Five gram (fresh weight) of the seeds of each treatment was kept in hot air oven at 130ºC for 1h. The seeds were removed from the oven and cooled over $CaCl_2$ in a desiccator. The dry weight was recorded and moisture content was determined. Seedling length (cm) was calculated by adding both root and shoot lengths. For determining seedling dry weight (gm), 10 normal seedlings, selected at random, were dried at 110^{0}C for 17h and weighed. Seedling vigour index I & II were calculated as per formula suggested by Abdul-Baki and Anderson (1973) [1]. Seedling vigour index I = Germination (%) x Mean seedling length (cm) and Seedling vigour index II = Germination (%) x Mean seedling dry weight (gm). Speed of germination was computed using "Top of Paper" method in three replicates in tight fitting Petri dishes, using 50 seeds each. Daily observations of emerged seedlings were recorded till the final count day. The speed of germination was calculated as suggested by Maguire (1962) [11].

Results and Discussion

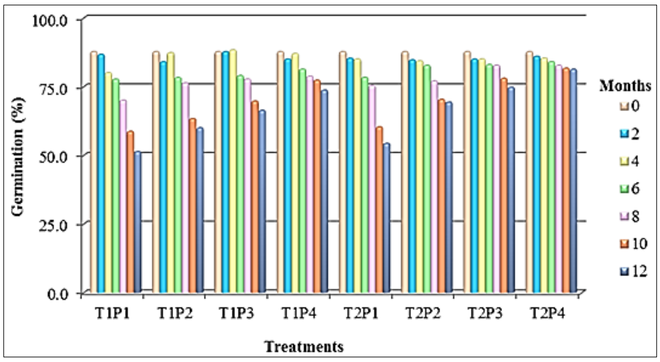
Initial germination percent of fresh and revalidated seed was 87.7% and 84.0% respectively. Both fresh and revalidated seed stored under both temperature conditions maintained Indian Minimum Seed Certification Standards upto 6 months of storage. After 8 months, under ambient temperature conditions, fresh seed lot maintained its germination percent in all other packings except cloth bag that showed 70.0% germination (Fig.1). Under similar conditions, in revalidated seed lot germination was maintained (76.0%) when stored in desiccator containing drying beads whereas it was declined in other packing materials used *i.e.* only desiccator (71%), cloth bag containing drying beads (67%) and cloth bag (66%) (Fig. 2). Under cold room conditions in fresh seed lot, all the packagings maintained seed germinability for 8 months whereas in revalidated seed lot, only desiccator (76.0%) and desiccator containing drying beads (81.6%) maintained its germination. After 10 months of ambient storage, fresh lot maintained germination (77.3%) when stored in desiccator containing drying beads whereas in revalidated seed lot, all the packings showed decline in germinability in same set of conditions. While under cold room conditions, desiccator and desiccator containing drying beads, seed germination was maintained (78.0% and 81.7% respectively) for 10 months. In revalidated seed lot, under cold room conditions, germination was maintained *i.e.* 76.0% in desiccator containing drying beads while in all other packings it was reduced. After storage of 12 month, 81.3% germination was observed only in fresh seed lot when stored under cold room conditions while in revalidated seed lot all the packings showed decline in seed germination and maximum decline (43.0%) was found when revalidated seeds were packed in cloth bag under ambient conditions. In cucumber (*Cucumis sativus*), maximum percent germination was observed when moisture contents was 10.66% and 10.95% but slightly decreased when the moisture content attained at 11.03% and 11.08% respectively. The declination of germinability with high moisture content is related to the hygroscopic nature of seeds, especially under warm temperatures, which in turn is associated with the relative humidity of the surrounding air (Khaldun and Haque, 2009)[10]. As reported by Shelar *et al.,* (2008) [14] in soybean, germination and seedlings vigour declined with increasing storage period but maximum storability was maintained (79%) during 9 months of storage at relative humidity (55-65%) under temperature (25-30 ^{0}C).

Seed moisture content is the important factor which affects the viability of seed. In the present study, initial seed moisture in fresh seed lot was 12.27% while in revalidated seed lot initial moisture content was 11.62%. With storage, moisture content decreased when packed in moisture impervious container *i.e.* desiccator and desiccator containing drying beads under high temperature conditions. During initial months moisture content differed non-significantly in both seed lots. After 6 months of storage, it was observed that fresh and revalidated seed lots when packed in desiccator containing drying beads, stored under ambient temperature conditions showed low moisture content *i.e.* 9.34% and 8.29% respectively while fresh and revalidated seeds that were stored in same packing under cold room temperature conditions showed 10.25% and 10.90% respectively (Figs. 3 and 4). Whereas maximum moisture content was found when fresh seeds were packed in cloth bag under cold room conditions (12.47%) which was followed by same seed stored under ambient conditions (11.66%). Till 12 months, in revalidated seed lot lowest moisture content (8.30%) was reported when seeds were packed in desiccator containing drying beads under ambient conditions while higher (12.70%) moisture content was found when seeds packed in cloth bag under cold room conditions. In fresh seed lot, minimum (8.54%) moisture was found when seeds were stored in desiccator containing drying beads under ambient temperature conditions while higher moisture content (12.75%) was found when stored in cloth bag under cold room conditions which was followed by seeds stored under ambient conditions *i.e.* 12.69%. The cause of high moisture content in cloth bag was due to higher permeability than the desiccators. It was observed that moisture impervious containers (desiccator containing drying beads) showed the maximum seed germination and vigour as compared to that in cloth bag containing drying beads and cloth bag. Seeds with higher moisture content percent have lesser shelf life. When two different seed lots were subjected to storage at different temperatures in different containers, even small increase in moisture content influenced the storability of seed at high temperature significantly and hence differences in germination percentage was reported (Suma *et al*., 2013) [15].

Speed of germination is defined as number of germinated seeds per unit day. Higher speed of germination indicates more rapid and uniform germination than low speed of germination where germination is slower and quite irregular. It is one of the best methods for determining seed vigour. In terms of speed of germination, initial data of fresh and revalidated seed lot was 18.78 and 16.71 respectively. After 6 months storage, in all the packings value of speed of germination was >15 except when revalidated seed was stored under ambient conditions in cloth bag *i.e*. 13.32. Under cold room temperature when seeds were packed in desiccator containing drying beads with relative humidity ~55.5% fresh and revalidated seed lot showed maximum speed of germination *i.e.* 14.93 and 13.18 respectively after 12 month of storage (Figs. 5 and 6). With decrease in percent germination, the speed of germination also decreases causing loss of vigour and thus seeds become less viable sometimes resulting in the seedling death (Gholami and Golepayegani, 2011) [7].

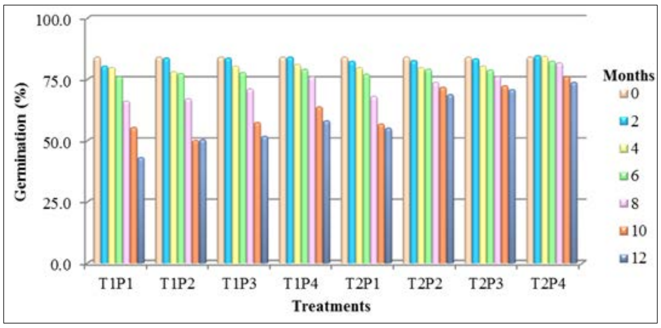
Temperature is regarded as one of the important factor that affects the percent germination as well as percent emergence (Nascimento, 2000)[12]. Initial data of fresh and revalidated seed lot in terms of emergence percent was taken before the start of storage period. In fresh seed lot it was 79.3% while revalidated seed lot showed 73.3% emergence. It showed that initial quality in terms of emergence was lower in revalidated seed as compared to fresh seed lot. Almost similar trend was observed in emergence with that of germination percent. After 6 months of storage, maximum emergence percent (78.3%) was observed when fresh seed stored in desiccator containing drying beads under cold room temperature while under similar conditions, revalidated seed lot showed 72.4% emergence percent (Figs. 7 and 8). Under ambient temperature conditions, minimum *i.e.* 66.7% emergence was observed when revalidated seeds packed in cloth bag while under similar conditions in fresh seed lot, emergence percent was 67.3%. Till 10 months, revalidated seed lot maintained emergence percent (68.0%) when stored under cold conditions in desiccator containing drying beads. After storage of 12 months, emergence percent of fresh seed lot of pigeonpea was 72.0% under cold room temperature conditions when seeds were stored in desiccator containing drying beads which was followed by seeds stored in desiccator (67.7%). Under cold room temperature conditions, revalidated seeds when stored in cloth bag showed more emergence percent (46.7%) as compared to seeds stored under ambient conditions (36.0%) in same packing after 12 months.

Assessment of seedling vigour is more relevant as the germination alone may not reveal the real potential of seed lots. Vigour index I and vigour index II is directly correlated to germination percent, seedling length and dry weight. Initial data of fresh lot of seedling vigour index I and vigour index II was 3365.59 and 23.82 respectively while in revalidated seed lot initial vigour index I and II was 3161.76 and 22.42 respectively. After 6 months of storage, fresh seed lot maintained its quality in all four packings under both temperature conditions while revalidated seeds packed in cloth bag showed maximum loss in vigour index I and vigour index II *i.e.* 2639.91 and 17.74 respectively when stored under ambient conditions. After 10 months, revalidated seed maintained seed quality *i.e.* 2733.72 and 19.76 respectively in terms of vigour index I and II when packed in desiccator containing drying beads under cold room conditions. After 12 month of storage, seedling vigour index I and vigour index II was observed to be maximum *i.e.* 2990.21 and 21.41 respectively in fresh seed lot when kept in the desiccator containing drying beads under cold room temperature while the minimum value of vigour index I and vigour index II *i.e.* 1380.33 and 9.03 respectively was found in the revalidated seed lot when packed in cloth bag under ambient temperature. In cow pea seeds, it was revealed that vigour index I and vigour index II decreased as the quality of seed became poor due to duration of storage (Saha and Sultana, 2008) [13]. Similar findings were obtained in rapeseed and mustard where seedling vigour deceased with increased age of seeds during storage (Verma *et al*., 1999) [17].



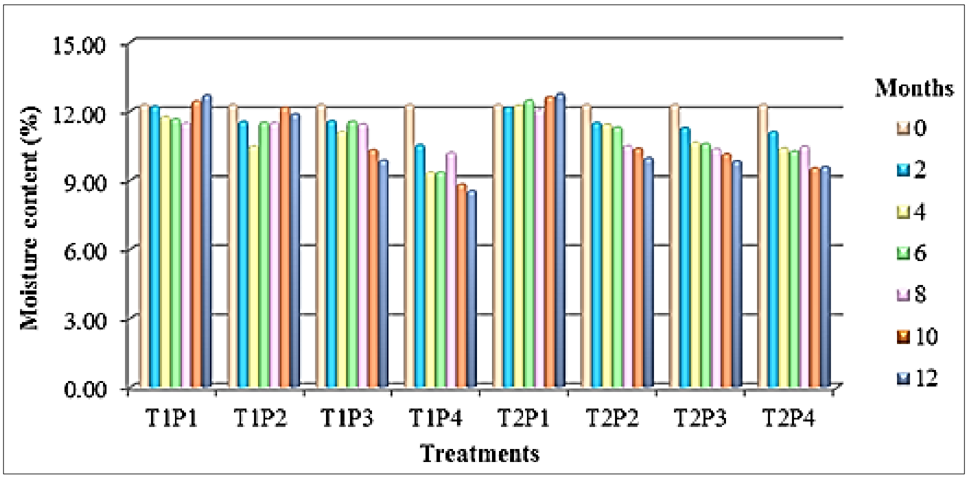
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 1: Effect of different temperatures and packagings on percent germination in fresh seed of pigeonpea during storage



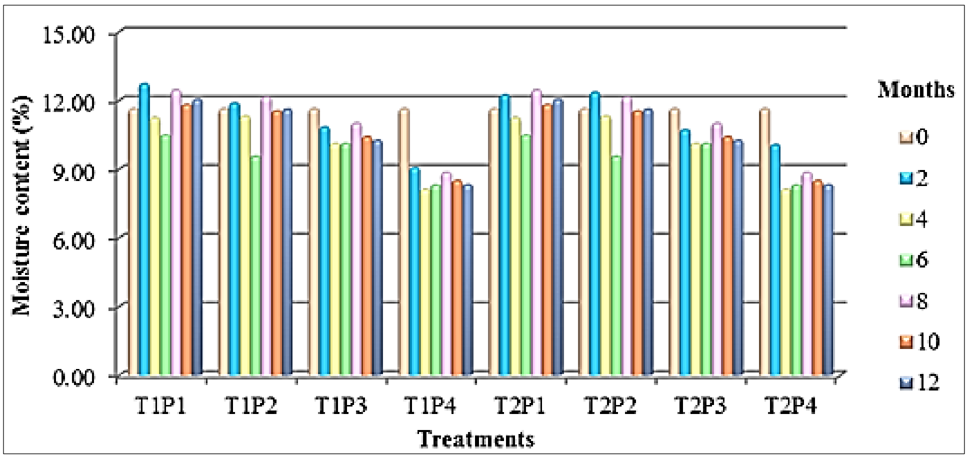
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 2: Effect of different temperatures and packagings on percent germination in revalidated seed of pigeonpea during storage



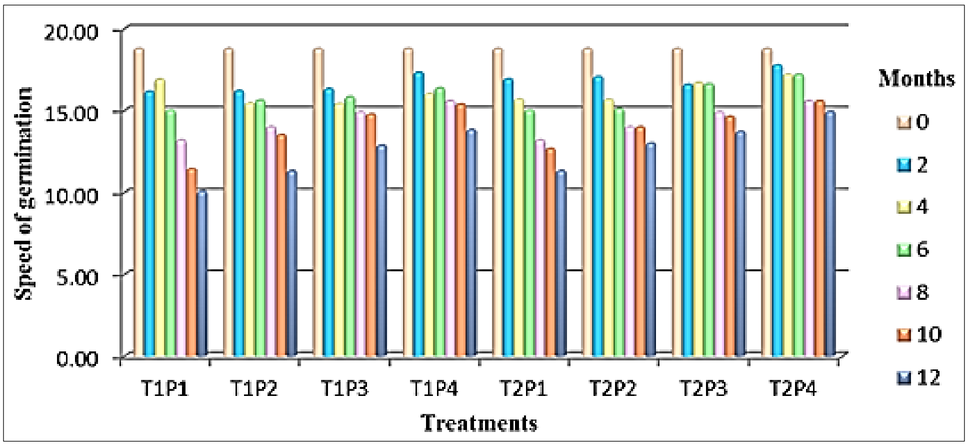
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 3: Effect of different temperatures and packagings on moisture content in fresh seed of pigeonpea during storage



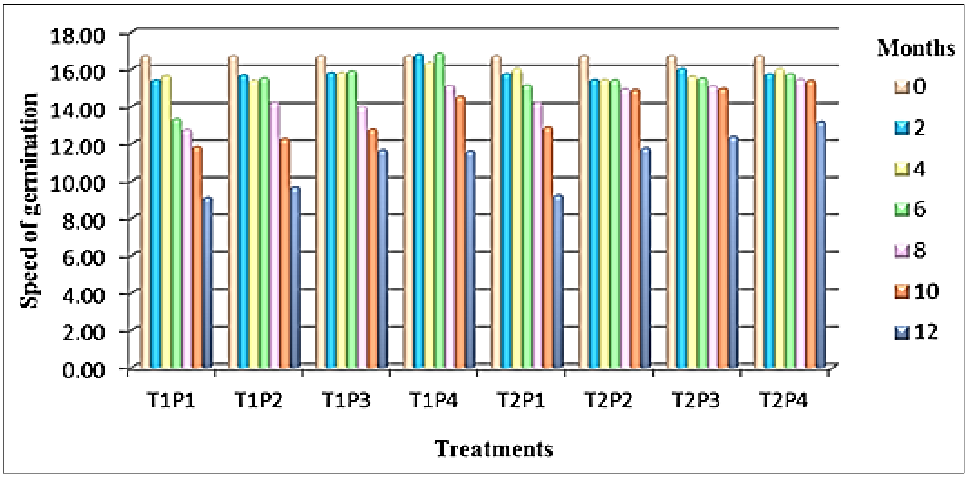
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 4: Effect of different temperatures and packagings on moisture content (%) in revalidated seed of pigeonpea during storage



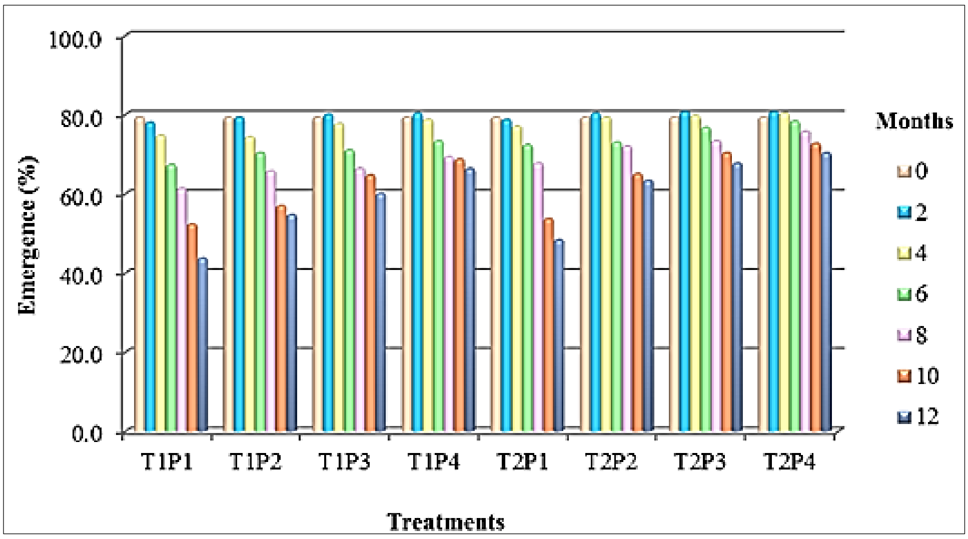
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 5: Effect of different temperatures and packagings on speed in germination in fresh seeds of pigeonpea during storage



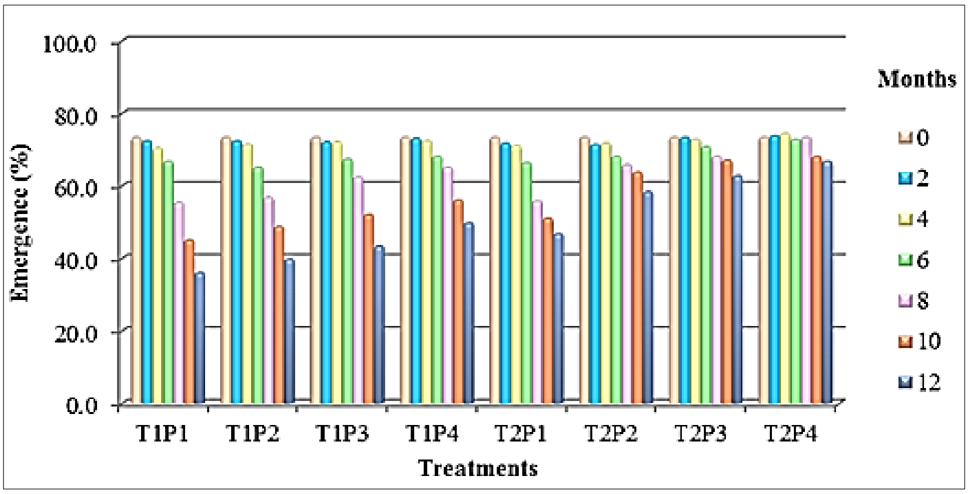
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 6: Effect of different temperatures and packagings on speed of germination in revalidated seeds of pigeonpea during storage



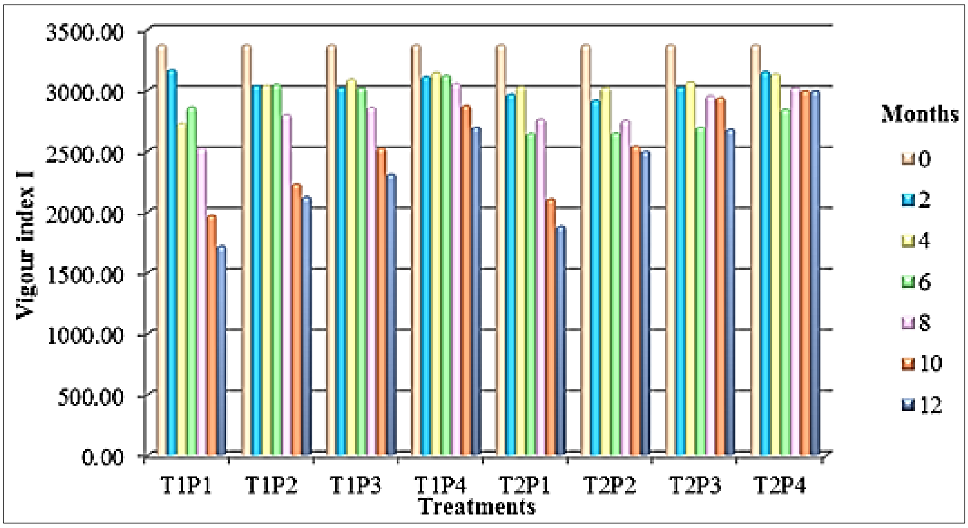
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 7: Effect of different temperatures and packagings on emergence (%) in fresh seeds of pigeonpea during storage



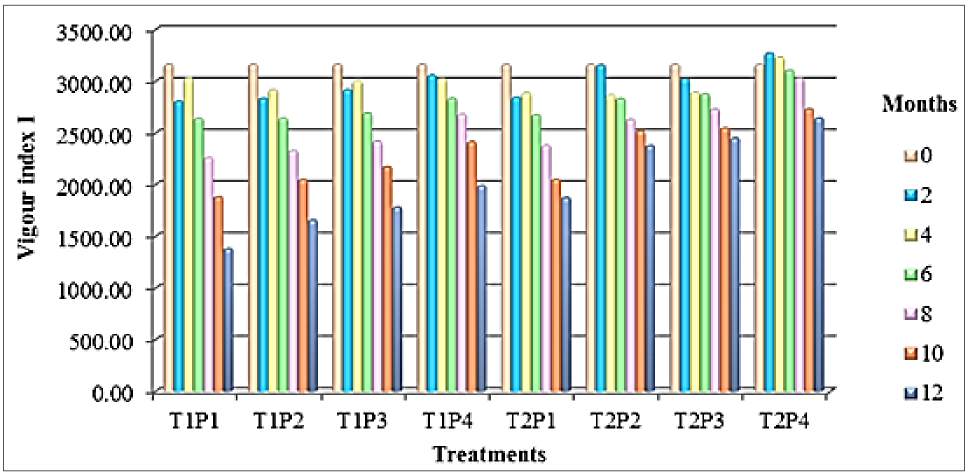
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying bead

Fig 8: Effect of different temperatures and packagings on emergence (%) in revalidated seeds of pigeonpea during storage



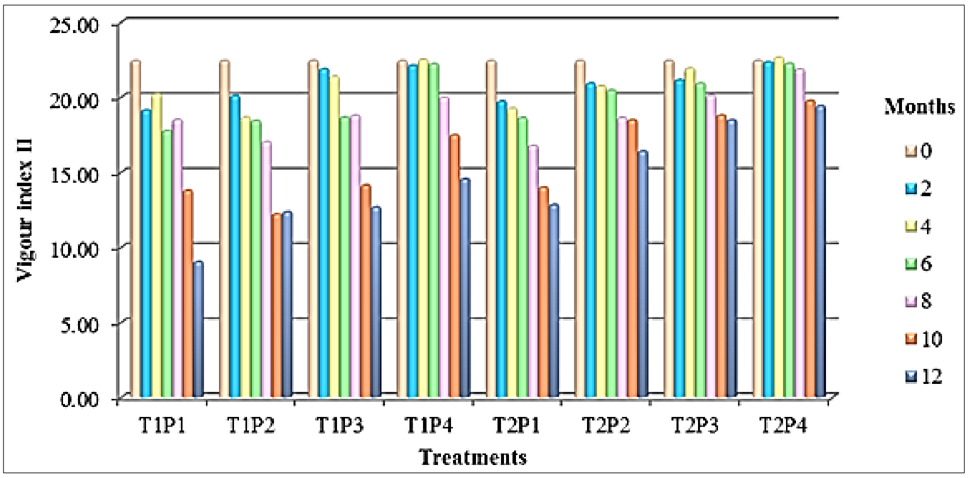
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 9: Effect of different temperatures and packagings on vigour index I in fresh seeds of pigeonpea during storage



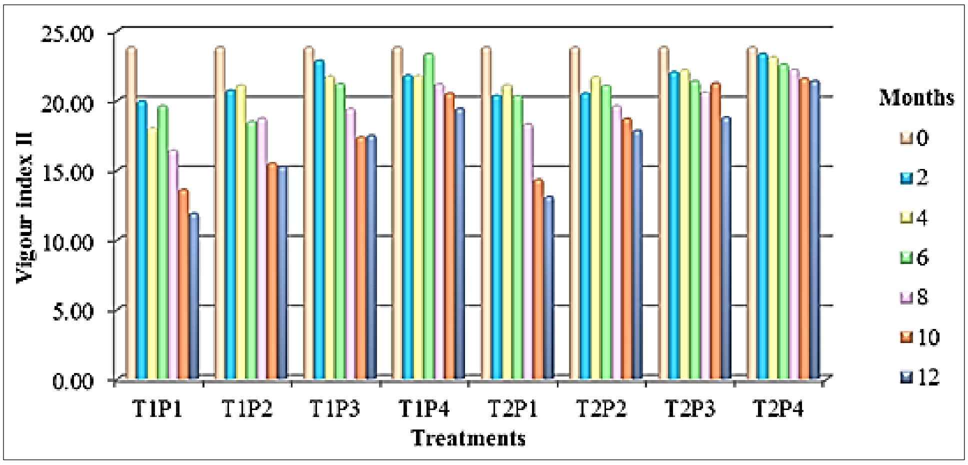
T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 10: Effect of different temperatures and packagings on vigour index I in revalidated seeds of pigeonpea during storage



T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 11: Effect of different temperatures and packagings on vigour index II in fresh seeds of pigeonpea during storage



T1= ambient temperature, T2= cold room temperature, P1= cloth bag, P2= cloth bag containing drying beads, P3= desiccator, P4= desiccator containing drying beads

Fig 12: Effect of different temperatures and packagings on vigour index II in revalidated seeds of pigeonpea during storage

Conclusion

Results obtained in this study allow us to conclude that that fresh seed of pigeonpea with moisture content ~8.42%, when stored in a desiccator containing drying beads under cold room temperature conditions (~15.5^{0}C with ~55.5% relative humidity), can maintain seed storability more than 12 months in terms of germination percent, speed of germination, emergence percent, vigour index I and vigour index II. Seed quality of revalidated lot was maintained for another 10 months when stored under similar storage conditions. Further it was also concluded that when seeds packed in cloth bag under ambient temperature conditions (~27.3^{0}C temperature and ~32.67% relative humidity) showed maximum deterioration in seed quality after 12 months.

References

1. Abdul-Baki, Anderson JD. Vigour determination in soyabean seeds by multiple criteria. Crop Science. 1973;13:630-633.
2. Al-Maskri A, Khan MM, Al-Manthery O, Al-Habsi K. Effect of accelerated aging on lipid peroxidation, leakage and seedling vigor (RGR) in cucumber (*Cucumis sativus* L.) seeds. Pakistan Journal of Agricultural Sciences. 2002;39:330-337.
3. Amjad M, Anjum MA. Effect of relative humidity and ageing period on the quality of onion seed. International Journal of Agriculture and Biology. 2002;2:291-296.
4. Anonymous. Project coordinator’s report, AICRP on pigeonpea ICAR-IIPR Kanpur, 2017, 23.
5. Baiyeri KP, Mbah BN. Surface sterilization and duration of seed storage influenced Emergence and seedling quality of African breadfruit (*Triculia africana*). African Journal of Biotechnology. 2006;5:1393-1396.
6. Biabani A, Boggs LC, Katozi M, Sabouri H. Effects of seed deterioration and inoculation with *Mesorhizobium cicerion* yield and plant performance of chickpea. Australian Journal of Crop Science. 2011;5(1):66-70.
7. Gholami TH, Golepayegani A. Effect of seed ageing on physiological and biochemical changes in rice seed (*Oryza sativa* L.). International Journal of Agricultural Science. 2011;1:138-143.
8. Ista. International Rules for Seed Testing, Zurich, Switzerland, 2014.
9. Karanth A. Seed Technology, 2013, 181-182.
10. Khaldun BM, Haque ME. Seed quality deterioration due to temporal variation of biotic and abiotic factors in cucumber. Bangladesh Journal of Agricultural Research. 2009;34:457-463.
11. Maguire JD. Speed of germination: Aid in selection and evaluation of seedlings emergence and vigour. Crop Science. 1962;2:176-177.
12. Nascimento WM. Temperatura Germinação de hortaliças. Seed News. 2000;4:44-45.
13. Saha RR, Sultana CAC. Influence of seed ageing on growth and yield of soybean. Bangladesh Journal of Botany. 2008;37:21-26.
14. Shelar VR, Shaikh RS, Nikam AS. Soybean seed quality during storage: A Review. 2008;29:125-131.
15. Suma A, Sreenivasan K, Singh AK, Radhamani J. Role of relative humidity in processing and storage of seeds and assessment of variability in storage behaviour in *Brassica* spp. and *Eruca sativa*. The Scientific World Journal. 2013;9:1-9.
16. Toledo MZ, Fonseca NR, Cesar ML, Soratto RP, Cavariani C, Crusciol CAC *et al*. Physiological quality and storage of bean seeds as affected by late side dressing nitrogen. Pesquisa agropecuaria tropical. 2009;39:124-133.
17. Verma SS, Tomar RPS, Verma U. Study on seed quality parameters in rapeseed and mustard under ambient condition. Indian Journal of Agriculture Sciences. 1999;39:840-842.