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Effect of priming on germination and seed vigour in Wheat (*Triticum aestivum* L.) Seeds

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Abstract
An experiment on priming was conducted in Post Graduate Laboratory, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences (SHUATS), Allahabad, Uttar Pradesh during 2016 - 2017 on wheat K8962. The seeds are treated with different chemicals like (KNO_3 1%) ($KMNO_4$ 1%), ($MgSO_4$ 1%) and (GA_3 100 ppm). The treated seeds are soaked for 6hrs and dried at ambient conditions for assessment of seed germination, shoot length, root length, seedling length, seedling fresh matter and dry matter, seedling vigour index I and II, where data was subjected to factorial experiment laid out in completely randomized design. Germination percentage, root length, shoot length, seedling length, seedling dry weight, Seed vigour index I and II. Among the treatments ($GA_3$100 ppm) (T_4) recorded higher germination percent shoot length, root length, seedling length, fresh weight, dry weight, vigour index I, vigour index II.

Keywords: Wheat, hydro priming, halo priming, organic priming, duration

1. Introduction
Wheat (*Triticum aestivum* L.) is the most popular staple and second most important food crop after rice in India, which contributes nearly one-third of the total food grains production. It is grown across a wide range of environments around the country and has the highest adaptation among all the crop species. In India wheat is cultivated in an area of 31.19 million hectares with an average productivity of 3075 kg ha^{-1} and production of 95.91 million tons (GOI, 2014). Seed priming has been successfully demonstrated to improve germination and emergence in seeds of many crops, particularly seeds of vegetables and small seeded grasses. The beneficial effects of priming have also been demonstrated for many field crops such as wheat, sugarbeet, maize, soybean, pea and vegetable crops (Basra *et al.*, 2003) [5, 7] reported that priming treatment significantly affected growth parameters and recorded an increase in LAI and dry matter accumulation due to priming in canola. The seed priming is a widely used technique to enhance seed performance, notably with respect to rate and uniformity of germination thereby enabling better crop establishment under a range of environmental conditions (Bradford, 1986) [8]. Besides, pea has got great recognition as an industrial crop due to presence of water soluble natural polymer galactomannan gum. Moisture stress conditions prevailing during sowing and crop growth period greatly affect the production and productivity of the crop. Several improved seed invigoration techniques are being used in many parts of the world to reduce the germination time, synchronize germination, improved germination rate and increase plant stand (Lee and Kim, 2000) [18]. Seed pretreatment with PEG-6000 increased seed germination and vigour index (Finch-Savage *et al.*, 1991) [11]. The direct benefits of seed priming in all crops included: faster emergence, better, more and uniform stands, less need to re-sow, more vigorous plants, better drought tolerance, earlier flowering, earlier harvest and higher grain yield. The indirect benefits reported were earlier sowing of crops, earlier harvesting of crops and increased willingness to use of fertilizer because of reduce risk of crop failure reported that guar genotypes responded positively to priming. Where priming was effective (*i.e.* in eleven trials) the extra grain produced varied from 0.3 t ha^{-1} to about 1.4 t ha^{-1} and represented increases ranging from 17 % to 76 %. In three remaining trials priming had no negative effect on yield. So keeping these aspects in view the present experiment entitled" "Effect of priming on germination and seed vigour in wheat (*Triticum aestivum L.*) Seeds" was carried out with following objectives.

Objective
1. To evaluate the effect of different priming methods on germination and seed vigour in wheat.

Materials and Methods

The present study entitled "Effect of priming on germination and seed vigour in wheat (*Triticum aestivum L.*) Seeds" under Post graduate laboratory of Seed Science and Technology was conducted in the Department of genetics and plant breeding, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Allahabad during 2016-2017. Allahabad is located in South Eastern part of Uttar Pradesh, India. The side of experiment is located at 25.57^{0}N latitude, 81.56^{0}N longitude and 98 meters above mean sea level. The lab experiment was analyzed by using C.R.D. (Complete Randomized Design) with four replications and 5 treatments under laboratory condition. Seed Treated with control, Potassium Nitrate (KNO3) (1%), Magnesium Sulphate (MgSO4) (1%), Potassium Permanganate (KMNO4) (1%), Gibberlic acid (GA3) (100ppm) soaking for 6 hrs. Afterward, primed seeds were allowed to dry back to their original moisture content under shade to assess the parameters. Seed quality parameters include speed of germination, Energy of emergence, Germination percentage, root length, shoot length, seedling length, seedling dry weight, seedling vigour index length and seedling vigour index mass.

For the preparation of solution one gram of each chemical was taken in a beaker. These chemicals were added separately in 1000 ml. of distilled water with constant stirring. The volume of solution will finally constituted to one litter, then it became 1000 ppm stock solution of each chemical. The flasks containing chemicals was covered with muslin cloth to avoid any contamination. For the preparation of Potassium Nitrate (KNO_3) (1%) solution 10 (g) KNO_3 was taken in a measuring flask and made up to 1000 ml. distilled water, while for (1%) Magnesium sulphate ($MgSO_4$) solution 10 (g) $MgSO_4$ salt was taken in a measuring flask and made up to 1000 ml with distilled water and Potassium Permanganate ($KMNO_4$) solution 10 (g) was taken in a measuring flask and made up to 1000 ml with distilled. After preparation of solutions wheat seeds were soaked of each solution separately for 6 hour at 25^{0}C temperature. After 6 hour of soaking the solution was drained out from the beaker and air dried to original weight and then placed four replication in completely randomized design (CRD) in between paper method and sand method for germination in laboratory under controlled condition.

The observation on the characters *viz.*, Germination percent (ISTA 2004) [14], Root length (cm), Shoot length (cm), Seedling length (cm), seedling Fresh weight (g), seedling dry weight (g), Seedling vigour index Ist, Vigor index IInd (Baki and Anderson 1973) [1] were recorded. The experimental data recorded were subjected to statistical analysis for calculating analysis of variance, range, and mean, critical Difference and coefficient of variation.

Results and Discusion

According to the results, all studied traits were affected by the treatments and there was completely significant difference between control (unprimed seeds) and primed seeds (Table-1).

All seedling characters *viz.* Germination percent, Speed of germination, Energy of emergence(%), Root length (cm), Shoot length (cm), Seedling length (cm), seedling fresh weight (g), seedling dry weight (g), Seedling vigour index Ist, Vigor index IInd were affected by GA_3 (100 ppm) concentration and significantly recorded maximum.

Significantly higher germination per cent (96.00) reported in treatment T_4 GA_3 (100 ppm) followed by T_1 (95.00) primed with KNO_3 1%. Minimum germination percent recorded by T_0 (84.25) with unprimed control (Table 2). Seeds were primed for 6 hours at three temperatures (25 °C). Similar finding were also reported by, Ghassemi (2008) [12]. It is reported that the earlier and better synchronized germination is associated with increased metabolic activities in the soaked seeds (Basra *et al.,* 2005) [6].

Table 4: Analysis of variance for seedling traits in wheat (*Triticum aestivum* L.) seeds.

Sl. No.	Source of variation	Treatment	Error
	Degrees of freedom	4	15
		Mean sum of squares	
1	Germination percentage	91.25**	0.68
2	Root length	14.05**	0.65
3	Shoot length	14.12**	0.80
4	Seedling length	28.02**	0.13
5	Fresh weight of seedling	1.83**	0.18
6	Dry weight of seedling	0.162**	0.15
7	Seedling Vigour Index- I	2237.33**	3080.87
8	Seedling Vigour Index- II	14.95**	0.06

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

Maximum root length (14.67cm) recorded by T_4 treatment GA_3 100ppm followed by T_1 (14.59cm) primed with KNO_3 1%. Minimum root length recorded by T_0 (12.13cm) primed with control. Maximum shoot length (15.05cm) recorded by T_4 treatment primed with GA_3 100ppm and it followed by T_1 (14.99cm) primed with KNO_3 1%. The shortest shoot length founded in T_0 unprimed control (12.13cm). Maximum seedling length (29.64cm) recorded by $T_{4\ primed}$ with GA_3 100ppm followed by T_1 (29.58cm) primed with KNO_3 1%. Shortest seedling length recorded in T_0 unprimed control (24.26cm) (Table 2). Demir and Oztokat 2003 [9] also found that root and shoot lengths increased in seeds due to hormonal priming as compared to non-primed seeds. Similar finding were also reported by Farooq (2007) [10].

Table 2: Mean Comparison of Germination and Vigour Traits in Wheat (*Triticum aestivum* L.) Seeds.

Treatment	Germination %	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Seedling fresh weight (g)	Seedling dry weight (g)	Vigour index 1	Vigour index 2
T0	84.25	12.13	12.13	24.26	1.71	0.12	1797.84	10.48
T1	95.00	14.99	14.59	29.58	1.90	0.16	2281.18	15.21
T2	92.00	13.57	14.46	28.03	1.73	0.14	2390.68	12.88
T3	89.00	14.87	14.41	28.62	1.84	0.15	2231.60	13.21
T4	96.00	15.05	14.67	29.64	1.97	0.24	2485.35	22.98
G mean	91.25	14.12	14.05	28.02	1.83	0.162	2237.33	14.95
SE(d)	0.583	0.005	0.008	0.254	0.004	0.002	123.857	0.178
CD@5%	1.236	0.010	0.016	0.538	0.009	0.005	262.576	0.377

Maximum seedling fresh weight (1.71 g) reported by T_4 treatment primed with GA_3 100ppm followed by T_1 (1.90g) primed with KNO_3 1%. Lowest value of seedling fresh weight founded in T_0 unprimed control (1.71g). Maximum seedling dry weight (0.24g) recorded by T_4 primed with GA_3 100ppm followed by T_1 (0.16g) primed with KNO_3 1%. Lowest value of seedling dry weight founded in T_0 unprimed control (0.12g) (Table 2). Kathiresan *et al*., (1984) [17] reported the increase in seedling vigour which may be due to enhanced oxygen uptake and the efficiency of mobilizing nutrients from the cotyledons to the embryonic axis. Study that the effects of hormonal - priming on seed vigour index length of pea seeds (*Pisum sativum* L). Seeds were primed in GA_3 25^C for 24 hours and there was also a control treatment. (Association of Official Seed Analysts 1983) [3] Maximum seedling vigour index I^{st} (2485.35) recorded by T_4 primed with GA_3 100ppm followed by T_1 (2281.18) primed with KNO_3 1%. Minimum seedling vigour index I^{st} recorded by T_0 unprimed (1797.84) in control (Unprimed) (Table 2) the osmo-priming, halopriming has positive effect on the seed germination and their consequences. They help to release in enzymes and accelerate seed metabolism and physiological activities. Maximum seedling vigour index II^{nd} (22.98) recorded by T_4 primed with GA_3 100ppm and it was followed by T_1 (15.21) primed with KNO_3 1%. Minimum seedling vigour index II^{nd} recorded by unprimed T_0 (10.48) in control (Table 2). Similar finding were also reported by Bakht (2011). It has been reported that primed seeds showed better germination pattern and higher vigour level than non- primed (Ruan *et al*., 2002) [22]

Conclusion

It is concluded from the present experiment, that among that the seed were primed with Gibberlic acid (GA_3) (100 ppm) was found to be the best among all priming treatments *i.e.* Potassium nitrate (KNO_3) 1%, Magnesium sulphate ($MgSo_4$) 1% and Potassium permanganate ($KMnO_4$) 1%, for the variety of K8962 of wheat for germination percentage and seed vigour in wheat.

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