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EFFECT OF SEED COATING WITH POLYMER AND CHEMICALS ON SEED STORABILITY OF MAIZE (*ZEA MAYS* L.)

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ABSTRACT

A laboratory experiment was carried out at the Seed Technology Laboratory, CSK Himachal Pradesh Krishi Vishwavidyalaya, Palampur in 2021-2022 in order to investigate the impact of seed coating with polymer and chemicals on the seed storability of "Bajaura Makka" the composite variety of maize. Nine different treatments were applied to the seeds, including polymer, fungicide, insecticide, polymer-fungicide, and polymer-insecticide combinations, as well as an untreated control. After being packed in interwoven HDPE (high density polyethylene) non-laminated bags, the seeds were kept in three replications for a period of twelve months. At bimonthly intervals, evaluations of the seed quality parameters were made for a period of twelve months. Regardless of seed coating treatments, after twelve months of storage, the seed deteriorated and its vigour decreased due to increased ageing. When compared to other treatments, seed coated with polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2 g/kg of seed (T_6) and vitavax power (containing thiram 37.5% and carboxin 37.5% @ 2 g/kg of seed (T_5) were found to be significantly better for all seed quality parameters, including germination percentage (first and final count), rate of germination, field emergence percentage, final plant establishment percentage, seedling length (cm), dry matter of seedling (mg), seedling vigour index - I & II, over T_1 - control.
***Keywords* :** Seed coating, Seed quality, Storability.

Introduction

Maize (*Zea mays* L.) is the third most significant cereal crop within the world economy. With the most important genetic output potential of all the cereals and superior adaptability to a wide range of agro-climatic conditions, maize is one of the most adaptable crops, earning it the title of "Queen of Cereals." It has worldwide significance as human food, animal feed and is good source of starch, protein (Zein), fat, oil and sucrose in addition to some of the important vitamins A, C and E and minerals. It is a high yielding, easy to process, readily digestible and cheaper than other cereals and used as a basic raw material for the production of alcoholic beverages, food sweeteners and more recently as biofuel. The crop is grown in low and mid hills of Himachal Pradesh and primarily used as cereal by the hill farmers. In India, the area of maize is 9900.00 thousand hectares, the production is 32500.00 thousand tones, and the productivity is 33 quintals per hectare during 2021-22 (Anonymous, 2022). It is a significant *Kharif* crop in Himachal Pradesh, growing over an area of 290.00 thousand hectares with a productivity of 26.27 quintals/hectare and a total production of 762.00 thousand tones in 2020-21 (Anonymous, 2021).

After harvest, the seeds are kept in storage until the following sowing season or till further use. It is estimated that 20 % of the seeds produced in India are carried over for a subsequent sowing and it is required that 80 % of them be stored for one planting season. It needs to be stored securely to preserve its viability and vigour. The viability and vigour of the seeds are affected by a number of physiological factors during storage, including moisture content, atmospheric relative humidity, temperature, initial seed quality, physical, chemical and genetic makeup of the seed, gaseous exchange, storage structure, packaging materials, location and methods of seed production, etc. (Doijode, 1990). In addition, microflora is primarily responsible for degrading proteins, carbohydrates, and other food reserves, which reduces the vigour and germination potential. Deterioration of seed is further associated with ageing phenomenon which has been defined as an irreversible degradation change in the quality of a seed after it has reached its physiological maturity (Abdul Baki and Anderson, 1973).

By storing the seeds in controlled environments or by applying polymer film coating and chemical seed treatments, this pace of seed breakdown can be slowed down. The greatest alternative strategy to maintain seed quality is seed treatment because controlled conditions need significant investment costs. The necessity for seed specialists to be aware of the issues with seed storage and potential solutions has arisen with the emergence of structured seed production and marketing systems. In light of this, the current study was designed to determine whether covering seeds with polymer alone or in combination with fungicides and insecticides can improve their capacity to be stored while also determining the impact of these treatments on the quality of the seeds in maize.

Materials and Methods

The experimental material consisted of freshly harvested (*Kharif* 2020) Bajaura Makka (composite variety of maize) seeds which were procured from the Hill Agricultural Research and Extension Centre, Bajaura (Kullu), CSK HPKV, Palampur. The seeds were coated with polymer, fungicides, and insecticides for conducting the experiment. One kilogram of seeds per treatment were taken. The details of the treatment are mentioned in Table 1. The treatments were applied manually to ensure uniform coating. After coating the seeds with different treatments, the seeds were kept for shade drying for 72 hours at room temperature and moisture content brought to the original i.e. around 10 % moisture content before packing the seeds for storability. The coated seeds of various treatments were packed in HDPE (high density polyethylene) interwoven non-laminated bags and stored under ambient storage condition for twelve months (March 2021 to March 2022) in Seed Technology Laboratory of the Department of Seed Science and Technology, CSKHPKV, Palampur. The experiment was laid out in Completely Randomized Design (CRD) with three replications. For the present study, the evaluation for seed quality parameters was made at bimonthly interval for twelve months i.e. from March 2021 to March 2022.The seeds were drawn at random from the each treatment bag at bimonthly intervals for analysing the seed quality parameters as detailed. Germination test was conducted using 100 seeds drawn at random from each treatment replication-wise (three replications) by adopting between paper method as described by ISTA procedures (Anonymous 1999). Seeds were incubated in germinator at the temperature of 25±1°C and RH of 90 per cent. Germinated seeds (final count) were counted on 7th day and germination percentage was calculated using the following formula:

Germination (final count) % = Number of germinated seeds / Total number of seeds × 100

Field emergence count was taken on the 10th day after sowing and the emergence percentage was calculated taking into account the number of seedlings emerged above the soil surface.

Ten normal seedlings from the germination test were selected from each replication of the treatment for measuring the seedling length and the average was worked out in centimeters. The same ten normal seedlings were then used for seedling dry weight measurements. The seedlings from each replication of the treatment were put in butter paper pocket and kept in hot air oven at 70°C for 18 hours. The dry weight of the seedlings was recorded and expressed in milli grams. The seedling vigour index - I and seedling vigour index - II was calculated as per the formula (Final count (%) × Seedling length) and (Final count % x Dry matter of seedling), respectively as suggested by (Abdul Baki and Anderson 1973). Rate of germination was determined on the basis of daily germination count and was calculated by the following formula.

Rate of germination = n1/d1+n2/d2+n3/d3+----------

Where,
n = number of germinated seeds, d= number of days.

The laboratory data were statistically analyzed using Completely Randomized Design (CRD) and software used was OPSTAT (Sheoran *et al*., 1998). The critical difference between the treatments was carried out at 5 % significance (Sundararaj *et al*., 1972). The data on germination (%), field emergence (%) and final plant establishment (%) were transformed into arcsine transformation and the transformed data were used for the statistical analysis.

Results and Discussion

The seeds coated with polymer and fungicide recorded significant superiority for the seed quality parameters and outperformed untreated seeds during storage. Germination percentage declined in all the treatments with the advancement in the storage period. Mean germination percentage (final count) in the beginning and end of storage period was 97.47 % and 95.40 %, respectively. Highest germination percentage (final count) was recorded for treatment T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed (97.30 %) and T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed (97.00 %), while the lowest germination was recorded for treatment T_1-control (94.00 %) at the end of twelve months of storage. The greater germination percentage observed in seeds treated with fungicides was due to an increased rate of imbibition as the fine particles in the treatment worked as moisture-attracting materials to aid germination. The polymer treatment on seeds served as a physical barrier that has been shown to prevent inhibitor leaching from the seed covering. Polymer and vitavax also reduces the impact of ageing enzymes on seed deterioration. As a result, the seed germination was sustained for a longer time. These results are in agreement with the findings of Sharma *et al.* (2017) in HQPM 1 hybrid maize wherein they reported that seeds treated with polymer + vitavax 200 @ 2.0 g/kg of seed showed higher germination over control after twelve months of storage, respectively.

Similar trend was observed in case of rate of germination. The rate of germination decreased from the first to the last month of storage, regardless of the various seed treatments. Average rate of germination at the start and end of the storage period were 47.97 and 45.51, respectively. Highest rate of germination was recorded in T_6-polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed (47.40) which was at par with T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed (47.33) as compared to T_1 - control (43.27) at the end of the twelve months of storage period. Higher speed of germination was recorded for polymer and chemical treated seeds. This may be due to protection of seeds from fungal infection. Similar results were reported by Kunkur (2006) in cotton, Sharma and Dhiman (2017) in paddy, Padhi *et al.* (2017) in paddy, Parihar *et al.* (2019) in okra, Kotia *et al.* (2020) in radish wherein they reported that seeds treated with polymer + vitavax 200 @ 2.0 g/kg of seed recorded significantly higher rate of germination over untreated control at the end of one year of storage.

Irrespective of various seed treatments, the field emergence decreased with increasing storage time. On an average the field emergence at the start and end of the storage period was 89.30 % and 85.32 %, respectively. Significantly higher field emergence percentage was recorded for T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed (88.60 %) and T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed (88.00 %) as compared to T_1 - control (81.60 %) at the end of twelve months of storage. This could be as a result of deteriorating changes brought on by ageing in cells and cell organelles as well as the seed's ability to germinate in natural soil conditions. Field emergence of seeds treated with polymer and fungicides was substantially higher than that of the control. This might be as a result of seeds being protected from microorganisms by chemicals and polymers, which in turn aids in better seedling establishment. These results are in agreement with the results of Sharma *et al.* (2017) in HQPM 1 hybrid maize wherein they concluded that seeds treated with polymer + vitavax 200 @ 2.0 g/kg of seed resulted in higher field emergence percentage (79.00 %) over the control (69.00 %) at the end of storage period of twelve months. The field emergence percentage results are consistent with those reported by Chachalis and Smith (2001) in soybean, Kunkur *et al.* (2006) in cotton, Baig *et al.* (2012) in soybean, Kotia *et al.* (2020) in radish, Prashar *et al.* (2020) in okra, Thakur and Dhiman (2020) in wheat, and Chaturvedi and Dhiman (2021) in wheat.

Regardless of the seed treatments, the length (cm) of the seedlings reduced as the storage period extended. The average seedling length measured at the start and end of storage was 39.92 cm and 36.46 cm, respectively. Significantly higher seedling length (cm) was recorded for T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed (37.00 cm) and T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed (36.96 cm) as compared to T_1 - control (35.66 cm) at the end of twelve months of storage period. Similarly, almost same trend was recorded for seedling dry weight (mg). Dry matter per seedling averaged 68.41 mg and 63.51 mg, respectively at the start and end of the storage period. Significantly maximum dry matter of seedling (mg) was recorded for T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed (65.73 mg) and T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed (65.66 mg) as compared to T_1 - control (60.66 mg) after twelve months of storage period. When compared to untreated seeds (T_1), seedling length (cm) and dry matter of seedling (mg) of seeds treated with polymer and vitavax (T_6) was greater. This could be attributed to the higher germination percentage and better initial growth of seedlings in seeds coated with polymer and fungicides, as it prevents fungal invasion and thereby results in better germination and subsequent higher seedling length and maximum dry matter of seedlings. These results are in agreement with the results of Sharma *et al*. (2017) in HQPM 1 hybrid maize wherein they reported that significantly more seedling length (30.83 cm) over control (24.50 cm) and higher dry matter of seedling was recorded in seeds treated with polymer + vitavax 200 @ 2.0 g/kg of seed over untreated seeds at the end of twelve months of storage period. These results are in conformity with the findings of Padhi *et al*. (2017) in paddy, Goswami *et al*. (2017) in soybean, Roopashree *et al*. (2018) in chickpea, Parihar *et al*. (2019) in okra, Kotia *et al*. (2020) in radish, Thakur and Dhiman (2020) in wheat, and Chaturvedi and Dhiman (2021) in wheat.

Regardless of the different seed treatments, the vigour of stored seed decreased as the storage period extended. Measured mean seedling vigour index - I at the start and end of storage was 3885.29 and 3479.32, respectively. Significantly higher seedling vigour index - I was recorded for T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed (3589.00) which was at par with T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed (3572.80) as compared to T_1 - control (3352.04) at the end of storage period of 12 months.

Similarly, same trend was followed for seedling vigour index – II. Regardless of the various seed treatments, the seedling vigor index - II decreased as storage time increased. At the beginning and end of storage, the average seedling vigour index - II was 6663.37 and 6061.04, respectively. Significantly higher seedling vigour index - II was recorded for T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed (6375.81) and T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed (6347.13) as compared to T_1 - control (5702.04) after twelve months of storage period. The computed vigour index which represents the entirety of seed performance, is regarded as a reliable indicator of the potential of seed lots.

Regardless of the various seed treatments, a fall in vigour index was observed as storage time increased. The fall in vigour index may be caused by natural ageing - induced declines in seedling germination and decreases in seedling length. This decline in vigour may be caused by the depletion of food reserves, which starves meristematic tissue and reduces the embryo's capacity for synthetic activity. Higher germination, longer seedlings and dry weight are the causes of the higher vigour index in polymer treatments combined with fungicides. The results are in agreement with the findings of Sharma *et al*. (2017) in HQPM 1 maize wherein they reported that seeds treated with polymer + vitavax 200 @ 2 g/kg of seed showed higher seedling vigour index over control after twelve months of storage period. Vangamudi *et al*. (2003) reported that maize seeds coated with pink polykote @ 3 g/kg of seed, added with fungicide recorded higher vigour index over the control. Similar findings were reported by Savitri *et al*. (1998) in groundnut, Harish *et al*. (2014) in tomato, Badiger *et al*. (2014) in cotton, Desai *et al*. (2015) in soybean, Kotia *et al*. (2020) in radish, Thakur and Dhiman (2020) in wheat, and Chaturvedi and Dhiman (2021) in wheat.

Conclusion

The present study concluded that maize seeds coated with polymer @ 3 ml per kg of seed and vitavax power @ 2 g per kg of seed and packed in high density polyethylene (HDPE) inter woven non-laminated bag can help in maintaining better seed quality upto 12 months of storage.

Table 1 : Treatment details

Sr. No.	Treatment symbol	Seed Treatment description
1	T_1	uncoated seeds - Control
2	T_2	polykote @ 3.0 ml/kg of seeds, diluted with 5 ml of water
3	T_3	treat (Tebuconazole) @ 1.0 g/kg of seed.
4	T_4	polymer + treat (tebuconazole) @ 1.0 g/kg of seed.
5	T_5	vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed.
6	T_6	polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed.
7	T_7	imidacloprid (Gaucho) @ 4.0 ml/kg of seed.
8	T_8	polymer + imidacloprid (Gaucho) @ 4.0 ml/kg of seed.
9	T_9	polymer + treat (tebuconazole) @ 1.0 g/kg seed + imidacloprid (Gaucho) @ 4.0 ml/kg of seed.
10	T_{10}	polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed + imidacloprid (Gaucho) @ 4.0 ml/kg of seed.

Table 2 : Effect of seed coating with polymer and chemicals on germination – final count (%) and field emergence (%) of maize seeds.

Treatment	Months after storage													
	Germination (%)							Field emergence (%)						
	0	2	4	6	8	10	12	0	2	4	6	8	10	12
T1	95.60 (77.97)	95.30 (77.50)	95.30 (77.50)	95.00 (77.23)	94.70 (76.62)	94.60 (76.62)	94.00 (75.79)	86.00 (68.00)	84.60 (66.92)	84.30 (66.65)	84.00 (66.40)	83.30 (65.88)	82.60 (65.37)	81.60 (64.62)
T2	96.60 (80.28)	96.60 (79.70)	96.30 (79.16)	96.00 (78.86)	95.60 (78.33)	95.60 (78.36)	94.30 (77.40)	87.00 (68.84)	86.60 (68.55)	86.00 (68.00)	85.30 (67.45)	84.60 (66.92)	84.00 (66.40)	83.00 (65.62)
T3	97.60 (81.23)	97.30 (80.60)	97.00 (79.99)	96.70 (79.47)	96.30 (78.95)	96.00 (78.43)	95.30 (78.33)	90.00 (71.55)	89.60 (71.22)	89.00 (70.60)	88.60 (70.30)	87.60 (69.41)	87.00 (68.84)	86.30 (68.27)
T4	97.70 (81.23)	97.30 (80.60)	97.30 (80.60)	97.30 (80.60)	96.60 (79.47)	96.00 (78.43)	95.60 (78.60)	90.00 (71.55)	89.60 (71.22)	89.00 (70.61)	88.60 (70.30)	88.00 (69.71)	87.30 (69.12)	86.60 (68.55)
T5	98.60 (83.43)	98.60 (83.43)	98.30 (82.63)	98.30 (82.63)	98.00 (82.63)	97.60 (81.22)	97.00 (79.99)	92.00 (73.56)	92.00 (73.56)	91.00 (72.53)	90.30 (71.86)	89.60 (70.30)	89.00 (70.61)	88.00 (69.71)
T6	99.00 (84.22)	99.00 (84.22)	98.60 (83.43)	98.60 (83.43)	98.30 (78.95)	98.00 (81.83)	97.30 (80.60)	93.00 (74.62)	92.60 (74.26)	92.00 (73.56)	91.30 (72.85)	90.60 (72.18)	89.60 (71.22)	88.60 (70.30)
T7	97.00 (80.36)	96.60 (79.70)	96.30 (79.16)	96.30 (78.95)	96.30 (78.95)	95.60 (77.97)	94.60 (77.58)	87.30 (69.12)	87.00 (68.84)	86.60 (68.55)	86.00 (68.00)	85.30 (67.45)	84.30 (66.65)	83.30 (65.88)
T8	97.30 (80.60)	97.00 (79.99)	96.70 (79.47)	96.30 (78.95)	96.60 (79.47)	95.70 (77.97)	95.00 (77.80)	87.70 (69.12)	87.00 (68.84)	86.60 (68.55)	86.30 (68.27)	85.60 (67.72)	84.60 (66.92)	83.60 (66.13)
T9	97.30 (80.60)	97.30 (80.60)	97.00 (79.99)	96.70 (79.47)	96.70 (79.47)	96.00 (78.43)	95.30 (78.33)	89.00 (70.61)	89.00 (70.61)	88.60 (70.30)	88.00 (69.71)	87.30 (69.12)	86.60 (68.55)	85.60 (67.72)
T10	98.00 (81.83)	97.60 (81.22)	97.30 (80.60)	97.00 (79.99)	96.70 (79.47)	96.60 (79.47)	96.00 (78.43)	91.00 (72.53)	90.60 (72.18)	90.00 (71.55)	89.30 (70.91)	88.60 (70.30)	87.60 (69.41)	86.60 (68.55)
Mean	97.47	97.26	97.01	96.82	96.58	96.17	95.40	89.30 (70.95)	88.86 (70.62)	88.31 (70.09)	87.77 (69.60)	87.05 (68.90)	86.26 (68.31)	85.32 (67.54)
SE(m±)	0.52	0.53	0.55	0.54	0.57	0.38	0.35	0.44	0.41	0.46	0.34	0.34	0.33	0.32
CD (5%)	1.57	1.60	1.64	1.61	1.70	1.13	1.05	1.33	1.22	1.38	1.01	1.01	0.98	0.95

Figures in parentheses indicate arc sine values.

T_1 - control (untreated seeds), T_2 - polymer coating (polykote @ 3.0 ml/kg of seed, diluted with 5.0 ml of water), T_3 - treat (Tebuconazole) @ 1.0 g/kg seed, T_4 - polymer + treat (tebuconazole) @ 1.0 g/kg seed, T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed, T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed, T_7 - imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_8 - polymer + imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_9 - polymer + treat (tebuconazole) @ 1.0 g/kg seed + imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_{10} - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed + imidacloprid (Gaucho) @ 4.0 ml/kg seed.

Table 3 : Effect of seed coating with polymer and chemicals on seedling length (cm) and dry matter of seedlings (mg) of maize seeds

Treatment	Months after storage													
	Seedling length (cm)							Dry matter of seedling (mg)						
	0	2	4	6	8	10	12	0	2	4	6	8	10	12
T1	38.43	38.00	37.66	37.23	36.46	36.00	35.66	67.13	66.73	66.13	65.23	63.73	62.13	60.66
T2	39.63	39.13	38.73	38.36	37.76	36.66	36.00	67.46	67.13	66.73	65.43	63.93	62.56	61.10
T3	40.13	39.71	39.43	38.98	38.28	37.53	36.63	68.73	68.53	67.93	67.20	66.46	65.26	64.03
T4	40.13	39.73	39.46	39.06	38.36	37.56	36.66	68.76	68.56	67.96	67.23	66.50	65.30	64.06
T5	40.46	40.13	39.73	39.36	38.66	37.86	36.96	69.23	68.83	68.36	67.73	67.16	66.40	65.66
T6	40.56	40.23	39.83	39.40	38.73	37.96	37.00	69.30	68.93	68.40	67.83	67.26	66.50	65.73
T7	39.73	39.26	38.86	38.43	37.83	36.76	36.16	67.96	67.73	67.23	66.03	64.93	63.63	62.83
T8	39.83	39.33	38.93	38.56	37.96	36.86	36.23	68.03	67.76	67.26	66.13	65.03	63.66	62.93
T9	40.13	39.68	39.38	38.98	38.26	37.51	36.61	68.70	68.50	67.90	67.16	66.40	65.20	64.00
T10	40.23	39.83	39.53	39.13	38.43	37.66	36.76	68.83	68.63	68.03	67.26	66.53	65.33	64.13
Mean	39.92	39.50	39.15	38.74	38.07	37.23	36.46	68.41	68.13	67.59	66.63	65.79	63.70	63.51
SE(m±)	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.04	0.04	0.05	0.06	0.05	0.06	0.04
CD (5%)	0.17	0.17	0.17	0.18	0.19	0.19	0.18	0.14	0.13	0.17	0.18	0.15	0.18	0.14

Figures in parentheses indicate arc sine values.

T_1 - control (untreated seeds), T_2 - polymer coating (polykote @ 3.0 ml/kg of seed, diluted with 5.0 ml of water), T_3 - treat (Tebuconazole) @ 1.0 g/kg seed, T_4 - polymer + treat (tebuconazole) @ 1.0 g/kg seed, T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed, T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed, T_7 - imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_8 - polymer + imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_9 - polymer + treat (tebuconazole) @ 1.0 g/kg seed + imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_{10} - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed + imidacloprid (Gaucho) @ 4.0 ml/kg seed.

Table 4 : Effect of seed coating with polymer and chemicals on seedling vigour index - I and seedling vigour index – II of maize seeds.

Treatment	Months after storage													
	Seedling vigour index - I							Seedling vigour index - I						
	0	2	4	6	8	10	12	0	2	4	6	8	10	12
T_1	3676.47	3622.67	3590.25	3549.26	3451.55	3470.48	3352.04	6422.10	6361.59	6304.39	6228.13	6033.11	5881.64	5702.04
T_2	3810.56	3775.57	3722.99	3669.61	3612.37	3487.14	3396.00	6514.23	6489.23	6428.32	6282.28	6115.97	5984.91	5768.77
T_3	3905.99	3865.11	3824.71	3768.07	3698.47	3602.88	3492.06	6709.70	6670.25	6589.21	6496.00	6418.67	6302.80	6104.19
T_4	3919.36	3867.05	3840.77	3795.61	3708.13	3605.76	3507.14	6712.63	6673.17	6614.77	6524.22	6428.33	6305.23	6128.41
T_5	3992.05	3959.49	3906.78	3870.40	3801.57	3697.66	3572.80	6830.69	6791.23	6722.07	6660.12	6604.07	6485.07	6347.13
T_6	4015.44	3982.77	3929.89	3887.47	3808.45	3720.08	3589.00	6860.70	6824.07	6748.80	6692.56	6613.90	6517.00	6375.81
T_7	3840.57	3795.13	3743.51	3702.09	3644.29	3516.71	3423.15	6569.47	6547.23	6476.49	6360.89	6254.92	6087.27	5947.91
T_8	3850.23	3815.01	3763.23	3714.61	3669.47	3526.27	3441.85	6576.23	6572.72	6501.80	6370.52	6286.23	6090.14	5978.35
T_9	3905.99	3862.19	3819.86	3768.07	3687.64	3602.68	3490.15	6692.64	6667.33	6586.30	6492.13	6402.31	6300.96	6101.33
T_{10}	3942.54	3890.06	3847.59	3801.84	3714.90	3640.47	3528.96	6745.34	6702.86	6621.59	6543.72	6431.23	6355.20	6156.48
Mean	3885.29	3843.51	3798.96	3752.70	3679.68	3587.01	3479.32	6663.37	6629.97	6559.37	6465.06	6358.87	6231.02	6061.04
SE(m±)	13.20	12.97	13.30	14.76	13.05	12.01	14.48	20.32	21.91	21.75	18.01	19.02	18.54	22.02
CD (5%)	39.23	38.55	39.52	43.86	38.79	37.86	42.10	60.37	65.10	64.61	53.51	56.52	55.09	65.43

Figures in parentheses indicate arc sine values.

T_1 - control (untreated seeds), T_2 - polymer coating (polykote @ 3.0 ml/kg of seed, diluted with 5.0 ml of water), T_3 - treat (Tebuconazole) @ 1.0 g/kg seed, T_4 - polymer + treat (tebuconazole) @ 1.0 g/kg seed, T_5 - vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed, T_6 - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg of seed, T_7 - imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_8 - polymer + imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_9 - polymer + treat (tebuconazole) @ 1.0 g/kg seed + imidacloprid (Gaucho) @ 4.0 ml/kg seed, T_{10} - polymer + vitavax power (containing thiram 37.5% and carboxin 37.5%) @ 2.0 g/kg seed + imidacloprid (Gaucho) @ 4.0 ml/kg seed.

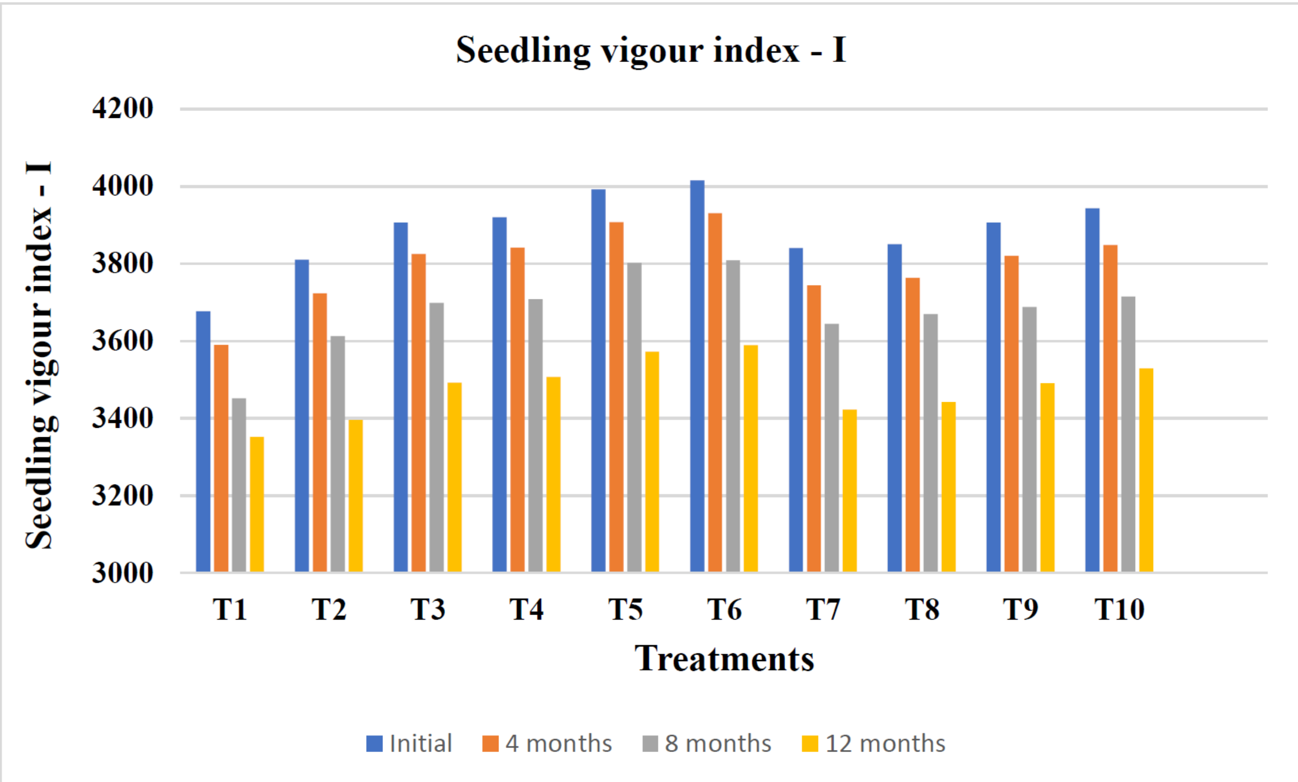

Fig. 1 : Effect of seed coating treatments on seedling vigour index - I during storage of maize

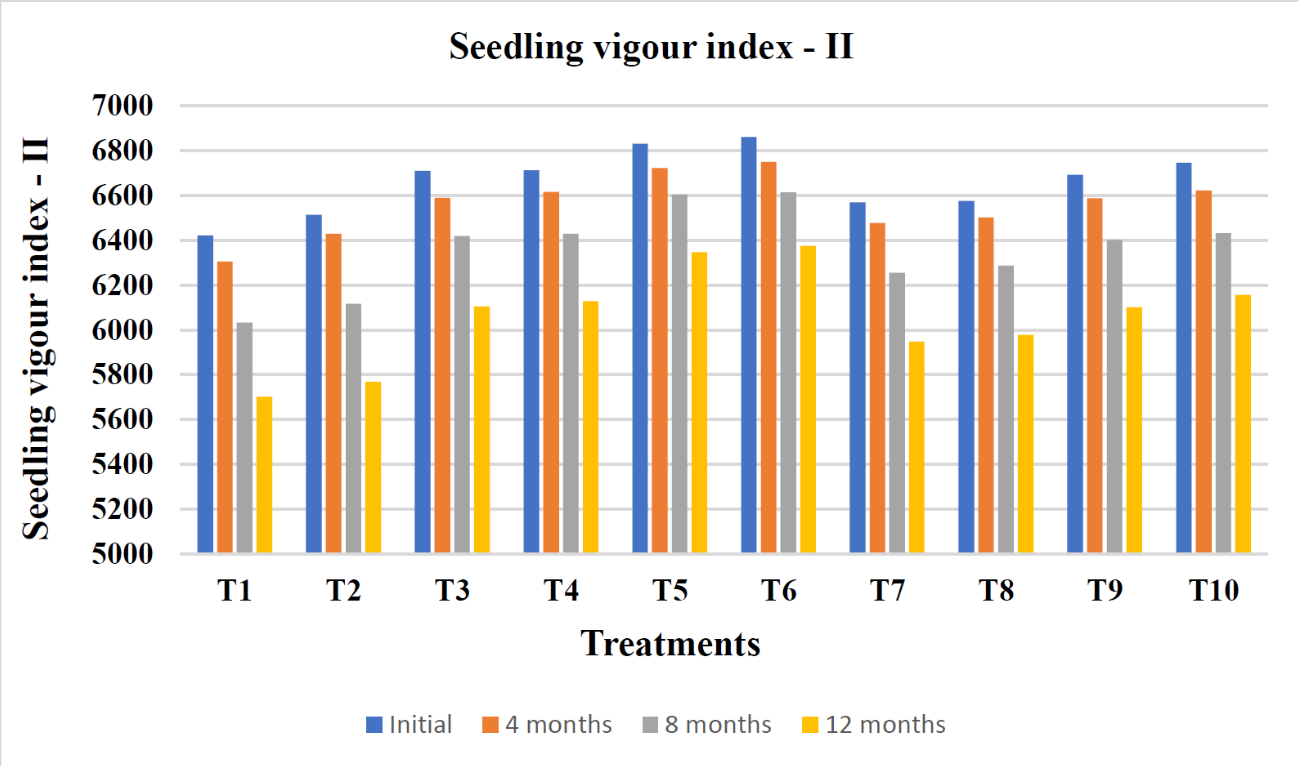

Fig. 2 : Effect of seed coating treatments on seedling vigour index - II during storage of maize

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Author's contribution

Conceptualization and designing of the research work (KC Dhiman); Execution of field/lab experiments and data collection (DIVYA and APARNA JYOTI); Analysis of data and interpretation (DIVYA, KC Dhiman, and RAJESH KANWAR); Preparation of manuscript (RK)

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