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Seed Priming, Nitrogen Levels and Moisture Regimes Affects Phenology of Wheat

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Abstract:

The project was conducted at New Developmental Farm of Agricultural University Peshawar in Rabi 2010-2011 to study the effects of moisture regimes, seed priming and nitrogen levels on phenology and yield components of wheat. The experiment consisted of three factors i.e. moisture regimes (low and high) seed priming (dry seed, water soaked seed and P-primed seed) and N levels (0, 60 and 120 kg ha^{-1}). Low moisture plots took more days to emergence (9) and heading (121) as compared to high moisture plots (8 and 120 respectively).Results showed that high moisture plots resulted in greater emergence m^{-2} (159), tiller m^{-2} (366), spike m^{-2}(323) and thousand grain weight (45g). Plots with 0 kg N ha^{-1} (control) took more *days to emergence (9) however, number of tiller m^{-2}(370) and days to physiological maturity (159) were higher at 120 kg N ha^{-1}. Higher emergence m^{-2}(166), number of tiller m^{-2}(363), were recorded at P primed seed plots. However, dry seed took more days to emergence (10) and water soaked seed plots took more days to physiological maturity (159). High moisture and P priming is recommended to the farmers on the basis of good crop stand and performance.*

Key words: wheat, seed priming, nitrogen

INTRODUCTION

Wheat (*Triticumaestivum* L.) is one of the most important grain crop of Pakistan. It is the staple food of obtained Pakistan because 73 % calories and 12 % protein requirement are met from wheat (Khalil and Jan, 2002). Wheat was grownon 9046.0 thousand ha with 24032.9 thousand tones food grain, while in Khyber Pakhtunkhwa the total area occupied by wheat was 769.5 thousandha^{-1}, which produced 1204.5 thousand tone (MINFAL, 2009).

Seed priming boost germination of crop and thus establish a good crop stand. It comprises of soaking seed nutrient solution. During seed priming a prompt break down of endosperm occur seed germinate quickly as priming accelerate the function of enzymes. Due to these processes the seed germinate earlier than dry seed (Asgedom and Becker, 2001).

In Pakistan nitrogen is one of the most limiting factor in crop production. Use of nitrogen fertilizer will upsurge from 60 to 90 percent (Galloway et al., 1995) in developing countries because they are trying to fulfill the necessity of food for increasing population for this purpose they are applying more and more fertilizers.

In this experiment we determined the influence of treated seed on emergence, plant growth and yield wheat at two contrasting seedbed moisture condition and available nitrogen.

MATERIALS AND METHODS

Experimental Site

The experiment was conducted at New Developmental Farm,the University of Agriculture Peshawar during Rabi 2011-12. The experimental farm is located at 34.01 Nlatitude, 71.35 E longitude at an altitude of 350 m above sea level in Peshawar valley.Peshawar is located about 1600 km north of the Indian Ocean and has continental type ofclimate. Soil is clay, low inorganic matter (0.87%), extractable P (5.6 mg P kg-1), exchangeable potassium (121 mg Kkg-1), alkaline (pH 8.2) and is calcareous in nature. Mean annual rainfall in the regionvaries from 300 to 500 mm, of which 70% occurs in summer.

Experimental Materials

The experiment consisted of three factors i.e. moisture regimes (Low and High), seed priming (dry seed, water soaked, seed primed with 0.2% P solution) and nitrogen levels (0, 60, 120 kg ha^{-1}). Two separate experiments were conducted in RCBD, one under high moisture seedbed condition and other under low moisture seedbed condition. Date of sowing was 25^{th} November 2010. Treatment combination of seed priming and N levels were kept in both experiments with three replications. Low moisture plots were irrigated two weeks before sowing while high moisture plots were irrigated a week before sowing. Both low and high moisture plots were not irrigated till 40^{th} day after sowing. Soil moisture of both low and high moisture regimes were 23 and 30 %, respectively at the time of sowing of the crop. Wheat variety Siran-2010 was cultivated at the rate of 120 kg

ha^{-1} in a subplot size of 4.8 m by 3 m having 16 rows 3 meter long and row to row distance was 30 cm.

STATISTICAL ANALYSIS

Data were statistically analyzed using the procedure suitable for RCBD design with significant F-value. The least significant difference (LSD) test was applied for the comparison of treatments means at 5% level of probability (Jan et al., 2009).

RESULTS AND DISCUSSIONS

Days to emergence

Data pertaining days to emergence of wheat are given in Table 1. Data analysis showed that the effects of moisture (M) and seed priming (P) were significant on days to emergence while nitrogen (N) effect was not significant. Similarly, all the interactions were also not significant except M x P. Low moisture plots resulted in higher days to emergence (9) as compared to high moisture plots (8). Seed priming significantly affected days to emergence. Higher days to emergence were recorded for dry seed (9.56) as compared to P primed seed (8.28) and water soaked (7.78) which took lower days to emergence. The M x P interaction indicated that water soaked and P primed seed took less days to emergence as compare to control in both low and high moisture plots. However, the same seed in high moisture plots took lesser days to emergence in contrast with low moisture plots (Fig 1.).

Emergence m^{-2}

Data regarding emergence m^{-2} of wheat are given in Table 1. Data analysis showed that moisture and seed priming positively affected emergence m^{-2}. Nitrogen level effect was significant. High moisture plots resulted in higher emergence

m^{-2} (159) as compared to low moisture plots (156). P primed seed (166) and water soaked seed (162) resulted in higher emergence m^{-2} as compared to dry seed (144).

Plant height (cm)

Data on plant height of wheat are given in Table 2. Obtained data showed that the effects of moisture, N levels and seed priming were not significant while plant height significantly varied during different weeks. Similarly, all interaction were remained non significant. Plant height significantly enhanced from week first to fifth week. It increased from 1.24 cm to 1.82 cm (46 %) during first week. During second week, it increased from 1.82 cm to 1.88 cm (3 %). In week third, it increased from 1.88 cm to 2.46cm (30 %). It increased from 2.46 cm to 2.52cm (2.5 %) during week four. Similarly, in week five, it increased from 2.52 cm to 3.10 cm (23 %).

Number of leaves

Data regarding number of leaves of wheat are given in Table 2. Analysis of data showed that the effects of moisture, N levels and seed priming were not significant while number of leaves significantly varied during weeks. All interactions were not significant. Number of leaves significantly increased with the passage of time. It increased from 1.0 to 1.68 (68.8 %) during first week. During second week, it increased from 1.68 to 2.0 (18.4 %). In week third, it increased from 2.0 to 2.82 (41%). It increased from 2.82 to 3.14 (11%) during week four. Similarly, in week five, it increased from 3.14 to 3.20 (2 %).

Number of tillers m^{-2}

Data regarding number of tillers $m^{-2}$of wheat are given in Table 3. Data analysis showed that moisture, nitrogen and seed priming positively influenced by no. of tillers m^{-2}. Maximum number of tillers m^{-2} produced in high moisture plots (366) as compared to low moisture plots (310). Number of tillers m^{-2} increased with increasing level of nitrogen. Highest number of tillers m^{-2} were recorded for 120 kg N ha^{-1} (370) followed by 60 (344) and 0 kg N ha^{-1} (300). Seed priming improved number of tillers m^{-2}. Higher number of tillers m^{-2} were recorded for P primed seed (363) as compared to water soaked (327) and dry seed (323).

Days to heading

Data regarding days to heading of wheat are given in Table 3. The effect of moisture was significant while that of nitrogen and seed priming were not significant. All the interactions were also significant except P x N and M x N. Higher days to heading were taken by low moisture plots (121) as compared to high moisture plots (120). Though the effect of nitrogen was not significant but higher days to heading were recorded for 0 and 120 kg N ha^{-1} (121) followed by 60 kg N ha^{-1} (120). Similarly, the effect of seed priming was not significant but maximum days to heading were recorded for dry seed as compared to water soaked and P primed seed (120). The P x N interaction indicated that days to heading increased with increasing levels of N in water soaked and dry seed. However, days to heading declined with increasing level of N in P primed seed (Fig 2.). The M x N interaction indicated that days to heading increased with increasing levels of N in high moisture. However, days to heading declined with increasing N levels in low moisture (Fig 3).

Days to physiological maturity

Data regarding days to physiological maturity of wheat are given in Table 3. Analysis of the data showed that the effect of moisture was not significant while the effects of nitrogen levels and seed priming were significant. All the interactions were not significant except P x N. Nitrogen levels increased days to physiological maturity of wheat. Maximum days to physiological maturity were recorded for 120 and 60 kg N ha^{-1} (159, 158, respectively) as compared to 0 kg N ha^{-1} (157).

DISCUSSION

Days to emergence were significantly influenced by moisture and seed priming while the effect of nitrogen levels was not significant. Low moisture plots resulted in higher days to emergence as compared to high moisture plots. Seed priming significantly affected days to emergence. Higher days to emergence were recorded for dry seed as compared to P primed seed and water soaked seed which took lower days to emergence. Similar results are reported by Le Gouis et al. (1999) who found that N levels had little or no effects on days to emergence of wheat. Arif et al. (2005) found that nutrient primed seed performed better than the dry seed in terms of accelerating and enhancing emergence. Seed treated with nutrients has positive effects on the performance of wheat because it improve emergence, tiller $m^{-2}$and also bring chemical changes in the endosperm due to activation of enzymes (Rowse, 1995).

Emergence m^{-2} was significantly influenced by moisture and seed priming while the effect of nitrogen levels was not significant. High moisture plots resulted in higher emergence m^{-2} as compared to low moisture plots. P primed seed and water soaked seed resulted in higher emergence m^{-2} in contrast with dry seed. The enhanced emergence in primed seed improves the stand of wheat crop, emergence m^{-2} and accelerates the chemical reactions in seed which are essential for emergence of seed. (Bray et al., 1989). Likewise, Arif et al. (2005) found that nutrient primed seed performed better than the dry seed in terms of improving and enhancing emergence of maize seed. The results similar with the results of Ullah et al. (2002a) who concludedthat influence of seed treated with micronutrient on emergence rate are benificial.

Plant height was not significantly affected by moisture, N levels and seed priming while the effect of different weeks was significant. Plant height increased 46, 3, 30, 2.5 and 23 % during first, second, third, fourth and fifth week, respectively. The agreements are not similar with Hafid et al. (1996) who found that irrigation increased the heading and stem elongation. Arif et al. (2006) determined positive improvement in plant height of wheat due to nitrogen application. Similarly, Khan and Khalil (2007) found taller plants in plots having seeds treated with phosphorus solution.

Number of leaves was not significantly influenced by moisture, N levels and seed priming while the effect of different weeks was significant. Number of leaves enhanced 68, 18.4, 41, 11 and 2 % during first, second, third, fourth and fifth week, respectively. Dissimilar results have reported by Sharp and Davies, (1989). They found that shoot is critical than root of a plant and among the shoot leaf is the sensitive part which affected adversely when soil moisture content decreased. Results are not in line with Kasem and Mesilhy (1992) who found that nitrogen increased number of leaves/ plant.

Number of tillers m^{-2} was significantly affected by moisture, N levels and seed priming. Maximum number of tillers m^{-2} produced in high moisture plots as compared to low moisture plots. Number of tillers m^{-2} increased with increasing level of nitrogen. Maximum number of tillers m^{-2} was recorded for 120 kg N ha^{-1} followed by 60 and 0 kg N ha^{-1}. Seed priming improved number of tillers m^{-2}. Higher number of tillers m^{-2} was recorded for P primed seed contrast to water soaked and dry seed. Similar views by Singh et al. (1998) who reported that number of tillers m^{-2} increased with increasing number of irrigation from two to four. Likewise, Akram (2000) reported that high levels of N application stimulated tillers m^{-2} in barley.

The increase in tillers due to priming might due to improved emergence and seedling growth in the plots of primed seed (Harris et al ., 2000).

Days to heading were significantly influenced by moisture while nitrogen levels and seed priming effects were not significant. Higher days to heading were taken by low moisture plots as compared to high moisture plots. These results are agreed with Hafid et al. (1996) who stated that irrigation increased days to heading and stem elongation. However, these results disagree with Zubair et al. (2009) who reported that increase in levels of nitrogen increased vegetative growth thus delayed days to heading.

Days to physiological maturity were not significantly affected by moisture while nitrogen levels and seed priming effects were significant. Nitrogen levels increased days to physiological maturity of wheat. More days to maturity were obtained for 120 and 60 kg N ha^{-1}as compared to 0 kg N ha^{-1}. Maximum days to physiological maturity were recorded for water soaked and dry seed as compared to P primed seed. Results are similar withSoane and Pidgeon (1991) who concluded that physiological maturity delayed with increased levels of nitrogen. However, these results are dissimilar with Harris et al. (2001) who concluded that priming treatment resulted in early maturity. These results are dissimilar with Hafid et al. (1996) who reported that irrigation increased life cycle of all wheat varieties.

RECOMMENDATIONS

It is concluded from the present study that High moisture and P priming is recommended to the farmers on the basis of good crop stand and performance of wheat.

Table 1. Days to emergence and emergence m^{-2} of wheat as effected by moisture, N levels and seed priming.

Moisture	Days to emergence	Emergence m^{-2}
Low	9 a	156 b
High	8 b	159 a
Significance level	*	**
Nitrogen (kg ha^{-1})		
0	9	156
60	8	163
120	9	153
LSD	Ns	ns
Seed priming		
Dry seed	10 a	144 b
Water soaked seed	8 b	162 a
P primed seed	8 b	166 a
LSD	0.70	13.39
Interactions		
P x N	Ns	ns
M x N	Ns	ns
M x P	* (Fig 1.)	ns
M x P x N	Ns	ns

Mean values followed by different letters in each category are significantly different at 5% level of probability using LSD test.
*, ** = significant at 5 and 1% level of probability, respectively. ns = non significant

Table 2. Fresh shoot weighttiller^{-1} (g) plant height (cm) and number of leaves tiller^{-1} of wheat as influenced by moisture, N levels, seed priming and weeks.

	Plant height (cm)	Number of leaves
Low	2.28	2.35
High	2.16	2.26
Significance level	Ns	ns
Nitrogen (kg ha^{-1})		
0	2.18	2.32
60	2.24	2.31
120	2.23	2.28
LSD	Ns	ns
Seed Priming		
Dry seed	2.17	2.27
Water soaked seed	2.20	2.33
P primed seed	2.27	2.31

LSD	Ns	ns
Weeks		
1	1.24 d	1.0 c
2	1.82 c	1.68 b
3	1.88 c	2.0 b
4	2.46 b	2.82 a
5	2.52 b	3.14 a
6	3.10 a	3.20 a
LSD	**0.57**	**0.38**
Interactions		
P x N	Ns	ns
M x N	Ns	ns
M x P	Ns	ns
M x P x N	Ns	ns
M x W	Ns	ns
W x N	Ns	ns
W x P	Ns	ns
M x W x N	Ns	ns
M x W x P	Ns	ns
W x N x P	Ns	ns
M x W x N x P	Ns	ns

Mean values followed by different letters in each category are significantly different at 5% level of probability using LSD test.
ns = non significant

Table 3. Numbers of tillers m^{-2}, days to heading and spike m^{-2} of wheat as influenced by moisture, N levels and seed priming.

Moisture	**Number of tillers m^{-2}**	**Days to heading**	**Days to Physiological maturity**
Low	310 b	121 a	158
High	366 a	120 b	158
Significance level	**	**	ns
Nitrogen (kg ha^{-1})			
0	300 b	121	157 b
60	344 a	120	158 ab
120	370 a	121	159 a
LSD	31.66	ns	1.15
Seed priming			
Dry seed	323 b	121	158 ab
Water soaked seed	327 b	120	159 a
P primed seed	363 a	120	157 b
LSD	31.66	ns	1.09
Interactions			

P x N	Ns	** (Fig 2.)	* (Fig 4.)
M x N	Ns	** (Fig 3.)	ns
M x P	Ns	ns	ns
M x P x N	Ns	ns	ns

Mean values followed by different letters in each category are significantly different at 5% level of probability using LSD test.
** = significant at 1% level of probability. ns = non significant

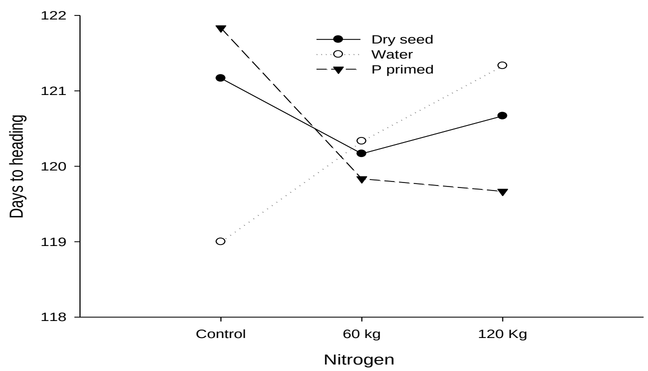

Fig 2. The priming x nitrogen interaction for days to heading of wheat.

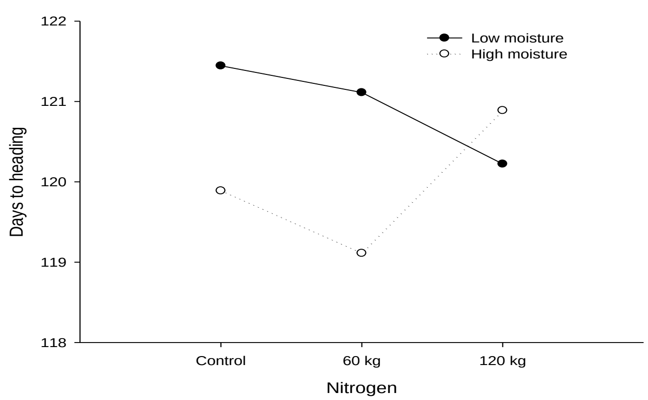

Fig 3. The moisture x nitrogen interaction for days to heading of wheat.

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