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Seed Priming on Crop Establishment of Late Sown Wheat Crop

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ABSTRACT

The field experiment was conducted to evaluate the effect of seed priming treatments on crop establishment of late sown wheat crop during *rabi* season of 2019-2020 at Student's Research Farm, Doon PG College of Agriculture and Allied Sciences, Rampur, Selaqui, Dehradun. The experiment consisted of 9 treatments, having five osmoprimed (3 KCL 1.5%, 2.0%, 2.5% and 2 PEG-6000 10%, 20%), one hydroprimed (H_2O),two hormoprimed (GA_3 75 ppm, 100 ppm) and one treatment consisted of non-primed was kept for comparison (control). Experiment was laid out in Randomized Block Design. The wheat variety HD-2967 was sown on 28.12.2019 at 20 cm spacing and with seed rate of 125 kg/ha. All the recommended package of practices except treatments was adopted in the experiment to get maximum crop establishment from each plot. The results revealed that the treatments where wheat seeds primed with 2.5% KCl for 12 hrs recorded higher field emergence percentage as compared to other primed or no-primed treatments. Under mean emergence time the primed treatments performed best as compare to non primed treatments. The wheat seeds primed with Gibberalic acid @ 75 ppm showed the highest speed of emergence, highest seedling length and having more seedling dry weight as compare to other treatments.

Keywords Seed priming, Hormopriming, Osmopriming, Hydropriming, Speed of emergence.

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INTRODUCTION

The oldest and most significant cereal crop in the global food supply is wheat. It is an important crop on a worldwide scale. It is grown in a variety of situations. Common wheat is one of the most significant food crops in the world, providing food for more than 30% of the world's population. It is one among the first cultivated food crops. The importance of wheat in the global food market has significantly expanded during the past 20 years, particularly in emerging nations. When it comes to production and area, wheat leads all other cereals in the globe. In India, it spans an area of 31 million hectares. It is known as the "King of Cereals" since it is consumed in second-place to rice.

The problems encountered under late sowing are twofold. First, the initial low temperature during sowing may delay seedling emergence by decreasing the pace of physiological activities connected to germination, including as water absorption and nutrient hydrolysis inside the embryo. Second, crops seeded late in the season have a shorter growing time, resulting in significantly less vegetative growth and grain development due to forced maturity as a result of high temperatures, resulting in low grain yield (Farooq *et al.* 2020) (Fig.1).

Crop establishment is a significant barrier for crop productivity (Chivas *et al*. 1998). Maintaining an optimal plant population, as measured by seed germination and early stand development, is required for improved yields. Good and early stand establishment is dependent on emergence speed and uniformity (Finch-Savage and Leubner-Metzger 2006), which is dependent on soil physical conditions (Weaich *et al.* 1992). In terms of water intake, seed germination is divided into three main stages (Bewley *et al.* 2013). During the first phase, the seeds rapidly absorb water, kicking off metabolism, DNA repair, and mitochondrial activity, as well as protein synthesis utilizing pre-existing mRNA. As the seed water potential enters equilibrium with the surrounding environment, water intake is reduced in the second phase. The second phase is known as the lag phase, and it is at this time that substantial metabolic changes occur, such as the manufacture of hydrolytic enzymes and embryo growth. In the third phase, there is a rapid water intake (Nonogaki *et al.* 2010, Bewley *et al*. 2013), which causes radical emergence, also known as seed germination (Farooq *et al.* 2019a, Lemmens *et al.* 2019).

Halo priming is a seed priming technique in which the seeds were immersed in different salt solutions. Other seed priming methods include hydro priming, osmo priming, seed soaking, hormone priming. The process of treating seed with salt to promote germination and reduce salinity tolerance. A technique for seed priming called hydro priming involves soaking the seeds in water that is twice their capacity. It is a method for starting germination without the radicle to emerge, and it includes soaking seeds in a solution containing a priming chemical before drying them. Osmo priming is a method of seed priming in which osmotic solutions were used to soak the seeds. A method of hydropriming where seed is immersed in a polyethylene glycol or comparable solution. Hormonal seed priming involves soaking the seeds in growth hormones before planting. This can be accomplished with GA_3, Salicyclic acid, Ascorbic acid, Cytokinins.

Pre-sowing seed priming creates a physiological condition that makes seed germination more effective (Farooq *et al.* 2019a, Lutts *et al.* 2016). It is a method of hydration in which seeds are partially hydrated to start the germination process without radicle emergence (Farooq *et al.* 2006a, 2006b, 2006c). The majority of the significant metabolic changes are seen during the second phase of seed germination, which is regarded as the most significant. The second stage of seed germination is significantly influenced by seed priming. In order to start metabolic processes, the seeds are exposed to liquids with different osmotic potentials during seed priming, and they are subsequently dried to their original moisture contents before planting (Di Girolamo and Barbanti 2012, Farooq *et al.* 2019b). In order to generate higher and more uniform crop stands and to shorten the interval between seed sowing and seedling emergence, seed priming is frequently utilized (Farooq *et al.* 2006a).

MATERIALS AND METHODS

A field experiment was conducted at student's research farm, Doon PG College of Agriculture and Allied Science, Rampur, Selaqui, Dehradun (Sri Dev Suman Uttarakhand Vishwavidyalaya) during *rabi* season, 2019-20. The geographical location of Rampur (Selaqui), surrounded by Shivalik and Jaunsar-Bawar region, which is in the foothills of Himalayas. It is situated between 30°22' N latitude and 77°50' E longitude at an altitude of 450 m above mean sea level. The soil of the experimental plot was clay loam with low organic carbon (0.40%), medium in available nitrogen (275 kg/ha) and available phosphorus (16.2 kg/ha) but low in available potassium (105 kg/ha). The soil reaction of the experimental field was nearly neutral (ph 6.7) with an electrical conductivity of 0.24 dS/m.

The experiment was laid out in a Randomized Block Design, with nine treatments (T_1 - T9) and three replications. The treatments was (T_1 - Non-Primed/

Control, T_2 - Distilled water, T_3 - Potassium Chloride (KCl) @ 1.5%, T_4 - Potassium Chloride (KCl) @ 2.0%, T_5- Potassium Chloride (KCl) @ 2.5%, T_6 - Polyethylene glycol (PEG-6000) @ 10%, T_7 - Polyethylene glycol (PEG-6000) @ 20%, T_8 - Gibberellic Acid (GA_3) @75 ppm, T_9 - Gibberellic Acid (GA_3) @100 ppm). HD-2967 variety of wheat crop was used for this experiment. Wheat seeds were treated with these primers for 12 hrs and dried at room temperature for 7 days and then sowed in well prepared soil in lines with 20cm row spacing with a 5cm in a net plot area of 2.4m × 2.1m with a uniform seed rate of 125 kg/ha. The recommended dose of nitrogen (120 kg N ha^{-1}), phosphorus (60 kg P ha^{-1}) and potash (40 kg K ha^{-1}) were applied. Full dose of phosphorus and potash and half dose of nitrogen were applied at sowing and remaining half dose of nitrogen was applied after first irrigation. The source of nitrogen, phosphorus and potash were Urea, Diammonium Phosphate and Muriate of Potash.

For T_2, T_3, T_4, T_5, T_6, T_7, T_8 and T_9 treatments, the seeds were put in their respective solutions for 12 hrs. As shown in Figs. 2(a) and then air dried for 7 days to have even distribution of seeds at sowing. The seeds were put in equal volume of water/solution i.e.,140 g of seeds in 280 ml of water/solution (Priming ratio 1:2) for each treatment. After treatment of 12 hrs, the excessive water/solution was drained off and seeds were put over gunny bag for maintenance of the moisture of the seeds and air dried for 7 days.

The crop was sown with a pre-sowing irrigation. Three post sowing irrigations were applied at CRI, jointing and flowering stages, because of high water table. One hand weeding was done after first irrigation and hoeing is done with hand hoe. The crop was harvested manually with the help of sickle. The crop in the respective plots was left for sun drying after tagging. Before threshing the biological yield (straw + grain) was recorded with spring balance. The crop was threshed plot wise with the help of a mini thresher and grain yield was recorded accordingly. A small sample of grains was also taken from each plot for estimating 1000 grain weight. After sowing of crop first twenty days data was taken for crop establishment studies i.e. Field emergence percentage, speed of emergence, mean emergence time, seedling length (shoot length + root length) and seedling dry weight**.**

RESULTS AND DISCUSSION

Crop establishment studies

The results obtained on field emergence (%), mean emergence time (days), speed of emergence (number of seeds emerged/day) are presented in Table 1 and Fig. 1.

Field emergence (%)

Seed priming treatments showed significant difference in field emergence per cent showed in Figs. 2(b)

Table 1. Effect of seed priming on seed germination (%), speed of emergence (%), mean germination time, root length (cm), shoot length (cm), seedling length (cm), dry weight of seedlings (g) in wheat seed.

Treatment	Germination (%)	Speed of emergence	Mean germination time	Shoot length (cm)	Root length (cm)	Seedling length (cm)	Seedling dry weight (g)
Control	55.767	5.424	12	8.860	5.100	13.960	0.540
Hydroprimed with water	63.367	6.251	13	9.647	5.607	15.253	0.683
KCL 1.5%	66.300	6.324	13	8.390	5.653	14.043	0.673
KCL 2.0%	64.833	6.294	14	9.123	5.247	14.370	0.743
KCL 2.5%	74.967	6.225	14	9.407	5.413	14.820	0.770
PEG-6000 10%	74.867	7.125	15	8.507	5.380	13.887	0.683
PEG-6000 20%	74.267	7.100	14	10.933	5.700	16.633	0.827
GA_3 75 ppm	74.533	7.450	16	11.450	6.313	17.763	0.867
GA_3 100 ppm	72.533	7.434	14	10.110	5.803	15.913	0.797
CD	5.707	0.510	N/A	1.978	N/A	N/A	0.147
SEm ±	1.887	0.169	0.714	0.654	0.275	0.884	0.049

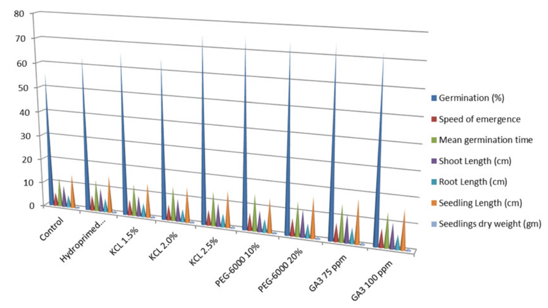


Fig. 1. Effect of seed priming on seed germination, speed of emergence, mean germination time, root length, shoot length, seedling length, dry weight of seedlings in wheat seed.

during the course of investigation. Wheat primed seed with 2.5% KCl for 12 h recorded higher field emergence per cent as compared to other primed or no-primed treatments.

Osmopriming helps in lowering water potential of seed which control imbibitions activities inside the seed and also activate amylase and proteases enzymes. Potassium ions also enter into embryonic cells of seed leads to pregerminative metabolic activities (McDonald 1999, Ruan *et al.* 2002 and Basra *et al,* 2005). In the present study, higher field emergence in primed seed may be due to improvement of internal metabolism required for activation of enzymes and cell division process (Farooq *et al.* 2008 and Kumar *et al.* 2016). Also reported that seed priming with KCl in wheat crop resulted higher field emergence as compared to no- primed seed.

Speed of emergence

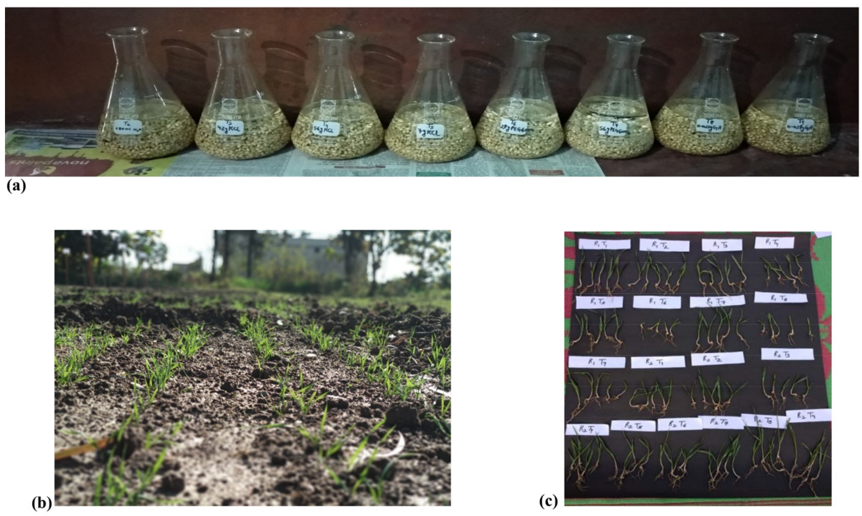
Speed of emergence which indicates number of seeds emerged per day was also significantly influenced by seed priming treatments.

Fig. 1 shows that oftenly there is reduction in speed of emergence in late sown conditions but due to seed priming there is higher speed of emergence. Seed priming with Gibberellic acid @ 75ppm for 12 h resulted significantly higher speed of emergence 7.4 seeds emerged/day as compared to 6.3, 6.2 and 5.4 seeds emerged/day in osmoprimng, hydropriming and no-primed seeds.

Primed seeds emerged faster due to readily available food material for germinating seedling. Faster emergence and uniformity in primed wheat seeds was also reported by Kant *et al.* (2004).

Mean emergence time

Seed priming treatments had significant effect on mean emergence. It is relevant from Table 1 that the crop had significantly higher mean emergence time.



Figs. 2. The soaking of wheat seeds in different priming solutions, (b) The emergence of seedlings of wheat up to first 20 days of sowing and (c) The seedlings at 20th day of observation.

This increase in mean emergence time in late sown wheat might be attributed to lower than optimum temperature required for germination.

Fig.1 shows that seed priming significantly reduced mean emergence time over no-primed or other primed seeds. Primed seeds took 13 to 15 days as compare to non-primed took 12 days.

Seedling length (Shoot length + Root length)

Seedling length (cm/seedling) in primed seeds perform better as compare to non-primed seeds showed in Figs. 2(c). Among priming treatments, the longest seedling (17.76 cm) was obtained with 75 ppm Gibberellic acid concentration. It was significantly superior to other treatments including hydropriming and osmopriming. The shortest seedling length (13.88 cm and 13.96 cm) was observed with 10% PEG-6000 and no-primed seeds respectively.

Seedling dry weight

Seedling dry weight (g/seedling) was significantly influenced by different priming treatments. The highest seedling dry weight was recorded with GA_3 100 ppm concentration and it was significantly superior to other priming treatments. The lowest seedling dry weight was recorded with 1.5% KCl concentration which was significantly lower than all other treatments.

CONCLUSION

On the basis of one year, it can be concluded that the wheat variety HD-2967 sowed under late sowing conditions perform better in case of speed of emergence, seedling length, seedling dry weight as well as mean germination time when treated with Gibberalic acid (GA3) @ 75 ppm for 12 hrs. While the seeds when treated with Potassium Chloride (KCl) @ 2.5% having highest germination percentage as compared to other treatments.

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