

Original Research Article

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## Effect of Polymer Seed Coating and Seed Treatment on Seed Quality Parameters and Yield Attributing Characters of Hybrid Maize (*Zea mays* L.)

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### ABSTRACT

#### Keywords

Seed treatment, Maize, Polymer Coating

#### Article Info

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The experiment was conducted in Post Graduate Seed Testing Laboratory, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) during *kharif* season 2018. Effect of polymer seed coating and seed treatment on seed quality parameters and yield attributing characters of hybrid maize consisted of 12 treatments with four replication in lab. The seeds were coated with Polymer@ 3g kg<sup>-1</sup> seed in combination with fungicides (Thiram@ 2g kg<sup>-1</sup> seed, Bavistin@ 2g kg<sup>-1</sup> seed, Captan@ 3g kg<sup>-1</sup> seed) and insecticide (Imidacloprid@ 5g kg<sup>-1</sup> seed, Chloropyriphos@ 3g kg<sup>-1</sup> seed) and maintained untreated seeds (control). The results of the present investigation revealed that T<sub>7</sub> (with polymer coating + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed) was found to be significantly superior viz., Germination Percentage (92.75), Seedling Root Length (11.28cm), Seedling Shoot Length (3.19cm), Seedling Length (14.47cm), Seedling Fresh Weight (1.47g), Seedling Dry Weight (0.40g), Seed Vigour Index-I (1341.99), Seed Vigour Index-II (37.10).

### Introduction

Maize (*Zea mays* L.) is one of the most important cereals of the world. It has worldwide significance as human food, animal feed and as a raw material for large number of industrial products. Maize is a high yielding cereal, which is readily digestible and extensively used in confectionaries. It is used as a basic raw material for the production of starch, oil, protein, alcoholic beverages, food sweetener and more recently as biofuel. It is a versatile, miracle crop and thus termed as “Queen of Cereals”.

According to the USDA world agricultural supply and demand estimates report, October 2018 maize production was forecasted 1068.30 million tonnes in 2018-19, India (26.50 MT). Whereas in Uttar Pradesh, it occupies an area 0.9 million hectares with an average productivity of 1.70 tonnes/ha and production of 1.10 million tonnes (Indian Institute of Maize Research–Annual Report, 2016).

Maize is a species with a great capacity to adapt to varied environmental conditions, but pest and disease incidence may result in

decreased production and quality. Quality seed is the key for successful agriculture which demands that each and every seed should be readily germinable and produce a vigorous seedling ensuring higher yield (Ananthi *et al.*, 2015). Seed coating technology has developed rapidly during the past two decades and provides an economical approach to seed enhancement. Seed coating is a process of directly applying useful material to form a thin and uniform coating without altering the shape or size of the seed. Seed coating has presented promising results in many crops including cereals. Seed coating with natural or synthetic polymers has gained rapid acceptance by the seed industry. It makes room for including all the required ingredients like inoculants, protectants, nutrients, plant growth promoters, hydrophobic / hydrophilic substances, herbicides, oxygen suppliers etc.

Seed coating with polymer improves the adherence of the chemical to the seed, ensures dust free handling of treated seed. Functionalized polymers were used to increase the efficiency of pesticides and herbicides, allowing the application of accurate and even dosage of chemicals and to indirectly protect the environment by reducing pollution and clean-up existing pollutants (Ekebafe *et al.*, 2011). Polymer coating is simple to apply, diffuses rapidly and non-toxic to the seed during germination.

The polymer film may act as physical barrier which has been reported to reduce the leaching of inhibitors from the seed coverings and may restrict oxygen diffusion to the embryo (Kumar *et al.*, 2014). Thereby, it provides protection from the stress imposed by ageing, improves plant stand and emergence of seedlings. Polymer acts as a temperature switch and protective coating by regulating the water uptake and subsequent germination of seed (John *et al.*, 2005a). Polymer in combination with fungicides and insecticides

can improve the health of the seed. Coating results in more uniform and accurate seed rate due to the smooth flow of the seed during mechanical sowing. Increase in germination can also be observed in polymer coated seed. Addition of colourant helps in visual monitoring of placement accuracy, enhance the appearance, marketability and consumer preference. An ideal polymer will not be permeable to water vapour but will be water-soluble and allow the seed to imbibe sufficient moisture for germination without scarification. Polymer film coating enhances the aesthetic value of the seed by improving the physical properties thereby helps in improving the marketability of the seed as well (John *et al.*, 2005b). It is usual to add colour to make treated seed less attractive to birds if spilt and easier to see and also to clean up in the case of an accidental spillage.

Seed treatment is a process in which a chemical, typically antimicrobial or fungicidal or insecticidal, with which seed is treated prior to planting to provide an inexpensive insurance against pathogens and pests. Seed treatment can be an environmentally more friendly way of using pesticides as the amount used can be very small. Chemical seed treatment is one of the efficient and economic plant protection practices that can be used to control both external and internal seed infection. It protects young seedlings or adult plants against attack from seed-borne, soil-borne or airborne diseases. It disinfects the seed from pathogen, checks spread of harmful organisms, promotes seedling establishment, maintains and improves seed quality or minimizes yield losses. Apart from disease control, seed treatment also has a positive effect on crop growth and yield, hence used in many crops for various purposes. Increasingly, commercial seed treaters are beginning to view seed treatment as a means to substantially increase the value of the seed and to improve plant growth and productivity.

Treating seed with fungicides is a common practice that is expected to prevent seed borne diseases caused by pathogenic fungi. Moreover, to avoid damage caused by insect pests, the combinations of fungicides with insecticides have been employed, resulting in a considerable increase in the number of chemical components used in seed treatments. Thiram is the simplest thiram disulfide and the oxidized dimer of dimethyldithiocarbamate, which is used as a fungicide to prevent seed and crops from fungal diseases. Imidacloprid is a systemic insecticide belonging to the chemical class of neonicotinoids which acts by specially blocking the microtinergetic neural pathway of insects (Jemec *et al.*, 2007). Seed treatment with imidacloprid controls the sucking pests upto 45 days effectively (Vijaykumar, 2005).

The positive and significant response of polymer seed coating either alone or in combination with insecticide/fungicide/bioagents/natural fillers on germination, seedling vigour, growth and yield improvement have been reported in mustard (Rana *et al.*, 2001), maize (Baxter and Waters, 1986 a and b and John, 2003) and cowpea (Ramya, 2003).

## Materials and Methods

The Lab experiment were conducted to study “The Effect of Polymer Seed Coating and Seed Treatment on seed Quality Parameters and Yield attributing characters of Hybrid Maize (*Zea mays L.*)”, Shivam Gold S-25, at Department of Genetics and Plant Breeding, Naini Agricultural Institute, SHUATS, Prayagraj. The treatments used were T<sub>0</sub>-Control, T<sub>1</sub>-Without polymer coating + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, T<sub>2</sub>-Without polymer coating + Seed treatment with Imidacloprid @ 5g kg<sup>-1</sup> seed, T<sub>3</sub>-Without polymer coating + Seed treatment with Bavistin @ 2g kg<sup>-1</sup> seed, T<sub>4</sub>-Without polymer

coating + Seed treatment with Chloropyriphos @ 3gm kg<sup>-1</sup> seed, T<sub>5</sub>-Without polymer coating + Seed treatment with Captan @ 3gm kg<sup>-1</sup> seed, T<sub>6</sub>-With polymer coating @3g kg<sup>-1</sup> seed + No chemical seed treatment, T<sub>7</sub>-With polymer coating @3g kg<sup>-1</sup> seed + Seed treatment with Thiram@ 2g kg<sup>-1</sup> seed, T<sub>8</sub>-With polymer coating @3g kg<sup>-1</sup> seed + Seed treatment with Imidacloprid @ 5g kg<sup>-1</sup>seed, T<sub>9</sub>-With polymer coating @3g kg<sup>-1</sup> seed + Seed treatment with Bavistin@ 2g kg<sup>-1</sup> seed, T<sub>10</sub>-With polymer coating @3g kg<sup>-1</sup> seed + Seed treatment with Chloropyriphos @ 3g kg<sup>-1</sup> seed, T<sub>11</sub>-With polymer coating@3g kg<sup>-1</sup> seed + Seed treatment with Captan @ 3g kg<sup>-1</sup> seed. Initially seed was treated with chemicals i.e., Thiram @ 2g kg<sup>-1</sup> seed, Imidacloprid @ 5g kg<sup>-1</sup> seed, Bavistin @ 2g kg<sup>-1</sup> seed, Chloropyriphos @3gm kg<sup>-1</sup> seed, Captan @3gm kg<sup>-1</sup> seed.

During seed treatment required concentration of the chemical (s) was manually mixed thoroughly with seed in 1 kg polythene bags to ensure uniform coating. After chemical seed treatment, the seed was air dried in shade for 24 hrs to bring back to 12% moisture content. Then the seed was coated with polymer @ 3 g kg<sup>-1</sup> seed for the treatments T<sub>6</sub>, T<sub>7</sub>, T<sub>8</sub>, T<sub>9</sub>, T<sub>10</sub> T<sub>11</sub> and the other Treatments are left uncoated with polymer. During the process of seed coating utmost care was taken to have uniformity in coating.

The laboratory test for germination was conducted as per the ISTA rules (ISTA 1985) by adopting between paper method for all the treatments of the experiment. Hundred seed each in four replications were taken from each treatment and uniformly placed on germination paper. The paper towels with seed inside rolled was placed in plastic tray in upright position at ambient conditions. Daily germination counts were performed until no further germination occurred for seven consecutive days.

## Observations recorded

Data was recorded on the following parameters as per the details mentioned below:

### Germination (%)

On the final day of germination test, the normal seedlings were counted and the germination (%) was calculated as per the formula mentioned below:

$$\text{Germination (\%)} = \frac{\text{Number of normal}}{\text{Total number of seeds}} \times 100$$

### Root length (cm)

Root length was determined by randomly selecting ten normal seedlings in each treatment and each replication at the end of the germination count. The root length was measured from the tip of the root to the base of the hypocotyl using a scale and the mean root length was expressed in centimetres.

### Shoot length (cm)

The same seedlings that were previously used to determine root length were also utilized to measure the shoot length. Shoot length was measured from the tip of the primary leaf to the base of the hypocotyl and the mean shoot length was expressed in centimetres.

### Seedling Length (cm)

The sum of root and shoot length of ten seedlings was calculated and their mean was expressed as seedling length in centimeters.

### Seedling Fresh Weight (g)

Ten representative seedlings used for shoot and root length measurement were taken and fresh weight of these seedlings was recorded by using an electronic weighing balance.

Average weight was calculated and was expressed in grams per seedling.

### Seedling dry weight (g)

Ten representative seedlings used for fresh weight measurement were taken in butter paper packet and kept in an oven maintained at  $75 \pm 1^\circ\text{C}$  for 48 hours. After cooling the weight of the dried seedlings was recorded using an electronic weighing balance and average weight was calculated and was expressed in grams per seedling.

### Seedling vigour index-I

Seedling vigour index-I was computed by adopting the following formula as suggested by Abdul-Baki and Anderson (1973) and was expressed in whole number. Seedling vigour index-I = Germination (%) x Seedling length (cm)

### Seedling vigour index-II

Seedling vigour index-II was computed by adopting the following formula:

$$\text{Seedling vigour index-II} = \text{Germination (\%)} \times \text{Seedling dry weight (g)}$$

## Results and Discussion

According to the results, all studied traits were affected by the treatments and there was completely significant difference between control (non-primed seeds) and treated seeds. All seedling characters *viz.* Germination percent, Root length (cm), Shoot length (cm), Seedling length (cm), seedling fresh weight (g), seedling dry weight (g), Seedling Vigour index-I, Seedling Vigor index-II were affected by significantly recorded maximum with T<sub>7</sub>-With polymer coating @3g kg<sup>-1</sup> seed + Seed treatment with Thiram@ 2g kg<sup>-1</sup> seed whereas found in lowest in control (Table 1).

**Table.1** Mean performance of maize for seedling characters

Sr.no	Treatments	Germination (%)	Seedling Root length (cm)	Seedling Shoot length (cm)	Seedling length (cm)	Seedling fresh wt (g)	Seedling dry wt (g)	Vigour index- I	Vigour index- II
1	T <sub>0</sub>	90.50	10.03	1.27	11.30	0.97	0.12	1022.81	10.86
2	T <sub>1</sub>	91.00	11.05	2.39	13.44	1.20	0.22	1223.04	19.80
3	T <sub>2</sub>	90.75	10.73	2.30	13.03	1.11	0.18	1182.06	16.33
4	T <sub>3</sub>	91.00	10.80	2.36	13.15	1.16	0.20	1196.61	18.43
5	T <sub>4</sub>	90.50	10.68	2.23	12.90	1.00	0.15	1167.62	13.12
6	T <sub>5</sub>	90.50	10.70	2.23	12.93	1.08	0.16	1169.66	14.71
7	T <sub>6</sub>	90.50	10.35	2.02	12.36	0.97	0.13	1118.82	11.31
8	T <sub>7</sub>	<b>92.75</b>	<b>11.28</b>	<b>3.19</b>	<b>14.47</b>	<b>1.47</b>	<b>0.40</b>	<b>1341.99</b>	<b>37.10</b>
9	T <sub>8</sub>	91.50	11.14	2.50	13.64	1.37	0.34	1247.87	31.11
10	T <sub>9</sub>	91.75	11.15	2.50	13.65	1.41	0.38	1252.23	34.41
11	T <sub>10</sub>	91.25	11.06	2.45	13.51	1.27	0.25	1232.72	23.04
12	T <sub>11</sub>	91.50	11.13	2.46	13.58	1.32	0.30	1242.92	27.22
<b>G.MEAN</b>		91.13	10.84	2.32	13.16	1.19	0.23	1199.87	21.45
<b>F.TEST</b>		S	S	S	S	S	S	S	S
<b>SE.D</b>		0.46	0.37	0.08	0.38	0.03	0.01	33.96	0.87
<b>CD (p=0.5)</b>		0.94	0.76	0.16	0.79	0.06	0.02	70.21	1.79
<b>CV</b>		0.71	4.77	4.86	4.1	3.36	5.68	4.00	5.72

The maximum germination (%) (92.75) was recorded in T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, while minimum (90.50) germination (%) was observed in T<sub>0</sub> (Control). Satyabhama *et al.*, (2016) observed significantly highest seed germination with polymer coating @ 4 ml kg<sup>-1</sup> seed in groundnut and concluded that the increase in germination might be due to the hydrophilic nature of the polymer that has increased imbibition rate which led to faster activation of cells and resulted in the enhancement of mitochondrial activity leading to the formation of more high energy compounds and vital biomolecules, which were made available during the early phase of germination and reduced imbibitional damage by regulating the water uptake.

The Maximum seedling root length (11.28cm) was recorded in T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, while minimum (10.03cm) seedling root length was observed in T<sub>0</sub> (Control). The Maximum seedling shoot length (3.19cm) was recorded in T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, while minimum (1.27cm) seedling shoot length was observed in T<sub>0</sub> (Control). The Maximum seedling length (14.47cm) was recorded in T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, while minimum (11.30cm) seedling length was observed in T<sub>0</sub> (Control). The highest seedling fresh weight (1.47g) was recorded in T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, while least (0.97g) seedling fresh weight was observed in T<sub>0</sub> (Control). The treatment T<sub>9</sub> (Polymer coating @3g kg<sup>-1</sup> seed + Seed treatment with Bavistin @2g kg<sup>-1</sup> seed) is statistically at par with T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed. The highest seedling dry weight (0.40g) was recorded in T<sub>7</sub> (Polymer

coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, while least (0.12g) seedling dry weight was observed in T<sub>0</sub> (Control). The treatment T<sub>9</sub> (Polymer coating @3g kg<sup>-1</sup> seed + Seed treatment with Bavistin @2g kg<sup>-1</sup> seed) is statistically at par with T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed. The highest seedling vigour index I (1341.99) was recorded in T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, while least (1022.81) seedling vigour index I was observed in T<sub>0</sub> (Control). Geetha *et al.*, (2014) and Rakesh *et al.*, (2017) obtained significant variation in seedling vigour. The highest seedling vigour index II (37.10) was recorded in T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed, while least (10.86) seedling vigour index II was observed in T<sub>0</sub> (Control).

The present investigation revealed that the maximum germination percentage (92.75), seedling root length (11.28cm), seedling shoot length (3.19cm), seedling length (14.47cm) were recorded with T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed. Maximum seedling fresh weight (1.47g), seedling dry weight (0.40g), seedling vigour index I (1341.99), seedling vigour index II (37.10), were recorded with T<sub>7</sub> (Polymer coating@ 3g kg<sup>-1</sup> seed + Seed treatment with Thiram @ 2g kg<sup>-1</sup> seed. These findings are based on one- season. So, for best results, it may need further trials

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