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Ashim Debnath

P.G. Student, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Chaurasia AK

Associate Professor, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Bineeta M Bara

Assistant Professor, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Suresh Vishwas

P.G. Student, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Rahul Saxena

P.G. Student, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Correspondence**Ashim Debnath**

P.G. Student, Department of Genetics and Plant Breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh, India

Effects of different priming methods and duration on seedling characters in maize (*Zea mays* L.) Seeds

Ashim Debnath, Chaurasia AK, Bineeta M Bara, Suresh Vishwas and Rahul Saxena

Abstract

The experiment was conducted in Post Graduate Laboratory, Department of Genetics and Plant Breeding, SHUATS, Allahabad, U.P. during *Rabi* (2016), in order to standardize the best method of priming specific to maize. Three methods of priming *viz.*, hydro priming, osmo priming and halo priming were evaluated by screening a range of durations and concentrations *viz.*, T₀ - Unprimed Control, T₁ - Distilled water hydration (08 hrs), T₂ - Distilled water hydration (12 hrs), T₃ - CaCl₂ at 1% (08 hrs), T₄ - CaCl₂ at 1% (12 hrs), T₅ - Glycerol at 5% (08 hrs) T₆ - Glycerol at 5% (12 hrs). It was found that all the priming methods showed significance difference with the control and the highest germination %, seedling length (cm), seedling fresh weight (g), seedling dry weight (g) and vigour indices were observed in T₃ for CaCl₂ at (08 hrs). The study helps to improve the quality of seeds with the help of seed priming treatments which are cost effective, nontoxic, economic and eco-friendly in use.

Keywords: maize, hydro priming, osmo priming, halo priming, cacl₂, glycerol

Introduction

Maize (*Zea mays* L.) 2n=20 is the world's leading crop and is widely cultivated as cereal grain that was domesticated in Central America. It is one of the most versatile emerging crops having wider adaptability. Globally, maize is known as queen of cereals because of its highest genetic yield potential. Maize is the only food cereal crop that can be grown in diverse seasons, ecologies and uses. Beside this maize have many types like normal yellow/ white grain, sweet corn, baby corn, popcorn, waxy corn, high amylase corn, high oil corn, quality protein maize, *etc.* Apart from this, maize is an important industrial raw material and provides large opportunity for value addition.

In India, maize is the third important food crop after rice and wheat. According to latest data (2010-11), it is being cultivated on 8.6 m ha with 80% area during *Kharif* season. The current maize production is 21.7 mt, with an average productivity of 2.5 t/ha. Despite maize being predominantly rainfed crop its productivity is more than rice which is mainly grown under assured irrigated/rainfed conditions. Maize contributes nearly 9 % in the national food basket and more than 400 billion to the agricultural GDP at current prices.

Maize grain has greater nutritional value as it contains 72% starch, 10% protein, 4.8% oil, 8.5% fibre, 3.0% sugar and 1.7% ash (Chaudhary, 1983).

Priming is the method used to improve stand establishment in several crops. Seed priming is a process in which seeds are imbibed either in water or in osmotic solution or combination of solid matrix carrier and water in specific proportion followed by drying before radical emergence. It is reported that seed priming is one of the most important developments to help rapid and uniform germination and emergence of seeds and to increase seed tolerance to adverse environmental conditions (Heydecker *et al.*, 1973; Harris *et al.*, 1999) [9, 8]. Seed priming has presented promising, and even surprising results, for many seeds including the cereal seeds (Bradford, 1986) [4, 5].

Materials and Methods

The present study was conducted during *Rabi* season of 2016, in Post- Graduate Laboratory of Seed Science at Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P.). The detail of the material used and techniques adopted during the course of the investigation are presented.

Experimental site

The experiment was carried out at the Laboratory of Seed Science and Technology in the

Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology and Science, Allahabad (U.P.), the area is situated on the south of Allahabad on the right side of the river Yamuna on the South of Rewa Road at a distance of about 6 Km from Allahabad city. It is situated at 25°24'23" N latitude, 81°50'38" E longitude and at the altitude of 98 meter above the sea level.

Climate condition in the experimental area

Allahabad is located in the South-East part of Uttar Pradesh, India. This region has subtropical climate with extreme of summer and winter. The temperature falls down to as low as 1°C - 2°C during winter season especially in the months of December and January. The mercury rises up to 46°C - 48°C during summer. The average rainfall in this area is around 1013.4 mm annually with maximum concentration during July to October with few showers and drizzles in winter also.

Preparation of solution

For the preparation of solution one gram of each chemical was taken in a beaker. These chemical was added separately in 1000 ml. of distilled water with constant stirring. The volume of solution will finally constituted to one liter, then it become 1000 ppm stock solution of each chemical. The flasks containing chemicals was covered with muslin cloth to avoid any contamination. For the preparation of CaCl₂ (1%), Glycerol (5%) was taken in a measuring flask and made up to 1000 ml. distilled water, while for (1%) Calcium chloride (CaCl₂) solution 10 (g) CaCl₂ salt was taken in a measuring flask and made up to 1000 ml. with distilled water and 5% Glycerol solution 50 (ml.) was taken in a measuring flask and made up to 1000 ml with distilled.

Soaking of seed

After preparation of solution of CaCl₂ and Glycerol maize seeds was soaked in required solution for 08 and 12 hour at 25°C temperature. After 08 and 12 hr. of soaking the solution was drained out from the beaker and pre-soaked air dried to original weight and then placed for germination in laboratory under controlled condition. After seed treatments seed was sown in Between paper method and sand method for occurring lab observations.

Experiment was conducted in Complete Randomized Design (C.R.D) Fisher, 1936 with four replications. Observations on lab viz- Seedling characters were worked out and the data was statistically analyzed using ANOVA.

1. Speed of germination (BRI): Speed of germination was calculated as Bartlett's Rate Index, which was worked out from the daily germination counts and calculated as follow:

$$BRI = \frac{P_1 + (P_1 + P_2) + (P_1 + P_2 + P_3) + \dots + (P_1 + P_2 + P_3 + \dots + P_n)}{N(P_1 + P_2 + P_3 + \dots + P_n)}$$

Where, P₁ + P₂ + P₃..... and P_n are the germination (%) at 1st, 2nd, and nth day, respectively and 'N' is the number of days taken for germination.

2. Standard germination count: For taking observation regarding seed germination. 100 seeds were kept blotting paper (BP method). The paper folds were kept in germination in an upright position at constant temperature 25°C ± 2°C and 80% RH. Three replications were made for each treatment with First count was taken on 4th day and Final count made after 7 days of treatment.

3. Measurement of shoot, root and total seedling length: For recording seedling length, 10 seedlings from each

sample were taken randomly. The length of roots, shoots and total seedling were measured. To find out the average length of roots, shoots and total seedling of the sample, mean often seedlings were taken.

- 4. Fresh weight of seedling:** For recording seedling fresh weight, 10 seedlings from each sample were taken randomly. The fresh weight of seedlings were weighted on electronic balance.
- 5. Dry weight of seedling:** For taking the observation of seedling dry weight, 10 seedlings were dried 100°C temperatures for 1 hours. The dried seedlings were weighted on electronic balance.
- 6. Vigour index I:** Seedling vigor index was calculated by adopting the method suggested By Abdul Baki and Anderson (1973).
- 7. Seedling vigor Index I=** Germination (%) x Total seedling length (cm)
- 8. Vigour index mass II:** Vigor index in terms of mass is determined by the multiplication of germination percentage with seedling dry weight on the day of final count.
- 9. Seedling Vigor index II=** germination (%) X seedling dry weight

Results and Discussions

According to the results, all studied traits were affected by the treatments and there was completely significant difference between control (non-primed seeds) and primed seeds (Table-1) and (Table-2). All seedling characters viz. Germination per cent, Germination index, Energy of emergence, Root length (cm), Shoot length (cm), Seedling length (cm), seedling fresh weight (g), seedling dry weight (g), Seedling vigour index I, Vigour index II were affected by (CaCl₂) 1% for 8 hours and significantly recorded maximum. The mean performance of germination per cent ranged from 83.75% to 98% with mean value of 91.35%. Significantly highest per cent of germination (98%) was reported in the primed with T₄ Calcium chloride (CaCl₂) 1% for 8 hours followed by T₆ (96%) primed with Glycerol 5% for 8 hours and T₄ (95%) primed with Calcium chloride (CaCl₂) 1%. Minimum germination per cent was recorded by T₀ (93.5%) with unprimed control. The mean performance of germination index ranged from 26.63 to 34.80 with mean value of 30.28. Significantly highest germination index (34.80) was reported in the primed with T₃ Calcium chloride (CaCl₂) 1% for 8 hours followed by T₆ (32.81) primed with Glycerol 5% for 8 hours and T₄ (32.50) primed with Calcium chloride (CaCl₂) 1%. Minimum germination index was recorded by T₀ (26.63) with unprimed control. The mean performance of seedling root length ranged from 11.675cm to 19.03 cm with mean value of 15.20 cm Significantly highest energy of emergence (19.15 cm) was reported in the primed with T₃ Calcium chloride (CaCl₂) 1% for 8 hours it was followed by T₆ (17.22cm) primed with Glycerol 5% for 8 hours and T₄ (17.40 cm) primed with Calcium chloride (CaCl₂) 1% 12 hours Minimum germination index was recorded by T₀ (11.67cm) with unprimed control. The mean performance of seedling shoot length ranged from 13.55 cm to 22.23cm with mean value of 17.52 cm Significantly highest seedling shoot length (22.23cm) was reported in the primed with T₃ Calcium chloride (CaCl₂) 1% for 8 hours followed by T₅ (20.03cm) primed with Glycerol 5% for 8 hours and T₄ (19.05cm) primed with Calcium chloride (CaCl₂) 1% 12 hours. Minimum germination index was recorded by T₀ (13.55cm) with unprimed control. The mean performance of seedling length ranged from 25.22cm to

41.27cm with mean value of 32.72cm. Significantly highest seedling length (41.27 cm) was reported in the primed with T₃ Calcium chloride (CaCl₂) 1% for 8 hours followed by T₅ (37.26 cm) primed with - Glycerol 5% for 8 hours and T₄ (35.17cm) primed with Calcium chloride (CaCl₂) 1%. Minimum germination index was recorded by T₀ (25.22cm) with unprimed control. The mean performance of energy of seedling fresh weight ranged from 6.3 g to 12.25g with mean value of 9.03 g. Significantly highest seedling fresh weight (12.02 g) was reported in the primed with T₃ Calcium chloride (CaCl₂) 1% for 8 hours followed by T₅ (11.01g) primed with Minimum germination index was recorded by T₀ (6.3 g) with unprimed control. The mean performance of energy of seedling dry weight ranged from 1.02 g to 2.73 g with mean value of 1.86 g. Significantly highest seedling dry weight (2.73g) was reported in the primed with T₃ Calcium chloride (CaCl₂) 1% for 8 hours followed by T₅ (2.41g) primed with

Glycerol 5% for 8 hours and T₄ (2.32g) primed with Calcium chloride (CaCl₂) 1%. For 12 hours Minimum germination index was recorded by T₀ (1.02g) with unprimed control. The mean performance of energy of seedling vigour I ranged from 2107.66 to 4044.46 with mean value of 3013.09. Significantly highest seedling vigour index I (4044.46) was reported in the primed with T₃ Calcium chloride (CaCl₂) 1% for 8 hours it was followed by T₅ (3293.33) primed with Glycerol 5% for 8 hours. Minimum germination index was recorded by T₀ (2107.66) with unprimed control. The mean performance of seedling vigour index II ranged from 85.86 to 267.61 with mean value of 173.58. Significantly highest seedling vigour index II (85.86) was reported in the primed with T₃ Calcium chloride (CaCl₂) 1% for 8 hours followed by T₅ (233.7) primed with Glycerol 5% for 8 hours. Minimum vigour index II was recorded by T₀ (85.86) with unprimed control.

Table 1: Analysis of variance for seedling traits in Maize

S. No.	Characters	Mean sum of squares	
		Treatments (df=6)	Error (df=21)
1.	Germination Percentage	98.98**	6.78
2.	Germination Index	40.67**	2.81
4.	Root length	24.74**	0.97
5.	Shoot Length	37.87**	1.13
6.	Seedling Length	123.53**	2.40
7.	Seedling Fresh Weight	17.54**	0.68
8.	Seedling Dry Weight	1.58**	0.14
9.	Seed Vigour Index I	1806792.60**	18634.63
10.	Seed Vigour Index II	17928.27**	1235.42

** Significant at 5% and 1% level of significance, respectively.

Table 2: Mean Value of Germination and Vigour Traits in Maize

Treatment	Germination %	Germination Index	Root Length (cm)	Shoot length(cm.)	Seedling Length (cm)	Seedling fresh weight (g)	Seedling dry weight (g)	Vigour index I	Vigour index II
T0	83.75	26.63	11.67	13.55	25.22	6.3	1.025	2107.66	85.86
T1	87.25	27.09	13.3	14.75	28.05	7.01	1.32	2448.11	115.13
T2	89.5	27.89	14.03	16.025	30.05	8.1	1.56	2689.49	139.34
T3	98	34.80	19.03	22.23	41.27	12.02	2.73	4044.46	267.61
T4	93.5	32.50	16.12	19.05	35.17	10	2.32	3293.33	216.66
T5	96	32.81	17.22	20.03	37.262	11.015	2.41	3576.67	233.7
T6	91.5	30.22	15.025	17.02	32.05	8.8	1.71	2931.95	156.79
G mean	91.35	30.28	15.20	17.52	32.72	9.036	1.86	3013.09	173.58
SE(d)	1.84	1.19	0.69	0.75	1.09	0.58	0.26	96.52	24.85
SEM+	1.30	0.84	0.49	0.53	0.77	0.41	0.18	68.25	17.57
CD@5%	3.83	2.47	1.45	1.56	2.28	1.21	0.55	200.73	51.68

Conclusion

It is concluded from the present investigation that the different concentration of priming treatment showed significant effect on seed germination and seed vigour parameters while priming with Calcium chloride at 1% for 8 hour recorded significantly higher germination percentage (98%), germination index (34.80), root length (19.03cm), shoot length (22.23cm), seedling length (41.27cm), seedling fresh weight (12.02g) and seedling dry weight (2.73g), seed vigour index I (4044.46) and seed vigour index II (267.61), followed by Glycerol 5% for 8 hour.

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