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# Effect of genotypes, seed treatment chemicals and packing materials on seed quality of onion (*Allium cepa* L.)

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**Abstract**
A laboratory experiment was conducted at Department of Seed Science and Technology, UAS, GKVK, Bangalore, during 2013-2014 to study the "Effect of genotypes, seed treatment chemicals and packaging materials on seed quality of onion **(***Alliums cepa* L.). The two genotypes of onion hybrid Arka Kirtiman and variety Arka Kalyan seeds were treated with Captan@2g/kg, Thiram@2 g/kg and untreated seeds served as control. The treated seeds were packed in cloth bag, polythene 700 gauge bag, super grain bag, poly pouch and aluminium foil and subsequently stored for a period of ten months under ambient conditions of Bangalore. The results revealed that onion seeds treated with Captan@2g/kg packed in 700 gauge polythene and aluminium foil. The seeds are stored under ambient condition maintained higher seed quality parameters with minimum seed certification standards up to 10 months.

**Keywords**: Onion, *Allium cepa* L., genotypes, packing materials

## Introduction
Onion (*Allium Cepa* L.) is one of the important commercial biennial cool season vegetable crop, which is used for both fresh and bulb purpose. Onion belongs to family Amaryllidaceae. Onion primary origin is Central Asia and considered that the Mediterranean area is the secondary center of origin (MC Collum, 1976) [11]. Onion is very important vegetable which have diuretic properties, it is beneficial for eyes and being used in the prevention of atherosclerosis and coronary heart disease as they can inhibit the aggregation of human blood platelets to form the clots, which have the potential for arterial blocking with good coagulation efficiency. Onion bulb is strongly contracted subterranean shoot with thickened fleshly leaves as food value. Globally onion occupies an area of 42, 96,495 ha with the production of 8, 33, 55,752 tons with a productivity of 19.4 tones ha-1. India occupies an area of 1051.5 thousand ha with a production of 16813 thousand tones with productivity 16 tones ha-1(Anon. 2013) [2]. Onion plays an important role in Indian economy. To increase the onion production there is a need for high quality seeds because high quality seeds are basic input in production and seed producers are responsible to preserve the quality of seeds from harvest to next sowing. However, onion seeds have short life and loose viability in short time under ambient condition and besides onion being a high value low volume seed crop.

The major factors affecting the seed quality during storage are temperature and relative humidity which results in drastic deterioration of seeds. To enhance the shelf life of onion seeds under storage is very often challenging and information available is scanty. The present study practically envisages developing methods for maintaining the viability and vigor of onion seeds to preserve and extend storage potential for longer period during storage with suitable seed treatment and packaging materials with minimum seed certification standards. Hence, keeping above facts in view, the present investigation was carried out to effect of genotypes, seed treatment chemicals and packing materials on seed quality of onion (*Alliums cepa* L.)

## Materials and methods
The experiment was conducted during 2013to 2014 at UAS, GKVK, Bangalore. Genotypes (G): G1 -Arka kirtiman (Hybrid), G2 -Arka kalyan (Variety). Chemicals (C): C0 – Control, C1 –Captan, C2 –Thiram. Packaging materials (P): P1 -Cloth bag, P2 -Polythene bag (700) gauge, P3 -Super grain bag, P4 -Poly pouch, P5 -Alluminium foil were tested in complete randomized design replicated thrice. The freshly harvested seeds of two onion genotypes hybrid Arka Kirtiman and variety Arka kalyan were obtained from Indian Institute of Horticulture Research Bangalore.Healthy, infection free and uniform size seeds of onion were used for all experiments. and used for the investigation of the present laboratory experiment. Before treating the seeds, the seeds were cleaned and graded to a uniform size and were dried in hot air oven at 32° C. The moisture content of the seed was brought down up to 6.3 per cent. The required quantity of chemicals Captan (C1) @ 2g/kg of seeds and Thiram (C2)@2g/kg of seeds were weighed accurately by using electronic balance and dry seed were treated obtain uniform dressing on all the seeds. For each bag 10 gm of treated seeds were weighed and packed in cloth bag (P1), polythene bag-700 gauge (P2), super grain bag (P3), poly pouch (P4) and in aluminum foil (P5) and sealed by using electrical heat sealer and stored under ambient condition

at department of seed science and technology, University of Agricultural Sciences, Bangalore for a period of 10 months (September, 2013 to June, 2014) and laid out in Factorial complete randomized design. The experimental data generated was statistically analyzed by using suitable ANOVA as per the method outlined by Gomez and Gomez (1983) [5]. Critical difference (CD) values were computed at 5 per cent level whenever 'F' test was significant.

**Germination**

The germination test was conducted in the laboratory by using between paper method as per ISTA (Anon., 2007). Hundred seeds in four replicates were placed on germination paper and rolled towels were in germination chamber maintained at 25 ± 1°C and 95±3 per cent relative humidity. The germinated seedlings were evaluated on 12th day as final count.

Ten seedlings from each treatment and replication were used for measuring the seedling length was kept in the hot air oven at 85±1°C for 24 hours.

**Root and Shoot length (cm)**

Ten normal seedlings were selected at random from each treatment. The root length was measured from point of attachment of seed to the tip as the longest root and shoot length was measured from the point as attachment of seed to the growing meristematic tip and expressed in cm.

Mean seedling length (cm)

Ten seedlings taken at randomly from each treatment and replication were separated carefully from the paper towel of laboratory germination test and total length of seedlings after removing the cotyledons was measured using metric scale on the germination table. The mean length of ten seedlings in each treatment and replications was calculated and expressed in centimeters.

**Mean seedling dry weight (mg)**

Ten seedlings from each treatment and replication were used for measuring the seedling length was kept in the hot air oven at 85±1°C for 24 hours. The dry weight (mg) was measured and expressed as mean dry weight (mg seedling-1)

**Seedling vigor index [SVI-I and SVI-II]**

The seedling vigour index was calculated as per the formula given by Abdul Baki and Anderson (1973).

SVI-I = Germination (%) x Mean seedling length (cm).

SVI-II= Germination (%) x Mean seedling dry weight (mg).

**Electrical conductivity (µSppm-1)**

Ten seeds of two replications were taken randomly from each treatment in a beaker. Then the seeds were soaked in 25 ml of distilled water for 24 hours at 25±1ºC. The steeped water from soaked seeds was collected and the electrical conductivity (EC) of seed leachate was measured in digital conductivity meter (Model: Systronic conductivity meter 306). After subtracting the EC of the distilled water from the value obtained from the seed leachate, the actual EC due to electrolyte was measured and expressed in µS ppm-1 (Anon., 2007).

**Total Dehydrogenase activity**

Twenty seeds from each treatment were preconditioned by soaking in water for 24 hours. Then ten pre imbibed seeds were randomly selected in each sample, seeds were cut longitudinally and soaked in 2ml of 0.5 per cent Tetrazolium solution. They were incubated at 25 ± 10C in dark for 6 h and then washed thoroughly in distilled water. The red colour (Formazan) developed was eluted from the stained embryos by soaking in 5ml of 2 Methoxy ethanol in a screw caped vials until all the seeds discolored. The extract was decanted and the colour intensity was measured in Spectrometer (model SL171) at 480nm with suitable blank. The TDH was expressed in terms of OD value (Perl *et al*., 1978) [13].

**Results and Discussion**

Results of storage studies as influenced by genotypes, seed treatment with chemicals, packing materials and their interaction effects on germination (%), seedling vigour index and total dehydrogenase activity (TDH) during storage period are presented below.

The results obtained from the present investigation have been discussed in the following sub heads.

Among the genotypes, highest germination (64.27 %), total dehydrogenase activity (0.965 A480nm) were observed in Arka Kirtiman hybrid (G1) which were on par with Arka Kalyan variety (G2),(63.93 %), (0.957 A480nm) respectively, but (G1) recorded highest seedling vigour index-I (803), which was significantly differed with (G2) (787). after ten months of storage period.

**Table 1:** Effect of genotypes, packaging materials and seed treatment chemicals on germination percentage of onion (*Allium cepa* L.) seeds.

| Treatments | Storage Period ( September, 2013 to June, 2014) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Genotypes (G)** | | | | | | | | | | |
| $G_1$ -Arka kirtiman (Hybrid) | 90.31 | 87.60 | 85.67 | 81.60 | 78.87 | 74.20 | 71.80 | 68.53 | 66.60 | 64.27 |
| $G_2$ -Arka kalyan (Variety) | 89.96 | 87.53 | 85.40 | 81.27 | 78.60 | 73.80 | 71.36 | 68.27 | 66.07 | 63.93 |
| S.Em± | 0.27 | 0.22 | 0.20 | 0.21 | 0.21 | 0.23 | 0.24 | 0.25 | 0.32 | 0.34 |
| CD (P=0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| **Chemicals (C)** | | | | | | | | | | |
| $C_0$ -Control | 89.50 | 87.00 | 84.70 | 80.80 | 78.00 | 73.00 | 70.40 | 67.00 | 64.50 | 62.00 |
| $C_1$ -Captan | 90.70 | 88.00 | 86.10 | 82.10 | 79.40 | 74.80 | 72.53 | 69.60 | 67.50 | 65.80 |
| $C_2$ -Thiram | 90.20 | 87.70 | 85.80 | 81.40 | 78.80 | 74.20 | 71.80 | 68.60 | 67.00 | 64.50 |
| S.Em± | 0.33 | 0.27 | 0.24 | 0.26 | 0.25 | 0.28 | 0.30 | 0.30 | 0.39 | 0.42 |
| CD (P=0.05) | 0.94 | 0.76 | 0.69 | 0.74 | 0.72 | 0.80 | 0.84 | 0.86 | 1.11 | 1.19 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Packaging materials (P)** | | | | | | | | | | |
| $P_1$ -Cloth bag | 88.33 | 85.67 | 83.17 | 79.33 | 75.67 | 70.33 | 67.17 | 62.50 | 59.33 | 56.17 |
| $P_2$ -Polythene bag (700) gauge | 92.00 | 89.00 | 87.67 | 83.50 | 81.33 | 77.17 | 75.17 | 73.17 | 71.67 | 69.78 |
| $P_3$ -Super grain bag | 90.00 | 87.50 | 85.50 | 81.33 | 78.67 | 74.00 | 71.50 | 69.33 | 67.50 | 65.39 |
| $P_4$ -Poly pouch | 89.44 | 87.00 | 84.67 | 80.33 | 77.33 | 72.67 | 70.17 | 65.33 | 63.00 | 60.67 |
| $P_5$ -Aluminium foil | 90.89 | 88.67 | 86.67 | 82.67 | 80.67 | 75.83 | 73.89 | 71.67 | 70.17 | 68.50 |
| S.Em± | 0.43 | 0.35 | 0.31 | 0.34 | 0.33 | 0.36 | 0.38 | 0.39 | 0.51 | 0.54 |
| CD (P=0.05) | 1.22 | 0.99 | 0.89 | 0.96 | 0.92 | 1.03 | 1.09 | 1.11 | 1.43 | 1.54 |
| **Interaction ( G x C x P )** | | | | | | | | | | |
| $G_1C_0P_1$ | 88.00 | 85.00 | 82.00 | 79.00 | 75.00 | 70.00 | 65.00 | 61.00 | 56.00 | 52.00 |
| $G_1C_0P_2$ | 91.00 | 88.00 | 87.00 | 83.00 | 80.00 | 76.00 | 74.00 | 71.00 | 69.00 | 67.00 |
| $G_1C_0P_3$ | 90.00 | 87.00 | 85.00 | 81.00 | 78.00 | 73.00 | 71.00 | 69.00 | 67.00 | 65.00 |
| $G_1C_0P_4$ | 88.67 | 87.00 | 84.00 | 80.00 | 77.00 | 72.00 | 70.00 | 65.00 | 63.00 | 60.00 |
| $G_1C_0P_5$ | 90.67 | 88.00 | 86.00 | 82.00 | 80.00 | 75.00 | 73.00 | 70.00 | 69.00 | 67.00 |
| $G_1C_1P_1$ | 89.00 | 86.00 | 84.00 | 80.00 | 76.00 | 72.00 | 69.00 | 64.00 | 62.00 | 59.00 |
| $G_1C_1P_2$ | 93.33 | 90.00 | 89.00 | 85.00 | 83.00 | 78.00 | 77.00 | 75.00 | 74.00 | 72.00 |
| $G_1C_1P_3$ | 90.00 | 88.00 | 86.00 | 82.00 | 80.00 | 75.00 | 72.00 | 70.00 | 68.00 | 66.00 |
| $G_1C_1P_4$ | 90.00 | 87.00 | 85.00 | 81.00 | 78.00 | 73.00 | 71.00 | 66.00 | 64.00 | 62.00 |
| $G_1C_1P_5$ | 92.00 | 89.00 | 87.00 | 83.00 | 81.00 | 77.00 | 75.00 | 73.00 | 71.00 | 70.00 |
| $G_1C_2P_1$ | 89.00 | 86.00 | 84.00 | 80.00 | 76.00 | 71.00 | 68.00 | 63.00 | 61.00 | 58.00 |
| $G_1C_2P_2$ | 92.00 | 89.00 | 88.00 | 84.00 | 82.00 | 78.00 | 76.00 | 74.00 | 73.00 | 70.67 |
| $G_1C_2P_3$ | 90.00 | 88.00 | 86.00 | 81.00 | 79.00 | 74.00 | 72.00 | 70.00 | 68.00 | 65.33 |
| $G_1C_2P_4$ | 90.00 | 87.00 | 85.00 | 80.00 | 77.00 | 73.00 | 70.00 | 65.00 | 63.00 | 61.00 |
| $G_1C_2P_5$ | 91.00 | 89.00 | 87.00 | 83.00 | 81.00 | 76.00 | 74.00 | 72.00 | 71.00 | 69.00 |
| $G_2C_0P_1$ | 87.00 | 85.00 | 82.00 | 78.00 | 75.00 | 68.00 | 64.00 | 60.00 | 55.00 | 51.00 |
| $G_2C_0P_2$ | 91.00 | 88.00 | 86.00 | 82.00 | 80.00 | 76.00 | 73.00 | 71.00 | 69.00 | 67.00 |
| $G_2C_0P_3$ | 90.00 | 87.00 | 85.00 | 81.00 | 78.00 | 73.00 | 71.00 | 68.00 | 66.00 | 65.00 |
| $G_2C_0P_4$ | 89.00 | 87.00 | 84.00 | 80.00 | 77.00 | 72.00 | 70.00 | 65.00 | 62.00 | 59.00 |
| $G_2C_0P_5$ | 89.67 | 88.00 | 86.00 | 82.00 | 80.00 | 75.00 | 73.00 | 70.00 | 69.00 | 67.00 |
| $G_2C_1P_1$ | 89.00 | 86.00 | 84.00 | 80.00 | 76.00 | 71.00 | 69.00 | 64.00 | 61.00 | 59.00 |
| $G_2C_1P_2$ | 92.67 | 90.00 | 88.00 | 84.00 | 82.00 | 78.00 | 76.00 | 75.00 | 73.00 | 72.00 |
| $G_2C_1P_3$ | 90.00 | 88.00 | 86.00 | 82.00 | 79.00 | 75.00 | 72.00 | 70.00 | 68.00 | 66.00 |
| $G_2C_1P_4$ | 90.00 | 87.00 | 85.00 | 81.00 | 78.00 | 73.00 | 70.00 | 66.00 | 63.00 | 62.00 |
| $G_2C_1P_5$ | 91.00 | 89.00 | 87.00 | 83.00 | 81.00 | 76.00 | 74.33 | 73.00 | 71.00 | 70.00 |
| $G_2C_2P_1$ | 88.00 | 86.00 | 83.00 | 79.00 | 76.00 | 70.00 | 68.00 | 63.00 | 61.00 | 58.00 |
| $G_2C_2P_2$ | 92.00 | 89.00 | 88.00 | 83.00 | 81.00 | 77.00 | 75.00 | 73.00 | 72.00 | 70.00 |
| $G_2C_2P_3$ | 90.00 | 87.00 | 85.00 | 81.00 | 78.00 | 74.00 | 71.00 | 69.00 | 68.00 | 65.00 |
| $G_2C_2P_4$ | 89.00 | 87.00 | 85.00 | 80.00 | 77.00 | 73.00 | 70.00 | 65.00 | 63.00 | 60.00 |
| $G_2C_2P_5$ | 91.00 | 89.00 | 87.00 | 83.00 | 81.00 | 76.00 | 74.00 | 72.00 | 70.00 | 68.00 |
| S.Em± | 1.05 | 0.85 | 0.77 | 0.83 | 0.80 | 0.89 | 0.94 | 0.96 | 1.24 | 1.33 |
| CD (P=0.05) | 2.98 | 2.42 | 2.17 | 2.35 | 2.26 | 2.52 | 2.66 | 2.72 | 3.50 | 3.77 |
| CV (%) | 5.02 | 4.69 | 4.55 | 4.76 | 4.76 | 5.09 | 5.27 | 5.43 | 5.23 | 4.60 |

G = Genotypes, $G_1$: Arka kirtiman, $G_2$: Arka kalyan

**Table 2:** Effect of genotypes, packaging materials and seed treatment chemicals on seedling vigour index-I of onion (*Allium cepa* L.) seeds.

| **Treatments** | **Storage Period ( September, 2013 to June, 2014)** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **Genotypes (G)** | | | | | | | | | | |
| $G_1$ -Arka kirtiman (Hybrid) | 1407 | 1304 | 1244 | 1153 | 1098 | 1017 | 966 | 900 | 860 | 803 |
| $G_2$ -Arka kalyan (Variety) | 1386 | 1286 | 1224 | 1135 | 1085 | 1003 | 953 | 888 | 843 | 787 |
| S.Em± | 6.49 | 5.13 | 5.10 | 3.88 | 3.33 | 3.57 | 3.65 | 4.08 | 4.92 | 5.44 |
| CD (P=0.05) | 18.38 | 14.53 | 14.43 | 10.97 | 9.42 | 10.10 | 10.34 | 11.54 | 13.91 | 15.40 |
| **Chemicals (C)** | | | | | | | | | | |
| $C_0$ -Control | 1356 | 1255 | 1187 | 1101 | 1055 | 971 | 922 | 853 | 804 | 742 |
| $C_1$ -Captan | 1432 | 1328 | 1275 | 1185 | 1128 | 1045 | 996 | 929 | 888 | 843 |
| $C_2$ -Thiram | 1402 | 1302 | 1240 | 1146 | 1092 | 1014 | 961 | 900 | 862 | 800 |
| S.Em± | 7.95 | 6.29 | 6.24 | 4.75 | 4.08 | 4.37 | 4.47 | 4.99 | 6.02 | 6.66 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| CD (P=0.05) | 22.51 | 17.80 | 17.68 | 13.44 | 11.54 | 12.37 | 12.66 | 14.14 | 17.04 | 18.86 |
| **Packaging materials (P)** | | | | | | | | | | |
| $P_1$ -Cloth bag | 1280 | 1171 | 1105 | 1022 | 960 | 872 | 817 | 730 | 673 | 610 |
| $P_2$ -Polythene bag (700) gauge | 1526 | 1420 | 1369 | 1274 | 1227 | 1141 | 1091 | 1040 | 1006 | 951 |
| $P_3$ -Super grain bag | 1384 | 1283 | 1220 | 1129 | 1077 | 999 | 949 | 896 | 860 | 806 |
| $P_4$ -Poly pouch | 1334 | 1240 | 1184 | 1092 | 1034 | 959 | 909 | 829 | 779 | 725 |
| $P_5$ -Aluminium foil | 1459 | 1361 | 1291 | 1200 | 1160 | 1078 | 1033 | 976 | 938 | 883 |
| S.Em± | 10.27 | 8.12 | 8.06 | 6.13 | 5.26 | 5.64 | 5.78 | 6.45 | 7.77 | 8.60 |
| CD (P=0.05) | 29.07 | 22.98 | 22.82 | 17.35 | 14.90 | 15.97 | 16.35 | 18.25 | 22.00 | 24.34 |
| **Interaction ( G x C x P )** | | | | | | | | | | |
| $G_1C_0P_1$ | 1258 | 1161 | 1061 | 980 | 938 | 847 | 774 | 702 | 621 | 558 |
| $G_1C_0P_2$ | 1447 | 1355 | 1305 | 1195 | 1152 | 1072 | 1021 | 959 | 924 | 858 |
| $G_1C_0P_3$ | 1378 | 1270 | 1207 | 1118 | 1061 | 978 | 937 | 890 | 850 | 793 |
| $G_1C_0P_4$ | 1313 | 1235 | 1168 | 1080 | 1024 | 943 | 903 | 819 | 762 | 708 |
| $G_1C_0P_5$ | 1433 | 1312 | 1247 | 1165 | 1120 | 1042 | 1007 | 931 | 897 | 838 |
| $G_1C_1P_1$ | 1317 | 1213 | 1171 | 1080 | 995 | 929 | 870 | 787 | 738 | 678 |
| $G_1C_1P_2$ | 1633 | 1521 | 1469 | 1377 | 1328 | 1217 | 1178 | 1117 | 1095 | 1063 |
| $G_1C_1P_3$ | 1404 | 1302 | 1238 | 1148 | 1112 | 1027 | 972 | 910 | 871 | 825 |
| $G_1C_1P_4$ | 1359 | 1245 | 1199 | 1118 | 1053 | 971 | 930 | 845 | 806 | 750 |
| $G_1C_1P_5$ | 1508 | 1406 | 1322 | 1236 | 1199 | 1124 | 1073 | 1015 | 980 | 932 |
| $G_1C_2P_1$ | 1309 | 1204 | 1151 | 1064 | 958 | 874 | 823 | 737 | 696 | 632 |
| $G_1C_2P_2$ | 1546 | 1424 | 1385 | 1294 | 1246 | 1178 | 1102 | 1058 | 1030 | 975 |
| $G_1C_2P_3$ | 1385 | 1294 | 1230 | 1126 | 1082 | 999 | 951 | 903 | 871 | 804 |
| $G_1C_2P_4$ | 1341 | 1244 | 1190 | 1088 | 1032 | 971 | 910 | 833 | 787 | 733 |
| $G_1C_2P_5$ | 1474 | 1379 | 1314 | 1220 | 1166 | 1087 | 1043 | 994 | 965 | 897 |
| $G_2C_0P_1$ | 1210 | 1074 | 1006 | 936 | 922 | 823 | 749 | 676 | 604 | 510 |
| $G_2C_0P_2$ | 1437 | 1355 | 1259 | 1181 | 1152 | 1064 | 1008 | 959 | 918 | 838 |
| $G_2C_0P_3$ | 1368 | 1262 | 1199 | 1118 | 1053 | 978 | 937 | 871 | 832 | 793 |
| $G_2C_0P_4$ | 1317 | 1227 | 1168 | 1080 | 1009 | 929 | 882 | 806 | 747 | 685 |
| $G_2C_0P_5$ | 1399 | 1302 | 1247 | 1156 | 1120 | 1035 | 1000 | 915 | 883 | 838 |
| $G_2C_1P_1$ | 1309 | 1204 | 1148 | 1064 | 996 | 916 | 863 | 755 | 702 | 667 |
| $G_2C_1P_2$ | 1566 | 1449 | 1443 | 1344 | 1263 | 1185 | 1148 | 1102 | 1059 | 1035 |
| $G_2C_1P_3$ | 1394 | 1302 | 1239 | 1148 | 1090 | 1013 | 958 | 910 | 870 | 821 |
| $G_2C_1P_4$ | 1350 | 1244 | 1199 | 1102 | 1053 | 971 | 917 | 845 | 790 | 750 |
| $G_2C_1P_5$ | 1483 | 1389 | 1319 | 1229 | 1191 | 1102 | 1048 | 1008 | 965 | 911 |
| $G_2C_2P_1$ | 1276 | 1169 | 1095 | 1011 | 950 | 847 | 823 | 725 | 677 | 615 |
| $G_2C_2P_2$ | 1527 | 1416 | 1355 | 1254 | 1223 | 1132 | 1087 | 1044 | 1008 | 938 |
| $G_2C_2P_3$ | 1377 | 1270 | 1207 | 1118 | 1061 | 999 | 937 | 890 | 864 | 800 |
| $G_2C_2P_4$ | 1326 | 1245 | 1182 | 1088 | 1032 | 971 | 910 | 826 | 782 | 721 |
| $G_2C_2P_5$ | 1457 | 1379 | 1296 | 1195 | 1167 | 1079 | 1029 | 993 | 938 | 884 |
| S.Em± | 25.15 | 19.88 | 19.75 | 15.01 | 12.89 | 13.82 | 14.15 | 15.80 | 19.04 | 21.06 |
| CD (P=0.05) | 71.20 | 56.29 | 55.90 | 42.49 | 36.50 | 39.12 | 40.05 | 44.71 | 53.89 | 59.63 |
| CV (%) | 3.12 | 3.66 | 3.77 | 4.27 | 4.05 | 3.37 | 2.55 | 3.06 | 3.87 | 4.59 |

G = Genotypes, $G_1$: Arka kirtiman, $G_2$: Arka kalyan

**Table 3:** Effect of genotypes, packaging materials and seed treatment chemicals on total dehydrogenase activity ($A_{480nm}$) of onion (*Allium cepa* L.) seeds.

| Treatments | Storage Period ( September, 2013 to June, 2014) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Genotypes (G)** | | | | | | | | | | |
| $G_1$ -Arka kirtiman (Hybrid) | 1.262 | 1.234 | 1.209 | 1.185 | 1.159 | 1.102 | 1.094 | 1.051 | 1.009 | 0.965 |
| $G_2$ -Arka kalyan (Variety) | 1.257 | 1.230 | 1.205 | 1.179 | 1.152 | 1.095 | 1.087 | 1.045 | 1.004 | 0.957 |
| S.Em± | 0.004 | 0.002 | 0.002 | 0.004 | 0.003 | 0.003 | 0.006 | 0.004 | 0.004 | 0.005 |
| CD (P=0.05) | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| **Chemicals (C)** | | | | | | | | | | |
| $C_0$ -Control | 1.233 | 1.199 | 1.173 | 1.141 | 1.115 | 1.067 | 1.038 | 0.991 | 0.946 | 0.899 |
| $C_1$ -Captan | 1.277 | 1.253 | 1.228 | 1.207 | 1.181 | 1.133 | 1.123 | 1.082 | 1.042 | 0.997 |
| $C_2$ -Thiram | 1.269 | 1.244 | 1.221 | 1.199 | 1.171 | 1.096 | 1.111 | 1.070 | 1.032 | 0.987 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| S.Em± | 0.005 | 0.003 | 0.002 | 0.005 | 0.004 | 0.004 | 0.007 | 0.005 | 0.005 | 0.006 |
| CD (P=0.05) | 0.013 | 0.007 | 0.006 | 0.013 | 0.012 | 0.010 | 0.020 | 0.015 | 0.013 | 0.018 |
| **Packaging materials (P)** | | | | | | | | | | |
| $P_1$ -Cloth bag | 1.195 | 1.153 | 1.109 | 1.057 | 1.014 | 0.970 | 0.908 | 0.832 | 0.774 | 0.721 |
| $P_2$ -Polythene bag (700) gauge | 1.343 | 1.318 | 1.297 | 1.284 | 1.264 | 1.219 | 1.210 | 1.184 | 1.143 | 1.113 |
| $P_3$ -Super grain bag | 1.230 | 1.211 | 1.191 | 1.176 | 1.156 | 1.126 | 1.106 | 1.071 | 1.035 | 0.989 |
| $P_4$ -Poly pouch | 1.212 | 1.180 | 1.159 | 1.134 | 1.109 | 1.032 | 1.041 | 0.991 | 0.951 | 0.900 |
| $P_5$ -Aluminium foil | 1.319 | 1.297 | 1.280 | 1.261 | 1.237 | 1.148 | 1.190 | 1.161 | 1.131 | 1.082 |
| S.Em± | 0.006 | 0.003 | 0.003 | 0.006 | 0.005 | 0.005 | 0.009 | 0.007 | 0.006 | 0.008 |
| CD (P=0.05) | 0.016 | 0.009 | 0.008 | 0.017 | 0.015 | 0.013 | 0.025 | 0.019 | 0.017 | 0.023 |
| **Interaction ( G x C x P )** | | | | | | | | | | |
| $G_1C_0P_1$ | 1.190 | 1.150 | 1.107 | 1.049 | 1.008 | 0.965 | 0.890 | 0.820 | 0.750 | 0.696 |
| $G_1C_0P_2$ | 1.289 | 1.245 | 1.227 | 1.214 | 1.197 | 1.141 | 1.139 | 1.098 | 1.063 | 1.057 |
| $G_1C_0P_3$ | 1.224 | 1.201 | 1.185 | 1.170 | 1.150 | 1.120 | 1.098 | 1.053 | 1.030 | 0.968 |
| $G_1C_0P_4$ | 1.210 | 1.163 | 1.132 | 1.093 | 1.052 | 0.988 | 0.956 | 0.905 | 0.857 | 0.802 |
| $G_1C_0P_5$ | 1.270 | 1.239 | 1.222 | 1.204 | 1.182 | 1.139 | 1.128 | 1.094 | 1.050 | 1.008 |
| $G_1C_1P_1$ | 1.205 | 1.158 | 1.116 | 1.068 | 1.028 | 0.985 | 0.926 | 0.846 | 0.794 | 0.742 |
| $G_1C_1P_2$ | 1.378 | 1.368 | 1.339 | 1.326 | 1.306 | 1.279 | 1.253 | 1.232 | 1.196 | 1.165 |
| $G_1C_1P_3$ | 1.240 | 1.221 | 1.201 | 1.186 | 1.168 | 1.135 | 1.115 | 1.092 | 1.046 | 1.004 |
| $G_1C_1P_4$ | 1.216 | 1.196 | 1.180 | 1.164 | 1.144 | 1.117 | 1.094 | 1.042 | 1.010 | 0.958 |
| $G_1C_1P_5$ | 1.355 | 1.335 | 1.316 | 1.301 | 1.283 | 1.168 | 1.238 | 1.208 | 1.175 | 1.130 |
| $G_1C_2P_1$ | 1.194 | 1.155 | 1.110 | 1.058 | 1.019 | 0.977 | 0.918 | 0.840 | 0.785 | 0.733 |
| $G_1C_2P_2$ | 1.370 | 1.350 | 1.332 | 1.319 | 1.297 | 1.251 | 1.248 | 1.225 | 1.180 | 1.148 |
| $G_1C_2P_3$ | 1.233 | 1.216 | 1.195 | 1.180 | 1.160 | 1.125 | 1.110 | 1.080 | 1.040 | 1.002 |
| $G_1C_2P_4$ | 1.215 | 1.190 | 1.170 | 1.160 | 1.140 | 1.001 | 1.089 | 1.035 | 0.990 | 0.948 |
| $G_1C_2P_5$ | 1.342 | 1.322 | 1.307 | 1.286 | 1.257 | 1.145 | 1.215 | 1.188 | 1.170 | 1.115 |
| $G_2C_0P_1$ | 1.188 | 1.148 | 1.102 | 1.040 | 0.997 | 0.938 | 0.880 | 0.809 | 0.740 | 0.688 |
| $G_2C_0P_2$ | 1.285 | 1.242 | 1.223 | 1.209 | 1.194 | 1.140 | 1.130 | 1.098 | 1.057 | 1.010 |
| $G_2C_0P_3$ | 1.220 | 1.200 | 1.181 | 1.166 | 1.148 | 1.118 | 1.095 | 1.045 | 1.012 | 0.960 |
| $G_2C_0P_4$ | 1.206 | 1.159 | 1.128 | 1.071 | 1.045 | 0.986 | 0.948 | 0.894 | 0.852 | 0.796 |
| $G_2C_0P_5$ | 1.252 | 1.238 | 1.218 | 1.198 | 1.179 | 1.138 | 1.120 | 1.093 | 1.050 | 1.004 |
| $G_2C_1P_1$ | 1.199 | 1.157 | 1.112 | 1.066 | 1.020 | 0.982 | 0.920 | 0.845 | 0.789 | 0.737 |
| $G_2C_1P_2$ | 1.371 | 1.354 | 1.333 | 1.320 | 1.299 | 1.270 | 1.250 | 1.231 | 1.181 | 1.158 |
| $G_2C_1P_3$ | 1.235 | 1.217 | 1.197 | 1.181 | 1.160 | 1.134 | 1.113 | 1.086 | 1.042 | 1.002 |
| $G_2C_1P_4$ | 1.216 | 1.191 | 1.175 | 1.161 | 1.140 | 1.108 | 1.090 | 1.037 | 1.010 | 0.951 |
| $G_2C_1P_5$ | 1.352 | 1.332 | 1.312 | 1.297 | 1.265 | 1.153 | 1.230 | 1.200 | 1.174 | 1.124 |
| $G_2C_2P_1$ | 1.191 | 1.152 | 1.109 | 1.058 | 1.011 | 0.973 | 0.911 | 0.833 | 0.784 | 0.729 |
| $G_2C_2P_2$ | 1.366 | 1.347 | 1.326 | 1.315 | 1.290 | 1.230 | 1.240 | 1.218 | 1.180 | 1.142 |
| $G_2C_2P_3$ | 1.228 | 1.211 | 1.190 | 1.175 | 1.151 | 1.124 | 1.103 | 1.070 | 1.038 | 1.000 |
| $G_2C_2P_4$ | 1.210 | 1.183 | 1.170 | 1.155 | 1.133 | 0.990 | 1.070 | 1.032 | 0.987 | 0.942 |
| $G_2C_2P_5$ | 1.340 | 1.318 | 1.303 | 1.280 | 1.255 | 1.142 | 1.210 | 1.181 | 1.165 | 1.110 |
| S.Em± | 0.014 | 0.008 | 0.007 | 0.014 | 0.013 | 0.012 | 0.022 | 0.016 | 0.015 | 0.020 |
| CD (P=0.05) | 0.040 | 0.023 | 0.020 | 0.041 | 0.038 | 0.033 | 0.062 | 0.046 | 0.043 | 0.056 |
| CV (%) | 2.958 | 2.149 | 2.988 | 2.106 | 2.990 | 2.829 | 3.466 | 2.706 | 2.589 | 3.537 |

G = Genotypes, $G_1$: Arka kirtiman, $G_2$: Arka kalyan

**Seed treatment with chemicals**

Significant difference was observed on germination, seedling vigour index-I and total dehydrogenase activity due to seed treatment chemicals. The highest germination (65.80 %), seedling vigour index-I (843) and total dehydrogenase activity (0.997 A480nm) were observed in Captan @ 2 g/kg (C1) compared to Control (C0), (62%), (742), (0.899 A480nm) respectively after ten months of storage period. The decline in seed quality parameters with advancement in storage period may be attributed to reduced seed vigour due to ageing effect might have led to various biochemical changes in sub cellular system and membrane degradation. This is in accordance with the findings of Gupta *et al*. (1989) in onion, Jayaraj *et al*. (1987) [7] in tomato and chilli, Vijay kumar *et al*. (1991) in onion, Reddy and Reddy (1994) [14] in eggplant, Pavan kumar (2000) in soybean, Sharma *et al*. (2002) [15] and Basavaraj *et al*. (2008) [4] in onion, Anuja Gupta and Aneja (2004) [3] in soybean.

Among the packaging materials, highest germination (69.78 %), seedling vigour index-I (951) and total dehydrogenase activity (1.113 A480nm) were observed in Polythene bag (700 gauge) (P2) compare to Cloth bag (P1): (56.17 %), (610) and (0.721 A480nm) respectively after ten months of storage period. Decline in seed quality parameters with advancement in storage period may be attributed to ageing effect. But greater storability of seeds in polythene 700 gauge bag compared to cloth bag (control) could be ascribed to the fact that the seeds stored in polythene bag (700 gauge) had got very less fluctuations in their moisture content which has very important factor in maintaining the viability of the seeds during storage similarly it kept the seeds away from contact of oxygen, due to its impervious nature. This is in accordance

with the finding of Pandey *et al*. (1994) [12] in onion, Kumari *et al*. (2001) [9] in onion, Swarn lata (2008) [17] in onion, Yahiya *et al*. (2012) [19] in onion and Khalequzzaman *et al*. (2013) [8] in French bean.

Significant difference was observed on germination, seedling vigour index-I and total dehydrogenase activity due to interaction effect of genotypes, seed treatment chemicals and packaging materials. The highest germination (81.63 %), seedling vigour index (1063) and total dehydrogenase activity (1.165 A480nm) were observed in G1C1P2 (Arka Kirtiman (hybrid) + Captan @ 2 g/kg + Polythene bag 700 gauge) compare to G2C0P1 (Arka Kalyan (variety) + Control + Cloth bag ), (51.00 %), (510), (0.688 A480nm), respectively after ten months of storage period. This might be due to hybrid seeds contain greater metabolites for resumption of embryonic growth and better accumulation of food reserves like protein and carbohydrates and effective role of fungicide inhibiting the storage fungal and impervious nature of packaging materials which acted as moisture entry barrier and also maintained the lower moisture content. These results are in agreement with Jayaraj *et al*. (1987) [7] in tomato Sharma *et al*. (1998) [16] in chilli, Pandey *et al*. (1994) [12] in onion and, Maholkar *et al*. (2001) [10] in soybean.

## Conclusion

The present study envisages the importance of treating onion seeds with captan @ 2g/kg and stored along with 700 gauge polythene bag resulted in maintaining seed quality up to 10 months. In onion to maintaining better seed quality for long time is a challenging task, seed treatment with chemicals is found more useful and storing the seeds in vapour proof containers like polythene (700 gauge) bag, aluminum foil, etc is found to be more useful in maintaining the desired quality of seeds for longer period.

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