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Impact of seed film coating polymers on growth, yield and seed quality of rice (*Oryza sativa* L.)

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ABSTRACT

The experiment was conducted during 2016 and 2017 to study the effect of film coating polymers on growth, yield and seed quality of Rice (Oryza sativa L.) variety MTU 1010. Experiment was laid out in Randomised Block Design with four replications. Four treatments viz.T_1 (treatment with water + Thiram), T_2 (Polymer DISCO AG SP RED L-200 + Thiram + Carboxine), T_3 (Polymer DISCO AG SP RED L-200 +Thiram+ Genious coat) and T_4 (Polymer DISCO AG SP RED L-200 + Thiram + Quick roots or Mycorriza) were compared with control T_0 (no treatment). It was revealed that highest seed yield in terms of kg ha^{-1} was recorded in T4 (Polymer DISCO AG SP RED L-200 +Thiram+ Quick roots or Mycorriza) (5100.0 kg ha^{-1}) followed by T3 (Polymer DISCO AG SP RED L-200 +Thiram+ Genious coat) (5054.2 kg ha^{-1}). Among the seed quality parameters under storage, germination percentage was highest in T_4 (93.5) but with increase of storage period germination percentage decreased significantly. Seeds treated with T_4also recorded maximum viable seeds (98.4%), maximum seedling length (26.4 cm) and vigour index value (2467.6). Considering seed yield and seed quality parameters, T4 (Polymer DISCO AG SP RED L-200 +Thiram+ Quick roots or Mycorriza) appears to be ideal among thetreatments for quality seed production in rice.

Keywords: Polymer, seed quality, rice and yield

In modern agriculture, farmers pursue continuous improvement through new technologies that help them face these obstacles in a sustainable way. This includes the responsible use of crop protection products (insecticides, herbicides and fungicides), applied to the soil, seeds or the growing crop (Hazra and Patanjali 2016). Seed treatment through seed coating formulations offer an increasingly precise mode of applying products in the field, and provide a high level of protection against insects and disease while reducing potential exposure of humans and the environment to crop protection products. Since seed is the basic input in agriculture and plays a crucial role in boosting up the production, productivity and economy of the country, without the use of quality seed, the investments incurred on inputs *i.e.* fertilizer, pesticide and irrigation will not pay dividend which ought to be realized. In order to improve the quality of the produced seed, seed film coating polymers can play an important role. Seed film coating includes any process for the addition of materials to the seed. The term'coated seed' has been defined as a seed that has been 'pelleted', 'tableted' or 'taped'.Seedcoating is one of the most useful areas of seed enhancements and an economical approach forimproving the seed performance. Seed placement and performance can be greatly enhanced byaltering the shape of seeds or placing the chemicals on seed coat which regulate and improvegermination. Seed coatings can be done in different ways, namely, Chemical protectants (Captan,Apron, Vitavax, etc.), microorganisms (Rhizobium, Trichoderma), slurry coating, film coating andtemperature-sensitive polymers (IntellicoatTM). In case of slurry coating, a wettable powder issuspended in water to make slurry and a known quantity of slurry and the seeds are dumped inmixing chamber where they are blended. The treatment fluid is directly applied to the seeds in theform of mist in a *mist-o-matic* seed treater. Film coating is the application of a thin, durable and water permeable coat which can be used to contain pesticides and other products securely, so that they may have maximum effect at the time of sowing. The seed shape is not changed and increase inseed weight is by 1-10 per cent. Keeping this view, the present experiment was conducted to find out the efficacy of seed film coating polymers on quality seed production of rice (*Oryza sativa* L.).

MATERIALS AND METHODS

The field experiment was conducted during *kharif* 2016-17 at the Mundouri Research Farm, and laboratory experiments were conducted during 2017-18 at the Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, West Bengal to study the effect of film coating polymers on growth and yield of rice (*Oryza sativa* L.) variety MTU 1010. The research station is located at a height of 9.75 m above sea level (23.5°N latitude and 89°E longitude). The experiment consists of 5 treatments including control T_0 (no treatment), T_1(treatment with

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water + Thiram), T_2 (Polymer DISCO AG SP RED L-200 +Thiram+ Carboxine), T_3 (Polymer DISCO AG SP RED L-200 +Thiram+ Genious coat) and T_4 (Polymer DISCO AG SP RED L-200 +Thiram+ Quick roots/ Mycorriza). Experiment was laid out in randomised block design with four replications. The soil of the experimental site is clayey in texture with pH 6.9. Basal fertilizers @ 30 kg N, 30 kg P_2O_5 and 30 kg K_2O ha^{-1} were applied as the time of transplantingin the main field and another 30 kg N ha^{-1} was applied during tillering stage. Crop was transplanted at a spacing of 20 cm row to row and 15 cm plant to plant in each plot of size 6 x 4 m. The sowing in seed bed was done on 12.07.2016 and transplanted on 05.08.2016. Recommended agronomic packages and need based plant protection measures were adopted for raising the crop. Ten hills from each replication in each treatment were selected at random to record data on morphological, yield and yield attributing characters. The freshly harvested seeds were packed into cloth bag and stored under ambient condition. Seed sample were drawn at an interval of two months up to eight months of storage. The seed quality characters *viz.*viability percentage, germination percentage, seedling length and vigour indexwas estimated in the laboratory of Department of Seed Science of Technology, Bidhan Chandra KrishiViswavidyalaya, Mohanpur, Nadia by following the methods as prescribed by International Seed Testing Association (ISTA). Data on various variables were analysed by analysis of variance (Panse and Sukhatme, 1985) and OPSTAT software programme.

RESULTS AND DISCUSSION

Effect of film coating polymers on growth and yield contributing parameters

The data presented in table 1 revealed that effect of polymer along with other seed treating chemical had non-significant effect on plant growth parameters like days to 50% flowering, plant height at 30 days after transplanting and at maturity, days to maturity. The treatments also showed non-significant variations on yieldcontributing characters except number of grains $panicle^{-1}$ and grain yield kg $^{-1}$.Numerically,T_3 (Polymer DISCO AG SP RED L-200 +Thiram+ Genious coat) treated plants were earliest in flowering (77.25 days) and T_1 (treatment with water + Thiram) plants matured first (107.75 days). Highest plant height at 30 days after transplanting (32.75 cm) was observed in T_4 (Polymer DISCO AG SP RED L-200 +Thiram+ Quick roots/ Mycorriza) but T_1 treated plants had maximum plant height at maturity (114.75 cm). T_0(untreated) plants produced lowest plant height at both 30 days after transplanting as well as at maturity (29.75 and 110.25

Table 1: Effect of film coating polymers on growth and yield contributing parameters

Treatments	50% flowering (days)	Plant height (cm)		Maturity (days)	Panicle Length (cm)	Tiller $hill^{-1}$ (no)	Grains $panicle^{-1}$ (no)	Seed setting (%)	100 seed weight (g)	Seed yield $Plot^{-1}$ (kg)	Seed yield (kg ha^{-1})
		30 DAT	At maturity								
T_0	78.25	29.75	110.25	107.75	23.73	14.30	148.55	71.21	2.24	10.79	4495.8
T_1	77.50	30.75	114.75	107.50	24.68	14.95	134.60	69.74	2.26	10.97	4570.8
T_2	77.25	31.50	112.50	108.00	24.53	14.55	144.25	72.60	2.31	11.02	4591.7
T_3	77.25	31.50	112.50	108.00	23.90	14.70	137.35	71.96	2.24	12.13	5054.2
T_4	79.25	32.75	112.75	109.25	23.93	15.40	135.60	71.83	2.23	12.24	5100.0
Range	77.25-79.25♣	29.75-32.75	110.25-114.75♣	107.50-109.25♣	23.73-24.68♣	14.30-15.40♣	134.60-148.55♠	69.74-72.60♣	2.23-2.31♣	10.79-12.24♣	4495.8-5100.0♠
Mean	77.90	31.25	112.55	108.10	24.15	14.78	140.07	71.47	2.26	11.43	4762.5
SEm (±)	**1.34**	**0.53**	**3.05**	**0.69**	**0.65**	**0.41**	**4.83**	**1.29**	**0.03**	**0.69**	**201.04**
LSD (0.05)	**3.82**	**1.53**	**8.72**	**1.97**	**1.86**	**1.17**	**13.82**	**3.69**	**0.08**	**1.98**	**575.63**

Note: T_0: No treatment; T_1: Treatment with water + Thiram; T_2: Polymer (DISCO AG SP RED L-200) + Thiram + Carboxine; T_3: Polymer (DISCO AG SP RED L-200) + Thiram + Genius Coat; T_4: Polymer (DISCO AG SP RED L-200) + Thiram + Quick roots / Mycorrhiza. ♣ Insignificant values, ♠Only T_0 is statistically different from T1.

Table 2: Effect of film coating polymers on seed quality under storage condition

Treatment	Germination(%)	Viability (%)	Seedling length (cm)	Vigour index
Treatments				
T_0	87.6	93.4	22.09	1935.8
T_1	90.4	96.9	24.02	2171.7
T_2	89.6	97.5	25.60	2295.7
T_3	89.0	97.8	25.90	2303.4
T_4	93.5	98.4	26.40	2467.6
SEm (±)	**0.342**	**0.181**	**0.219**	**22.24**
LSD (0.05)	**1.132**	**0.598**	**0.727**	**73.66**
Storage Duration				
D_1	91.3	98.1	26.16	2391.8
D_2	89.9	97.2	25.00	2249.7
D_3	88.8	96.4	24.48	2174.9
D_4	89.9	95.4	23.56	2123.1
SEm (±)	**0.350**	**0.138**	**0.177**	**17.38**
LSD (0.05)	**1.015**	**0.400**	**0.512**	**50.45**
Interaction				
SEm (±)	**0.759**	**0.322**	**0.406**	**40.35**
LSD (0.05)	**2.265**	**0.977**	**1.227**	**122.12**

Notes: T_0: No treatment ; T_1: Treatment with water + Thiram; T_2: Polymer (DISCO AG SP RED L-200) + Thiram + Carboxine; T_3: Polymer (DISCO AG SP RED L-200) + Thiram + Genius Coat; T_4: Polymer (DISCO AG SP RED L-200) + Thiram + Quick roots / Mycorrhiza
D1: Seeds stored for 2 months;D2: Seeds stored for 4 months;D3: Seeds stored for 6 months;D4: Seeds stored for 8 months.

cm respectively).Numerically there is little difference in days to flowering and maturity irrespective of treatments. This may be due to non-photoperiod nature of the crop.

Among the yield contributing characters highest panicle length was observed in T_1 (24.68 cm) followed by T_2 (24.53 cm). Maximum number of tillers hill^{-1} was observed in T_4 (15.40) followed by T_1 (14.95). Although number of grains panicle^{-1} was highest in T_0 (148.55) followed by T_2 (144.25), the seed setting percentage was highest in T_2 (72.60%) followed by T_3 (71.96%). 100 seed weight was maximum in T_2 (2.31g) followed by T_1 (2.26 g). Highest seed yield per plot as well as in terms of kg ha^{-1} was recorded in T_4 (12.24 kg plot^{-1}and 5100.0 kg ha^{-1} respectively) followed by T_3(12.13kg plot^{-1}and 5054.2 kg ha^{-1} respectively).This may be due to more number of tillers hill^{-1} resulting higher seed yield kg plot^{-1}. The presence of Thiram and quick roots/ mycorriza present in T_4 (Polymer DISCO AG SP RED L-200 +Thiram+ Quick roots/Mycorriza) influenced more translocation of nutrients from the root zone thereby increased the number of tillers hill^{-1} and seed yield significantly compared to control (T_0). Similar findings were reported by Gevrek*et.al*.where seed treatment with GA_3 @ 1000 mg^{-1} water using seed film coating technique increased seed yield of rice.

Effect of film coating polymers on seed quality under storage condition

The ability of the seeds to maintain their quality during storage is influenced by several factors, including water content when the seeds were stored, the temperature and relative humidity of the air in the storage environment. Seed quality is also governed by genetic make up, retention of viability and seed vigour (Deepa *et al*. 2013). Germination percentage of the seeds under storage condition was studied at two months interval upto eight months (Table 2). It revealed that germination percentage was highest in T_4 (93.5) but with increase of storage period germination percentage decreased significantly. The seed viability percentage was statistically significant in treatments and duration of storage. Seeds treated with T_4 (Polymer DISCO AG SP RED L-200 +Thiram+ Quick roots/Mycorriza) recorded maximum viable seeds (98.4%) but with increase of storage period viability also decreased significantly. Seedling length and vigour index showed similar trends where vigour index decreased with advancement of

storage but T_4 treated seeds showed maximum seedling length(26.4 cm) andvigour index value (2467.6).

It can be inferred that seeds treated with T_4 (Polymer DISCO AG SP RED L-200 +Thiram+ Quick roots/ Mycorriza) appears to be most promising for increase of seed yield followed by T3 (Polymer DISCO AG SP RED L-200 +Thiram+ Genious coat).Among the seed quality parameters under storage, germination percentage was highest in T_4 (Polymer DISCO AG SP RED L-200 +Thiram+ Quick roots/Mycorriza) but with increase of storage period germination percentage decreased significantly.Seeds treated with T_4recorded maximum viable seeds;maximum seedling lengthandvigour index value.The above formulated seed coating products may be used by the seed producers that are safe to the seed, the environment and the user. But this requires further validation of the results and identification of other new formulations for better delivery of the products.

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