Research Article

Enhancing productivity of late sown wheat with hydro-priming

Shazma Anwar¹, Murtaza Amin¹, Beena Saeed², Shehryar Khan¹,
Muhammad Owais Khan³, Shaheen Kashmir⁴ and Muhammad Islam^{1*}

1. Department of Agronomy, The University of Agriculture, Peshawar-Pakistan

2. Department of Agriculture, University of Sawabi, Sawabi-Pakistan

3. Department of Soil & Environmental Sciences, The University of Agriculture, Peshawar-Pakistan

4. Department of Botany, The University of Agriculture, Peshawar-Pakistan

*Corresponding author's email: islamswati439@yahoo.com

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Abstract

A field trial was carried out to investigate the effect of seed priming on the productivity of late sown wheat during fall-2016. The experiment was laid out in randomized complete block design (RCBD) with split-plot arrangement having three replications. Two factors (sowing dates and priming) were tested in the experiment. Sowing dates (29th Oct, 10th Nov, 24th Nov, 10th Dec, 26th Dec and 10th Jan) were assigned to main plots, while priming (non-primed and primed) was allotted to sub-plots. Wheat variety "SIRAN-2010" was sown in a plot size of 1.8m x 5m. Results showed that wheat crop sown on 29th Oct resulted in early emergence (6 days), increased emergence m⁻² (139) plant height (101.61cm), spikes m⁻² (280), grains spike⁻¹ (46.63), thousand grain weight (44g), biological yield (9770 kg ha⁻¹) and grain yield (4038 kg ha⁻¹). Late sown wheat in (10th Jan) took lesser days (136) to maturity. In case of seed priming early emergence (11 days), more emergence m⁻² (102), taller plants (85.19cm), more spikes m⁻² (216), higher grains spike⁻¹ (40.18), maximum 1000-grains weight (37g), maximum grain yield (3116 kg ha⁻¹) and maximum biological yield (7630 kg ha⁻¹) was recorded in plots sown with hydro-primed seed. However, dry sown seed took more days (163) to emergence. Hence it is concluded that sowing from 29th Oct to 10th Nov significantly increased yield and yield related components of wheat. Similarly seed priming is necessary for higher yield of late sown wheat.

Keywords: Hydro-priming; Wheat; Sowing dates

Introduction

Wheat (*Triticum aestivum* L.) is an annual self-pollinated, long day cereal crop. It is a staple food and high value crop containing approximately 11-15% protein, 60-70% carbohydrates and traces of minerals [1]. In Pakistan, wheat is grown on 68% of the total cropped area and is the major food item that fulfills 95% of the food requirements of the whole country [2]. It is mostly grown in the northern hemisphere; North America, Europe, China and Russia,

which account for more than 80% of the world wheat supply [3]. The per capita wheat consumption is 125 kg year⁻¹, which is among the highest in the world. In Pakistan, area under wheat cultivation was 8.64 million hectares and production was 23.47 million tones with an average yield of 2714 kg ha⁻¹. In Khyber Pakhtunkhwa total area under wheat cultivation was 0.729 million hectares while its production was 1.13 million tones and average yield was 1550 kg ha⁻¹ [4].

Sowing date is one of the important factors which directly affect growth and grain yield of wheat. Flowering, maturity, seed filling duration, seed weight and grains spike⁻¹ are significantly affected by time of sowing. Too early sowing may utilize soil moisture accumulated in the fall. However, medium season seeding of winter wheat for any locality is usually favorable [5]. Grain yield declined with delaying sowing with a loss of 200-250 kg grain ha⁻¹ for each week's delay in sowing time [6]. Delayed sowing decreased grain yield due to decrease in germination count m⁻², number of grains spike⁻¹ and thousand grains weight whereas increase in seed rate did not affect grain yield [7]. Wheat yield ha⁻¹ in Pakistan is very low as compared to others countries where the yield ha⁻¹ is three times more and almost double in china [4] the causes could be low germination and poor stand establishment.

In Khyber Pakhtunkhwa more than 60% of the wheat is cultivated on rain-fed land. Seed priming improves percentage and time to germination and it is more successful in wheat [8, 9]. Seed priming benefits wheat germination under mild drought stress [10]. Wheat cv. Inqilab and S-24 when soaked in water sustained salinity [11] and germinate earlier than dry seed [12]. Seed priming improves the vigor and uniformity of germination [13]. For wheat seed priming with water is also used as a best medium [14]. Keeping in view the importance of suitable sowing time and seed priming the current experiment was carried out to investigate the effect of seed priming on the productivity of late sown wheat.

Materials and methods

The effect of hydro-priming on late sown wheat was tested at the Agronomy Research Farm, The University of Agriculture Peshawar-Pakistan during fall 2016-17. Two factorial experiment (sowing dates and seed priming with water) was carried out in a randomized complete block design (RCBD) with split-plot arrangement. Sowing dates (29th October,

10th November, 24th November, 10th December, 26th December and 10th January) were allotted to main plots, whereas seed priming (dry seed and water soaked seed) were allotted to sub plots. A sub plot of size 5m x 1.8m (with 6 rows 30cm apart) was used. Seed of wheat variety "SIRAN-2010" were soaked in water for six hours at room temperature and sown @150 kg ha⁻¹. All other agronomic practices were uniformly maintained for all the experimental units. Data were recorded on days to emergence, emergence m⁻², plant height, days to physiological maturity, spikes m⁻², grains spike⁻¹, 1000-grains weight, biological yield and grain yield following the desirable standard procedure. Method applicable to the randomized complete block design (split-plot arrangement) was used for statistical analysis of the recorded data. For mean comparison in case of significant difference least significant difference (LSD) test at 5% level of significance was used [15].

Results and discussion

Days to emergence

Sowing dates and seed priming significantly affected days to emergence of wheat (Table 1). More days to emergence (16 days) were taken by late sown plant (10th January), while wheat crop sown on 29th October took lesser days to emergence (6 days). Increase in days to emergence with delay in sowing may be due to drop in temperature. Seed priming also showed a significant effect on days to emergence of wheat. More days to emergence (12 days) were taken by dry sown seeds (non-primed) as compared to seed primed with water which took less days (11). Similar results were also reported by [16] who found early emergence of wheat seed primed with distilled water and saturated gunny bags.

Emergence m⁻²

Table 1 showed that sowing dates and seed priming significantly affected emergence m⁻² of wheat. Interaction between sowing dates and hydro priming was found non-significant. Maximum emergence m⁻² (139) was observed in plots sown on 10th

November, while late sowing (10th January) gave minimum emergence m⁻² (20). These results are in conformity with [17] who stated that different sowing dates had significant effect on germination. Delayed sowing for all varieties of wheat had negative effect on emergence per unit area [18]. In case of seed priming, less emergence m⁻² (94) was recorded in plots sown with non-primed seed, while more emergence m⁻² (102) was recorded in plots sown with hydro-primed seed. The enhanced emergence in primed seed improved the stand of wheat crop, emergence m⁻² and accelerated the chemical reactions in seed which are essential for emergence of seed [19].

Plant height (cm)

Plant height considerably varied by sowing dates and seed priming while their interaction was found non-significant (Table 1). Plant height significantly decreased (49.50 cm) in delayed sowing (10th Jan), whereas taller plants (101.61cm) were observed in plot sown on 29th October. These results are in agreement with [20]

who stated that plant height decreased significantly as planting was delayed from mid-November to December. Taller plants (85.19 cm) were recorded by hydro-priming, while non-primed seed produced dwarf plants (83.20 cm). Similar results were reported [21] who found taller plants in plots having seeds treated with phosphorous solution.

Days to physiological maturity

A significant effect of sowing dates on days to physiological maturity of wheat is presented in (Table 2). Seed priming and the interaction between sowing dates and priming was found non-significant. Delayed maturity (187 days) was observed in plots sown on 29th October, while early maturity (133 days) was noticed in plots sown on 10th January. Delaying sowing plants had less vegetative period due to long day nature of wheat crop and enter into reproductive stage earlier and thereby took fewer days to maturity. The results are in agreement with findings of [22], who reported that delay in sowing hastened physiological maturity.

Table 1. Days to emergence, emergence m⁻² and plant height of wheat as affected by sowing dates and priming

Treatments	Days to emergence	Emergence m ⁻²	Plant height (cm)
Sowing Dates (SD)			
29-Oct	6f	124b	101.61a
10-Nov	7e	139a	99.61a
24-Nov	9d	125b	98.83a
10-Dec	12c	111c	91.67b
26-Dec	14b	70d	63.94c
10-Jan	16a	20e	49.50d
LSD value	1.18	15.56	4.5
Priming (P)			
Dry seed	12a	94b	83.20b
Water soaked seed	11b	102a	85.19a
LSD value	0.29	3.43	1.09
LSD values for interaction			
SD x P	NS	NS	NS

Means with different letters differ significantly according to Least Significant Difference (LSD) test ($P < 0.05$). NS stands for non-significant difference

Spikes m⁻²

It is evident that sowing dates and seed priming significantly affected spikes m⁻² of

wheat (Table 2). In case of sowing dates more number of spike m⁻² (280) were observed in 29th October sown plots, while

less number of spikes m^{-2} (50) were observed in plots sown on 10th January. These results are in agreement with [23] who reported that number of spikes per unit area reduced in earlier and late planted plots of wheat than normal sowing date. Similarly, greater no of spikes m^{-2} (216) was observed for water soaked seed as compared to dry seed which produced 207 spikes m^{-2} . Similar results were observed by [11] who stated that increase in spikes m^{-2} due to priming might be due to improved emergence and better seedling growth. The interaction of sowing dates and priming stayed not significant.

Grains spike⁻¹

A significant variation in number of grains

spike⁻¹ of wheat by sowing dates and seed priming is presented in (Table 2). Maximum grains spike⁻¹ (46.63) were counted in plots sown on 29th October, minimum grains spike⁻¹ (17.88) were recorded in last sowing (10th January). These results are in agreement with [24, 25, 26], who concluded that grains spike⁻¹ significantly decreased with delay in sowing. In case of seed priming more grains spike⁻¹ (40.18) were produced by water soaked seeds and less number of grains spike⁻¹ (39.33) were produced by dry sown seed. Our results are in line with the findings of [16, 27] who reported that in mung bean grains pod⁻¹ enhanced by treated seeds.

Table 2. Spikes m^{-2} , grains spike⁻¹ and days to physiological maturity of wheat as affected by sowing dates and priming

Treatments	Spikes m^{-2}	Grain spike ⁻¹	Days to physiological maturity
Sowing Dates (SD)			
29-Oct	280a	46.63a	187a
10-Nov	266ab	46.10ab	183b
24-Nov	226bc	45.03bc	163c
10-Dec	245c	44.02c	154d
26-Dec	200d	38.86d	151d
10-Jan	50e	17.88e	136e
LSD value	32.23	1.4	4.65
Priming (P)			
Dry seed	207b	29.33b	163
Water soaked seed	216a	40.18a	161
LSD value	3.57	0.42	NS
LSD values for interaction			
SD x P	NS	NS	NS

Means with different letters differ significantly according to Least Significant Difference (LSD) test ($P < 0.05$). NS stands for non-significant difference

Thousand grains weight (g)

It is revealed from statistical analysis of the data that 1000-grains weight of wheat varied considerably by both sowing dates and seed priming (Table 3). Higher thousand grains weight (44g) was recorded in plots sown on 29th October, while the lower thousand grains weight (22g) was recorded in late sown plots (10th January). Decrease in grains weight with delay in sowing might be due to short growth

period, where grains did not develop properly and hence resulted in low weight. The results are in conformity with [23] who reported that thousand grains weight significantly decrease with delay in sowing date. Similarly, maximum thousand grains weight (37g) was recorded in case of primed seed, while minimum 1000-grains weight (36g) was recorded by non-primed seed. Similar results were found by [16]

who stated that seed priming increased grains weight and biomass.

Grain yield (kg ha⁻¹)

A significant variation in grain yield of wheat was observed with different sowing dates and seed hydro-priming, while their interaction was found non-significant (Table 3). Early sown plants (29th October) produced maximum grain yield (4038 kg ha⁻¹), whereas minimum grain yield (1065 kg ha⁻¹) was recorded in plots sown late (10th January). A significant decrease in grain yield was also found by [28]. Likewise water soaked seed gave maximum grain yield (3116 kg ha⁻¹) than that of dry sown seed which produced minimum yield (2779 kg ha⁻¹). Our results are in conformity with the investigation of [29] who found significant increase in grain

yield of wheat when seed was primed different agents (PEG, Na₂SO₄, KNO₃ and hydro-priming).

Biological yield (kg ha⁻¹)

Sowing dates and seed priming significantly affected biological yield of wheat (Table 3). Higher biological yield (9770 kg ha⁻¹) was recorded in plots sown on 29th October, while lower biological yield (3200 kg ha⁻¹) was produced by the plots sown on 10th January.

In case seed priming minimum biological yield (6983 kg ha⁻¹) was obtained from dry seed (non-primed), whereas water primed seed gave maximum biological yield (7630 kg ha⁻¹). Similar results were noticed by [28], who observed significant increase in biological yield by seed priming.

Table 3. Thousand grain weight, grain yield and biological yield of wheat as affected by sowing dates and priming

Treatments	Thousand grains weight (g)	Grain yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)
Sowing Dates (SD)			
29-Oct	44a	4038a	9770a
10-Nov	42b	3984a	9432a
24-Nov	41c	3569a	9045a
10-Dec	37d	2788b	6878b
26-Dec	31e	2243b	5512b
10-Jan	22f	1065c	3200c
LSD value	0.94	849.55	1825.24
Priming (P)			
Dry seed	36b	2779b	6983b
Water soaked seed	37a	3116a	7630a
LSD value	0.54	134.55	309.04
LSD values for interaction			
SD x P	NS	NS	NS

Means with different letters differ significantly according to Least Significant Difference (LSD) test ($P < 0.05$). NS stands for non-significant difference

Conclusion

It is concluded from the results that optimum sowing date (29th Oct to 10th Nov) significantly increased yield and yield related components of wheat. Similarly seed priming with water for at least six hours enhanced growth and yield of late sown wheat.

Authors' contributions

Conceived and designed the experiments: S Anwar & M Amin, Performed the experiments: M Amin & S Anwar, Contributed reagents/materials/analysis tools: S Anwar, B Saeed & M Islam, Analyzed the data: B Saeed, M Islam & S

Khan, Wrote the paper: M Islam & S Anwar.

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