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Studies on Different Seed Treatments with Polymer and Chemicals on Longevity of Wheat (*Triticum aestivum* L.) Seeds Stored for 24 Months

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Abstract

The experiment was conducted during (January–December, 2021) at CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh, India to examine how seed treatments affect seed quality and to determine which one of the seed treatments is most efficacious in enhancing the longevity of seeds of wheat. The wheat variety (HPW 155) seeds were treated with nine various treatments containing polym., FC, IC, polym.-FC and polym.-IC combinations and a control total of ten treatments. The seeds were stored in HDPE (High-density polyethene) interwoven non-laminated bags after treatments. The seed quality attributes were evaluated at the interval of two months for the period of twelve months (25th–36th months). Amongst different seed treatments, seed coated with Polm.+vitavax 200 (containing thiram, 37.5% and carboxyl, 37.5%) @ 2.0 g kg^{-1} of seed (T_6) was found superior for quality attributes viz., GP (88.33%), SG (17.86), SL (15.11 cm), SDW (10.42 mg), SVI-I (1335), SVI-II (920) and FE (69.00%) which was at par with Vitavax 200 (containing thiram, 37.5% and carboxyl, 37.5%) @ 2.0 g kg^{-1} seed (T_5) at the completion of 36 months of storage in comparison to UC (T_1) Hence, polymer in combination with vitavax or vitavax alone can also effectively prevent the fast deterioration of seed during the storage period as they maintain the seed quality parameters for a long duration of time.

Keywords: Wheat, polymer, quality seed, storage, HDPE, chemicals

1. Introduction

Wheat (*Triticum aestivum L.*) is a cereal grass; geographically, its origin is Middle East. Wheat is polypoid (2n=6x=42; AABBDD) in nature and it belongs to Gramineae family. It is the most critical and well-thought-out cereal crop for most of the world's population. Because of its greater area of coverage, high productivity, and significant role in the global food grain trade, it is known as the "King of Cereals. The wheat plant features hollow stems in most species, long, thin leaves and flower heads with anywhere from 20 to 100 distinct kinds of blooms. Spikelets, or clusters of flowers, form. It plays a vital role in the human diet and provides significant monetary support for the country (Singh et al., 2012). Additionally, there are trace amounts of vitamin A, riboflavin, thiamin and niacin.

One of the best methods for achieving the highest possible crop production is by utilising high-quality seed. The use of high-quality seeds can increase yield by 15–20%, which can be boosted to 45% with effective management of other inputs. to 45% by effective management of other inputs (Thakur et al., 2024). High-quality seeds are essential for successful agriculture, as they must be readily germinable and produce vigorous seedlings to ensure higher yields. (Ananthi et al., 2015). When exposed to varying environmental conditions, these seeds are more likely to perform well, as seen by high emergence rates and speed of germination, strong plant stand establishment, healthy seedling development in the beginning, and higher final yield (Tillmann and Miranda, 2006).

Seed germination and seedling growth are the most vulnerable periods in the seed life process and germination is easily disturbed by numerous stressors that in turn, affect seedling growth and final yield and quality (Smolikova and Medvedev, 2022). Seed deterioration begins as soon as the plant reaches its physiological maturity. Through research advancements over the past few decades, seed treatment technology has developed and produced a number of items that can be used to control the seeds' and the crop's performance potential (Jacob et al., 2016). The seeds had just undergone a variety of quality-enhancement procedures prior to storage and sowing. Soil-borne wheat diseases caused by various pathogens are common and seriously affect seed germination and subsequent seedling growth (Capo et al., 2020). Seed treatment technology is widely utilized for various purposes. It enhances precision sowing (Lagoa et al., 2012), facilitates the delivery of nutrients (Farooq et al., 2012), provides growth hormones (Gevrek et al., 2012), acts as a bioactive coating (Ziani et al., 2010), and serves as an anti-counterfeiting measure to prevent the distribution of fake seeds in the market (Guan et al., 2013). Coating seeds with fungicide agents provides a potential method to control seed-borne and soil-borne fungal diseases. (Zhang et al., 2011). One of these methods is seed coating, which involves applying external substances directly to the seed such as polym., FC, and IC- to improve its quality and potential for production without appreciably changing the seed's size, weight, or shape (Kumar et al., 2007). Functionalized polymers enhance the efficiency of pesticides and herbicides by allowing for precise and uniform application of chemicals. This also helps in protecting the environment by reducing pollution and cleaning up existing pollutants (Ekebafe et al., 2011). Sowing is made easier by polymer coating since the seeds flow through it smoothly. In addition to enhancing seedling vigour, this helps boost seeds' resistance to pests and diseases during the crucial juvenile stage. In these circumstances, seed treated with polymer, fungicides and insecticides were found effective in enhancing germination, final plant establishment and other seed quality parameters.

2. Materials and Methods

The experiment was carried out from (January–December, 2021) in at Department of Seed Science and Technology, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh, India situated at 32.101 'N latitude and 76.547 'E longitudes. For the successful conduction of experiment carry-over seeds of HPW155 wheat variety of *rabi* 2017–18 (six months old seeds). To achieve uniform seed coating, the different treatments were applied manually and the details of the different treatments are mentioned in Table 1 in abbreviated form. After applying various coatings, seeds were kept for drying in the shade for seventy-two hours at room temperature. Nine different treatment combinations and one uncoated i.e., control were used to study the effect of different seed treatments on longevity in wheat. The treatment details are mentioned in Table 1. The mc was then reduced to its original level 10%, before the seeds were packed for storage. All the treated and untreated seed were stored for 36 months (January–December, 2021) at the Seed Technology Laboratory of the Department of Seed Science and Technology, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, Himachal Pradesh in interwoven non-laminated bags made of high-density polyethylene (HDPE). Three replications of each treatment and control were used in the completely randomised design (CRD) experiment. In the current investigations, the bi-monthly evaluation of seed quality parameters was done.

Table 1: Treatments detail

Sl. No.	Treatment symbol	Seed treatment description
1.	T_1	Control (uncoated seeds)
2.	T_2	Polym. coating (polykote @ 3.0 ml kg^{-1}) of seed, diluted with 5.0 ml of water
3.	T_3	Flowable thiram (Royal flow 40 SC) @2.4 ml kg^{-1} of seed
4.	T_4	Poly.+flowable thiram (Royal flow 40 SC) @ 2.4 ml kg^{-1} seed
5.	T_5	Vitavax 200 (containing thiram, 37.5% and carboxyl, 37.5%) @ 2.0 g kg^{-1} seed
6.	T_6	Polm.+vitavax 200 (containing thiram, 37.5% and carboxyl, 37.5%) @ 2.0 g kg^{-1} of seed
7.	T_7	Imidacloprid (Gaucho) @ 4.0 ml kg^{-1} seed
8.	T_8	Polym.+imidacloprid (Gaucho) @ 4.0 ml kg^{-1} seed
9.	T_9	Polym.+flowable thiram (Royal flow 40 SC) @ 2.4 ml kg^{-1} seed+imidacloprid (Gaucho) @ 4.0 ml kg^{-1} seed
10.	T_{10}	Polym.+vitavax 200 (containing thiram, 37.5% and carboxyl, 37.5%) @ 2.0 g kg^{-1} of seed+imidacloprid (Gaucho) @ 4.0 ml kg^{-1} of seed

For the ongoing studies, seed quality attributes were evaluated bi-monthly for 12 months (25^{th}–36^{th} months), i.e. from (January–December, 2021) to examine different seed quality parameters as described below:

One hundred randomly selected seeds from each treatment of each replication (three replications) were used for the germination test by using blotter paper method (BP) as per ISTA. On the 8^{th} day from date when seeds were kept for germination the final count (%) were recorded.

It was calculated as:

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

One hundred seeds were drawn randomly from each treatment in three replications for field emergence. The seeds were placed 3 to 5 cm deep in well-prepared soil and then covered with dirt. On the tenth day of following sowing, the field emergence (%) count was conducted. The number of seedlings that arose above the soil surface was taken into consideration while calculating the emergence percentage.

Length of seedling (cm) has been calculated by taking 10 normal seedlings were randomly taken from each treatment (three replications) at the final count of germination and it was measured from tip of leaf to tip of root, expressed in centimetres (cm).

Seedling dry weight (mg) has been calculated by keeping the same seedlings in butter paper which were used for measuring seedling length in the oven at 70°C for 18 hrs. It was expressed in milligram (mg).

A seed sample weighing 170 g (as per the specification of the moisture meter) was withdrawn randomly from each treatment of (three replications), and then mc (%) was recorded using a moisture meter (NDMM PM600).

For the calculation of speed of germination number of seeds germinated everyday were counted up to last count. For the calculation, formula mentioned below were used and was expressed in numbers.

SOG=n1/d1+n2/d2+n3/d3+n4/d4+…..+ n/d

Where n1, n2, n3…..n is the number of seeds germinated

And d1, d2, d3…..d are the days to germination

For the calculation of vigour index, Abdul-Baki and Anderson (1973) method were used. The formula for the same is represented below:

SVI-I=Germination percentage×Seedling length (cm)

SV-II=Germination percentage×Seedling dry weight (mg)

From each treatment were of all three replications hundred seeds were taken randomly to determine the insect infestation (%) level in wheat seeds. These seeds were critically observed for insect infestation using a magnifying glass.

For the analysis of data OPSTAT (Sheoran et al., 1998) software was used. The data on germination (%), field emergence (%) were transformed into arcsine transformation, and the transformed data were used for the statistical analysis. The CD between the treatments was carried out at 5% significance.

3. Results and Discussion

All the seed quality contributing characters were evaluated in the lab revealed a significant difference due application of different seed treatments. The mean germination percentage at the beginning and at the end of the storage period was 88.90% and 82.20%, respectively. The average germination percentage declined gradually from 88.90% to 82.20% at the end of 36 months of storage (Table 2) in spite of having different treatments. Out of nine different treatments and one control, two treatments which showed significantly higher germination percentages at 36 months of storage were T_6-polym.+vitavax 200 @2.0 g kg^{-1} of seed (88.33%), which was comparable with T_5-vitavax 200 @ 2.0 g kg^{-1} of seed (88.00%) over T_1-control (76.33%).

Significantly, higher seedling length (cm) in comparison to T_1 - untreated control (12.13 cm) was observed in T_6 (15.11 cm), which was comparable with T_5 (15.02 cm). The seedling length of polymer and vitavax (T_6) coated seeds were longer than that of untreated seeds (T_1). The result of seedling length was represented (Table 3).

A similar pattern was observed for the seedling dry weight (mg) and is presented in (Table 3). Significantly higher dry matter of seedling (mg) in comparison to T_1-untreated control (8.19 mg) at 36 months of storage was observed in T_6-(10.42 mg), which was comparable with T_5-(10.40 mg) (Table 3). With the advancement of storage period, the dry matter of the seedling declined.

After 26 months of storage, significantly highest moisture content was observed in T_1-control (12.63%) and lower moisture content (%) was recorded in T_{10}-(10.60%). A similar trend was observed at the end of 36 months of storage; the highest moisture content was recorded in treatment T_1-control (11.70%) and significantly lower moisture content (%) was recorded in T_{10} (10.18%) (Table 4).

Throughout the storage period, the speed of germination consistently slowed down despite various seed coating treatments. At the beginning and conclusion of the storage period, the average germination speed was 18.19 and 17.33, respectively (Table 4). After 26 months of storage, a significantly higher speed of germination was recorded in T_6-(18.40), which was comparable with T_5-(18.35) and at the end of storage period, a similar pattern was observed in T_6- (17.86), which was comparable with T_5-(17.75).

The average vigour index - I recorded at the start (26th month) was 1362 and at the (36th month) of the storage period was 1171 (Table 5) (Figure 1). Highest vigour index-I was observed at the end of 36 months of storage in T_6-(1335) which was comparable with T_5-(1322). Significantly higher vigour index - II at the end of storage (36 months) was observed in T_6- (920), which were comparable with T_5-(915) in comparison to T_1-untreated control (628) (Table 5) (Figure 2).

The average field emergence percentage was 73.00% and 64.33% at the beginning and end of the storage period, respectively (Table 2). Significantly higher field emergence was recorded for T_6 (69.00%), which was at par with T_5 (67.33%) as compared to T_1 (58.00%) at the end of 36 months of storage.

There was no evidence of insect infestations were seen in any treatments along with the control until the end of the storage period.

By the end of storage period, higher germination was recorded in treated seeds which may be because of suppressive nature of chemicals on pest and pathogen. Polymer and vitavax reduces the impact of ageing enzymes on seed deterioration, while polymer film act as a physical barrier that has been reported to reduce the leaching of inhibitors from the seed coat and restricting oxygen diffusion to the embryo. As a

Table 2 : Effect of different seed treatments on germination (%) and field emergence (%) during storage of wheat variety HPW155

Treat-ments	Months after storage											
	Germination (%)						Field emergence					
	26	28	30	32	34	36	26	28	30	32	34	36
T_1	86.00 (68.03)	85.00 (67.22)	83.33 (65.92)	82.67 (65.40)	79.67 (63.20)	76.33 (60.89)	66.33 (54.54)	66.00 (54.34)	64.67 (53.54)	62.00 (51.95)	60.67 (51.17)	58.00 (49.60)
T_2	87.67 (69.74)	87.00 (68.87)	86.00 (68.03)	84.33 (66.69)	82.67 (65.40)	80.67 (63.92)	69.67 (56.63)	68.00 (55.56)	67.00 (54.95)	65.33 (53.14)	63.00 (53.14)	62.00 (51.95)
T_3	88.33 (70.03)	87.33 (69.15)	86.67 (68.60)	85.33 (67.48)	83.67 (66.16)	81.33 (64.40)	70.67 (57.26)	69.67 (56.61)	68.67 (56.00)	67.67 (55.35)	63.33 (54.55)	64.67 (53.53)
T_4	86.67 (68.59)	86.33 (68.31)	85.33 (67.48)	83.67 (66.16)	80.67 (63.92)	78.00 (62.05)	69.00 (56.19)	67.00 (54.95)	65.67 (54.14)	64.33 (52.54)	62.00 (52.54)	61.00 (52.54)
T_5	92.00 (73.59)	91.33 (72.88)	90.67 (72.22)	90.33 (71.92)	89.00 (70.64)	88.00 (69.77)	78.00 (62.03)	76.33 (60.91)	75.00 (60.00)	72.67 (57.46)	69.33 (57.46)	67.33 (56.20)
T_6	93.00 (74.68)	92.67 (74.40)	92.00 (73.59)	91.00 (72.56)	89.33 (70.94)	88.33 (70.03)	81.33 (64.41)	79.00 (62.83)	77.33 (61.58)	74.00 (58.96)	71.33 (58.96)	69.00 (57.46)
T_7	89.67 (71.25)	89.00 (70.64)	88.00 (69.74)	86.67 (68.59)	85.00 (67.22)	83.00 (65.66)	75.67 (60.46)	74.00 (59.35)	72.67 (58.48)	71.00 (56.00)	68.67 (56.00)	66.67 (54.74)
T_8	90.00 (71.58)	89.33 (70.99)	88.33 (70.03)	87.00 (68.87)	85.33 (67.48)	83.33 (65.92)	76.00 (60.69)	74.33 (59.56)	73.33 (58.92)	72.00 (56.79)	69.00 (56.79)	67.67 (55.35)
T_9	87.00 (68.87)	86.67 (68.59)	85.67 (67.76)	84.00 (66.43)	82.33 (65.15)	80.33 (63.68)	69.33 (56.39)	67.33 (55.15)	66.00 (54.35)	64.67 (52.74)	62.33 (52.74)	61.67 (51.75)
T_{10}	88.67 (70.33)	88.00 (69.74)	87.00 (68.87)	86.00 (68.03)	84.33 (66.87)	82.67 (65.39)	74.00 (59.35)	72.67 (58.48)	71.67 (57.84)	70.00 (55.15)	67.33 (55.15)	65.33 (53.93)
Mean	88.90 (70.67)	88.13 (70.05)	87.23 (69.17)	86.10 (68.21)	84.20 (66.63)	82.20 (65.17)	73.00 (58.79)	71.43 (57.77)	70.20 (56.98)	68.30 (54.85)	66.00 (54.85)	64.33 (53.49)
SEm±	0.44	0.59	0.50	0.46	0.46	0.47	1.16	1.04	1.03	1.19	1.19	0.91
CD (p=0.05)	1.30	1.75	1.46	1.36	1.37	1.40	3.43	3.06	3.03	3.51	3.51	2.67

T_1: Control (untreated seeds); T_2: Polymer coating (polykote @ 3 ml kg^{-1} of seed; diluted with 5 ml of water); T_3: Flowable thiram (Royal Flow 40 SC) @ 2.4 ml kg^{-1} of seed; T_4: Polymer+flowable thiram (Royal Flow 40 SC) @ 2.4 ml kg^{-1} of seed; T_5: vitavax 200 (containing thiram 37.5% and carboxil 37.5%) @2 g kg^{-1} of seed; T_6: polymer+vitavax 200 (containing thiram 37.5% and carboxil 37.5%) @ 2 g kg^{-1} of seed; T_7: Imidachloprid (Gaucho) @ 4 ml kg^{-1} of seed; T_8: polymer+imidachloprid (Gaucho) @ 4 ml kg^{-1} of seed; T_9: Polymer+flowable thiram (Royal Flow 40 SC) @ 2.4 ml kg^{-1} of seed+imidachloprid (Gaucho) @ 4 ml kg^{-1} of seed; T_{10}: Polymer +vitavax 200 (containing thiram 37.5% and carboxil 37.5%) @ 2 g kg^{-1} of seed+imidachloprid (Gaucho) @ 4 ml kg^{-1} of seed; Figures in parenthesis indicates arcsine values

result, germination was retained for longer period of time. These results are in agreement with the These results are in agreement with the findings of Vijaykumar et al. (2007) in cotton, Siri et al. (2014) in hybrid rice, Rao et al. (2015) in hybrid cotton, Chaturvedi et al. (2021) in wheat, Singh et al. (2021) in rice. All the researchers deduced that seeds coated with polymer+vitavax or thiram recorded higher germination percentage at the end of storage period. Further, it has been observed that the treatments T_6 and T_5 were able to retain the germination percentage above the IMSCS by the end of storage period i.e. 36 months.

The decline in seedling length over time in all the treatments may be due to age induced decrement in germination and damage caused by toxic metabolite accumulation which might have hindered the seedling growth. However, seedling length (cm) of polymer and vitavax treated seeds were retained highest as compared to untreated seeds. The reason for this may be because of higher germination percentage and better initial growth of seedlings in seed treated with polymer and fungicides, as it prevented the seeds from fungal invasion, leading to better germination and subsequently higher seedling length. This may be because

Table 3: Effect of different seed treatments on seedling length (cm) and seedling dry weight (mg) during storage of wheat variety HPW155

Treatments	Months after storage											
	Seedling length (cm)						Seedling dry weight (mg)					
	26	28	30	32	34	36	26	28	30	32	34	36
T_1	13.15	13.02	12.95	12.78	12.50	12.13	8.80	8.72	8.59	8.41	8.33	8.19
T_2	15.48	15.33	15.21	15.09	14.82	14.16	10.03	9.71	9.69	9.65	9.52	9.36
T_3	14.52	15.36	15.24	15.11	14.84	14.36	10.07	9.95	9.87	9.78	9.64	9.50
T_4	14.82	14.57	14.50	14.32	14.13	13.63	9.28	9.15	9.00	8.95	8.88	8.80
T_5	15.85	15.79	15.75	15.66	15.38	15.02	11.38	11.17	10.92	10.61	10.54	10.40
T_6	15.90	15.85	15.79	15.71	15.44	15.11	11.40	11.20	10.94	10.63	10.56	10.42
T_7	15.64	15.41	15.30	15.27	15.00	14.55	10.64	10.54	10.45	10.33	10.22	10.08
T_8	15.66	15.55	15.47	15.36	15.10	14.64	10.68	10.57	10.47	10.36	10.24	10.12
T_9	15.41	15.21	15.10	14.95	14.54	14.12	9.54	9.40	9.32	9.21	9.12	9.00
T_{10}	15.57	15.38	15.27	15.24	14.96	14.44	10.29	10.01	9.96	9.87	9.77	9.59
Mean	15.30	15.15	15.06	14.95	14.67	14.22	10.21	10.04	9.92	9.78	9.68	9.55
SEm±	0.08	0.08	0.09	0.10	0.11	0.16	0.10	0.11	0.14	0.13	0.10	0.11
CD (p=0.05)	0.23	0.24	0.26	0.29	0.33	0.49	0.30	0.32	0.40	0.37	0.28	0.31

Table 4: Effect of different seed treatments on speed of germination and moisture content (%) during storage of wheat variety HPW155

Treatments	Months after storage											
	Moisture content (%)						Speed of germination					
	26	28	30	32	34	36	26	28	30	32	34	36
T_1	12.63	11.60	12.70	13.80	11.90	11.70	17.56	17.50	16.93	16.33	16.09	15.81
T_2	12.40	11.09	12.89	13.47	11.73	11.45	18.20	18.15	18.10	17.76	17.47	17.29
T_3	12.20	10.87	12.63	13.10	11.54	11.35	18.25	18.20	18.16	17.83	17.59	17.45
T_4	11.68	10.60	11.82	12.53	11.20	11.00	17.99	17.89	17.58	17.18	16.91	16.73
T_5	11.50	10.80	11.59	12.18	11.09	10.90	18.35	18.30	18.25	18.00	17.86	17.75
T_6	11.10	10.58	11.30	11.50	10.83	10.60	18.40	18.35	18.31	18.08	17.96	17.86
T_7	11.87	10.69	12.22	12.70	11.40	11.10	18.30	18.26	18.23	17.95	17.80	17.66
T_8	11.07	10.50	11.13	11.20	10.90	10.50	18.33	18.28	18.21	17.98	17.84	17.78
T_9	10.91	10.39	10.93	11.10	10.80	10.40	18.18	18.10	18.00	17.67	17.38	17.25
T_{10}	10.60	10.27	10.63	10.50	10.58	10.18	18.29	18.25	18.19	17.91	17.78	17.76
Mean	11.60	10.78	11.79	12.22	11.20	10.93	18.19	18.13	18.00	17.67	17.47	17.33
SEm±	0.07	0.06	0.14	0.17	0.06	0.07	0.05	0.05	0.06	0.06	0.06	0.09
CD (p=0.05)	0.20	0.17	0.40	0.51	0.19	0.21	0.14	0.15	0.17	0.17	0.18	0.27

of adequate supply of water, nutrients and due to initiation of photosynthesis and synthesis of protease, alpha-amylase and other hydrolytic enzymes which appear to stimulate the activity of gluconeogenic enzymes during initial stage of seed germination, thus resulting in higher seedling length. Similar findings were observed by Bharamaraj (2011) in cotton seed, Kotia et al. (2020) in radish, in wheat, and Chaturvedi et al. (2021) in wheat reported that seeds treated with polymer+vitavax 200 @2.0 g kg^{-1} of seed resulted in significantly higher seedling length (16.06 cm) over control (13.16) at the end of 24 months of storage in wheat and Thakur et al. (2022) in wheat, Dhiman et al. (2024) in maize.

The decrement in dry matter of seedling could be attributed to natural ageing, resulting in seed decomposition, reduced

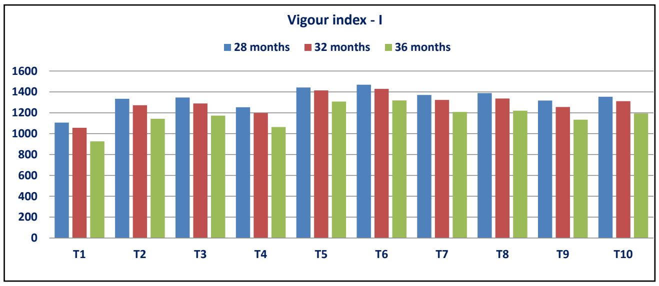

Figure 1: Effect of different seed treatments on vigour index-I during storage of wheat variety HPW155

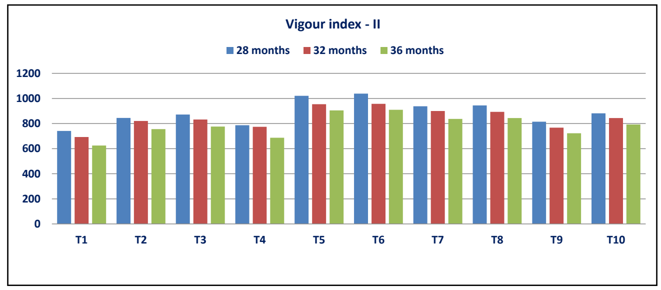

Figure 2: Effect of different seed treatments on vigour index-II during storage of wheat variety HPW155

Table 5: Effect of different seed treatments on vigour index-I and vigour index-II during storage of wheat variety HPW155

Treatments	Months after storage											
	Vigour index-I						Vigour index-II					
	26	28	30	32	34	36	26	28	30	32	34	36
T_1	1130	1106	1079	1056	996	926	757	741	716	693	664	625
T_2	1363	1334	1308	1273	1225	1142	883	845	833	821	787	755
T_3	1371	1347	1321	1289	1242	1168	889	872	856	832	806	773
T_4	1284	1253	1228	1198	1140	1063	804	787	762	774	717	687
T_5	1459	1442	1428	1415	1368	1322	1047	1021	990	955	938	915
T_6	1479	1469	1452	1429	1379	1335	1060	1039	1007	957	943	920
T_7	1403	1371	1346	1323	1275	1207	954	938	920	900	869	837
T_8	1410	1389	1366	1336	1289	1220	961	944	925	893	874	844
T_9	1341	1318	1294	1256	1197	1134	830	815	799	767	751	723
T_{10}	1381	1353	1328	1311	1262	1194	912	881	866	843	824	793
Mean	1362	1338	1315	1289	1237	1171	910	888	867	844	817	785
SEm±	9.02	11.17	10.56	8.50	13.28	15.07	10.29	12.98	14.10	10.94	11.37	11.08
CD (p=0.05)	26.61	32.96	31.15	25.08	39.18	44.46	30.36	36.81	41.61	32.27	33.53	32.69

germination percentage and seedling length. However, seeds treated with polymer and fungicide exhibited higher dry matter of seedling (mg) due to the advantage of polymer seed coating. The polymer acts as a binding agent and covers minor cracks and aberrations on the seed coat and keeps the seed intact. It may also act as a physical barrier which limits leaching of inhibitors from seed coverings and restraining oxygen transport and thus decreasing embryo respiration and thereby reducing the ageing effect on seed and the treatments with fungicide protects the seed from fungal invasion. Similar findings were reported by Chaturvedi et al. (2021) in wheat.

The coating of chemicals and polymer on seeds cover the pores in the seed coat which consequentially restricted the entry of water in the seeds and protected from any physical damage. These results are in agreements with Singh et al. (2021) in paddy reported that seed treated with polymer+vitavax 200 @ 2.0 g kg^{-1}+imidacloprid (Gaucho) @4.0 ml kg^{-1} of seed exhibited lower moisture content (%) at the end of 36 months of storage, Chaturvedi et al. (2021) in wheat reported that seed treated with polymer+vitavax 200 @ 2.0 g kg^{-1}+imidacloprid (Gaucho) @ 4.0 ml kg^{-1} of seed exhibited lower moisture content (%) at the end of 24 months of storage.

The reduction in rate of germination might be due to limited supply of oxygen to the embryo and retaining of water soluble germination inhibitors. Higher rate of germination was observed in seeds treated with chemical and polymer. The reason for this might be due to protection of seeds from insect attack and fungal invasion. These are in agreement with findings of Kotia et al. (2020) in radish seeds.

The reduction in vigour index - I and vigour index - II may be due to natural ageing which resulted in decreased germination, dry matter accumulations in seedlings and seedling length. Higher vigour index - I and vigour index - II in polymer treatment in combination with fungicide is due to better germination and seedling length. It may be due to synergistic effect of both polymer and chemicals which contributed in better vigour and lowered down the action of seed deterioration during storage. In addition, the polymer treatment safeguards against the stress associated with rapid ageing. Similar results were depicted by Kotia et al. (2020) in radish, Singh et al. (2021) in paddy wherein they reported that seed treated with polymer+vitavax 200 @ 2.0 g kg^{-1} seed resulted in significantly higher vigour index - I over control at the end of 36 months of storage.

This may be because of the covering of seed by chemicals and polymers which leads to enhanced rate of imbibition, wherein the fine particles of coating act as a moisture attracting material, as well as provides protection against microorganism which in turn helps in better plant establishment.

Similar results were reported by Chaturvedi et al. (2021) in wheat seeds treated with different seed coating treatments at the end of 36 and 24 months of storage, respectively.

5. Conclusion

Seed coating enhanced the longevity of seed to a much more extended period in comparison to uncoated seed. The quality attributes of seed declined continuously with the time. The results depicted that seeds treated with Polym.+vitavax 200 @ 2.0 g kg^{-1} of seed (T_6) and vitavax 200 @ 2.0 g kg^{-1} of seed (T_5) recorded significant superiority over control (T_1) for almost all the seed quality attributes during storage.

5. References

Abdul-Baki, A.A., Anderson, J.D., 1973. Vigor determination in soybean seed by multiple criteria. Crop Science 13(6), 630–633.

Ananthi, M., Selvaraju, P., Srimathi, P., 2015. Effect of seed treatment on seed and seedling quality characters in redgram cv. CO (Rg) 7. International Journal of Science and Nature 6(2), 205–208.

Bharamaraj, B., 2011. Influence of seed coating with synthetic polymer and seed treatment chemicals on seed quality and longevity of cotton seed (*Gossypium hirsutum* L.) (Doctoral dissertation, University of Agricultural Sciences, Bangalore).

Capo, L., Zappino, A., Reyneri, A., Blandino, M., 2020. Role of the fungicide seed dressing in controlling seed-borne Fusarium spp. infection and in enhancing the early development and grain yield of maize. Agronomy 10(6), 784.

Chaturvedi, R., Dhiman, K.C., Kanwar, R., Thakur, M., 2021. Effect of seed coating treatments on longevity of wheat (*Triticum aestivum* L.) seeds. Journal of Cereal Research 13(Spl-1), 57–66. http://doi. org/10.25174/2582-2675/2021, 114886.

Dhiman, S., Dhiman, K.C., Kanwar, R., Kapila, R.K., 2024. Effect of seed coating with polymer and chemicals on longevity of maize (*Zea mays* L.). Journal of Cereal Research 15(3). https://ebook.icar.gov.in/index.php/JWR/article/view/142455.

Ekebafe, L.O., Ogbeifun, D.E., Okieimen, F.E., 2011. Polymer applications in agriculture. Biokemistri 23(2), 81–89.

Farooq, M., Wahid, A., Siddique, K.H., 2012. Micronutrient application through seed treatments: a review. Journal of Soil Science and Plant Nutrition 12(1), 125–142.

Gevrek, M.N., Atasoy, G.D., Yigi, A., 2012. Growth and yield response of rice (*Oryza sativa*) to different seed coating agents. International Journal Agriculture and Biology 14, 826–830.

Guan, Y., Wang, J., Tian, Y., Hu, W., Zhu, L., 2013. The novel approach to enhance seed security dual anti-counterfeiting methods applied on tobacco pelleted seeds. PLoS One 8, 210–219.

Jacob, S.R., Kumar, M.A., Varghese, E., Sinha, S.N., 2016. Hydrophilic polymer film coat as a micro-container of individual seed facilitates safe storage of tomato seeds. Scientia Horticulture 204, 116–122.

Kotia, K., Dhiman, K.C., Kanwar, R., 2020. Effect of seed treatments on quality and storability of radish (*Raphanus sativus* L.) seeds. Agriculture Research 57, 414–424.

Kumar, J., Nisar, K., Kumar, M.A., Walia, S., Shakil, N.A., Prasad, R., 2007. Development of polymeric seed coats for seed quality enhancement of soybean *Glycine max*. Indian Journal of Agricultural Sciences 77(11).

Lagôa, A.D.O., Ferreira, A.C., Vieira, R.D., 2012. Plantability and moisture content of naked and pelleted seeds of supersweet (Sh2) corn during cold storage conditions. Revista Brasileira de Sementes 34, 39–46.

Rao, P.S., Parimala, K., Rajasri, M., Rani, M.S., 2015. Effect of seed coating with polymers and chemicals on seed quality during storage in hybrid cotton. Journal of Research, ANGRAU 43(1/2), 44–48.

Sheoran, O.P., Tonk, D.S., Kaushik, L.S., Hasija, R.C., Pannu, R.S., 1998. Statistical software package for agricultural research workers. Recent advances in information theory, statistics & computer applications by DS Hooda & RC Hasija Department of Mathematics Statistics, CCS HAU, Hisar 8(12), 139–143.

Singh, A., Dhiman, K.C., Kanwar, R., Kapila, R.K., 2021. Effect of seed coating on seed storability and longevity in rice (*Oryza sativa* L.). Agriculture Research 58, 399–406.

Singh, S.K., Mishra, V.K., Srivastava, U.K., Kumar, A., 2012. Impact of irrigation levels on growth, yield and quality of wheat (*Triticum aestivum* L.). Environment and Ecology 30, 72–77.

Siri, B., Reddy, P.V., 2014. Effect of polymer seed coating and seed dressing with pesticides on storability of treated seeds in hybrid rice (*Oryza sativa* L.). Australian Journal of Crop Science 8(10), 1415–1420.

Smolikova, G., Medvedev, S., 2022. Seed-to-seedling transition: novel aspects. Plants 11(15), 1988.

Thakur, A., Dhiman, K.C., Kanwar, R., 2022. Effects of seed treatment on seed quality and storability in wheat (*Triticum aestivum* L.) in North Western Himalayas. Bangladesh Journal of Botany 51(1), 113–121.

Thakur, A., Sharma, P., Jyoti, A., Nissa, K., Kanwar, R., 2024. Hybrid seed production. In book: Elements of Plant Breeding, 63–73.

Tillmann, M.A.A., Miranda, D.M., 2006. Seed analysis. Seeds: Scientific and Technological Foundations, 159–255.

Vijaykumar, R.H., Biradar Patil, N.K.,Vyakarnhal, B.S., 2007. Effect of seed coating with polymer, fungicide, and insecticide on seed quality in cotton during storage. Karnataka Journal of Agricultural Sciences 20(1), 137–139.

Zhang, L., Greenberg, S.M., Zhang, Y., Liu, T.X., 2011. Effectiveness of thiamethoxam and imidacloprid seed treatments against *Bemisia tabaci* (Hemiptera: Aleyrodidae) on cotton. Pest Management Science 67(2), 226–232.

Ziani, K., Ursua, B., Mate, J.I., 2010. Application of bioactive coatings based on chitosan for artichoke seed protection. Crop Protection 29, 853–859.