



Research Article

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Germination and Seedling Growth of Wheat as Affected by Seed Priming and its Duration



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Abstract

A lab experiment was conducted to evaluate the germination and early seedling growth of wheat (OPV Pirsabak- 2013), as influenced by different seed priming techniques (Control, Halo, Osmo, and Solid matrix priming) and durations for priming (6 and 12 Hours). The experiment was conducted at Agronomy Research lab, University of Agriculture Peshawar, KPK, in a complete randomized design with four replications during winter season 2018. Results showed that Osmopriming with PEG-6000 and halo priming with CaCl₂ reduced time to germination (2 days) and time is taken to 50 % emergence (1 day) and increased germination % (85.83) and (61.66), germination index (39.2) and (30.1). Solid matrix priming with press mud increase root length (15.3cm), shoot length (14.6cm), shoot fresh weight (0.95 g), shoot dry weight (0.03 g), root fresh weight (0.40g), root dry weight (0.12g) compared to control (dry seeds). While priming durations (12 hours) of seed priming increase speed of germination (2 days) and reduced time to 50% emergence (1 day) enhanced germination (80)%, germination index (31.4), increased root length (13.1cm), shoot length (15.0cm), shoot fresh weight (0.32g), dry weight (0.03g), root fresh weight (0.30g) and dry weight (0.08g) compared to 6 hours of priming duration. Therefore, it was concluded from the experiment that Osmo priming with PEG-6000 and solid matrix priming with press mud with 12hrs duration increase germination, final emergence, root and shoot length and enhanced the fresh and dry weight of roots and shoots of wheat.

Keywords: Wheat; Priming; Duration; Germination; Seedling

Introduction

Insufficient seedling emergence and inappropriate stand establishment are the main restraints in areas receiving less rainfall [1]. One of the important aspects of quality grain production is a speedy emergence and beneficial seedlings establishment in the field. Thus, quick and uniform field emergence is the necessity to attain high yield in annual crops [2]. One of the most important strategies to accelerate germination, to produce high-quality seedling and plant optimal establishment seed priming is used. The beneficial effect of priming has been demonstrated for many crops such as wheat, soybean, maize, and sunflower [3]. Seed priming has been mostly used to reduce the time between seed sowing and seedling emergence and to synchronize emergence [4]. It is reported that seed priming is one of the most important developments to help rapid and uniform germination and the emergence of seeds and to increase tolerance to adverse and environmental conditions [5,6]. The mean time for 50% germination at 20 °C of 12 Indian wheat cultivars was nearly halved, from 51h to 27h, by soaking seed in water for 8h prior to sowing. A delay of 24h without further soaking, intended

to simulate postponement of sowing, reduced the time saved by priming to 16%. Priming had no effect on the final germination percentage [7]. Moringa leaf extracts improve seedling vigor, growth, and productivity of wheat crop [8]. Polyethylene glycol and KNO₃ solutions increased the fresh and dry weight of roots in maize at 2% and 5% concentration primed for 12h and 18h and it also increased the vigor index [9]. Therefore, the aim of this trial was to find out the effect of seed different priming techniques with 6 and 12hrs priming duration on emergence, vigor, and growth of wheat. It has also been reported that seed priming improves emergence, stand establishment, Germination index, Shoot length, Root length, Shoot fresh and dry weight, and Root fresh and dry weight. Keeping in view the desirable effect of seed priming on seed germination and further establishment, the experiment was planned to evaluate the effect of different seed priming with different time duration.

Materials and Methods

The experiment was conducted at Agronomy Research labs, The University of Agriculture Peshawar, during rabi season 2018

with a completely randomized design. Wheat OPV Pirsabak- 2013 were used in the experiment. The experiment comprised of two factors, the 1st factor was priming techniques (Dry seed, Halo, Osmo, Solid matrix priming). 2nd factor was priming durations (6 and 12 Hours), with three replications. Parameters that were studied in the experiment were “Mean emergence time, Time taken 50% germination, Final emergence %, Germination index, Shoot length(cm), Root length (cm), Shoot fresh weight (g), Shoot dry weight (g), Root fresh weight (g), Root dry weight (g)”.

Mean germination time

Mean emergence time (MET) was calculated according to the equation of Ellis and Roberts 1981 [10].

$$MGT = \frac{\sum Dn}{\sum n}$$

Where n is the number of seedlings emerged on day D, and D is the number of days counted from the beginning of emergence.

Time taken 50% germination

Time to get 50% emergence (E_{50}) was calculated [11] and [12].

$$E_{50} = t_i \frac{(N/2) - n_i(t_j - t_i)}{n_j - n_i}$$

Where N is the final number of seedling emerged, and n_i and n_j the cumulative number of seedling emerged by adjacent counts at times t_i and t_j when $n_i < N/2 < n_j$.

Germination index (GI)

Germination index was calculated according to ISTA. 2009, International Rules for Seed Testing. Seed Vigor Determination, 1-9.

$$GI = \frac{\text{No. of germinated seeds at first count}}{\text{Days of first count}} + \dots + \frac{\text{No. germinated seeds at final count}}{\text{Days of final count}}$$

Results

Mean emergence time (days)

Analyses of the data revealed that mean emergence time was significantly affected by priming media and priming duration

Table 1: Mean germination time (days), time taken to 50% (days) emergence and germination (%) as affect by different priming techniques and priming durations.

Priming Techniques	Mean Germination Time	Time Taken to 50% Emergence	Germination %
Control	4:00 AM	2:00 AM	61.66c
Halo Priming	2c	1b	81.66b
Osmo Priming	2c	1b	85.83a
Matrix Priming	3b	1b	78.33b
LSD (0.05)	0.35	0.55	1.62
Duration			
6 Hours	3:00 AM	2:00 AM	74.00B
12 Hours	2b	1b	80.00A
LSD (0.05)	0.24	0.39	1.14
Interaction (PxD)	NS	NS	NS

Germination %

Analysis of data revealed that final germination was significantly affected by priming techniques and durations (Table

1). The interaction between priming techniques and its duration was found non-significant. Among different priming techniques halo priming with $CaCl_2$ resulted in the minimum value of mean emergence time (2 days) which was statistically similar to Osmo priming with PEG-6000 (2 days). Solid matrix priming with press mud took (3 days) to mean emergence time. Control (dry seeds) took more days to mean emergence time (4). Among different priming durations, 12 hours priming took fewer days to mean emergence time (2) while 6 hours priming took more days to mean emergence time (3). [14] confirm our result he stated that hormonal priming with GA3 and osmopriming with PEG-6000 for 24 hours gave faster and earlier germination followed by hydro priming. [15] also indicated that seed priming for 24 hours caused a significant reduction in the time to 50% emergence which took mean minimum germination time compared to untreated seeds.

Time taken to 50% emergence

Analysis of data revealed that the time taken to 50% emergence was significantly affected by priming techniques and duration (Table 1). The interaction between priming techniques and durations was found non-significant. Among different priming techniques halo priming ($CaCl_2$) reduced time to 50% emergence (1 day) which was statistically similar with Osmo priming with PEG-6000 (1 day). Solid matrix priming with press mud took (1 day) to 50% emergence. Control took more days to 50% emergence (2 days). Among different priming duration, 12 hours priming took fewer days to the time taken 50% emergence (1 day) while 6 hours priming took more days to the time taken 50% emergence (2 days). A significant reduction in emergence time and enhancement in final germination may be due to fact that seed priming activate biochemical changes such as hydrolysis, activation of enzymes and breaking of dormancy in the seed [16,17] and [15] also indicated that seed priming for 24 hours caused significant reduction in the time 50% emergence which took mean minimum germination time compared to untreated seeds.

1). The interaction between priming techniques and durations was found non-significant. Among different priming techniques, Osmo priming with PEG-6000 resulted in high final germination

(85.8%) whereas halo priming with CaCl₂ resulted in (81.6%) to final germination while solid matrix priming with press mud resulted in (78.3%) final emergence. Control (dry seeds) resulted in less final germination (61.6%). Among different priming durations, 12 hours priming resulted in more final germination (80.0%) while 6 hours priming resulted in less value to final germination (74.0%). A significant reduction in emergence time and enhancement in final emergence may be due to the fact that seed priming stimulates an array of biochemical changes such as hydrolysis, activation of enzymes and dormancy breaking in the seed [16,17], which are required to initiate the germination process.

Germination index

Analysis of data showed that germination index was significantly affected by priming techniques and duration (Table 2). The interaction between priming techniques and durations was

found non-significant. Among different priming techniques, Osmo priming with PEG-6000 resulted in higher germination index (39.2). Halo priming with CaCl₂ resulted in (33.6 germination index. Solid matrix with press mud priming resulted in (30.1) value of germination index. Control (dry seeds) resulted in (18.0) less value of germination index. Among different priming durations, 12 hours priming resulted in (31.4) higher value of germination index while 6 hours priming resulted in (29.1) less value of germination index. The possible reason for improvement in germination % and germination index by hormonal priming and osmopriming for 24 hours may be due to greater hydration of colloids higher viscosity and elasticity of protoplasm, offer an increased inbound water content, lower water deficit and increased metabolic activity [18,19], also stated that different seed enhancement techniques positively affected the germination index, vigor index and final emergence of maize hybrid in a laboratory-based experiment.

Table 2: Germination index, root length (cm) and shoot length (cm) as affect by different priming techniques and priming durations.

Priming Techniques	Germination Index	Root Length (cm)	Shoot Length (cm)
Control	18.1d	9.9b	6.5c
Halo Priming	33.7b	13.8a	14.3a
Osmo Priming	39.2a	14.1a	10.1b
Matrix Priming	30.1c	15.3a	14.6a
LSD (0.05)	1.6	2.6	2.4
Duration			
6 Hours	29.1b	10.1b	13.7b
12 Hours	31.4a	13.1a	15.0a
LSD (0.05)	1.14	1.88	1.7
Interaction (PxD)	NS	NS	NS

Root length

Analysis of data revealed that root length was significantly affected by priming techniques and durations (Table 2). The interaction between priming techniques and durations was found non-significant. Among different priming techniques, solid matrix priming with press, mud resulted in a higher value of root length (15.3cm) which was statistically similar to Osmo priming with PEG-6000 (14.1cm). Halo priming with CaCl₂ resulted in (13.8cm) root length. Control (dry seeds) resulted in less root length (9.9cm). Among different priming durations 12 hours seeds priming resulted in (13.7cm) higher value of root length while 6 hours priming resulted (10.1cm) less value of root length. Karmore et al. [15] stated that root and shoot length were positively affected by seed priming techniques compared to untreated seed [12], also supported the present like-wise, improved performance by osmopriming with CaCl₂ to expedite germination, vigor index and seedling vigor in spring maize.

Shoot length

Analysis of data revealed that shoot length was significantly affected by priming techniques and durations (Table 2). The interaction between priming techniques and durations was found non-significant. Among different priming techniques solid matrix

priming with the pressmud resulted in large shoot length (14.6cm) which was statistically similar to halo priming with CaCl₂ (14.3cm). While Osmo priming with PEG-6000 resulted in (14.3cm) shoot length. Control (dry seeds) resulted in less shoot length (6.5cm). Among different priming durations 12 hours seeds priming resulted in higher (15.0cm) shoot length while less value of shoot length was produced by 6 hours priming (13.7cm). Karmore et al. [15] stated that root and shoot length were positively affected by seed priming techniques compared to untreated seed. Improved seedling growth by hormonal priming with SA may be attributed to increase cell division within the apical meristem and regulate plant growth through enhanced cell enlargement and cell division within the growing seedlings [20,21].

Shoot fresh weight

Analysis of data revealed that shoot fresh weight was significantly affected by priming techniques and duration (Table 3). The interaction between priming techniques and durations was found significant. Among different priming techniques solid matrix priming with press mud resulted (0.95g) higher shoot fresh weight followed by Osmo priming with PEG-6000 (0.14g). Halo priming resulted with CaCl₂ (0.13g) shoot fresh weight. Control (Dry seeds) resulted in (0.07g) less shoot fresh weight.

Among different priming durations 12 hours seeds priming resulted in more shoot fresh weight (0.32g) which statistically similar with 6 hours (0.32g). These results are supported by [22],

who found that seed priming treatments considerably enhanced fresh seedling weight.

Table 3: Shoot fresh weight (g), shoot dry weight (g), root fresh weight (g) and shoot dry weight (g) as affect by different priming techniques and priming durations.

Priming Techniques	Shoot Fresh Weight (g)	Shoot Dry Weight (g)	Root Fresh Weight (g)	Root Dry Weight (g)
Control	0.07d	0.01b	0.05b	0.02c
Halo Priming	0.13c	0.02c	0.07b	0.03b
Osmo Priming	0.14b	0.02d	0.22ab	0.03b
Matrix Priming	0.95a	0.03a	0.40a	0.12a
LSD (0.05)	0.009	0	0.3	0.005
Duration				
6 Hours	0.32a	0.02b	0.06b	0.02b
12 Hours	0.32a	0.03a	0.30a	0.08a
LSD (0.05)	0.006	0	0.21	0.0003
Interaction (Px)	***	***	NS	***

Shoot dry weight

Analysis of the data revealed that shoot dry weight was significantly affected by priming techniques and durations (Table 3). The interaction between priming techniques and durations was found also significant. Among different priming techniques solid matrix priming with pressmud resulted in (0.03g) higher shoot dry weight followed by halo priming with CaCl₂ (0.02g) which was statistically similar to Osmo priming with PEG-6000 (0.02g). Control (dry seeds) recorded in less shoot dry weight (0.01g). Among priming durations, 12 hours priming resulted (0.03g) higher shoot dry weight while 6 hours priming resulted in (0.02g) less shoot dry weight. The higher dry weight of seedlings and more shoot length was earlier reported by priming with CaCl₂ [23], which might be due to the emergence of seedlings. Improved seedling FW might be due to increased cell division within the apical meristem of seedling roots, which cause an increase in plant growth, which resulted in early stand establishment [24].

Root fresh weight

Analysis of data revealed that root fresh weight was greatly affected by priming techniques and durations (Table 3). The interaction between priming techniques and durations was found non-significant. Among the priming techniques, solid matrix priming with press mud was resulted in (0.40g) higher root fresh weight followed by Osmo priming with PEG-6000 (0.22g). Halo priming with CaCl₂ resulted in (0.07g) value for root fresh weight. Control (dry seeds) resulted in (0.05) less value for root fresh weight. Among priming different durations 12 hours seeds priming resulted in (0.30g) higher value of root fresh weight while 6 hours seeds priming resulted in (0.06g) less value of root fresh weight. Thangarasu et al. [25], reported that the combination of plant growth promoting rhizobacteria enhanced the root weight. Jha Y & Subramanian RB [26], also reported that the plants inoculated with PGPR showed higher dry weight.

Root dry weight

Analysis of data revealed that root dry weight was significantly affected by priming techniques and durations (Table 3). The interaction between priming techniques and durations was also found significant. Among different priming techniques solid matrix priming with press mud was resulted in (0.12g) higher root dry weight followed by Osmo priming with PEG-6000 (0.03g) which was statistically similar with halo priming with CaCl₂ (0.03g). Control (dry seeds) recorded in less root dry weight (0.02g). Among the priming durations 12 hours seeds priming resulted in (0.08g) higher value of root dry weight while 6 hours seeds priming resulted in (0.02g) less value of root dry weight. The higher dry weight of seedlings and more shoot length was earlier reported by priming with CaCl₂ [22], which might be due to the early emergence of seedlings. Jha et al. [26], also reported that the plants inoculated with PGPR showed higher dry weight.

Conclusion and Recommendation

Osmopriming with PEG-6000 and solid matrix priming with press mud improved germination and seedling growth of wheat compared to other priming techniques. Among seed priming duration's seed primed for 12 hours speed up the germination and enhanced crop growth. On the basis of the above conclusion, it is recommended that Osmo priming with PEG-6000 and solid matrix priming with press mud for 12 hours is recommended for obtaining higher germination and crop growth.

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Conflict of Interest

I report no conflicts of interest.

References

1. Nawaz J, Hussain M, Jabbar A, Nadeem GA, Sajid M, et al. (2013) Seed priming a technique. IJACS 6(20): 1373-1381.
2. Yari L, Aghaalikani M, Khazaei F (2010) Effect of seed priming duration and temperature on seed germination behaviour of bread wheat (*Triticum aestivum L.*). ARPN J Agric Biol Sci 5(1): 1-6.
3. Sadeghian SY, Yavari N (2004) Effect of water deficit stress on germination, early seedling growth in sugarbeet. J of Agron Crop Sci 190(2): 138-144.
4. Parera AC, Cantliffe DJ (1994) Pre-sowing seed priming. Horticult Rev 16: 109-148.
5. Heydecker W, Coolbear P (1978) Seed treatment for improved performance: Survey and attempted prognosis. Seed Sci Technol 5: 353-425.
6. Harris D, Joshi A, Khan PA, Gothakar P, Sodhi PS (1999) On-farm seed priming in semi-arid agriculture: Development and evaluation in corn, rice and chickpea in India using participatory methods. Exp Agric 35(1): 15-29.
7. Harris D, Raghuvanshi BS, Gangwar JS, Singh SC, Joshi K, et al. (2001) Participatory Evaluation by Farmers of on-farm seed priming in Wheat in India. Nepal and Pakistan. Expl Agric 37(3): 403-415.
8. Khan S, Basra SMA, Afzal I, Nawaz M, Rehman H (2017) Growth promoting potential of fresh and stored Moringa oleifera leaf extracts in improving seedling vigor, growth and productivity of wheat crop. Environ Sci Pollut Res 24(35): 27601-27612.
9. Abandani RR, Ramezani M (2012) The physiological effects on some traits of osmopriming germination of maize (*Zea mays L.*), rice (*Oryza sativa L.*) and cucumber (*Cucumis sativus L.*). Int J Agron 41(2): 32-148.
10. Ellis RH, Roberts EH (1981) The quantification of ageing and survival in orthodox seeds. AGRIS.
11. Coolbear P, Francis A, Grierson D (1984) The effect of low temperature pre-sowing treatment under the germination performance and membrane integrity of artificially aged tomato seeds. J Exp Bot 35(11): 1609-1617.
12. Farooq M, Basra SMA, Hafeez K, Ahmad A (2005) Thermal hardening: a new seed vigor enhancement tool in rice. J Integr Plant Biol 47(2): 187-193.
13. ISTA (2009) International Rules for Seed Testing. Seed Vigor Determination. 2015(1): 1-9.
14. Khan AZ, Shah T, Khan S, Rehman A, Akbar H, et al. (2017) Influence of seed invigoration techniques on germination and seedling vigor of Maize (*Zea mays L.*). Cercetări Agron Moldova 50(3): 61-70.
15. Karmore JV, Tomar GS (2015) Effects of seed priming methods on germination and seedling development of winter maize (*Zea mays L.*). Advance Res J of Crop Impro 6(2): 88-93.
16. Aziza A, Haben A, Becker M (2004) Seed priming enhances germination and seedling growth of barley under condition of P and Zn deficiency. J Plant Nutr Soil Sci 167(5): 630-636.
17. Farooq M, Wahid A, Basra SMA, Siddique KHM (2010) Improving crop resistance to abiotic stresses through seed invigoration. Handbook of Plant and Crop Stress, CRC Press, USA, pp. 1031-1050.
18. Shah T, Khan AZ, Rehman A, Muhammad A, Akbar H, et al. (2017) Influence of pre-sowing seed treatments on germination properties and seedling vigor of wheat. Research in: Agricultural & Vet Sci 1(1): 62-70.
19. Dezfuli PM, Sharif-Zadeh F, Janmohammadi M (2008) Influence of priming techniques on seed germination behavior of maize inbred lines (*Zea mays L.*). J Agric Biol Sci 3(3): 22-25.
20. Vanacker H, Lu H, Rate DN, Greenberg JT (2001) A role for salicylic acid and NPR1 in regulating cell growth in Arabidopsis. Plant J 28(2): 209-216.
21. Rehman H, Iqbal H, Basra SMA, Afzal I, Farooq M, et al. (2015) Seed priming improves early seedling vigor, growth and productivity of spring maize (*Zea mays L.*). J Integ Agric 14(9): 1745-1754.
22. Afzal I, Basra SMA, Farooq M, Nawaz A (2005) Alleviation of salinity stress in spring wheat (*Triticum aestivum L.*) by hormonal priming with ABA, Salicylic acid and ascorbic acid. Int J Agric Biol 8(1): 23-28.
23. Farooq M, Basra SMA, Rehman H, Saleem BA (2008) Seed priming enhances the performance of late sown wheat (*Triticum aestivum L.*) by improving chilling tolerance. J Agric and Crop Sci 194(1): 55-60.
24. Farooq M, Basra SMA, Tabassum R, Afzal I (2006) Enhancing the performance of direct seeded fine rice by seed priming. Plant Prod Sci 9(4): 446-456.
25. Thangarasu M, Kaliyamoorthy K, Kuppasamy (2014) Pesticidal and Mosquitocidal Activities of *Clausena excavata* Burm. F. against *Spodoptera litura* and *Aedes aegypti L.*, *Anopheles stephensi* Liston, and *Culex quinquefasciatus* Say. (Diptera: Culicidae). Hindawi Publishing Corporation Advances in Zoology. p. 7.
26. Jha Y, Subramanian RB (2013) Paddy plants inoculated with PGPR show better growth physiology and nutrient content under saline conditions. Chilean J Agri Res 73(3): 78-81.



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