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# Effect of seed priming on germination percentage, shoot length, root length, seedling vigour index, moisture content and electrical conductivity in storage of kabuli chickpea cv., MNK – 1 (*Cicer arietinum* L.)

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**Abstract**
The storage experiment was conducted at Department of Seed Science and Technology, College of Agriculture, UAS, Raichur, to know the effect of seed priming treatments on storability of kabuli chickpea. The experiment consists of seven treatments and four replications in Complete Randomized Design, seed treated with mancozeb 50% + carbendazim 25% at 3 g/kg of seed recorded significantly higher germination (85.00%), shoot length (5.38 cm), root length (13.31 cm), seedling vigour index (1589), lowest electrical conductivity (0.742 $dSm^{-1}$) and moisture content (7.65%) at the end of ninth month of storage.

**Keywords:** Chickpea, hydration, seed priming, seed treatment

## Introduction

Chickpea is a major and cheap source of protein, predominantly consumed in the form of whole grain or dhal, sprouted grain, green or matured dry seeds. It has highly digestible protein (21.1%), carbohydrates (61.5%) and fats (4.5%) and also rich in fibre, minerals and β-carotene. The storability of seeds is an important aspect of seed vigour which can speak about the quality. The seed quality can be maintained either by storing in a controlled conditions or by a seed treatments. Storing the seeds under controlled conditions is a costly affair and hence seed treatments like priming needs to be practiced for improving the viability and vigour of seeds before sowing. Seed treatment is reported to improve the germination and increase the seedling emergence at changing soil moisture regime especially in the sub-optimal range (Mucke, 1987) [12].

The beneficial effect of these seed priming treatments were reflected in greater cellular membrane integrity, counter action of lipid peroxidation and free radical chain reaction often found to be directly correlated with the maintenance of viability and reduced moisture uptake by hydrated dehydrated seed (Dollypan and Basu, 1985) [8], antipathogenic effects (Powell and Mathews, 1986), repair of biochemical lesions by the cellular enzymatic repair system (Villiers and Edgcumbe, 1975) [21], metabolic removal of toxic substances (Basu *et al.*, 1974) [6] and counteraction of free radical and lipid peroxidation reactions (Rudrapal and Basu, 1982) [18].

The seed treatment and priming with chemicals and growth regulators act as protective agent against seed deterioration due to fungal invision and physiological ageing as a result of which the seed viability was maintained for longer period. So keeping all the above facts in view, an attempt was made to study the effect of seed treatment and priming on storability of kabuli chickpea.

## Material and Methods

A storage experiment was conducted during 2015-16 at Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur to investigate the effect of priming treatments on storability of kabuli chickpea. The experiment was laid out in CRD with four replications. The experiment consisted of seven treatments *viz.*, seed priming with vitavax power @ 0.25% ($T_1$), seed priming with $GA_3$ @ 50 ppm ($T_2$), seed priming with sodium molybdate @ 500 ppm ($T_3$), seed coating with extract of *Lantana camera* @ 10% ($T_4$), seed treatment with carbendazim @ 3 g per kg of seed ($T_5$), seed treatment with mancozeb 50% + carbendazim 25% (sprint) @ 3 g per kg of seed ($T_6$) and control ($T_7$). The observations recorded were described as follows.

**Germination percentage:** Germination test was conducted using eight replicates of 50 seeds each in the paper (between paper) medium and incubated in the walk in germination room.

The germination room was maintained at 25 ± 2º C temperature and 90 ± 5% RH. The number of normal seedlings in each replication was counted at the end of 8th day and the normal seedlings germination per cent was calculated and was expressed in percentage (Anon., 2013) [4].

**Shoot length and Root length:** From the germination test, ten normal seedlings were selected randomly in each treatment from each replication on 8th day. The shoot length was measured from the base of the primary leaf to the base of the hypocotyls and root length was measured from the tip of the primary root to the base of the hypocotyls, mean shoot length and root length was expressed in centimetre.

**Seedling Vigour Index:** The seedling vigour index was determined by multiplying the per cent germination and total seedling length (Abdul-Baki and Anderson, 1973) [1].

Seedling Vigour Index = Germination (%) x Total seedling length (cm)

**Moisture Content:** The five grams of seed material were taken for determining the moisture content using hot air oven - low constant temperature method. The powdered seed material was placed in a weighed moisture cup. After removing the lid, moisture cups were placed in hot air oven maintained at 103 ± 2º C for 17 ± 1 hours and the contents were allowed to dry. Then, the contents were weighed in an electronic balance along with metal cup and lid. The moisture content was worked out using the formula and expressed as percentage (Anon., 2013) [4].

**Electrical Conductivity (ds/m):** The electrical conductivity of seed leachate was determined as per procedure outlined by ISTA (Anon., 2013) [4]. Five gram of seed sample was soaked in 25 ml of distilled water for 24 hours at 25 °C ± 1 °C. The EC at 25 °C ± 1 °C was measured using conductivity meter.

The data collected from the above observations were analyzed statistically by the procedure prescribed by Panse and Sukhatme (1967) [14].

**Result and Discussion**

The results of the present study revealed that significant difference were recorded for seed quality parameters due to priming and seed treatment at all months of the storage period. Seed primed with $GA_3$ @ 50 ppm ($T_2$) recorded significantly highest germination percentage up to four months of storage followed by seed primed with vitavax power @ 0.25 per cent ($T_1$) and seed primed with sodium molybdate @ 500 ppm ($T_3$), while, lowest was recorded in control ($T_7$). but it was out performed by mancozeb 50% + carbendazim 25% @ 3 g per kg treated seeds in the rest of the storage period. The seeds treated with $GA_3$ showed rapid decline in the germination from fourth month onwards up to nine month of storage. $GA_3$ had promotory effect at initial few months of storage (Table.1). This might be due to a decline in the endogenous levels of gibberellins which is the limiting factor for the maintenance of viability or germination of seed (Sharma and Dhillon, 1986) [19]. These results are in agreement with the findings of Anil *et al.* (1998) in cotton, cowpea and mustard.

The next best treatment was the seeds treated with mancozeb 50% + carbendazim 25% @ 3 g per kg ($T_6$) recorded significantly highest germination percentage (94.00, 93.00, 91.50, 89.25, 87.50 and 85.00%) in fourth, fifth, sixth, seventh, eighth and ninth month of storage (Fig. 1 and Plate 1). Further, $T_6$ treatment was on par with $T_5$ (seed treated with carbendazim @ 3 g per kg seed) (93.75, 92.50, 91.00, 89.00, 87.00 and 84.75%) and $T_1$ (seed primed with vitavax power @ 0.25%) (93.50, 92.50, 90.75, 88.50, 86.75 and 84.50%) in fourth, fifth, sixth, seventh, eighth and ninth month of storage. This might be due to seed treatment with mancozeb 50% + carbendazim 25%. Carbendazim and mancozeb is a combo product, which preserve the quality of seed due to its antifungal activity and also reduces the activity of ageing enzymes, this suggesting that mancozeb 50% + carbendazim 25% acts as a protective agent against seed deterioration. Hence the metabolic activities of fungi could be arrested because fungicide acting on specific or localized sites of action in the fungi, thus stopping further multiplication of the fungi (Ibiam *et al.*, 2006). Hence, the seed viability was maintained for comparatively longer period of time. These findings are in agreement with the results obtained by Avinash and Shankar (2012) in sorghum.

However, a decline in germination percentage was observed in all the treatments with advancement in the storage period, which may be attributed to the phenomenon of ageing and due to depletion of food reserves, decline in synthetic activity as reported by Nair (1966) and Joeraj (2000). The decline in synthetic activity of embryo apart from death of seed because of fungal invasion, insect damage, reduced dry matter accumulation in seedling, decrease in seedling growth, fluctuating temperature as well as relative humidity and storage containers in which seeds are stored. Similar results were reported by Abnavi and Mokhtar (2012) in wheat.

Significant variation with respect to root length, shoot length, and seedling vigour index were observed in all the months of storage due to priming and seed treatment. A gradual reduction in these parameters was noticed with advancement of storage period. At the initial month, higher root length, shoot length, seedling vigour index were recorded in seed priming with $GA_3$ @ 50 ppm ($T_2$) and it was on par with $T_1$ and $T_3$ (Table.2, 3and 4). While least was recorded in control ($T_7$) and at the end month of storage also control recorded significantly lowest observation. This is due to $GA_3$ might enhanced germination and early seedling emergence and better seedling growth, $GA_3$ increased the enzymatic activity during germination and hence increased the seedling length. These results are in agreement with the findings of Jhorar *et al.* (1982) in cotton and Singh *et al*. (2004) in okra.

However, from fourth month onwards the seeds treated with mancozeb 50% + carbendazim 25% @ 3 g per kg of seed ($T_6$) recorded significantly highest vigour index (2069) (Fig. 2), the increase in this parameter may be due to increased germination percentage, root length (14.68 cm) and shoot length (7.33 cm) of seedlings followed by $T_5$ (2033, 14.45 cm and 7.23 cm respectively) and $T_1$ (2009, 14.40 cm and 7.20 cm respectively).

With respect to storage periods, the germination, root length, shoot length and seedling vigour index, decreased as the storage period increased. This may be due to ageing effect leading to depletion of food reserves and decline in synthetic activity of embryo apart from death of seed because of fungal invasion, insect attack, fluctuating temperature, relative humidity and storage containers, damage to membrane enzyme, proteins and nucleic acids and such degenerative changes resulted in the complete disorganization of membrane and cell organelle (Roberts, 1972) [17].

The moisture content varied significantly with priming and seed treatments throughout the storage period. The increase in seed moisture per cent may be attributed to the hydrophilic in nature which provided continuous and slow supply of moisture. Among the treatment, the seeds treated with mancozeb 50% + carbendazim 25% @ 3 g per kg ($T_6$) recorded significantly lowest moisture content at initial (7.19%) and ninth month (7.65%) of storage, while control ($T_7$) recorded highest moisture content 7.90 to 8.50 per cent (Table.6). This fluctuation in moisture content might be due to the variation in a atmospheric humidity, as the seeds are hygroscopic in nature and they absorb moisture from atmosphere when they were stored in moisture pervious containers like cloth bags. The lowest seed moisture content was recorded in the mancozeb 50% + carbendazim 25% treated seed cover the pores in the seed coat and prevents the entry of water and fungal mycelia and provide protection from physical damage, similar results were also recorded by Rathinavel and Raja (2007) [16] in cotton.

The present study revealed that, the electrical conductivity was increased with advancement of storage period. The seeds priming with $GA_3$ @ 50 ppm ($T_2$) showed significantly lowest electrical conductivity at the initial, first and third month of storage followed by $T_1$ and $T_3$. However from fifth (0.710 $dSm^{-1}$) to end (0.742 $dSm^{-1}$) (Table. 5) month of storage, mancozeb 50% + carbendazim 25% treated seeds @ 3 g per kg ($T_6$) recorded significantly lowest electrical conductivity. While control recorded significantly highest electrical conductivity from initial (0.715 $dSm^{-1}$) to end (1.110 $dSm^{-1}$) month of storage. This might be due to less vigorous or more deteriorated seeds show a lower speed of cell membrane repair during seed water uptake for germination and therefore release greater amounts of solutes to the external environment. The loss of leachate includes sugars, amino acids, fatty acids, proteins, enzymes and inorganic ions ($K^+$, $Ca^{+2}$, $Mg^{+2}$, $Na^+$, and $Mn^{+2}$) and the test evaluates the amount of ion leakage, primed seeds recorded lower electrolyte leakage from the seeds compared to control seeds. Damage to the membrane system could be repaired and protected against such changes by primed treatment as indicated by low electrical conductivity of seed leachate. Protective action of primed chemicals could presumably have extended the viability of seeds. Seed soaking in water effectively controlled the leakage of electrolytes, sugars and amino acids from the seeds (Dias *et al.*, 2004) [7].

**Table 1:** Effect of seed priming and treatment on germination (%) in kabuli chickpea cv. MNK-1 during storage

| Treatments | Months after storage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| $T_1$: Seed primimg with vitavax power @ 0.25% | 97.75 | 97.00 | 96.00 | 95.25 | 93.50 | 92.50 | 90.75 | 88.50 | 86.75 | 84.50 |
| $T_2$: Seed primimg with $GA_3$ @ 50 ppm | 98.00 | 97.50 | 96.75 | 95.50 | 92.50 | 90.25 | 89.25 | 87.00 | 83.50 | 80.75 |
| $T_3$: Seed primimg with sodium molybdate @ 500 ppm | 97.25 | 96.75 | 95.75 | 95.00 | 92.25 | 89.50 | 87.00 | 85.25 | 82.00 | 79.00 |
| $T_4$: Seed treated with *Lantana camera* @ 10% | 95.25 | 94.50 | 93.25 | 91.00 | 89.25 | 87.00 | 85.00 | 83.25 | 81.50 | 78.50 |
| $T_5$: Seed treated with carbendazim @ 3g per kg of seed | 96.25 | 95.75 | 95.00 | 94.00 | 93.75 | 92.50 | 91.00 | 89.00 | 87.00 | 84.75 |
| $T_6$: Seed treated with mancozeb 50% + carbendazim 25% @ 3 g per kg of seed | 96.50 | 96.25 | 95.25 | 94.25 | 94.00 | 93.00 | 91.50 | 89.25 | 87.50 | 85.00 |
| $T_7$: Control | 93.75 | 90.50 | 87.25 | 85.50 | 83.50 | 81.25 | 79.50 | 77.00 | 75.50 | 72.00 |
| S.Em± | 0.23 | 0.25 | 0.26 | 0.22 | 0.25 | 0.23 | 0.25 | 0.25 | 0.23 | 0.20 |
| C D @ 1% | 0.95 | 1.00 | 1.04 | 0.90 | 1.00 | 0.92 | 1.02 | 1.00 | 0.95 | 0.81 |

**Table 2:** Effect of seed priming and treatment on shoot length (cm) in kabuli chickpea cv. MNK-1 during storage

| Treatments | Months after storage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| $T_1$: Seed primimg with vitavax power @ 0.25% | 8.95 | 8.90 | 8.33 | 8.00 | 7.20 | 7.00 | 6.18 | 5.40 | 5.05 | 4.63 |
| $T_2$: Seed primimg with $GA_3$ @ 50 ppm | 9.10 | 8.95 | 8.39 | 8.05 | 7.18 | 6.95 | 5.80 | 5.20 | 4.80 | 4.13 |
| $T_3$: Seed primimg with sodium molybdate @ 500 ppm | 8.80 | 8.86 | 8.28 | 7.95 | 7.00 | 6.18 | 5.70 | 4.80 | 4.50 | 4.00 |
| $T_4$: Seed treated with *Lantana camera* @ 10% | 8.60 | 8.40 | 7.75 | 7.50 | 6.98 | 6.60 | 5.50 | 5.00 | 4.70 | 4.23 |
| $T_5$: Seed treated with carbendazim @ 3g per kg of seed | 8.65 | 8.50 | 8.00 | 7.80 | 7.23 | 7.02 | 6.20 | 5.88 | 5.50 | 5.25 |
| $T_6$: Seed treated with mancozeb 50% + carbendazim 25% @ 3 g per kg of seed | 8.67 | 8.60 | 8.10 | 7.85 | 7.33 | 7.10 | 6.30 | 6.15 | 6.03 | 5.38 |
| $T_7$: Control | 8.40 | 7.30 | 7.20 | 6.53 | 6.00 | 5.80 | 5.20 | 4.50 | 4.30 | 3.63 |
| S.Em± | 0.10 | 0.04 | 0.05 | 0.03 | 0.04 | 0.03 | 0.05 | 0.25 | 0.33 | 0.25 |
| C D @ 1% | 0.32 | 0.11 | 0.13 | 0.10 | 0.14 | 0.10 | 0.14 | 0.75 | 0.99 | 0.77 |

**Table 3:** Effect of seed priming on root length (cm) in kabuli chickpea cv. MNK-1 during storage

| Treatments | Months after storage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| $T_1$: Seed primimg with vitavax power @ 0.25% | 16.13 | 16.02 | 15.95 | 15.37 | 14.40 | 14.02 | 13.47 | 13.36 | 13.00 | 12.32 |
| $T_2$: Seed primimg with $GA_3$ @ 50 ppm | 16.16 | 16.11 | 16.00 | 15.43 | 14.35 | 13.40 | 13.05 | 12.45 | 12.05 | 11.48 |
| $T_3$: Seed primimg with sodium molybdate @ 500 ppm | 16.09 | 16.00 | 15.85 | 15.26 | 14.02 | 13.38 | 13.00 | 12.38 | 12.00 | 10.99 |
| $T_4$: Seed treated with *Lantana camera* @ 10% | 16.00 | 15.80 | 15.30 | 15.00 | 14.21 | 13.50 | 13.22 | 13.15 | 12.45 | 12.26 |
| $T_5$: Seed treated with carbendazim @ 3g per kg of seed | 16.03 | 15.90 | 15.73 | 15.09 | 14.45 | 14.35 | 14.23 | 14.19 | 13.22 | 13.08 |
| $T_6$: Seed treated with mancozeb 50% + carbendazim 25% @ 3 g per kg of seed | 16.05 | 15.95 | 15.80 | 15.13 | 14.68 | 14.49 | 14.35 | 14.31 | 14.25 | 13.31 |
| $T_7$: Control | 15.38 | 15.18 | 14.50 | 14.35 | 13.91 | 13.03 | 12.42 | 12.07 | 11.38 | 10.52 |
| S.Em± | 0.02 | 0.04 | 0.06 | 0.06 | 0.09 | 0.15 | 0.30 | 0.33 | 0.43 | 0.34 |
| C D @ 1% | 0.07 | 0.12 | 0.16 | 0.19 | 0.29 | 0.48 | 0.91 | 0.98 | 1.28 | 1.03 |

**Table 4:** Effect of seed priming on seedling vigour index in kabuli chickpea cv. MNK-1 during storage

| Treatments | Months after storage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| $T_1$: Seed primimg with vitavax power @ 0.25% | 2452 | 2417 | 2331 | 2226 | 2009 | 1929 | 1759 | 1693 | 1645 | 1468 |
| $T_2$: Seed primimg with $GA_3$ @ 50 ppm | 2475 | 2443 | 2360 | 2242 | 1950 | 1837 | 1682 | 1536 | 1407 | 1261 |
| $T_3$: Seed primimg with sodium molybdate @ 500 ppm | 2421 | 2396 | 2304 | 2192 | 1939 | 1751 | 1627 | 1465 | 1353 | 1184 |
| $T_4$: Seed treated with *Lantana camera* @ 10% | 2343 | 2287 | 2149 | 2048 | 1891 | 1749 | 1591 | 1511 | 1398 | 1294 |
| $T_5$: Seed treated with carbendazim @ 3 g per kg of seed | 2369 | 2325 | 2210 | 2077 | 2033 | 1977 | 1859 | 1786 | 1650 | 1553 |
| $T_6$: Seed treated with mancozeb 50% + carbendazim 25% @ 3 g per kg of seed | 2366 | 2330 | 2222 | 2080 | 2069 | 2008 | 1889 | 1826 | 1775 | 1589 |
| $T_7$: Control | 2229 | 2034 | 1893 | 1785 | 1662 | 1530 | 1401 | 1276 | 1184 | 1019 |
| S.Em± | 25.97 | 27.74 | 34.05 | 39.91 | 29.42 | 29.04 | 33.74 | 33.63 | 33.77 | 31.75 |
| C D @ 1% | 104.00 | 111.09 | 136.34 | 159.83 | 117.83 | 116.31 | 135.13 | 134.68 | 135.24 | 127.1 |

**Table 5:** Effect of seed priming on electrical conductivity ($dSm^{-1}$) in kabuli chickpea cv. MNK-1 during storage

| Treatments | Months after storage | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 1 | 3 | 5 | 7 | 9 |
| $T_1$: Seed primimg with vitavax power @ 0.25% | 0.663 | 0.675 | 0.715 | 0.723 | 0.740 | 0.760 |
| $T_2$: Seed primimg with $GA_3$ @ 50 ppm | 0.650 | 0.683 | 0.710 | 0.738 | 0.802 | 0.890 |
| $T_3$: Seed primimg with sodium molybdate @ 500 ppm | 0.667 | 0.687 | 0.723 | 0.742 | 0.825 | 0.921 |
| $T_4$: Seed treated with *Lantana camera* @ 10% | 0.703 | 0.710 | 0.756 | 0.768 | 0.836 | 0.943 |
| $T_5$: Seed treated with carbendazim @ 3 g per kg of seed | 0.671 | 0.689 | 0.709 | 0.715 | 0.735 | 0.756 |
| $T_6$: Seed treated with mancozeb 50% + carbendazim 25% @ 3 g per kg of seed | 0.669 | 0.692 | 0.705 | 0.710 | 0.720 | 0.742 |
| $T_7$: Control | 0.715 | 0.720 | 0.763 | 0.775 | 0.890 | 1.110 |
| S.Em± | 0.005 | 0.004 | 0.005 | 0.004 | 0.006 | 0.006 |
| C D @ 1% | 0.017 | 0.014 | 0.014 | 0.014 | 0.020 | 0.018 |

**Table 6:** Effect of seed priming on moisture content (%) in kabuli chickpea cv. MNK-1 during storage

| Treatments | Months after storage | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| $T_1$: Seed primimg with vitavax power @ 0.25% | 7.60 | 7.58 | 7.50 | 7.62 | 8.50 | 9.00 | 8.43 | 8.40 | 8.38 | 8.35 |
| $T_2$: Seed primimg with $GA_3$ @ 50 ppm | 7.50 | 7.46 | 7.42 | 7.48 | 8.45 | 9.32 | 8.38 | 8.32 | 8.28 | 8.22 |
| $T_3$: Seed primimg with sodium molybdate @ 500 ppm | 7.80 | 7.75 | 7.73 | 7.80 | 8.42 | 9.10 | 8.40 | 8.62 | 8.50 | 8.49 |
| $T_4$: Seed treated with *Lantana camera* @ 10% | 7.30 | 7.26 | 7.19 | 7.30 | 8.67 | 9.67 | 8.65 | 8.35 | 8.28 | 8.20 |
| $T_5$: Seed treated with carbendazim @ 3 g per kg of seed | 7.19 | 7.17 | 7.15 | 7.20 | 8.05 | 9.07 | 7.95 | 7.90 | 7.85 | 7.78 |
| $T_6$: Seed treated with mancozeb 50% + carbendazim 25% @ 3 g per kg of seed | 7.19 | 7.16 | 7.11 | 7.19 | 8.00 | 9.04 | 7.90 | 7.85 | 7.79 | 7.65 |
| $T_7$: Control | 7.90 | 7.85 | 7.83 | 7.87 | 8.70 | 9.50 | 8.65 | 8.63 | 8.60 | 8.50 |
| S.E ± | 0.02 | 0.03 | 0.02 | 0.01 | 0.06 | 0.04 | 0.06 | 0.03 | 0.05 | 0.07 |
| C D @ 1% | 0.07 | 0.09 | 0.05 | 0.03 | 0.16 | 0.13 | 0.15 | 0.10 | 0.13 | 0.18 |

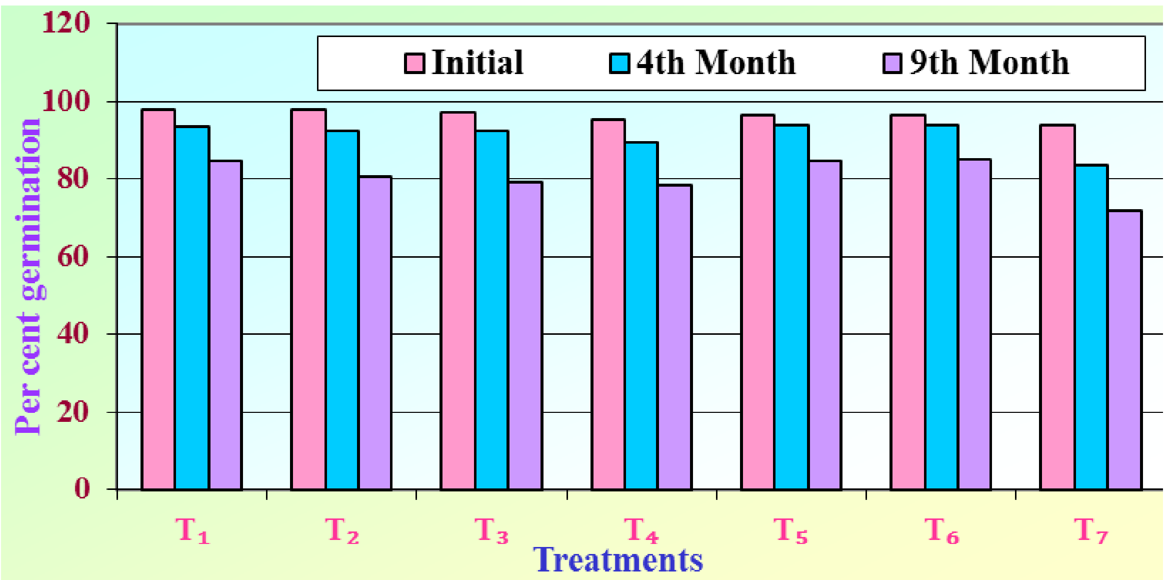


**Fig 1:** Seed germination percentage as influenced by seed priming in kabuli chickpea cv. MNK-1 during storage

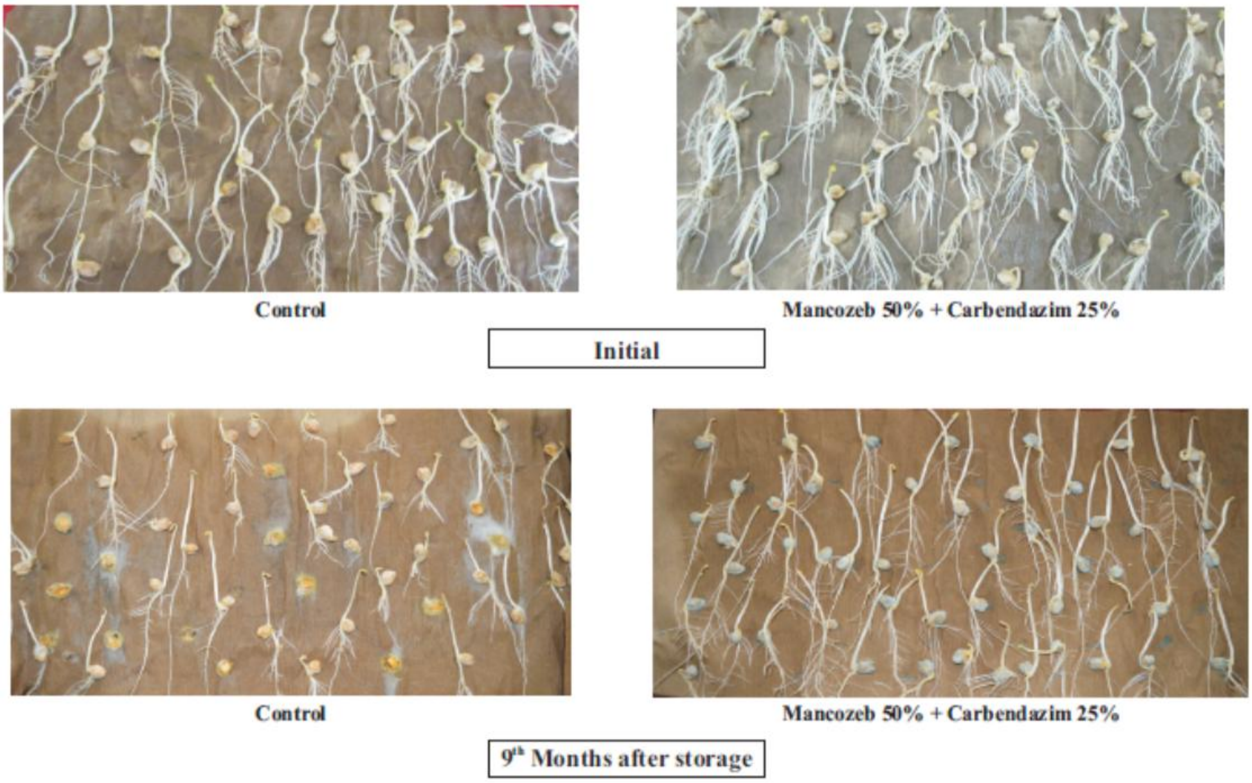


**Plate 1:** Effect of seed priming on germination percentage at initial and 9th month after storage

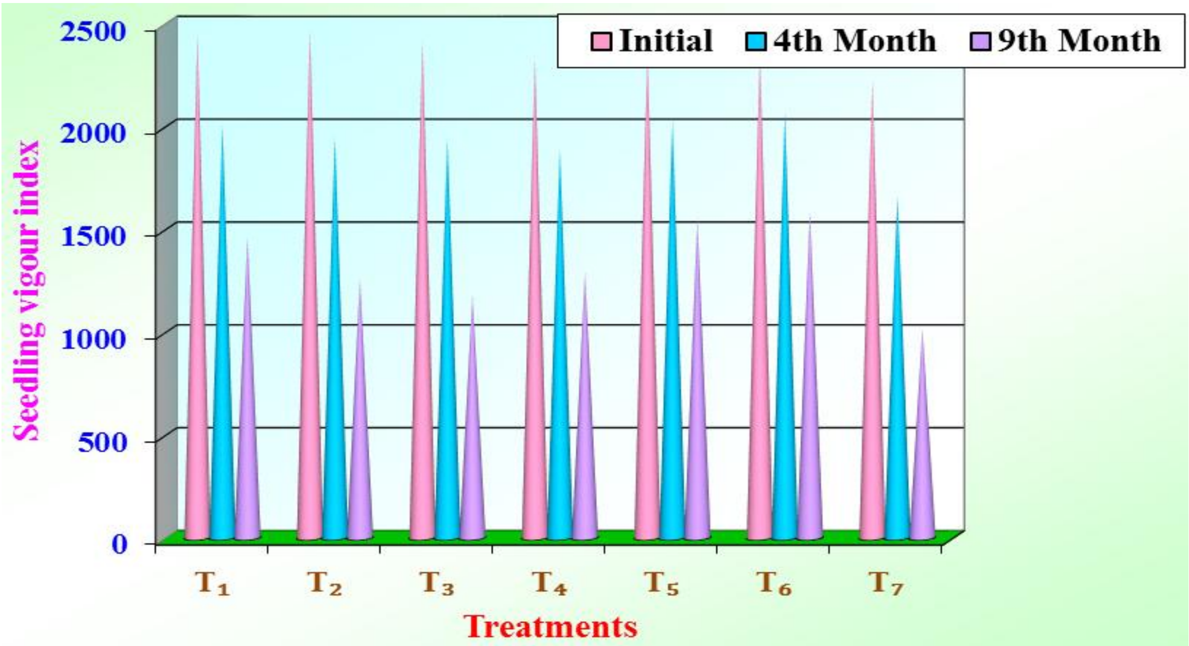


**Fig 2:** Seedling vigour index as influenced by seed priming in kabuli chickpea cv. MNK-1 during storage

## Conclusion

Based on the findings of the present study it may be concluded that among different seed treatment, mancozeb 50% + carbendazim 25% @ 3 g/ kg seed has been proved as superior for preserving the seed quality of kabuli chickpea during storage.

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