

Determination of Relative Seed Storage Potential using Natural and Accelerated Ageing in Pea (*Pisum sativum* L.)

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ABSTRACT Seeds of five varieties of pea (*Pisum sativum* L.) viz. Arkel, Matar Ageta 6, Mithi Phali, Punjab-87 and Punjab-88 were subjected to natural *vis-a-vis* accelerated ageing conditions to predict seed storage potential and relative storage potential of the seeds. Seeds of 'Matar Ageta 6' registered 18 months of storability in terms of maintaining minimum seed certification standards (MSCS) for germination per cent and thus designated as good storer. Whereas variety Arkel was adjudged to be the poor storer as it showed 10 months of seed storage potential under ambient conditions. Seed storability of Punjab 88 was 14 months and that of Mithi Phali and Punjab-87 was 12 months, thus adjudged to be the intermediate storers. Seeds with good/intermediate storability under natural storage conditions could withstand the accelerated ageing even up to 21/14 days. However, increased chronological age rendered seeds more susceptible to accelerated ageing. It was also observed that accelerated ageing of only one day enhanced the germination over control in all the cultivars under study.

Key words: Accelerated ageing, pea, seed quality, seed storability.

Various crop species have variable life span when stored under identical conditions. Two types of seeds viz. poor and good storers for seed storability have been identified. A third category having intermediate storability has also been included. However, these seed storability differences are not confined only to species, as many studies have demonstrated that storability variation prevails at the genotypic level too. Significant cultivar responses for differential seed storability have been reported in cucumber, pea [1] and soybean [2, 3]. There is not much information as to the storage response and relative storability of carryover seed lots in pea. Therefore, in view of the above, present study was undertaken to obtain reliable information on the seed storage potential and relative storability of five varieties by taking their 19 months old carryover seed.

MATERIALS AND METHODS

Carryover foundation seed of five varieties of pea

(*Pisum sativum* L.) comprising Arkel, Matar Ageta 6, Mithi Phali, Punjab-87 and Punjab-88, produced under identical agro-climatic conditions, was collected from Dept of Vegetable Crops, PAU Ludhiana. The seeds were stored in cloth bags under ambient conditions as well as subjected to accelerated ageing (95% RH and 40±1°C) for 1-21 days followed by air drying at room temperature. The moisture content was between 8.9 to 9.1 per cent in the seeds at the time of the initiation of the experiment. The data on seed germination and seed vigour in terms of seedling dry weight and electrical conductance of seed leachates was recorded at bi-monthly interval till the germination fell below minimum seed certification standard which is 75 per cent for pea. The germination was tested as per ISTA seed testing rules [4] in quadruplicate of 100 seeds each at 25±1°C in a germinator. For determining seedling dry weight, 10 randomly selected normal seedlings were dried at 110°C for 17h and weighed and vigour index

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was calculated using formula given by Abdul-Baki and Anderson [5]. For calculating electrical conductance fifty sterilized seeds were dipped in 100 ml of triple distilled water and kept at $25\pm 1^\circ\text{C}$ in an incubator for 18h and the electrical conductance of the seed leachates was recorded.

RESULTS AND DISCUSSION

Seed germinability of several species has been reported to reduce with age during storage [6, 7]. In the present studies, data on per cent germination, electrical conductance of seed leachates and vigour index after ambient storage (Table 1) as well as after accelerated ageing (Table 2), indicated that different pea varieties registered differential seed storability. Seeds of Arkel showed decline in per cent germination (67%) below minimum seed certification standards after 10 months of ambient storage. However, Matar Ageta 6 maintained MSCS and higher vigour index up to 18 months under ambient storage conditions, indicating its good storability. A positive correlation between vigour index and germination for different cereals and vegetable crops has also been reported by Delouche and Baskin [8] and Mian and Coeffey [9]. This observation was corroborated in Punjab 87, as its germination (75%) and vigour

index (26.36) remained on higher side up to 12 months of ambient storage. Quantification of seed vigour showed decline as seedling dry weight reduced with storage. One of the reasons associated with seed deterioration leading to the loss of vigour and viability is loss of membrane integrity. This membrane loss is indirectly measured with electrical conductance of seed leachates. Almost all the genotypes under study exhibited increased EC due to storage and induced damage to the integrity of cell membrane.

Accelerated ageing for various days depicted variable relative storability of seeds of different pea cultivars. The varieties that can resist changes in membrane are also able to maintain viability and quality of seeds [10]. Six and eight month old seeds withstood 14 days of accelerated ageing in Matar Ageta 6 which was considered to be good storer under ambient storage. Whereas, 8 and 10-months old seed of Arkel, which showed poor storability under ambient storage conditions, withstood accelerated ageing of only one day. Mithi Phali, Punjab-87 and Punjab-88 could withstand accelerated ageing up to 7 days in 4 months old seeds that also demonstrated intermediate seed storability under ambient storage conditions.

Table 1. Effect of ambient storage on different seed quality parameters in pea seeds

| Storage period (months) | Arkel | | | Matar Ageta 6 | | | Mitthi Phalli | | | Punjab 87 | | | Punjab 88 | | |
|-------------------------|-------|-------|-------|---------------|-------|-------|---------------|-------|-------|-----------|-------|-------|-----------|-------|-------|
| | *G | *VI | *EC | *G | *VI | *EC | *G | *VI | *EC | *G | *VI | *EC | *G | *VI | *EC |
| 0 | 90 | 34.02 | 0.45 | 87 | 32.37 | 0.45 | 92 | 34.5 | 0.49 | 92 | 26.13 | 0.53 | 92 | 31.84 | 0.7 |
| 2 | 88 | 32.65 | 0.42 | 85 | 33.92 | 0.42 | 90 | 33.3 | 0.48 | 87 | 27.06 | 0.54 | 90 | 33.03 | 0.66 |
| 4 | 84 | 29.24 | 0.43 | 84 | 33.35 | 0.42 | 89 | 24.71 | 0.54 | 82 | 22.63 | 0.55 | 88 | 24.47 | 0.84 |
| 6 | 81 | 28.43 | 0.59 | 81 | 23.65 | 0.72 | 82 | 18.25 | 0.76 | 82 | 25.26 | 0.72 | 87 | 24.19 | 1.00 |
| 8 | 79 | 23.31 | 0.73 | 83 | 24.98 | 0.75 | 80 | 16 | 0.82 | 78 | 23.4 | 0.81 | 86 | 29.5 | 1.12 |
| 10 | 70 | 10.57 | 0.89 | 80 | 18 | 0.79 | 76 | 14.9 | 0.99 | 75 | 26.7 | 0.86 | 84 | 19.92 | 1.21 |
| 12 | 67 | 8.11 | 0.95 | 81 | 11.91 | 0.85 | 70 | 11.76 | 1.18 | 75 | 25.73 | 0.86 | 78 | 16.23 | 1.56 |
| 14 | - | - | - | 78 | 10.45 | 0.88 | 61 | 7.44 | 1.39 | 68 | 19.12 | 0.88 | 72 | 13.42 | 1.64 |
| 16 | - | - | - | 76 | 8.47 | 0.9 | - | - | - | - | - | - | - | - | - |
| 18 | - | - | - | 70 | 8.08 | 1.12 | - | - | - | - | - | - | - | - | - |
| CD at 5% | 7.05 | 9.34 | 19.91 | 2.91 | 7.87 | 17.49 | 8.53 | 8.24 | 28.07 | 6.31 | 2.23 | 13.04 | 4.68 | 6.02 | 30.75 |

*G - Germination per cent, *VI - Vigour Index, *EC - Electrical conductance (mMhos)

Table 2. Effect of accelerated ageing on different seed quality parameters in pea seeds

| Period of accelerated ageing (days after ambient storage) | Arkel | | | Matar Ageta 6 | | | Mitthi Phalli | | | Punjab 87 | | | Punjab 88 | | |
|--|-------|-------|------|---------------|-------|------|---------------|-------|------|-----------|-------|------|-----------|-------|------|
| | *G | *VI | *EC | *G | *VI | *EC | *G | *VI | *EC | *G | *VI | *EC | *G | *VI | *EC |
| 0 month | 90 | 34.02 | 0.45 | 87 | 32.37 | 0.45 | 92 | 34.5 | 0.49 | 92 | 26.13 | 0.53 | 92 | 31.84 | 0.7 |
| 1d | 92 | 31.93 | 0.49 | 89 | 28.13 | 0.49 | 94 | 30.45 | 0.45 | 94 | 29.24 | 0.38 | 94 | 32.13 | 0.77 |
| 7d | 88 | 29.39 | 0.61 | 85 | 22.53 | 0.53 | 84 | 26.46 | 0.59 | 80 | 18.80 | 0.49 | 83 | 25.32 | 1.18 |
| 14d | 84 | 28.23 | 0.66 | 83 | 22.58 | 0.58 | 82 | 25.67 | 0.61 | 76 | 22.95 | 0.66 | 75 | 25.57 | 1.36 |
| 21d | 68 | 21.83 | 0.71 | 70 | 17.78 | 0.59 | 70 | 21.14 | 0.82 | 60 | 16.68 | 0.86 | 67 | 19.50 | 1.40 |
| 2 months | 88 | 32.65 | 0.42 | 85 | 33.92 | 0.42 | 90 | 33.3 | 0.48 | 87 | 27.06 | 0.54 | 90 | 33.03 | 0.66 |
| 1d | 85 | 30.18 | 0.37 | 84 | 30.24 | 0.36 | 86 | 31.29 | 0.36 | 82 | 30.50 | 0.38 | 83 | 27.81 | 0.50 |
| 7d | 80 | 28.56 | 0.37 | 76 | 26.53 | 0.36 | 79 | 26.71 | 0.39 | 78 | 24.96 | 0.45 | 80 | 26.64 | 0.61 |
| 14d | 78 | 25.66 | 0.44 | 72 | 22.54 | 0.37 | 63 | 21.40 | 0.45 | 70 | 19.74 | 0.52 | 75 | 19.28 | 0.63 |
| 21d | 70 | 24.88 | 0.45 | 70 | 19.46 | 0.42 | 53 | 14.21 | 0.48 | 68 | 19.01 | 0.54 | 74 | 20.12 | 0.66 |
| 4 months | 84 | 29.24 | 0.43 | 84 | 33.35 | 0.42 | 89 | 24.71 | 0.54 | 82 | 22.63 | 0.55 | 88 | 24.47 | 0.84 |
| 1d | 84 | 27.64 | 0.42 | 84 | 25.12 | 0.52 | 83 | 26.39 | 0.43 | 80 | 23.52 | 0.71 | 80 | 24.48 | 0.71 |
| 7d | 82 | 24.44 | 0.43 | 80 | 22.48 | 0.53 | 73 | 20.73 | 0.43 | 77 | 21.56 | 0.84 | 78 | 21.45 | 0.86 |
| 14d | 79 | 20.31 | 0.54 | 74 | 18.80 | 0.54 | 67 | 16.89 | 0.55 | 60 | 16.56 | 0.86 | 69 | 19.39 | 0.84 |
| 21d | 68 | 18.29 | 0.73 | 69 | 18.56 | 0.54 | 60 | 17.52 | 0.53 | 56 | 14.89 | 0.89 | 61 | 15.98 | 0.92 |
| 6 months | 81 | 28.43 | 0.59 | 81 | 23.65 | 0.72 | 82 | 18.25 | 0.76 | 82 | 25.26 | 0.72 | 87 | 24.19 | 1.00 |
| 1d | 78 | 25.12 | 0.75 | 82 | 27.64 | 0.81 | 75 | 26.16 | 0.73 | 78 | 26.51 | 0.72 | 78 | 26.76 | 1.15 |
| 7d | 70 | 20.93 | 0.77 | 78 | 19.97 | 1.21 | 66 | 20.06 | 0.76 | 69 | 19.80 | 0.77 | 71 | 22.79 | 1.44 |
| 14d | 65 | 13.54 | 0.79 | 75 | 19.57 | 1.23 | 56 | 16.80 | 0.76 | 61 | 17.63 | 0.79 | 63 | 18.21 | 1.40 |
| 21d | 61 | 12.38 | 0.79 | 60 | 16.68 | 1.25 | 50 | 15.00 | 0.89 | 52 | 14.41 | 0.81 | 62 | 17.54 | 1.45 |
| 8 months | 79 | 23.31 | 0.73 | 83 | 24.98 | 0.75 | 80 | 16 | 0.82 | 78 | 23.4 | 0.81 | 86 | 29.5 | 1.12 |
| 1d | 75 | 26.55 | 0.97 | 80 | 31.95 | 0.90 | 76 | 26.60 | 1.25 | 76 | 24.47 | 1.08 | 80 | 25.36 | 1.21 |
| 7d | 67 | 22.82 | 1.47 | 78 | 26.13 | 1.27 | 62 | 20.15 | 1.33 | 60 | 19.14 | 1.25 | 69 | 21.53 | 1.48 |
| 14d | 59 | 19.11 | 1.71 | 70 | 23.24 | 1.25 | 54 | 17.72 | 1.81 | 55 | 17.22 | 1.43 | 63 | 19.27 | 1.98 |
| 21d | 45 | 11.43 | 1.93 | 57 | 18.53 | 1.34 | 49 | 14.79 | 1.89 | 44 | 13.55 | 1.63 | 41 | 11.15 | 1.99 |
| 10 months | 70 | 10.57 | 0.89 | 80 | 18 | 0.79 | 76 | 14.9 | 0.99 | 75 | 26.7 | 0.86 | 84 | 19.92 | 1.21 |
| 1d | 72 | 23.68 | 0.98 | 78 | 24.30 | 0.91 | 75 | 25.5 | 1.31 | 76 | 23.79 | 1.08 | 75 | 23.1 | 0.92 |
| 7d | 60 | 16.66 | 1.48 | 66 | 17.42 | 1.29 | 70 | 19.46 | 1.36 | 68 | 18.63 | 1.27 | 68 | 15.51 | 1.49 |
| 14d | 54 | 13.53 | 1.72 | 57 | 16.01 | 1.27 | 61 | 16.34 | 1.38 | 50 | 12.35 | 1.45 | 52 | 12.12 | 1.69 |
| 21d | 40 | 8.84 | 1.93 | 46 | 11.92 | 1.35 | 49 | 11.72 | 1.85 | 44 | 10.34 | 1.63 | 41 | 08.73 | 1.98 |

*G - Germination per cent, *VI - Vigour Index, *EC - Electrical conductance (mMhos)

Increased chronological age rendered seeds increasingly susceptible to accelerated ageing. Seeds undergo several structural, biochemical and genetic alterations with age. These include reduced capacity for synthesis of proteins, lipids and RNA, injury to membranes, chromosomes and decreased repair systems [11, 12]. In the present studies with progressive storage of pea seed an increased electrical conductance was observed which indicated reduced vigour level in seeds which corroborated the findings by Bradford and Haigh [13] revealing that electrical conductance has a significant negative correlation with per cent germination, speed of germination, seedling growth and dehydrogenase activity. The greater leakage of solutes from stored and aged seeds implies that the integrity of plasma lemma and tonoplast is lost during accelerated ageing [11].

It was also observed that accelerated ageing of one day enhanced the germination over control in all the cultivars under study. This is a very interesting and useful observation that may be the seed invigorating effect which increased metabolic activity of the seeds facilitating the -rapid radical emergence during germination due to slow hydration.

From the present studies it can safely be inferred that Arkel is a poor storer with 10 months of seed storage potential under natural conditions whereas var. Matar Ageta 6 can be designated as good storer with 18 months of storage potential. Seed storability of var. Punjab 87 and of Mithi Phali was 12 months and of Punjab 88 was 14 months thus adjudged to be intermediate storers. It was also concluded that accelerated ageing of just one day enhanced the germination per cent over control in all the cultivars under study, which can be used as a very good and efficient tool to invigorate the pea seeds having low germination as well as the revalidated seed.

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