**Effect of polymer seed coating, chemicals and biological agent on storability of chickpea (*Cicer arietinum* L.) seeds**

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**Abstract:** The present storage experiment was conducted at Department of Genetic and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Uttar Pradesh during 2015 - 2016 with chickpea cv. Pusa-256 obtained from Department of Genetics and Plant Breeding, SHIATS. The seeds were coated with polymer in combination with fungicide (bavistin 2 g/kg seed), insecticide (imidacloprid @ 2.5 ml/kg seed), bioagent (*Pseudomonas florosence* @ 10 g/kg seed) and maintained untreated seeds (control) where T1 is polymer coat alone, T2 is polymer + thiram, T3 is polymer + imidacloprid, T4 is polymer + thiram + imidacloprid, T5 is polymer + bavistin + imidacloprid + *Pseudomonas florosence* and T0 is control. Treated seeds were packed in cloth bag and polythene bag (700 gauge) (factor P1 and P2) at ambient conditions for assessment of seed germination, seedling length, seedling dry matter, seedling vigour indices, moisture content, insect infestation and electrical conductivity where data was subjected to factorial experiment laid out in completely randomized design. The present investigation revealed that the treatment T5 and stored in polythene bag was found to be superior in germination, seedling length, seedling dry matter, seedling vigour indices, and maintained lower moisture content, insect infestation and electrical conductivity as compared to other treatments. However moisture content, insect infestation and electrical conductivity were found in T5.

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**Key words:** chickpea, germination, polymer, bavistin, imidacloprid, polythene bag, cloth bag.

**Introduction**

Chickpea **(*Cicer arietinum* L.)** is commonly known as bengalgram, gram, channa, kadle *etc.* and is the third most important pulse crop in the world after beans and peas. Anatolia in Turkey was the area where chickpea was believed to has originated (**Van Der Maesen, 1984**). Chickpea is popularly cultivated in sub tropical and semi arid to warm temperate regions under dry season. Chickpea is predominantly consumed in the form of whole grain dhal, sprouted grain, green or matured dry seeds and is used in the preparation of variety of snacks, sweets and condiments. It has highly digestible protein (21.1%), carbohydrate (61.5%), and fat (4.5%), relatively free from anti nutritional factors and is rich in phosphorous, iron, niacin and calcium compared to other pulses (**Saxena, 1990**).

As seed is an efficient media for survival and dissemination of pathogens, in order to reduce the losses due to these pathogens and preserve viability, it is advisable to treat the seeds with fungicides without significant reduction in quality. One of the major constraints in chickpea production is the non availability of quality seeds at the time of planting. The polymer coat provides protection from the stress imposed by accelerated ageing, fungal infection and pest infestation. It improves emergence of seedlings and plant stand in the field. Accurate application of chemicals reduces the wastage, polymer coat helps to make room for including all required ingredients, protectants, nutrients, plant growth promoters, hydrophobic / hydrophilic substances, oxygen suppliers etc. by encasing the seed within a thin film of biodegradable polymer, the adherence of seed treatment chemicals to the seed it ensures dust free handling and make treated seed both useful and environment friendly. Polymer coating makes sowing operation easier due to the smooth flow of seeds. Addition of colorant helps in visual monitoring of placement accuracy, enhance the appearance, marketability and consumer preference. The polymer film coat may act as a physical barrier, which has been reported to reduce the leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo **(Vanangamudi *et al*., 2003)**.

The detailed information on these aspects of chickpea is lacking and thus deserves the attention of understanding the above aspects that would be of much practical significance to improve the seed production. Hence, an investigation was carried out to know effect of polymer seed coating, chemicals and biological agent on storability of chickpea Cv Pusa-256.

**Materials and Methods**

The chickpea cv. Pusa-256 seeds obtained from Department of Genetics and Plant Breeding, SHIATS were coated with polymer in combination with fungicide (bavistin @ 2 g/kg seed), insecticide (imidacloprid @ 2.5 ml/kg seed), bioagent (*Pseudomonas florosence* @ 10 g/kg seed) and maintained untreated seeds (control) where T1 is polymer coat alone, T2 is polymer + bavistin, T3 is polymer + imidacloprid, T4 is polymer + bavistin + imidacloprid, T5 is polymer + bavistin + imidacloprid + *Pseudomonas florosence* and T0 is control. Treated seeds were packed in cloth bag and polythene bag (700 gauge) (factor C1 and C2) for assessment of seed germination, seedling length, seedling dry matter, seedling vigour indices, moisture content, insect infestation and electrical conductivity where data was subjected to factorial experiment laid out in completely randomized design. After imposition of seed treatments, the treated seed along with untreated seeds (control) were packed in alluminium foil pouch and polythene bag (700 gauge) and stored under ambient conditions of Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh for six months i.e. from September 2015 to march 2016. The seed samples drawn at bimonthly intervals were evaluated for various seed quality parameters like germination percentage (Anon., 2011), vigour index (Abdul-Baki and Anderson, 1973), seedling dry weight (ISTA, 1985), moisture content (ISTA rules, 1996) electrical conductivity (Dadlani and Agarwal, 1983) in order to determine the suitable treatment for better storage.

**Results and Discussion**

The results obtained on different seed quality parameters like seed germination, seedling length, seedling dry matter, seedling vigour indices, moisture content, insect infestation and electrical conductivity are presented as follows. The polymer coated seeds coupled with chemical & biological treatment stored in polythene bag (700 gauge) exhibited superiority in maintaining the seed quality throughout the storage period. Irrespective of the treatments overall the seed quality parameters decreased as the storage period advanced. Significant results were obtained due to seed treatment with polymer coating and fungicide for the seed quality parameters.

***Germination percentage***

A significant effect on germination percentage was observed by using different seed treatment throughout the storage periods (Table 1). The germination percentage gradually decreased (89.88%) and it was above minimum seed certification standards (85%) at the end of six months of storage. Among the seed treatment combinations, T5 (89.88%)followed by T4 (89.63%) recorded significantly higher germination as compared to control T0 (79.88%) at the end of 6 months of storage period. The seeds stored in polythene bag P1 (87.58%)was found effective for maintaining the germination over cloth bag P2 (81.92%) at the end of six months of storage period (Table 1). The decline in seed germination percentage over the storage period may be attributed to ageing effect leading to depletion of food reserves, decline in synthetic activity of embryo, fluctuating temperature, relative humidity and seed moisture content as influenced by storage containers. Coating of seeds with polymer, insecticides and fungicides might have protected the seed from influence of above factors resulting in maintenance of seed viability for a comparatively longer period. The similar findings are in agreement with the results obtained by Verma and Verma (2014), Almeida (2014), Pawar *et al.* (2015).

***Seedling length & Vigour Indices***

Seedling length and vigour index I (due to seedling length) & SVI-II (due to seedling dry weight) of chickpea were significantly higher in seed coated with Polymer @ 5ml/kg + Bavistin @ 2g/kg + imidacloprid @ 2.5ml/kg + *P.florosence* @10g/kg of seed T5 (28.85 cm, 2594.3, 21191) followed by T4 (Polymer @ 5ml/kg + Bavistin @ 2g/kg + imidacloprid @ 2.5ml/kg of seed) (28.30 cm, 2481.9, 19887) and lowest recorded in T1 (control) (24.09 cm, 1872, 14602). The seeds stored in polythene bag P1 (28.41 cm, 2491.2, 20199)was found effective for maintaining the Seedling length and vigour index I & II over cloth bag P2 (25.91 cm, 2109.2, 16071) at the end of six months of storage period respectively (Table 2, 3 and 4). The decrease in the vigour index, root length, shoot length and seedling dry weight may be due to natural ageing induced decline in germination, decrease in dry matter accumulation in seedlings and decrease in seedling length. Similar results were also reported by, Kamara *et al.* (2014), Almeida (2014) and Veraja and Rai (2015).

***Seedling dry weight (mg)***

Significant differences in seedling dry weight were observed in seed treatment combinations and between packaging materials. However, at the end of six months of seed storage period, T5 (235.49 mg) recorded highest seedling dry weight followed by T4 (226.62 mg) and the lowest seedling dry weight was recorded in T0 (185.39 mg). The seeds stored in polythene bag P1 (230.17 mg)was found effective for maintaining the seedling dry weight over cloth bag P2 (196.44 mg) at the end of six months of storage period (Table 5). These results are in conformity with findings of Basavaraj *et al*. (2008) in onion, Manjunatha *et al*. (2008) in chilli andVeraja and Rai (2015).

**Table 1: Effect of seed treatments and packaging materials of germination (%)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Period of seed storage** | | | | | | | | | |
| **Treatment** | **2 months** | | **Mean** | **4 months** | | **Mean** | **6 months** | | **Mean** |
| **P1** | **P2** |  | **P1** | **P2** |  | **P1** | **P2** |  |
| T0 | 90.25 | 90.00 | 90.13 | 87.25 | 85.50 | 86.38 | 83.25 | 76.50 | 79.88 |
| T1 | 91.75 | 91.00 | 91.38 | 89.25 | 87.75 | 88.50 | 85.25 | 79.00 | 82.13 |
| T2 | 94.00 | 92.50 | 93.25 | 91.50 | 90.50 | 91.00 | 88.50 | 82.25 | 85.38 |
| T3 | 93.50 | 91.75 | 92.63 | 90.00 | 88.25 | 89.13 | 87.25 | 80.00 | 83.63 |
| T4 | 95.25 | 93.25 | 94.25 | 92.75 | 91.25 | 92.00 | 89.50 | 85.75 | 87.63 |
| T5 | 96.75 | 94.75 | 95.75 | 94.25 | 92.50 | 93.38 | 91.75 | 88.00 | 89.88 |
| Mean | 93.58 | 92.21 | **92.90** | 90.83 | 89.29 | **90.06** | 87.58 | 81.92 | **84.75** |
|  | **T** | **P** | **T x P** | **T** | **P** | **T x P** | **T** | **P** | **T x P** |
| SEm± | 0.57 | 0.33 | 0.80 | 0.37 | 0.21 | 0.52 | 0.41 | 0.23 | 0.57 |
| CD at 5% | 1.63 | 0.94 | NS | 1.06 | 0.61 | NS | 1.16 | 0.67 | 1.65 |

**Table 2: Effect of seed treatments and packaging materials of seedling length (cm)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Period of seed storage** | | | | | | | | | |
| **Treatment** | **2 months** | | **Mean** | **4 months** | | **Mean** | **6 months** | | **Mean** |
| **P1** | **P2** |  | **P1** | **P2** |  | **P1** | **P2** |  |
| T0 | 31.25 | 28.17 | 29.71 | 28.93 | 26.93 | 27.93 | 26.17 | 22.00 | 24.09 |
| T1 | 31.71 | 29.39 | 30.55 | 29.41 | 27.55 | 28.48 | 27.82 | 25.69 | 26.76 |
| T2 | 32.11 | 29.88 | 31.00 | 30.55 | 28.40 | 29.48 | 28.86 | 26.63 | 27.75 |
| T3 | 31.88 | 29.76 | 30.82 | 30.06 | 28.04 | 29.05 | 28.31 | 26.13 | 27.22 |
| T4 | 32.35 | 30.02 | 31.19 | 31.34 | 28.80 | 30.07 | 29.44 | 27.16 | 28.30 |
| T5 | 32.80 | 30.19 | 31.50 | 31.62 | 29.36 | 30.49 | 29.84 | 27.85 | 28.85 |
| Mean | 32.02 | 29.57 | **30.79** | 30.32 | 28.18 | **29.25** | 28.41 | 25.91 | **27.16** |
|  | **T** | **P** | **T x P** | **T** | **P** | **T x P** | **T** | **P** | **T x P** |
| SEm± | 0.30 | 0.17 | 0.42 | 0.28 | 0.16 | 0.40 | 0.16 | 0.09 | 0.22 |
| CD at 5% | 0.89 | 0.49 | NS | 0.81 | 0.47 | NS | 0.45 | 0.26 | 0.64 |

**Table 3: Effect of seed treatments and packaging materials of seedling vigour index-I**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Period of seed storage** | | | | | | | | | |
| **Treatment** | **2 months** | | **Mean** | **4 months** | | **Mean** | **6 months** | | **Mean** |
| **P1** | **P2** |  | **P1** | **P2** |  | **P1** | **P2** |  |
| T0 | 2820.3 | 2457.0 | 2638.7 | 2524.1 | 2302.5 | 2413.3 | 2178.7 | 1565.3 | 1872.0 |
| T1 | 2909.4 | 2674.5 | 2791.9 | 2624.8 | 2417.5 | 2521.2 | 2371.7 | 2029.5 | 2200.6 |
| T2 | 3018.3 | 2763.9 | 2891.1 | 2795.3 | 2570.2 | 2682.8 | 2554.1 | 2190.3 | 2372.2 |
| T3 | 2980.8 | 2730.5 | 2855.6 | 2705.4 | 2474.5 | 2590.0 | 2470.1 | 2090.4 | 2280.2 |
| T4 | 3081.3 | 2799.4 | 2940.4 | 2906.8 | 2628.0 | 2767.4 | 2634.9 | 2329.0 | 2481.9 |
| T5 | 3173.4 | 2860.5 | 3017.0 | 2980.2 | 2715.8 | 2848.0 | 2737.8 | 2450.8 | 2594.3 |
| Mean | 2997.3 | 2714.3 | **2855.8** | 2756.1 | 2518.1 | **2637.1** | 2491.2 | 2109.2 | **2300.2** |
|  | **T** | **P** | **T x P** | **T** | **P** | **T x P** | **T** | **P** | **T x P** |
| SEm± | 18.74 | 10.82 | 26.51 | 19.39 | 11.20 | 27.42 | 14.77 | 8.52 | 20.88 |
| CD at 5% | 53.76 | 31.04 | NS | 55.62 | 32.11 | NS | 42.35 | 24.45 | 59.89 |

**Table 4: Effect of seed treatments and packaging materials of seedling vigour index-II**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Period of seed storage** | | | | | | | | | |
| **Treatment** | **2 months** | | **Mean** | **4 months** | | **Mean** | **6 months** | | **Mean** |
| **P1** | **P2** |  | **P1** | **P2** |  | **P1** | **P2** |  |
| T0 | 23670 | 20996 | 22333 | 20013 | 16744 | 18379 | 17047 | 12095 | 14602 |
| T1 | 24143 | 21301 | 22722 | 21216 | 18147 | 19681 | 18822 | 14512 | 16667 |
| T2 | 25553 | 22552 | 24053 | 23223 | 20017 | 21620 | 20729 | 16594 | 18662 |
| T3 | 24987 | 21948 | 23468 | 22165 | 18957 | 20561 | 20013 | 15587 | 17800 |
| T4 | 26072 | 23230 | 24651 | 23971 | 20888 | 22430 | 21701 | 18074 | 19887 |
| T5 | 26819 | 23822 | 25321 | 24896 | 22007 | 23451 | 22881 | 19501 | 21191 |
| Mean | 25207 | 22308 | **23758** | 22581 | 19460 | **21020** | 20199 | 16071 | **18135** |
|  | **T** | **P** | **T x P** | **T** | **P** | **T x P** | **T** | **P** | **T x P** |
| SEm± | 230.68 | 133.19 | 326.24 | 204.75 | 118.21 | 289.56 | 177.92 | 102.72 | 251.61 |
| CD at 5% | 661.64 | 382.00 | NS | 587.25 | 339.05 | NS | 510.29 | 294.62 | 721.66 |

***Seed moisture content (%)***

The moisture content differed significantly due to packaging materials and seed treatment combinations during storage period. At the end of six months of storage period, the lowest (9.65%) moisture content was recorded in T5 followed by T4 (10.49%) stored in polythene bag and the highest (11.78%) moisture content was recorded in T0 (control). Among the packaging materials, significantly lowest (10.20%) seed moisture content was noticed in polythene bag P1 compared to cloth bag (11.69%) at the end of the storage period, respectively (Table 6). The results of the present study revealed that the moisture content of the seeds increased with increase in period of storage Increase in seed moisture might be due to metabolic release of water during respiration and the hygroscopic nature of seed. Similar results were recorded by Malimath and Merwade (2007), Chattha *et al.* (2012) Monira *et al.* (2012) andVeraja and Rai (2015).

***Insect infestation***

At the end of six months of storage period period, the lowest insect infestation was recorded in the seeds treated with Polymer.

@ 5ml/kg + Bavistin @ 2g/kg + imidacloprid @ 2.5ml/kg + *P.florosence* @10g/kg of seeds T5 (3.78%) followed by T4 (Polymer @ 5ml/kg + Bavistin @ 2g/kg + imidacloprid @ 2.5ml/kg of seed) (4.06%) lowest recorded in T0 (control) (5.12%). The seeds stored in polythene bag P1 (4.24%) had lesser insect infestation as compared to cloth bag P2 (4.66%) (Table 7). Imidacloprid in combination in T5 and T4 was found very effective in controlling in insect pest due to phytotoxic effect and reduced the insect infestation. Similar findings were reported by Suresh Vegulla, (2008) in maize and Shushma, *et al.* (2014).

***Electrical conductivity (*dSm-1*)***

The electrical conductivity of seed leachate indicate the membrane integrity and quality of seed and it is negatively correlated with seed quality. The electrical conductivity increases as the storage period advances. At the end of six months period of seed storage, the seed treatment combinations, T5 recorded lesser (0.495 dSm-1) electrical conductivity, followed by T4 (0.520 dSm-1) and it was significantly higher in T0 (0.699 dSm-1). At the end of six months of storage period, seeds stored in polythene bag P1 (0.572dSm-1) was effective as it is having lesser electrical conductivity over P2 (0.610 dSm-1) (Table 8). Polymer film may acts as physical barrier, which has been reported to reduced leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to embryo. So the viability maintained for a comparatively longer period of time. Similar results were observed by Avelar *et al*. (2012), Wilson and Geneva (2004) in maize.

Interaction effect due to different seed treatment combinations and packaging materials were observed the seeds quality parameters were higher with T5P1 followed by T4P1 and lower with T0P2 at the end of storage period in most of the cases.

**Table 5: Effect of seed treatments and packaging materials of Seedling dry weight (mg)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Period of seed storage** | | | | | | | | | |
| **Treatment** | **2 months** | | **Mean** | **4 months** | | **Mean** | **6 months** | | **Mean** |
| **P1** | **P2** |  | **P1** | **P2** |  | **P1** | **P2** |  |
| T0 | 262.27 | 243.29 | 252.78 | 229.38 | 195.84 | 212.61 | 204.77 | 166.00 | 185.39 |
| T1 | 263.14 | 243.56 | 253.35 | 237.71 | 206.80 | 222.26 | 220.79 | 183.69 | 202.24 |
| T2 | 271.84 | 253.81 | 262.83 | 253.80 | 221.18 | 237.49 | 234.23 | 201.75 | 217.99 |
| T3 | 267.24 | 249.22 | 258.23 | 246.28 | 214.81 | 230.55 | 229.38 | 194.84 | 212.11 |
| T4 | 273.72 | 259.12 | 266.42 | 258.45 | 228.91 | 243.68 | 242.47 | 210.77 | 226.62 |
| T5 | 277.20 | 261.42 | 269.31 | 264.15 | 237.91 | 251.03 | 249.38 | 221.60 | 235.49 |
| Mean | 269.24 | 251.74 | **260.49** | 248.30 | 217.57 | **232.93** | 230.17 | 196.44 | **213.31** |
|  | **T** | **P** | **T x P** | **T** | **P** | **T x P** | **T** | **P** | **T x P** |
| SEm± | 2.52 | 1.46 | 3.57 | 2.76 | 1.59 | 3.90 | 1.06 | 0.61 | 1.50 |
| CD at 5% | 7.24 | 4.18 | NS | 7.91 | 4.57 | NS | 3.04 | 1.75 | 4.30 |

**Table 6: Effect of seed treatments and packaging materials on seed moisture content (%)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Period of seed storage** | | | | | | | | | |
| **Treatment** | **2 months** | | **Mean** | **4 months** | | **Mean** | **6 months** | | **Mean** |
| **P1** | **P2** |  | **P1** | **P2** |  | **P1** | **P2** |  |
| T0 | 9.02 | 9.21 | 9.12 | 10.70 | 11.21 | 10.96 | 10.89 | 12.66 | 11.78 |
| T1 | 8.90 | 9.18 | 9.04 | 10.26 | 10.98 | 10.62 | 10.56 | 12.33 | 11.45 |
| T2 | 8.88 | 9.09 | 8.99 | 9.35 | 10.46 | 9.91 | 10.60 | 11.66 | 11.13 |
| T3 | 8.81 | 9.14 | 8.98 | 9.49 | 10.63 | 10.06 | 10.47 | 11.87 | 11.17 |
| T4 | 8.78 | 9.05 | 8.92 | 9.22 | 10.23 | 9.73 | 9.81 | 11.17 | 10.49 |
| T5 | 8.65 | 9.00 | 8.83 | 8.68 | 9.98 | 9.33 | 8.84 | 10.45 | 9.65 |
| Mean | 8.84 | 9.11 | **8.98** | 9.62 | 10.58 | **10.10** | 10.20 | 11.69 | **10.94** |
|  | **T** | **P** | **T x P** | **T** | **P** | **T x P** | **T** | **P** | **T x P** |
| SEm± | 0.09 | 0.05 | 0.12 | 0.10 | 0.06 | 0.14 | 0.11 | 0.06 | 0.15 |
| CD at 5% | NS | 0.14 | NS | 0.28 | 0.16 | NS | 0.31 | 0.18 | NS |

**Table 7: Effect of seed treatments and packaging materials on insect infestation (%)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Period of seed storage** | | | | | | | | | |
| **Treatment** | **2 months** | | **Mean** | **4 months** | | **Mean** | **6 months** | | **Mean** |
| **P1** | **P2** |  | **P1** | **P2** |  | **P1** | **P2** |  |
| T0 | 2.19 | 2.25 | 2.22 | 3.25 | 4.07 | 3.66 | 4.86 | 5.38 | 5.12 |
| T1 | 2.18 | 2.23 | 2.21 | 3.14 | 3.98 | 3.56 | 4.65 | 4.93 | 4.79 |
| T2 | 2.16 | 2.21 | 2.19 | 3.05 | 3.85 | 3.45 | 4.33 | 4.79 | 4.56 |
| T3 | 2.17 | 2.21 | 2.19 | 2.97 | 3.76 | 3.37 | 4.11 | 4.68 | 4.40 |
| T4 | 2.16 | 2.19 | 2.18 | 2.91 | 3.69 | 3.30 | 3.85 | 4.26 | 4.06 |
| T5 | 2.14 | 2.18 | 2.16 | 2.86 | 3.63 | 3.25 | 3.63 | 3.93 | 3.78 |
| Mean | 2.17 | 2.21 | **2.19** | 3.03 | 3.83 | **3.43** | 4.24 | 4.66 | **4.45** |
|  | **T** | **P** | **T x P** | **T** | **P** | **T x P** | **T** | **P** | **T x P** |
| SEm± | 0.02 | 0.01 | 0.03 | 0.03 | 0.02 | 0.05 | 0.04 | 0.03 | 0.06 |
| CD at 5% | NS | 0.04 | NS | 0.10 | 0.06 | NS | 0.12 | 0.07 | NS |

**Table 8: Effect of seed treatments and packaging materials on electrical conductivity (%)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Period of seed storage** | | | | | | | | | |
| **Treatment** | **2 months** | | **Mean** | **4 months** | | **Mean** | **6 months** | | **Mean** |
| **P1** | **P2** |  | **P1** | **P2** |  | **P1** | **P2** |  |
| T0 | 0.330 | 0.332 | 0.331 | 0.498 | 0.554 | 0.526 | 0.652 | 0.746 | 0.699 |
| T1 | 0.328 | 0.331 | 0.330 | 0.489 | 0.532 | 0.511 | 0.621 | 0.659 | 0.640 |
| T2 | 0.323 | 0.327 | 0.325 | 0.455 | 0.493 | 0.474 | 0.609 | 0.643 | 0.626 |
| T3 | 0.324 | 0.327 | 0.326 | 0.463 | 0.509 | 0.486 | 0.551 | 0.583 | 0.567 |
| T4 | 0.319 | 0.324 | 0.322 | 0.438 | 0.478 | 0.458 | 0.509 | 0.531 | 0.520 |
| T5 | 0.315 | 0.321 | 0.318 | 0.425 | 0.449 | 0.437 | 0.491 | 0.498 | 0.495 |
| Mean | 0.323 | 0.327 | **0.325** | 0.461 | 0.503 | **0.482** | 0.572 | 0.610 | **0.591** |
|  | **T** | **P** | **T x P** | **T** | **P** | **T x P** | **T** | **P** | **T x P** |
| SEm± | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.01 |
| CD at 5% | NS | NS | NS | 0.01 | 0.01 | NS | 0.02 | 0.01 | 0.02 |

T0 - Control (Untreated) P1 – Polythene bag 700gauge

T1 - Polymer coating alone @ 5ml kg-1 of seeds P2 – Cloth bag

T2 - T1 + Bavistin @ 2g kg-1 of seeds

T3 - T1 + imidacloprid @ 2.5ml kg-1 of seeds S: Significant

T4 - T1 + Bavistin @ 2g kg-1 + imidacloprid @ 2.5ml kg-1 of seeds NS: Non significant

T5 - T4 + *P.florosence* @ 10g kg-1 of seeds

**Conclusion**

From the present investigation it is concluded that the seeds treated with combination of polymer @ 5 ml kg-1 + bavistin @2g kg-1 + imidacloprid @2.5ml kg-1 + *P.florosence* @10g kg-1 of seeds (T­­­5­) andpolymer @ 5ml kg-1 + bavistin @ 2g kg-1 + imidacloprid @ 2.5ml kg-1 of seeds (T4) were found to be the best treatment combination for maintenance of chickpea seed quality under ambient conditions for six months period of storage. Chickpea seeds packed in vapour proof packaging material i.e. polythene bag (700 gauge) was very effective for extending the seed longevity and maintaining the storability by safe guarding seed.

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