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INFLUENCE OF SEED COATING WITH POLYMER ON SEED QUALITY OF HYBRID MAIZE (*ZEA MAYS* L.)

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ABSTRACT

A laboratory experiment was undertaken to standardize the optimum dosage from different dosages (2, 4, 6, 8 and 10 ml kg^{-1} seeds) of seed coating polymer for hybrid maize (Hema) based on various seed quality parameters in the Department of Seed Science and Technology, UAS, Raichur. Among the different dosages, maize seeds treated with 6 ml polymer kg^{-1} recorded significantly higher seed germination (95.50 %) compared to control (93.00 %). However, 6 ml polymer kg^{-1} seed was on par with 4 ml kg^{-1} seed (95.00 %). While, 4 ml polymer kg^{-1} recorded significantly higher speed of germination, shoot length, root length, seedling dry weight and seedling vigour index (38.29, 22.23 cm, 20.98 cm, 93.68 mg and 4105, respectively) compared to all other treatments and control (93.00, 35.05, 21.25 cm, 20.49 cm, 89.00 mg and 3882, respectively). Hence, in order to get better seed germination and seedling vigour, maize seeds can be treated with 4 ml polymer kg^{-1} (dissolved in 40 ml distilled water).

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INTRODUCTION

Maize (*Zea mays* L.) is considered as the "queen of cereals" because of its high yielding potential among the cereals. It is a prime staple food for large proportion of human population in the developing countries (Saleem *et al.*, 2012). It is cultivated on nearly 150 million ha that covers about 160 countries contributing to nearly 36 per cent (782 million tonnes) of the global grain production with an average productivity of 4920 kg per ha (Anon., 2014). As it is well known fact that initially when the seed is sown in the field it has to overcome all the vagaries of nature in the initial stages of it growth, the seeds of any crop for its matter need to be invariably treated with protectants (micronutrients, fungicides, insecticides etc) (Gajendra kidrapure *et al.,* 2015: Gurung *et al.,* 2014). It is also well evident that the seed quality parameters decline gradually with advancement in storage period (Tejashwi *et al.,* 2014: Rakesh *et al.,* 2013). This also can be prevented through use of different seed protectants through seed coating with polymer that prevent seed deterioration. In order to supply these protectants to the seed we need a binding agent which should be very thin enough and it should not come in the way of seed germination in the field when the seed is being sown. Hence, polymer can effectively serve this purpose.

Seed polymer coating is the application process of the plasticizer polymer to the seed that does not obscure its shape but forms a flexible film that adheres and protects the active ingredients (micronutrients, fungicides, insecticides etc) on the seed surface (Sherin, 2003). Since polymer is readily water soluble, it does not impede the germination and reduces imbibitions damages and thereby improves germination, seedling emergence and also maintains the longevity of the seed for a longer period of time (Sherin *et al.,* 2005).Since the polymer acts as a binding agent in addition it also has some positive effect on seed quality. Hence, its crop specific optimum dosage standardization is the need of the hour as 6 ml polymer per kg seed (Shinde *et al.,* 2015) proved to be optimum for Bengal gram seed coating in order to get higher seed germination and seedling vigour.

With these views, an attempt was made in the Department of Seed Science and Technology, University of Agricultural Sciences, Raichur with an objective to standardize the optimum dosage of polymer for seed treatment in maize.

MATERIALS AND METHODS

The Laboratory experiment was conducted during 2015-2016 in the Department of Seed Science and Technology, College of Agriculture, University of Agricultural Sciences, Raichur to standardize the optimum dosage of seed coating polymer (Disco Agro DC Red L-603 procured from Incotec Pvt. Ltd. Ahmadabad, Gujarat) for maize (hybrid Hema). The experiment consisted of 5 different dosages of polymer (P) along with a control *viz.,* P_1: Control, P_2: polymer @ 2 ml per kg of seed, P_3: polymer @ 4 ml per kg of seed, P_4: polymer @ 6 ml per kg of seed, P_5: polymer @ 8 ml per kg of seed and P_6: polymer @ 10 ml per kg of seed. These dosages were used for coating the cleaned and graded seeds in a rotary seed coating machine

after diluting with 40ml of distilled water (standardized from the preliminary experiment).The coated seeds were shade dried for 24 hours in order to bring them back to original moisture content. The properly dried seeds were subjected for assessment of various seed quality parameters as mentioned below.

Germination (%)

The germination test was conducted in four replications of 100 seeds each by following between paper method and the rolled towels were incubated in a walk in seed germination chamber maintained at 25 ± 2 °C temperature and 90 ± 5 % RH (ISTA, 2013). The numbers of normal seedlings in each replication were counted on 7th day and the mean germination was calculated and expressed in percentage

Speed of germination

Seeds were germinated on paper medium with four replications of 100 seeds each. The number of seeds that germinated were recorded on daily basis up to the day of final count. The speed of germination was calculated by using the formula as suggested by Maguire (1962).

$$\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \ldots\ldots\ldots\ldots \frac{X_n - X_{(n-1)}}{Y_n}$$

Where, X_n = Number of seeds germinated at nth count

Y_n = Number of days from sowing to nth count

Root length (cm)

From the germination test, five normal seedlings were randomly selected from each treatment replication wise on the day of final count. The root length was measured from tip of the root to hypocotyl point and the mean length was calculated and expressed as root length in centimeters (ISTA, 2013).

Shoot length (cm)

From the germination test, five normal seedlings were randomly selected from each treatment replication wise on the day of final count. The shoot length was measured from tip of shoot to hypocotyl point and the mean length was calculated and expressed as shoot length in centimeters (ISTA, 2013).

Seedling dry weight (mg)

From the germination test, ten normal seedlings were taken in butter paper and dried in hot air oven maintained at 70 ± 2 ^{0}C temperatures for 24 hours. Then, the seedlings were removed and allowed to cool in a desiccator for 30 minutes before weighing in an electronic balance. The average weight was calculated and expressed as seedling dry weight in milligram per seedling (ISTA, 2013).

Seedling vigour index

Seedling vigour index was worked out by multiplying germination percentage and total seedling length (Abdul-Baki and Anderson, 1973).

Seedling Vigour Index = Germination (%) x Mean seedling length (cm).

The data obtained from the experiment were analyzed as per procedure prescribed by Panse and Sukhatme (1985).

RESULTS

Among the different doses of polymer studied, the germination percentage was significantly higher (95.50 %) in P_4 at 6 ml polymer kg^{-1} of seeds compared to all other treatments and control (93.00 %). However, P_4 was statistically on par with P_5 @ 8 ml kg^{-1} of seed (95.25 %), P_3 @ 4 ml kg^{-1} of seed (95.00 %) and P_6 @ 10 ml kg^{-1} of seed (94.75). While, the speed of germination (38.29) was significantly higher in P_3 @ 4 ml polymer kg^{-1} of seed. While, it was on par with P_4 (37.81) and P_5 (37.63) compared to control (35.05) and all other treatments. In the same line, the highest root length (20.98 cm) was recorded by 4 ml polymer kg^{-1} of seed, which was statistically on par with seeds coated at 6 ml polymer kg^1 seed (20.61 cm). While, significantly lowest root length was recorded in uncoated seed (20.49 cm) and it was on par with seed treated with 2 ml polymer kg^{-1} (20.54 cm) of seed. Similarly, the highest shoot length (22.23 cm) was recorded by 4 ml polymer kg^{-1} of seed and significantly lowest shoot length was recorded by control (21.25 cm) and it was on par with seed treated with 2 ml polymer kg^{-1} (21.34 cm) of seed. It was observed that seedling dry weight (93.68 mg) and seedling vigour index (4105) were significantly higher in P_3 compared to control (89 mg and 3882, respectively). While, they were on par with P_4 (93.13 mg and 4064, respectively). Although polymer at 8 ml kg^{-1} and 6 ml kg^{-1}of seed were higher for seed germination over 4 ml kg^{-1}of seed, it was found to be on par with 4 ml kg^{-1}of seed . While, all other seed quality parameters were higher at 4 ml kg^{-1}of seed.

DISCUSSION

Irrespective of the treatments, treating maize seeds with polymer improved the germination over control. This might be due to hydrophilic nature of the polymer that might have increased imbibition rate which led to faster activation of cells and resulting in the enhanced mitochondrial activity and formation of high energy compounds and vital bio molecules that were available during the early phase of germination due to reduced imbibition damage by regulating the water uptake (Baxter and Waters, 1986). These results are in agreement with Natarajan *et al*. (2012) who have also reported higher germination (98.00%) compared to control (93.00%) in maize with pink Polykote @ 3 g/kg of seeds + fungicide + insecticide treatment.

The better speed of germination through seed coating polymer is attributed to its hydrophilic nature, leading to faster and higher water uptake leading to quick radicle emergence (Henderson and Hensley, 1987). Similarly, Vanangamudi *et al*., (2003) opined that the fine particles in the polymer coating act as a wick or moisture attracting material and perhaps improves the seed surface area. These results are in agreement with the findings of Sherin *et al*. (2005) in maize.

The improvement in shoot and root length might be due to accelerated water uptake (Suma and Srimathi, 2014) and enhanced metabolic activity (Dexter and Takoa, 1960; Sherin *et al*., 2005) leading to early germination and better growth of seedlings (root and shoot). Polymer coating also improved the seedling dry weight due to higher root and shoot length. The positive response of polymer coating with respect to shoot

Table 1: Influence of seed coating polymer on various seed quality parameters in maize

Treatments	Germination (%)	Speed of germination	Shoot length (cm)	Root length (cm)	Seedling dry weight (mg)	Seedling vigour index
P_1: Uncoated control	93.00	35.05	21.25	20.49	89.00	3882
P_2: 2 ml per kg of seed	94.00	36.44	21.34	20.54	92.08	3937
P_3: 4 ml per kg of seed	95.00	38.29	22.23	20.98	93.68	4105
P_4: 6 ml per kg of seed	95.50	37.81	21.94	20.61	93.13	4064
P_5: 8 ml per kg of seed	95.25	37.63	21.83	20.58	92.53	4039
P_6: 10 ml per kg of seed	94.75	37.56	21.67	20.5	91.25	3995
Mean	94.54	37.13	21.71	20.62	91.94	4004
SEm ±	0.32	0.11	0.10	0.13	0.35	18
CD at 1%	0.95	0.32	0.29	0.39	1.04	53

length, root length and seedling dry weight are in line with the findings of Shakuntala *et al*. (2010) in sunflower with polymer @ 5 ml per kg seed along with vitavax and imidachlorprid, Ramesh *et al*. (2011) and Chandravathi *et al*. (2012) in pearl millet and Suma and Srimathi (2014) in sesamum with polymer @ 4 g per kg of seed.

Seed polymer coating effectively improved the seedling vigour which might be due to higher seed germination percentage, root and shoot length registered by the polymer coated treatments. Similarly, Natarajan *et al*. (2012) in maize (pink polykote @ 3 g/kg of seeds + fungicide + insecticide) and Suma and Srimathi (2014) in sesamum (polymer @ 4 g per kg of seed) reported higher seedling vigour index compared to uncoated control.

Reduced seed quality parameters at higher doses of polymer could be due to the restricted oxygen supply to the embryo and to the retention or water-soluble germination inhibitors (Xianming and Joseph, 1997). Similar findings were also reported by Suma and Srimathi (2014) in sesame, Taylor and Kwiatkowski (2001) in snap beans, Basavaraj *et al*. (2008) in onion, Natarajan *et al*. (2012) in maize, Ransing *et al*. (2013) in sorghum and Shinde *et al*., (2015) in chickpea due to seed polymer coating.

Apart from improving the seed quality parameters polymer coating makes sowing operation easier due to smooth flow of seeds. Addition of colorant helps in visual monitoring of placement accuracy, enhance the seed appearance, marketability and consumer preference (Shakuntala *et al*., 2010).

REFERENCES

Abdul-Baki, A. A. and Anderson, J. D. 1973. Vigour determination in soybean seeds by multiple criteria. *Crop Sci.* **13:** 630-633.

Anonymous 2014. Area, production and productivity of maize. *Agropedia. iitk. ac.in.*

Arantes, H. A. G., Cicero, S. M. and Novembre, A. D. 2000. Encapsulation effects on cotton seed health and germination. *Sci. Agric.* **57(1):** 81-88.

Basavaraj, B. O., Biradar, P. N. K., Vyakarnahal, B. S., Basavaraj, N., Channappagoudar, B. B. and Ravi Hunje, 2008. Effect of fungicide and polymer film coating on storabilityof onion seeds. *Kar. J. Agric. Sci.* **21(2):** 212-218.

Baxter, L. and Waters, J. L. 1986. Effect of a hydrophilic polymer seed coating on imbibitions, respiration and germination of sweet corn at four metric potentials. *J. America Soc. Hort.* **111(4):** 31-34.

Chachalis, D. and Smith, M. L. 2001. Hydrophilic polymer application reduces imbibition damage and partially improve germination or emergence of soybean seedlings. *Seed Sci. and Tech*. **29(1):** 91-98.

Chandravathi, B., Gurumurthy, R., Halesh Kumar, H. B., Prabhu Nayaka, Waghamore, A. N. and Chandrashekar, S. S. 2012. Effect of hydropriming and polymer coating seed treatments on storability in pearl millet Cv. ICMV-221, *Res. J. Agric. Sci.* **3(3):** 635-638.

Dexter, S. T. and Takao, M. 1960. Acceleration of water uptake and germination of sugar beet seed balls by surface coatings of hydrophilic colloids. *Agron. J.* **51:** 388-389.

Gajendra khidrapure, Vasudevan, S. N., Janagoudar, B. S., Sreenivas, A. G., Satynarayan, Rao. and Doddagoudar, S. R. 2015. Orgo priming: An innovative seed quality enhancement technique in Rice cv Sonamasoori. *The Ecoscan.* **9(1&2):** 403-406.

Gurung, N. Swamy, G. S. K. Sarkar, S. K. and Ubale, N. B. 2014. Effect of chemicals and growth regulators on germination, vigour and growth of passion fruit (*Passiflora Edulis Sims*.). *The Bioscan.* **9(1):** 155-157.

Henderson, J. C. and Hensley, L. 1987. Effect of a hydrophilic gel on seed germination of three tree species. *Hort. Sci.* **22:** 450-452.

ISTA. 2013. International Rules of Seed Testing. *Seed Sci. and Tech*. **27:** 25-30.

Maguire, J. D. 1962. Speed of germination-aid in selection and evaluation for seedling emergence and vigour. *Crop Sci.,* **2:** 176-177.

Manjunatha, S. N. 2007. Effect of polymer coating on storability of chilli (*Capsicum annuum* L.) seeds. *M.Sc. (Agri.) Thesis, Uni. of Agric. Sci., Dharwad (India).*

Narayanan, S. G., Prakash, M. and Sunil Kumar, B. 2011. Seed enhancement techniques to improve productivity of certain oilseed crops. *Global J. Plant Ecophysiology*. **1(1):** 1-13.

Natarajan, N., Ramesh, R. and Powel, K. 2012. Effect of hydropriming and polycoating on field performance of maize. *Res. J. Agric. Sci.* **3(2):** 512-514.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical methods for agricultural workers. *ICAR Publication,* New Delhi. p. 359.

Pradeep, K., Vasudevan, S. N., Shakuntala, N. M and Doddagoudar, S. R. 2016. Standardization of seed coating polymer dosage in pigeon pea. *Res. J. Agri. Sci.* **7(2):** 336-338.

Rakesh, C. M., Shakuntala, N. M., Vasudevan, S. N., Nagaraj, N. M. and Patil, S. B. 2013. The anti-fungal properties of aqueous extracts from *psorolea corylifolia linn*. seeds in controlling grain smut and seed quality enhancement of sorghum. *The Bioscan.* **8(2):** 685-687.

Ramesh, R., Rajashri, C. S. and Rangnath 2011. Hydrophilic polymer seed treatment on seed quality and yield in Pearl millet, cowpea and groundnut. *Seed Res.* **8(3):** 32-35.

Ransing, S. K., Shelar, V. R. and Karjule, A. P. 2013. Effect of seed coating with synthetic polymers on seed viability of sorghum during sorghum. Paper presented in: *13th Nation. Seed Sem., Innovations in Seed Res. and Dev.*, UAS, Bangalore, June 8-10, p. 84.

Saleem, M. J., Rukhsana, B., Abdul, H. and Qaiser, T. A. 2012. Maize seed storage mycoflora in Pakistan and its chemical control. *Pak. J. Bot*. **44(2):** 807-812.

Shakuntala, N. M., Vyakarnahal, B. S., Shankregoud, I., Deshpande, V. K., Pujari, B. T. and Nadaf, H. L. 2010. Effect of seed polymer coating on growth and yield of sunflower hybrid RSFH-130. *Kar. J. Agric. Sci.* **23(5):** 708-711.

Sherin, S. J. 2003. Seed film coating technology using polykote for maximizing the planting value, growth and productivity of maize, (*Zea mays* L.). CO 1. *M.Sc (Agri.) Thesis*, Tamil Nadu Agric. Univ., Coimbatore (India).

Sherin, S. J., Bharthi, A., Nateshan, P. and Raja, K. 2005. Seed film coating technologyfor maximizing the growth and productivity of maize. *Kar. J. Agric. Sci.* **18(2):** 349-356.

Shinde, P., Doddagoudar, S. R., Vasudevan, S. N., Patil, S. B. and Konda, C. 2015. Standardization of seed coating polymer in chickpea (*Cicer arietinum* L.). *Kar. J. Agric. Sci.* **28(3):** 412-413.

Suma, N. and Srimathi, P. 2014. Influence of polymer coating on seed and seedling qualitycharacteristics. *J. Agril. and Vet. Sci.* **7(5):** 48-50.

Taylor, A. G. and Kwiatkowski, J. 2001. Polymer film coatings decrease water uptake and water vapour movement into seeds and reduce imbibitional chilling injury. *BritishCrop Protection Council Symp. Proc.* **76:** 215-220.

Tejashwi, P., Kumar, A. M., Asha Maruthi, J. B. and Vishwanath, K., 2014. Influence of seed treatment chemicals and containers on seed quality of marigold during storage. *The Ecoscan*. **9(3):** 937-942.

Vanangamudi, K., Srimathi, P., Natarajan, N. and Bhaskaran, M. 2003. Current scenario of seed coating polymer. *ICAR - Short Course on Seed Hardening and Pelleting Technologies for Rainfed or Garden Land Ecosystems*, pp. 80-100.

Xianming, D. and Joseph, S. B. 1997. Seed physiology, production and technology- Filmcoating impairs leaching of germination inhibitors in sugar beet. *Crop Sci.* **37:** 515-520.