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Influence of Halopriming and organic priming on germination and seedling vigour in Wheat (*Triticum aestivum* L.) seeds

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Abstract
The experiment was conducted in post Graduate laboratory, Department of Genetics and Plant Breeding SHUATS Allahabad UP during 2015-17, in order to standardize the best method of priming specific to wheat seeds.Seed Priming viz.,hydropriming, halopriming, and organic priming were evaluated by screening a range of durations and concentrations viz., T_0-Unprimed Control, T_1-Distilled water hydration, T_2 –KCI (2.5%), T_3– $CaSO_4$ (1%), T_4 –KH_2PO_4(0.5%), T_5- cow urine (5%) and T_6- Curi leaf extract (5%) for 12hrs. It was found that all the priming methods showed significance difference with the control and the highest germination percentage, speed of germination, energy of emergence, shoot length, root length, seedling length, seedling fresh weight, seedling dry weight and seed vigour index-1 and 2 were observed for KCL priming for 12hrs. Seed priming, its simplicity and no requirement for expensive equipment and chemical could be used as a simple method for overcoming related to a poor germination and seedling establishment and helps in sustaining agriculture.

Keywords: Wheat, seed priming, duration, seed quality parameters

Introduction
Wheat (*Triticum aestivum* L.) is considered to be one of the first domesticated crops and has been a staple food in North Africa, West Asia and Europe for more than eight thousand years **(**Curtis, Rajaram, and Macpherson 2002) [11] and is the single most important crop planted for human food and animal feed (Colmer, Flowers, and Munns 2006; Akman 2009) [10, 1]. It has been reported that wheat is a staple food for one third of the world's population and an important source of carbohydrates, fibre, vitamins, proteins, and provides nutrition for both human beings and animals (Basra, Pannu, and Afzal 2003) [7]. More than 20% of the total calorie needs of the world's population are provided by wheat (Bushuk and Rasper 1994; Naseem *et al.* 2001) [6, 22].

In India, recorded wheat production of 95.91million tons from an area of 31.34 million hectare with productivity of 30.61q/ha and Haryana recorded production of 118 lakh tons and productivity of 47.22q/ha from an area of 22.99 lakh ha (Anonymous, 2014) [2]. Harris (2004) [18] suggests that wheat seed priming has been successful in countries such as India, Nepal and Pakistan. It is also indicated that halopriming can increase the yield of maize, wheat and chickpea.

Priming is a procedure which partially hydrates the seed and then allows them to dry so that germination processes begins but radicle emergence does not occur (Giri and Schillinger 2003; Dezfuli, Sharif-Zadeh, and Janmohammadi 2008) [16, 13]. Priming is easy to use, its cost is low, and there are no risks with its use (Iqbal and Ashraf 2005; Bakare and Ukwungwu 2009) [20, 8]. Seed priming has been successfully confirmed to enhance germination percentage, germination rate and emergence in seeds of many crops such as maize, wheat, rice, canola, sugar beet, sunflower and soybean (Kaya *et al*. 2006; Ghiyasi *et al*. 2008; Salehzade *et al*. 2009) [21, 17, 24]. Assorted seed priming techniques have been used, including osmopriming, hydropriming, halopriming, thermopriming and hormone priming (Ashraf and Foolad 2005; Golezani *et al*. 2008; Ashraf *et al.* 2008; Tzortzakis 2009) [20, 15, 5].

Stand establishment is of primary importance for optimizing field production of any crop plant, rapid germination and emergence are essential for successful crop establishment, for which seed priming could play an important role. Hence the present study was formulated to assess the Influence of Halopriming and Organic priming on Germination and Seedling Vigour in Wheat seeds (cv.HD2967).

Material and Methods

The experiment was conducted in Post Graduate Laboratory of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and science, Allahabad (U.P.) using wheat cv.HD2967. The treatments used at different concentrations for priming were T_0-Unprimed (Control), T_1-Distilled water, T_2- Potassium Chloride (KCL) 2.5%, T_3–Calcium Sulphate ($CaSO_4$) 1%, T_4– Potassium Di-hydrogen Phosphate (KH_2PO_4) 0.5%, T_5-Cow Urine 5% and T_6-Curi Leaf Extract 5%.

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 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 Potassium chloride (KCL-2.5%) solution 25 (gm) KCL was taken in a measuring flask and made up to 1000 ml. distilled water, while for (1%) Calcium sulphate ($CaSO_4$) solution 10 (gm) $CaSO_4$ salt was taken in a measuring flask and made up to 1000 ml with distilled water and Potassium di-hydrogen phophate (KH_2PO_4) solution 5 (gm) was taken in a measuring flask and made up to 1000 ml with distilled. Preparation of Curi leaf extract (5%), 50 ml solution of Curi leaf extract was taken in a measuring flask and made up to 1000 ml distilled water. Cow urine (5%), 50 ml solution of Cow urine was taken in a measuring flask and made up to 1000 ml distilled water.

After preparation of solutions wheat seeds were soaked of each solution separately for 12 hour at 25 ^{0}C temperature. After 12 hour of soaking the solution was drained out from the beaker and presoaked air dried to original weight and then placed four replication in completely randomized design (CRD) in between paper method for germination in laboratory under controlled condition.

The observation on the characters *viz.*, Germination percent (ISTA 2004), 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 (Baki and Anderson 1973) were recorded. The experimental data recorded were subjected to statistical analysis for calculating analysis of variance, range, mean, critical difference and coefficient of variation (Fisher 1936).

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 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 KCL 2.5% concentration and significantly recorded maximum.

Significantly higher germination percent (97.5) reported in treatment T_2 KCI 2.5% followed by T_4 (95.25) primed with KH_2PO_4 0.5%. Minimum germination percent recorded by T_0 (89.00) with unprimed control (Table 2)

Table 1: Analysis of variance for seedling characters in wheat.

Characters	Mean Square	
	Treatments (df=6)	**Error (df=21)**
Germination Percentage	34.97*	10.77
Speed of germination	46.35**	2.80
Energy of emergence	207.47*	71.71
Root Length	7.79**	0.62
Shoot Length	12.83**	0.87
Seedling Length	41.08**	0.66
Seedling Fresh Weight	0.01**	0.00
Seedling Dry Weight	0.00**	0.00
Seed Vigour Index Ist	535972.67**	11645.99
Seed Vigour Index IInd	41.72**	2.91

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

± Table No 2 .Mean Comparison of Germination and Vigor Traits in wheat

Treatment	Germination %	Speed of germination	Energy of emergence %	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Seedling fresh weight (gm)	Seedling dry weight (gm)	Vigour index 1	Vigour index 2
T0	89.00	24.00	53.75	10.43	9.09	19.44	0.87	0.12	1730.02	10.70
T1	92.50	28.87	67.25	12.75	10.70	23.47	0.94	0.16	2173.13	14.78
T2	**97.50**	**33.94**	**72.00**	**15.10**	**12.54**	**27.73**	**1.03**	**0.20**	**2703.11**	**19.74**
T3	90.25	25.10	69.50	11.71	9.84	21.51	0.91	0.14	1940.49	12.60
T4	95.25	25.99	56.75	14.43	12.26	26.65	0.98	0.18	2538.80	17.36
T5	93.25	27.75	67.75	13.72	11.86	25.61	0.95	0.17	2389.29	15.89
T6	91.00	24.97	58.00	10.88	9.54	20.50	0.89	0.13	1865.66	11.81
G.mean	**92.67**	**27.23**	**63.57**	**12.71**	**10.83**	**23.56**	**0.94**	**0.15**	**2191.50**	**14.70**
SE(d)	2.32	1.18	5.98	0.66	0.55	0.57	0.01	0.01	76.30	1.20
SEM	1.64	0.83	4.23	0.46	0.39	0.40	0.01	0.00	53.95	0.85
CD@5%	4.82	2.46	12.45	1.37	1.16	1.19	0.04	0.02	158.69	2.51

Higher speed of germination (33.94) reported in treatment T_2 KCI 2.5% followed by T_1 (28.87) primed with Distilled water. Minimum speed of germination recorded by T_0 (24.00) with unprimed control (Table 2). Maximum energy of emergence (72.00%) recorded by T_2 primed with KCI 2.5% followed by T_3 (69.5%) primed with $CaSO_4$ 1%. Minimum recorded in T_0 unprimed control (53.75%) (Table 2).

Maximum root length (12.54cm) recorded by T_2 treatment KCI 2.5% followed by T_4 (12.26cm) primed with KH_2PO_4 0.5%. Minimum root length recorded by T_0 (9.09cm) primed with control. Maximum shoot length (15.10cm) recorded by T_2 treatment primed with KCI 2.5% and it followed by T_4 (14.43cm) primed with KH_2PO_4 0.5%. The shortest shoot length founded in T_0 unprimed control (10.43cm). Maximum seedling length (27.73cm) recorded by T_2 primed with KCI 2.5% followed by T_4 (26.65cm) primed with KH_2PO_4 0.5%. Shortest seedling length recorded in T_0 unprimed control (19.74cm) (Table 2). (Demir and Oztokat 2003) also found that root and shoot lengths increased in seeds due to salt priming as compared to non-primed seeds.

Maximum seedling fresh weight (1.03gm) reportedby T_2 treatment primed with KCL 2.5% followed by T_4 (0.98gm) primed with KH_2PO_4 0.5% . Lowest value of seedling fresh weight founded in T_0 unprimed control (0.87gm). Maximum seedling dry weight (0.20gm) recorded by T_2 primed with KCL 2.5% followed by T_4 (0.18gm) primed with KH_2PO_4 0.5%. Lowest value of seedling dry weight founded in T_0 unprimed control (0.12gm) (Table 2). Ashraf and Rauf (2001) also reported to the results regarding root and shoot fresh weights are in agreement with those of who reported that fresh and dry weights of seedlings from haloprimed seeds were significantly higher, as compared to other unprimed seeds.

Maximum seedling vigour index I^{st} (2703.11) recorded by T_2 primed with KCI2.5% followed by T_4 (2538.80) primed with KH_2PO_4 0.5%. Minimum seedling vigour index I^{st} recorded by T_0 unprimed (1730.02) in control (Unprimed) (Table 2

Maximum seedling vigour index II^{nd} (19.74) recorded by T_2 primed with KCL 2.5% and it was followed by T_4 (17.36) primed with KH_2PO_4 0.5%. Minimum seedling vigour index II^{nd} recorded by unprimed T_0 (10.70) in control (Table 2). It has been reported that primed seeds showed better germination pattern and higher vigour level than non- primed (Ruan *et al*., 2002).

Conclusion

It is concluded form the present investigation that treatment T_2 [Potassium chloride (KCI) 2.5%] exhibited higher mean value for germination and seedling characters like seed germination percent (97.5%),speed of germination (33.94), energy of emergence (72%) , shoot length (15.1cm), root length (12.54cm), seedling length (27.73cm), seed vigour index I^{st} (2703.11), seed vigour index II^{nd} (19.74), seedling fresh weight (1.03gm) and seedling dry weight (0.20gm) in compared with other treatments. Soaking of seed with KCL solution is advantageous to obtain healthy seedlings. The second best option for priming is halopriming with KH_2PO_4.

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