Maize seed quality with fungicide treatment during the storage period

Rahmawati and Muhammad Aqil
Indonesian Cereals Research Institute
Email: wati_syal99@yahoo.com

Abstract. In some areas, farmers sometimes delay planting due to several factors, including: unfavorable climate, unprepared land and insufficient manpower so that planting takes a long time. As a result, seeds that have been given a fungicide cannot be planted and stored under uncontrolled conditions, both at the place and temperature of the storage room. Therefore, the purpose of this study was to determine the storage resistance of seeds that have been given a fungicide (saromyl) so that they can be used as a reference for storing seeds of saromyl. The research was carried out in June - December 2020 at the seed quality testing laboratory of the Cereal Crops Research Institute (Balitsereal), Maros, South Sulawesi Province. The corn seeds used in the study were Bisma 2018 and 2019, Sukmaraga 2017 and 2019, Srikandi Kuning 2018 and 2019, Lamuru 2017 and 2019 varieties. Observations were made on 1000 grain weight, moisture content, electrical conductivity, maximum growth potential, seed growth speed, length of primary root, length of shoot and number of secondary roots. This study used a completely randomized design with 4 replications. The results showed that at room temperature storage (25-26°C and relative humidity 50-58 %) the seeds that had been given a fungicide (saromil) with a storage period of 21 days still had high seed quality. Even at low temperature storage (18-18.9°C and Rh 50-55%) during the 6-month storage period, the quality of the seeds was very good. The shelf life of seeds that have been given a fungicide (saromil), is influenced by the shelf life of the seeds, the temperature and relative humidity of the storage room.

1. Introduction
The demand for corn in Indonesia is quite high, including as food, animal feed, fuel and industrial raw materials. For this reason, it is expected that corn production will continue to increase because in addition to domestic needs, the government also plans to export to other countries. In corn cultivation, one of the obstacles that are often encountered in its cultivation is downy mildew caused by the fungus Peronosclerospora maydis. The typical symptoms of downy mildew on corn are chlorotic elongated parallel to the leaf bones, the growth of the affected plant is inhibited, and in the morning a white powdery layer can be seen under the leaf surface [1]. Plants that are attacked by downy mildew cannot produce seeds [2]. One way to treat downy mildew is to use a fungicide on the seeds before planting.

Seed is the main factor that plays a very important role in determining the success of planting in the field. Good seed quality will provide a high percentage of growing plants and uniformity of plant growth in the field. Giving fungicides to seeds before planting, including using saromil or ridomil with metalaxyl active ingredients which are easily obtained and the price is affordable. In general, the method of giving saromyl fungicide is quite simple, namely by dissolving saromyl with a little water as recommended (1.25 - 2.5 grams dissolved in 8 ml of water for the use of 1 kg of corn seeds). Then the
saromyl solution was mixed with the seeds and stirred until evenly distributed. Seeds that are given saromyl in excessive doses can kill the seed embryo so that the seeds cannot grow, while in plants the concentration of fungicides that are too high can cause damage to plants. According to [3], synthetic fungicides with high concentrations can have a negative impact on plants, namely the occurrence of phytotoxicity (plant poisoning).

In some areas, farmers sometimes delay planting due to several factors, including: unfavorable climate, unprepared land and insufficient manpower so that planting takes a long time. As a result, seeds that have been given a fungicide cannot be planted and stored under uncontrolled conditions, both at the place and temperature of the storage room. Unqualified storage conditions can accelerate seed deterioration. In addition, seed damage is also related to storage time [4]), while [5)), stated that during seed storage, seed quality can survive as at the beginning of storage or may experience a decrease in quality until the seeds cannot be used for planting.

Therefore, the purpose of this study was to determine the storage resistance of seeds that have been given a fungicide (saromyl) so that they can be used as a reference for storage seeds of saromyl.

2. Methodology
The research was conducted in June 2020 at the Seed Quality Testing Laboratory of the Cereal Crops Research Institute (Balitsereal), Maros, South Sulawesi Province. The corn seeds used in the study were Bisma 2018 and 2019, Sukmaraga 2017 and 2019, Srikantri Kuning 2018 and 2019, Lamuru 2017 and 2019 varieties. The application of saromyl to corn seeds according to the instructions for use was :1.25 – 2.5 grams dissolved into 8 ml of water for the use of 1 kg of corn seeds. The seeds are then air-dried to dry. Seed storage is carried out using plastic packaging with a storage room temperature of 25-26ºC and a relative humidity of 50-58% in a laboratory room for testing the quality of cereal grains. The treatments used were seeds without saromyl, seeds with saromyl without a storage period and seeds with saromyl which were stored for 21 days. In another study, seed storage used low temperatures with a temperature range of 18 -18.9ºC and Rh 50- 55%. Observations were made on the weight of 1000 grains, moisture content, electrical conductivity, maximum growth potential, seed growth speed, primary root length, shoots length and number of secondary roots. This study used a completely randomized design with 4 replications.

3. Results and Discussion

3.1 Room temperature storage
The water content contained in the seeds greatly affects the quality of the seeds. One of the requirements for seeds to be stored for a long time is to have a low water content. In maize seeds, the safe moisture content for storage is in the range of 10 – 11%. Observation of water content in all treatments (can be seen in Tables 1 and 3) showed a fairly safe water content value. The results of the analysis of the water content in the old and new seeds showed significantly different results between treatments on each variety. The increase in water content occurred due to the provision of saromyl solution and storage time which provided an opportunity for the seeds to absorb the surrounding water content, especially the water content from the saromyl solution.

Storage with high and fluctuating temperature and relative humidity contributed to the increase in moisture content and weight of 1000 seeds [6]. The results of observations showed that the weight of 1000 grains increased in line with the increase in water content. The results of research by [7], showed that in corn seed storage for 34 days using a temperature of 0ºC and Rh 55%, the moisture content of corn decreased by 0.2% and at a temperature of 20ºC, Rh 55% the moisture content of corn decreased by 1.5 %.

The electrical conductivity value indicates the physical condition of the seeds at the time of testing. If the value of the electrical conductivity in the seed soaking water is high, it indicates that the seeds have been physically damaged or there has been a leakage of the cell membrane. Damage to seeds causes a decrease in germination capacity and quality, viability and strength either due to aging or the role of adverse environmental conditions [8]. Observations of electrical conductivity showed that the
Electrical conductivity values were significantly different for each variety, both for new and old seeds. There was an increase in the value of electrical conductivity with the provision of saromil and storage time.

In the new seeds, the treatment without saromyl and storage had the same electrical conductivity between varieties, while the electrical conductivity values in other treatments were different. The electrical conductivity value was low enough to indicate that the seed quality at the beginning (pre-treatment/control) was in good condition and the same in all varieties. The same thing happened to old seeds (can be seen in Table 3), even the treatment of saromyl seeds with a storage period of 21 days also showed the same electrical conductivity between varieties. The increase in the value of electrical conductivity was caused by the application of a fungicide (saromil) and was given according to the recommendations so that it did not adversely affect seed quality. This is evidenced by the results of observations of the maximum growth potential and the speed of seed growth showing a fairly high value.

**Table 1.** Average weight of 1000 grains, moisture content, electrical conductivity, maximum growth potential, on new seeds of saromyl.

| Treatment          | Storage Period (day) | Weight 1000 grains (g) | Moisture content (%) | Electrical Conductivity (µs/cm/g) | Maximum Growth Potential (%) |
|--------------------|----------------------|------------------------|----------------------|-----------------------------------|------------------------------|
| **Bisma 2019**     |                      |                        |                      |                                   |                              |
| Control            | 0                    | 283.79                 | 9.07 f               | 8.08 f                            | 98.50 ab                     |
| Saromil            | 0                    | 286.92                 | 9.70 e               | 14.98 e                           | 98.75 ab                     |
| Saromil            | 21                   | 286.40                 | 11.82 a              | 21.57 bc                          | 99.25 a                      |
| **Sukmaraga 2019** |                      |                        |                      |                                   |                              |
| Control            | 0                    | 224.49                 | 7.67 h               | 8.65 f                            | 98.75 ab                     |
| Saromil            | 0                    | 234.79                 | 10.49 d              | 14.68 e                           | 96.75 abc                    |
| Saromil            | 21                   | 233.30                 | 12.03 a              | 19.60 cd                          | 98.25 ab                     |
| **Srikandi Kuning 2019** |                |                        |                      |                                   |                              |
| Control            | 0                    | 238.04                 | 9.26 f               | 11.75 ef                          | 96.00 bcd                    |
| Saromil            | 0                    | 246.63                 | 11.15 c              | 21.93 bc                          | 95.25 cd                     |
| Saromil            | 21                   | 246.10                 | 11.44 b              | 33.73 a                           | 93.75 d                      |
| **Lamuru 2019**    |                      |                        |                      |                                   |                              |
| Control            | 0                    | 264.66                 | 8.44 g               | 8.16 f                            | 97.25 abc                    |
| Saromil            | 0                    | 266.00                 | 10.66 d              | 15.63 de                          | 97.00 abc                    |
| Saromil            | 21                   | 270.50                 | 11.24 bc             | 25.70 b                           | 97.75 abc                    |
| **CV (%)**         |                      |                        |                      |                                   |                              |
|                    |                      |                        |                      | 1.87                              | 17.60                        | 1.75                         |

Note: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test.

The results showed that the seeds that had been given saromil both produced in 2017, 2018 and 2019, had a good maximum growth potential of above 90%, except for the Lamuru variety which was produced in 2017 (old seeds) with a maximum growth potential of below 90%. (can be seen in Table 3).

In the new seeds, the results of the analysis showed that there was no difference in maximum growth potential between treatments for each variety. Likewise between varieties except Srikandi Kuning 2019. This shows that the provision of saromil has no effect on seed quality. The condition of the seed storage room has a temperature of 25-26°C and a relative humidity of 50-58%. Storage under these conditions is safe enough to suppress fungal attacks. [9], stated that high temperature and relative humidity in the warehouse will reduce seed viability due to an increase in fungal attack on seeds during storage, while [10] stated that high humidity and temperature increase A. flavus and
reduce the germination of soybean seeds. The results of the research by [11] also noted that the higher the fungal infection in the seed, the lower the germination rate.

The old seeds produced in 2017 and 2018, have a maximum growth potential that is significantly different between treatments for each variety except the Srikandi Kuning 2018 variety. The data obtained is quite varied so that it shows the instability of seed quality which is influenced by the shelf life of the seeds. [12] and [13] stated that the decrease in the percentage of germination may be caused by the occurrence of chromosomal aberrations that occur due to the conditions of seed storage in the long term. Likewise, [14], stated that the long storage period of seeds was one of the factors causing a decrease in the percentage of germination, while seed deterioration was also related to storage time [15]. The shelf life of seeds is mainly influenced by genetic characters and seed conditions before storage, physiological maturity of seeds and environmental factors before and after harvest [16].

**Table 2.** The average speed of seed growth, length of primary root, length of shoot and number of secondary roots on new seeds of saromyl.

| Treatment          | Storage Period (day) | Speed of seed growth (%/etmal) | Length of primary root (cm) | Length of shoot (cm) | Number of secondary roots |
|--------------------|----------------------|-------------------------------|-----------------------------|----------------------|--------------------------|
| **Bisma 2019**     |                      |                               |                             |                      |                          |
| Control            | 0                    | 32.15 a                       | 15.03 b                     | 13.89 bc             | 4.38 abc                 |
| Saromil            | 0                    | 32.15 a                       | 12.49 c                     | 16.55 a              | 4.61 ab                  |
| Saromil            | 21                   | 32.38 a                       | 14.71 b                     | 10.72 c              | 4.71 a                   |
| **Sukmaraga 2019** |                      |                               |                             |                      |                          |
| Control            | 0                    | 31.76 a                       | 15.30 ab                    | 14.45 b              | 3.94 de                  |
| Saromil            | 0                    | 31.64 a                       | 14.54 b                     | 12.14 d              | 3.94 de                  |
| Saromil            | 21                   | 32.51 a                       | 16.86 a                     | 12.20 d              | 3.73 e                   |
| **Srikandi Kuning 2019** |              |                               |                             |                      |                          |
| Control            | 0                    | 29.28 b                       | 14.77 b                     | 12.95 cd             | 4.34 abcd                |
| Saromil            | 0                    | 29.81 b                       | 14.23 b                     | 12.14 d              | 4.28 bcd                 |
| Saromil            | 21                   | 30.23 b                       | 14.20 b                     | 10.77 e              | 3.94 de                  |
| **Lamuru 2019**    |                      |                               |                             |                      |                          |
| Control            | 0                    | 31.98 a                       | 15.32 ab                    | 15.93 a              | 4.44 abc                 |
| Saromil            | 0                    | 31.82 a                       | 14.53 b                     | 12.63 d              | 4.31 abcd                |
| Saromil            | 21                   | 32.28 a                       | 14.48 b                     | 12.38 d              | 4.06 cde                 |
| **CV (%)**         |                      |                               |                             |                      |                          |
|                    |                      | 2.34                          | 7.04                        | 5.42                 | 5.90                     |

Note: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test.

The results of the analysis on the speed of seed growth for new seeds showed that there was no significant difference between treatments for each variety. Likewise between varieties except Srikandi Kuning 2019. Furthermore, for old seeds, the speed of seed growth has started to decline and the value of growth speed varies quite a bit. Even in the 2017 Lamuru variety, the value of seed growth speed is below 27%/etmal. The condition of the old seeds and storage with a temperature of 25 - 26°C and a relative humidity of 50 - 58%, allows for a decrease in the speed of seed growth faster. [17], also stated that under tropical conditions, seeds will lose germination worse. The speed of seed growth greatly affects the vigor of a seed. The results of research [18], concluded that seed deterioration cannot be stopped in long storage, especially in ordinary storage conditions where the seeds experience environmental fluctuations that adversely affect the viability of the seeds. [19], observed that stored seeds can undergo many changes due to naturally occurring deterioration.
Table 3. Average weight of 1000 grains, moisture content, electrical conductivity, maximum growth potential, on old seeds of saromyl.

| Treatment      | Storage Period (day) | Weight 1000 grains (g) | Moisture content (%) | Electrical Conductivity (µs/cm) | Maximum Growth Potential (%) |
|----------------|----------------------|------------------------|----------------------|--------------------------------|------------------------------|
| Bisma 2018     | Control 0            | 242.59                 | 8.22 h               | 10.26 f                        | 96.25 cd                     |
|                | Saromil 0            | 244.54                 | 9.01 g               | 17.60 de                       | 94.75 e                      |
|                | Saromil 21           | 248.77                 | 11.12 c               | 23.33 a                        | 93.00 f                      |
| Sukmaraga 2017 | Control 0            | 283.79                 | 8.03 i               | 9.90 f                         | 96.50 bcd                    |
|                | Saromil 0            | 284.92                 | 10.80 d              | 19.11 cd                       | 95.25 de                     |
|                | Saromil 21           | 284.30                 | 10.85 d              | 21.89 ab                       | 98.00 ab                     |
| Srikandi Kuning 2018 | Control 0    | 225.13                 | 7.70 j               | 11.40 f                        | 98.50 a                      |
|                | Saromil 0            | 228.74                 | 10.02 e              | 16.28 e                        | 98.00 ab                     |
|                | Saromil 21           | 228.70                 | 11.46 b               | 22.59 ab                       | 97.00 abc                    |
| Lamuru 2017    | Control 0            | 274.93                 | 9.11 f               | 9.88 f                         | 88.00 g                      |
|                | Saromil 0            | 281.39                 | 11.49 b              | 20.82 bc                       | 86.00 h                      |
|                | Saromil 21           | 280.70                 | 11.91 a              | 23.18 a                        | 81.25 i                      |
| CV (%)         | 1.24                 | 23.13                 | 3.04                 |

Note: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test.

Observation of the size of the germination is also a test parameter in determining the level of vigor of a seed. In the new seeds, the primary root lengths of the Srikandi Kuning 2019 and Lamuru 2019 varieties were not significantly different between treatments for each variety as well as between varieties. Meanwhile, the Bisma and Sukmaraga 2019 varieties showed varying values, but with fairly good primary root lengths. Observation of shoot length showed that treatment without saromyl fungicide was generally significantly different from other treatments in each variety, while the number of secondary roots was not significantly different between treatments in each variety. The length of primary roots and shoots on old seeds was significantly different between treatments on each variety, while the number of secondary roots in general was not significantly different between treatments.
Table 4. The average speed of seed growth, length of primary root, length of shoot and number of secondary roots on old seeds of saromyl.

| Treatment            | Storage Period (day) | Speed of seed growth (%/etmal) | Length of primary root (cm) | Length of shoot (cm) | Number of secondary roots |
|----------------------|----------------------|--------------------------------|-----------------------------|----------------------|--------------------------|
| **Bisma 2018**       |                      |                                |                             |                      |                          |
| Control              | 0                    | 27.50 f                        | 13.98 g                     | 13.74 c              | 4.52 ab                  |
| Saromil              | 0                    | 30.27 c                        | 17.10 b                     | 15.37 a              | 4.50 ab                  |
| Saromil              | 21                   | 29.63 d                        | 14.24 fg                    | 11.76 c              | 4.44 b                   |
| **Sukmaraga 2017**   |                      |                                |                             |                      |                          |
| Control              | 0                    | 28.58 e                        | 14.50 ef                    | 14.58 b              | 3.69 f                   |
| Saromil              | 0                    | 30.09 c                        | 15.66 c                     | 11.14 f              | 3.90 de                  |
| Saromil              | 21                   | 30.44 c                        | 14.73 e                     | 10.28 g              | 3.83 ef                  |
| **Srikandi Kuning 2018** |                    |                                |                             |                      |                          |
| Control              | 0                    | 31.67 b                        | 15.15 d                     | 15.14 a              | 4.13 c                   |
| Saromil              | 0                    | 32.31 a                        | 18.51 a                     | 12.67 d              | 3.98 ecd                 |
| Saromil              | 21                   | 31.77 b                        | 14.48 ef                    | 11.12 f              | 4.02 cd                  |
| **Lamuru 2017**      |                      |                                |                             |                      |                          |
| Control              | 0                    | 22.69 i                        | 12.59 i                     | 11.91 e              | 4.65 a                   |
| Saromil              | 0                    | 26.06 g                        | 14.89 de                    | 10.13 g              | 4.67 a                   |
| Saromil              | 21                   | 24.87 h                        | 13.48 h                     | 9.37 h               | 4.50 ab                  |
| **CV (%)**           | 3.21                 | 5.48                           | 6.90                        | 7.93                 |

Note: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test.

3.2 Low temperature storage
In another study, seeds that had been given a fungicide (saromil) with a storage period of 6 months were stored at low temperatures (18-18.9°C). The results of the analysis showed that the maximum growth potential was significantly different between new and old seeds, although the quality of the seeds was still very high, except for the 2017 Lamuru variety. The maximum growth potential value was above 90% except for Lamuru 2017 with the maximum growth potential percentage of only 82.50%.

Observation of seed growth rate on new seeds showed no significant difference between Bisma, Sukmaraga, Srikandi Kuning and Lamuru varieties with high values above 32%/etmal. The old seeds were not significantly different between the varieties Bisma, Sukmaraga and Srikandi Kuning, while Lamuru was significantly different from other varieties with a seed growth rate of 27.35%/etmal. Other test parameters showed good values although significantly different between varieties in both new and old seeds.
Table 5. Average moisture content, electrical conductivity, maximum growth potential and growth speed of saromyl corn seeds with a shelf life of 6 months.

| Treatment          | Moisture content (%) | Electrical conductivity (µs/cm·g) | Maximum growth potential (%) | Growth speed of saromyl (%/etmal) |
|--------------------|----------------------|----------------------------------|------------------------------|----------------------------------|
| New seeds          |                      |                                  |                              |                                  |
| Bisma 2019         | 13,03b               | 18,70c                           | 98,50ab                      | 32,53a                           |
| Sukmaraga 2019     | 11,88cd              | 19,28c                           | 99,00a                       | 32,93a                           |
| Srikandi Kuning 2019 | 11,93c             | 14,60e                           | 98,00b                       | 32,53a                           |
| Lamuru 2019        | 11,50e               | 16,55d                           | 98,75b                       | 32,53a                           |
| Old seed           |                      |                                  |                              |                                  |
| Bisma 2018         | 12,98b               | 16,95d                           | 93,25d                       | 31,33b                           |
| Sukmaraga 2017     | 11,35f               | 19,13c                           | 95,25e                       | 31,55b                           |
| Srikandi Kuning 2018 | 13,23a             | 26,63b                           | 92,50d                       | 31,48b                           |
| Lamuru 2017        | 11,78d               | 28,98a                           | 82,50e                       | 27,35c                           |
| CV (%)             | 2,16                 | 15,59                            | 1,85                         | 2,45                             |

Note: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test.

Table 6. Average length of primary roots, length of shoots and number of secondary roots of maize seeds of saromyl with a shelf life of 6 months.

| Treatment          | length of primary roots (cm) | length of shoots (cm) | number of secondary roots |
|--------------------|-------------------------------|-----------------------|---------------------------|
| New seeds          |                               |                       |                           |
| Bisma 2019         | 16,38d                        | 16,38e                | 4,5a                      |
| Sukmaraga 2019     | 16,58cd                       | 17,45cd               | 4,0c                      |
| Srikandi Kuning 2019 | 16,53cd           | 17,60c                | 4,0c                      |
| Lamuru 2019        | 17,25b                        | 18,40ab               | 4,5a                      |
| Old seed           |                               |                       |                           |
| Bisma 2018         | 17,85a                        | 18,68a                | 4,5a                      |
| Sukmaraga 2017     | 15,65e                        | 18,18b                | 4,25b                     |
| Srikandi Kuning 2018 | 16,95bc          | 17,10d                | 4,0c                      |
| Lamuru 2017        | 14,33f                        | 15,33f                | 4,0c                      |
| CV (%)             | 6,52                          | 4,58                  | 9,37                      |

Note: Numbers followed by the same letter in the same column are not significantly different according to the 5% DMRT test.

4. Conclusion
The results showed that at room temperature (25-26°C and relative humidity 50-58%) the seeds that had been given a fungicide (saromil) with a storage period of 21 days still had high seed quality. Even at low temperature storage (18-18.9°C and Rh 50-55%) during the 6-month storage period, the quality of the seeds was very good. The shelf life of seeds that have been given a fungicide (saromyl), is influenced by the shelf life of the seeds, the temperature and relative humidity of the storage room.
References

[1] Jatnika, W., A.L. Abadi, dan L.Q. Aini. 2013. Pengaruh aplikasi Bacillus sp. dan Pseudomonas sp. terhadap perkembangan penyakit bulai yang disebabkan oleh jamur Peronosclerospora maydis pada tanaman jagung. Jurnal HPT, 1(4): 19-29.

[2] Ridwan, H.M., M. Nurdin dan S. Ratih. 2015. Pengaruh Paenibacillus polymyxa dan Pseudomonas fluorescens dalam molase terhadap keterjadian penyakit bulai (Peronosclerospora maydis L.) pada tanaman jagung manis. Agrotek Tropika, 3(1): 144-147.

[3] Irawan, A., I. Anggraeni dan M. Christita. 2015. Identifikasi penyebab penyakit bercak daun pada bibit cempaka (Magnolia elegans (Blume) H.Keng) dan teknik pengendaliannya. J. Wasian, 2(2) : 87 – 94.

[4] Sheler, V. R. 2007. Strategies to improve the seed quality and storability of soybean. A Review: Seed Technology Research Unit (NSP), Mathmte Phule Krighi Vidyprth, Rahuri 413- 722, India. Agricultural Review, 28 (3): 188-196, 2007.

[5] Pratt, P., P. Bolin and C. Godsey. (Eds.). 2009. Soybean Production Guide. Oklahoma Cooperative Extension Service, Division of Agricultural Sciences and Natural Resources, Oklahoma State University. Pp. 12-114.

[6] Isaac, O.T., E. A. Seweh, S. Apuri, B. K. Banful and S. Amoah. 2016. Effect of storage periods on seed quality characteristics of three soybean (Glycine max (L) Merrill) varieties. International Journal of Scientific Research in Science, Engineering and Technology 2(4): 823-830.

[7] Volenik, M., V. Rozman, I. Kalinovic, A. Liska, D. Kis and B. Simic. 2007. Influence of relative humidity and temperature on the changes in grain moisture in stored soybean and maize. Agriculturae Conspectus Scientifi cus 72(3): 215-219.

[8] Kapoor, N., A. Arya, M.A. Siddiqui, A. Amir and H. Kumar. 2010. Seed deterioration in chickpea (Cicer arietinum L.) under accelerated aging. Asian J Plant Sci, 9(3): 158-162.

[9] Dejene, M. 2004. Grain storage methods and their effects on sorghum grain quality in Hararge, Ethiopia. PhD thesis Swedish university of Agriculture Sciences, pp. 1-29.

[10] Tariq, M., S. Dawar and F.S. Mehi. 2005. Effect of moisture and storage temperature on seed borne mycoflora of soybean. Int .J. Biol. Biotech , 2(4): 947-958.

[11] Owolade O.F.1, J.O. I. Olasoji and C.G. Afolabi. 2011. Effect of storage temperature and packaging materials on seed germination and seed-borne fungi of sorghum (Sorghum bicolor (L.) Moench.) in South West Nigeria. African Journal of Plant Science 5(15): 873-877.

[12] Akhter, F.N., G. Kabir, M.A. Mannan, N.N. Shaheen. 1992. Aging effect of wheat and barley seeds upon germination mitotic index and chromosomal damage. J. Islam Acad Sci, 5: 44-48.

[13] Subedi, K.D., B.L. Ma. 2005. Seed priming does not improve corn Yield in a humid temperate environment. Agron. J, 97: 211-218.

[14] Tiwari, R.K.S. and K. Das. 2014. Impact of differential storage conditions on seed germination and viability of some medicinal plants. African Journal Agric. Research 9(20): 1578-1585.

[15] Siadat, S.A., A. Moosavi and M. Sharafizadeh. 2012. Effect of seed priming on antioxidant activity and germination characteristics of Maize seeds under different aging treatments. Research Journals of Seed Science, 5(2): 51-62.

[16] Mahesha, C.R., A.S. Channaveeraswami, M.B. Kurdikeri, M. Shekhargouda and M.N. Mervade. 2001. Storability of sunflower seeds harvested at different maturity dates. Seed Res. 29(1): 98-102.

[17] Shelar, V.R., R.S. Shaik and A.S. Nikam. 2008. Soybean seed quality during Storage. A Review. Agric. Rev., 29(2): 125 – 131.

[18] Cheyed and H. Saddam 2020. Effect of storage method and period on vitality and vigour of seed wheat. Indian Journal of Ecology 47(10): 27-31. Manuscript Number: S-324 NAAS Rating: 4.96.
[19] Oskouei, B., E.H. Majidi, A. Hamidi, F. Moradi and A. Moghadam. 2014. Study on seed vigor deterioration in hybrid corn (Zea mays), cv. single cross 704. Bulletin of Environment, Pharmacology and Life Sciences 3(6): 207-210.