

EFFECT OF PRIMING PERIODS ON SEED GERMINATION AND EARLY SEEDLINGS GROWTH OF WHEAT

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ABSTRACT: The experiment was conducted to investigate the effect of priming periods on seed germination and early seedlings growth of wheat. Three wheat varieties viz; Mehran-89, TJ-83 and TD-1 and three priming periods viz; 6 hrs, 12 hrs and 24 hrs were used. The experiment was laid out in Completely Randomized Design having three replications. The results for wheat varieties showed that maximum (88.80%) seed germination, shoot length (13.31cm), root length (8.27 cm), shoot fresh weight (3811.90 mg), root fresh weight (330.89 mg), shoot dry weight (235.67 mg), root dry weight (116.56 mg) and seed vigor index (1182.00) were observed in Mehran-89. Wheat variety TJ-83 ranked second with (84.36%) seed germination, shoot length (8.41cm), root length (6.64 cm), shoot fresh weight (3425.80 mg), root fresh weight (305.31mg), shoot dry weight (212.78 mg), root dry weight (107.56 mg) and seed vigor index (703.30). Whereas wheat variety TD-1 had minimum (83.43%) germination, shoot length (6.45 cm), root length (5.73 cm), shoot fresh weight (3258.00 mg), root fresh weight (303.22 mg), shoot dry weight (220.89 mg), root dry weight (105.40 mg), seed vigor index (530.80). The results further showed that the 24 hours priming period recorded maximum (87.36%) seed germination, shoot length (9.71 cm), root length (7.67 cm), shoot fresh weight (3758.10 mg), root fresh weight (326.11 mg), shoot dry weight (231.00 mg), root dry weight (117.11 mg) and seed vigor index (850.00). Whereas the 12 hours priming period had ranked second with (85.61%) seed germination, shoot length (9.54 cm), root length (6.77 cm), shoot fresh weight (3347.90 mg), root fresh weight (305.56 mg), shoot dry weight (218.56 mg), root dry weight (106.73 mg), seed vigor index (820.12). However the 6 hours priming periods had lowest (83.62%) seed germination, shoot length (8.92 cm), root length (6.20 cm), shoot fresh weight (3389.70 mg), root fresh weight (307.76 mg), shoot dry weight (219.78 mg), root dry weight (105.67 mg), seed vigor index (746.01).

Keywords: Wheat, priming period, seed germination.

INTRODUCTION

In Pakistan, wheat (*Triticum aestivum* L.) production is facing many constraints. Among all, low seed germination is one of the factor for low grain yield. Germination of seed is an important factor for seedling establishment and for seedling vigor index. Seed exposed to environmental stresses are more susceptible [1]. However, rapid seed germination and vigorous seedling determines good stand establishment which results in higher wheat yields. Enhancing germination in seeds is important for higher crop productivity [2]. Seed priming is an important method associated with the process of seed germination and is widely used to synchronize the germination of seeds [3]. Seed priming is a technique by which seeds are partially hydrated to a point where germination processes begin but radicle emergence does not occur [4]. The pre-hydrated seeds improve germination even if, the soil surface is dry. Seed invigoration treatments have been developed to improve seed performance during germination and emergence. Hydro priming method in one of them and has been used successfully in wheat [5], chickpea [6], sunflower [7] and cotton [8]. Hydro priming increases seed germination and seedling growth under salt and drought stresses [6;7;8]. Although, priming improves the rate and uniformity of seedling emergence and growth particularly under stress conditions [9], the effectiveness of different priming agents varies under different stresses. The efficiency of seed hydro-priming for better seedling establishment has been reported in barley [10], lentil [11] and chickpea [12]. However, the resultant effect of priming depends on duration of seed soaking [12,13] found safe maximum lengths of time for which seed should be primed, beyond which it could be damaging to the seed or seedling. Recommended safe limits were 24 h for maize and rice, 10 h for chickpeas and 8 h for pearl millet. The general purpose of seed priming is to

stimulate the germination processes, thus, treated seeds would exhibit rapid germination when sown in normal or stress conditions [14]. Therefore, this was set to determine the appropriate hydro priming period for the improvement of germination and related traits of three wheat varieties.

MATERIALS AND METHODS

The present experiment was conducted to determine effect of priming periods on germination and early seedlings growth of wheat at Seed Testing Laboratory, Department of Agronomy, Faculty of Crop Production, Sindh Agriculture University Tandojam during 2013. The experiments was laid out in a Completely Randomized Design (CRD) factorial, treatments included two factors (A and B), Factor -A included three wheat varieties V1 = Mehran-89, V2 = TJ-83, V3 = TD-1, Factor-B priming periods = 03 P1 = 6 hrs. P2 = 12 hrs. P3 = 24 hrs, with three replications.

Observations recorded:

1. Seed germination (%)
2. Shoot and root length (cm)
3. Shoot fresh weight (mg)
4. Root fresh weight (mg)
5. Shoot dry weight (mg)
6. Root dry weight (mg)
7. Seed vigor index

Procedure for recording observation

Seed germination Procedure

Counted number of seeds (20) was placed on double layer of Whatman filter paper No.1 in each Petri dish adding distilled water. The Petri dishes were placed in the germinator at 25°C with different priming periods (Integrated in Factor-B). Seeds were considered germinated when radicle stick out for 2 cm.

The Seed germination was recorded at 7th day after the start of the experiment.

1. Seed germination (%): Total germinated seed after 7days/ total number of seeds.
2. Shoot and root length (cm): The shoot and root length of the seedling was recorded by measuring them through scale.
3. Shoot and root fresh weights (mg): The shoot and root fresh weight (mg) of the 20 seedling was determined after 7 days of germination and their means was worked-out.
4. Shoot and root dry weights (mg): The shoot and root dry weight (mg) of same seedling was determined after 7 days of germination and their means was worked-out.
5. Seed vigor index: Seed vigor index was calculated after determining germination percentage and seedling length of the same seed lot. Seed vigor index was calculated by multiplying germination (%) and seedling length (cm).

The data was statistically analyzed through MSTATC computer software. The LSD value for mean comparison was calculated only if the general treatment *F* test was significant at a probability of ≤ 0.05 [15].

RESULTS

Seed germination (%)

The table 01 revealed that wheat varieties Mehran-89 produced maximum seed germination than TJ-83 variety with seed germination (%) of 88.80 and 84.36 (%), whereas, the lowest (83.43%) seed germination was observed in wheat variety TD-1. However the seed priming had statistically significant effects on seed germination (%). The results indicated that the maximum (87.36%) seed germination was observed when seed were primed under 24 hours as compared to seed primed at 12 hours which recorded (85.61%) seed germination. The lowest (83.00%) seed germination was observed under 6 hour priming period.

The interactive effect of varieties x seed priming period for seed germination (%) was also significant. The maximum germination of (93.16%) was observed from interaction of variety Mehran-89 seed primed under 24 hours, whereas, the lowest seed germination of (82.46%) was recorded from variety TD-1 seed primed under 6 hours.

Table 1. Seed germination (%) of wheat varieties as influenced by priming periods.

Verities	Priming Period			Mean
	6 hrs	12hrs	24hrs	
Mehran-89	85.40	87.83	93.16	80.80a
TJ-83	83.00	84.80	85.30	84.36b
TD-1	82.46	84.20	83.63	83.43b
Mean	83.62c	85.61b	87.36a	-----
Means followed by common letter are not significantly different at 5% probability level.				
	Varieties	Priming Period	VxP	-----
SE	0.5958	0.5958	1.0319	-----
LSD@5%	1.2630	1.2630	2.1876	-----

Table 2. Shoot length (cm) of wheat varieties as influenced by priming periods.

Verities	Priming Period			Mean
	6 hrs	12hrs	24hrs	
Mehran-89	12.03	13.63	14.26	13.31a
TJ-83	8.36	8.50	8.36	8.41b
TD-1	6.30	6.50	6.50	6.45c
Mean	8.92b	9.54a	9.71a	-----
Means followed by common letter are not significantly different at 5% probability level.				
	Varieties	Priming Period	VxP	-----
SE	0.1223	0.1223	0.2118	-----
LSD@5%	0.2593	0.2593	0.4491	-----

Shoot length (cm)

Table 02 revealed that wheat varieties Mehran-89 was recorded maximum (13.31cm) shoot length as compared to TJ-83 variety which was recorded (8.41cm) shoot length, whereas, the lowest (6.45 cm) shoot length was observed in wheat variety TD-1. Whereas, the results indicated that the maximum (9.71 cm) shoot length was observed when seed primed for 24 hours as compared to seed primed at 12 hours which was recorded (9.54 cm) shoot length. The lowest (8.92 cm) shoot length was noted from seed priming at 6 hours. The interactive effect of varieties x seed priming period for shoot length (cm) was also significant. The maximum shoot length of 14.26 was observed from interaction of variety Mehran-89 seed primed under 24 hours, whereas, the lowest shoot length of (6.30 cm) was recorded from variety TD-1 seed primed under 6 hours. It is clear from the results that variety Mehran-89 had maximum shoot length seed primed for 24 hours.

Root length (cm)

The results revealed in table 03 that wheat variety Mehran-89 was observed maximum (8.27 cm) root length as compared to TJ-83 variety which was observed (6.64 cm) root length. The results further observed that the lowest (5.73 cm) root length in wheat variety TD-1. The results further showed that the seed priming had statistically significant effects on root length. It is seen from the results that maximum (7.67 cm) root length was observed when seeds were primed for 24 hours as compared to seed primed at 12 hours which was recorded (6.77 cm) root length. The lowest (6.20 cm) root length was observed when seeds were primed for 6 hours. The interactive effect of varieties x seed priming period for root length (cm) was also significant. The maximum (9.43 cm) root length was observed in variety Mehran-89 under 24 hours seed priming periods, on other hand the lowest root length of (5.20 cm) was recorded from wheat variety TD-1 under 6 hours seed priming period. It is clear from the results that wheat variety Mehran-89 had maximum root length under 24 hours' seed priming periods.

Table 3. Root length (cm) of wheat varieties as influenced by priming periods.

Verities	Priming Period			Mean
	6 hrs	12hrs	24hrs	
Mehran-89	7.16	8.23	9.43	8.27a
TJ-83	6.23	6.40	7.30	6.64b
TD-1	5.20	5.70	6.30	5.73c
Mean	6.20c	6.77b	7.67a	-----

Means followed by common letter are not significantly different at 5% probability level.				
	Varieties	Priming Period	VxP	-----
SE	0.0847	0.0847	0.1468	-----
LSD@5%	0.1796	0.1796	0.3112	-----

Shoot fresh weight (mg)

The results in table 04 revealed that wheat variety Mehran-89 was recorded maximum (3811.90 mg) shoot fresh weight as compared to wheat variety TJ-83 which was recorded (3425.80 mg) shoot fresh weight. The lowest (3258.00 mg) shoot fresh weight was observed in wheat variety TD-1. The results further revealed that the maximum (3758.10 mg) shoot fresh weight was observed under 24 hours seed priming periods as compared to under 12 hours seed priming period which was recorded (3347.90 mg) shoot fresh weight. The lowest (3389.70 mg) shoot fresh weight was observed under 6 hours priming periods. The interactive effect of varieties x seed priming period for shoot fresh weight was also significant. The maximum (4221.70 mg) shoot fresh weight was observed from interaction of variety Mehran-89 under 24 hours seed priming periods, whereas, the lowest shoot fresh weight (3325.00 mg) was recorded from wheat variety TD-1 under 6 hours seed priming periods. It is clear from the results that wheat variety Mehran-89 had more shoot fresh weight under 24 hours seed priming periods.

Table 4. Shoot fresh weight (mg) of wheat varieties as influenced by priming periods.

Verities	Priming Period			Mean
	6 hrs	12hrs	24hrs	
Mehran-89	3666.10	3548.00	4221.70	3811.90a
TJ-83	3325.00	3301.30	3651.00	3425.80b
TD-1	3178.00	3194.30	3401.00	3258.00b
Mean	3389.70b	3347.90b	3756a	
Means followed by common letter are not significantly different at 5% probability level.				
	Varieties	Priming Period	VxP	-----
SE	93.751	93.751	62.38	-----
LSD@5%	198.74	198.74	344.23	-----

Root fresh weight (mg)

The results revealed in table 05 that wheat variety Mehran-89 was observed maximum (330.89 mg) root fresh weight as compared to wheat variety TJ-83 which was recorded (305.31mg) root fresh weight. However the lowest (303.22 mg) root fresh weight was observed in wheat variety TD-1. The results indicated that the maximum (326.11 mg) root fresh weight was observed under 24 hours seed priming periods as compared to seed primed under 12 hours which was recorded (305.56 mg) root fresh weight. The lowest (307.76 mg) root fresh weight was observed under 6 hours' priming periods. The interactive effect of varieties x seed priming period for root fresh weight (mg) was also significant. The maximum (354.33 mg) root fresh weight was observed from interaction of variety Mehran-89 under 24 hour's seed priming periods. The results further indicated that the lowest (299.67 mg) root fresh weight was recorded from wheat variety TD-1 when primed for 6 hours. It is clear from

the results that variety Mehran-89 had more root fresh weight under 24 hours' seed priming periods.

Table 5. Root fresh weight (mg) of wheat varieties as influenced by priming periods.

Verities	Priming Period			Mean
	6 hrs	12hrs	24hrs	
Mehran-89	322.67	315.67	354.33	330.89a
TJ-83	300.93	296.00	319.00	305.31b
TD-1	299.67	305.00	305.00	303.22b
Mean	307.76b	305.56b	326.11a	-----
Means followed by common letter are not significantly different at 5% probability level.				
	Varieties	Priming Period	VxP	-----
SE	7.7202	7.7202	13.372	-----
LSD@5%	16.366	16.366	28.347	-----

Shoot dry weight (mg)

The results indicated in table 06 that the wheat variety Mehran-89 was observed maximum (235.67 mg) shoot dry weight as compared to wheat variety TJ-83 which was recorded (212.78 mg) shoot dry weight. The lowest (220.89 mg) shoot dry weight was observed in wheat variety TD-1. It is noted from the results the maximum (231.00 mg) shoot dry weight was observed under 24 hours priming period as compared to seed primed at 12 hours which was recorded (218.56 mg) shoot dry weight. It is seen from the results that the lowest (219.78 mg) shoot dry weight was observed when seeds primed for 6 hours. The interactive effect of varieties x seed priming period for shoot dry weight was also significant. The maximum (246.67 mg) shoot dry weight was observed from interaction of variety Mehran-89 under 24 hour's seed priming period. The lowest (204.00 mg) shoot dry weight was recorded from variety TD-1 under 6 hours seed priming period. It is clear from the results that variety Mehran-89 had more shoot dry weight under 24 hours seed priming periods.

Table 6. Shoot dry weight (mg) of wheat varieties as influenced by priming periods.

Verities	Priming Period			Mean
	6 hrs	12hrs	24hrs	
Mehran-89	231.33	229.00	246.67	235.67a
TJ-83	204.00	213.00	221.33	212.78b
TD-1	224.00	213.67	225.00	220.89ab
Mean	219.78	218.56	231.00	-----
Means followed by common letter are not significantly different at 5% probability level.				
	Varieties	Priming Period	VxP	-----
SE	9.8775	9.8775	7.108	-----
LSD@5%	20.939	20.939	6.268	-----

Root dry weight (mg)

The results revealed in table 07 that wheat variety Mehran-89 produced maximum (116.56 mg) root dry weight as compared to wheat variety TJ-83 which was observed (107.56 mg). The results further indicated that the lowest (105.40 mg) root dry weight was observed in wheat variety TD-1. The results showed that the maximum (117.11 mg) root dry weight was observed under 24 hours priming period as compared to seed primed at 12 hours which was recorded (106.73 mg) root dry weight. However, the lowest (105.67

mg) root dry weight was observed under 6 hours seed priming periods. The interactive effect of varieties x seed priming period for root dry weight was also significant. The maximum (128.67 mg) root dry weight was observed from interaction of wheat variety Mehran-89, under 24 hours' seed priming periods. It is seen from the results the lowest (99.67mg) root dry weight was observed from wheat variety TJ-83 under 6 hours seed priming period. It is clear from the results that variety Mehran-89 had more root dry weight (mg) when primed for 24 hours.

Table 7. Root dry weight (mg) of wheat varieties as influenced by priming periods.

Verities	Priming Period			Mean
	6 hrs	12hrs	24hrs	
Mehran-89	115.67	105.33	128.67	116.56a
TJ-83	99.67	108.67	114.33	107.56ab
TD-1	101.67	106.20	108.33	105.40b
Mean	105.67b	106.73b	117.11a	-----
Means followed by common letter are not significantly different at 5% probability level.				
	Varieties	Priming Period	VxP	-----
SE	4.4383	4.4383	6.874	-----
LSD@5%	9.4089	9.4089	6.297	-----

Seed vigor index

The table 08 revealed that wheat variety Mehran-89 produced maximum (1182.00) seed vigor index as compared to wheat variety TJ-83 which was recorded (703.30) seed vigor index. The lowest (530.80) seed vigor index was observed in wheat variety TD-1. The seed priming period had statistically significant effects on seed vigor index. The results indicated that the maximum (850.00) seed vigor index was observed when seed prime under 24 hours as compared to seed primed at 12 hours which was recorded (820.12) seed vigor index. The lowest (746.01) seed vigor index was observed under 6 hours seed priming periods. The interactive effect of varieties x seed priming period for seed vigor index was also significant. The maximum (1329.30) seed vigor index was recorded from interaction of wheat variety Mehran-89 under 24 hours seed priming period, the lowest (522.30) seed vigor index was recorded from variety TD-1 seed primed under 6 hours. It is clear from the results that variety Mehran-89 had more seed vigor index when seeds primed for 24 hours.

Table 8. Seed vigor index of wheat varieties as influenced by priming periods.

Verities	Priming Period			Mean
	6 hrs	12hrs	24hrs	
Mehran-89	1021.40	1195.50	1329.30	1182.00a
TJ-83	694.40	718.90	696.60	703.30b
TD-1	522.30	546.00	524.10	530.80c
Mean	746.01b	820.12a	850.00a	-----
Means followed by common letter are not significantly different at 5% probability level.				
	Varieties	Priming Period	VxP	-----
SE	14.433	14.433	24.998	-----
LSD@5%	30.596	30.596	52.994	-----

DISCUSSION

The results observed that wheat variety Mehran-89 produced maximum germination than TJ-83 variety with seed

germination (%) of 88.80 and 84.36 (%), the lowest (83.43%) seed germination was observed in wheat variety TD-1. Maximum (87.36%) seed germination was observed when seed primed for 24 hours as compared to seed primed at 12 hours which recorded (85.61) seed germination. The results further showed that the lowest (83.00%) seed germination was observed seed primed for 6 hours. Seed priming is known as the seed treatment which improves seed performance under environmental conditions[14]. Constraints to good cost abolishment include improper seedbed preparation, low quality seed, untimely sowing [16], poor sowing techniques, inadequate soil moisture [5] and adverse soil conditions [17]. The seed priming had statistically significant effects on germination (%). Variety Mehran-89 was recorded maximum (13.31 cm) shoot length as compared to TJ-83 variety which was recorded (8.41 cm) shoot length, whereas, the lowest (6.45 cm) shoot length was observed in wheat variety TD-1. The results further revealed that the maximum (9.71 cm) shoot length was observed when seed prime under 24 hours as compared to seed primed at 12 hours which was recorded (9.54 cm) shoot length. However the lowest (8.92 cm) shoot length was noted from seed priming at 6 hours. The results showed that the varieties and seed priming had statistically significant effects on root length. The results further revealed that wheat variety Mehran-89 was observed maximum (8.27 cm) root length as compared to TJ-83 variety which was observed (6.64 cm) root length. The results further observed that the lowest (5.73 cm) root length in wheat variety TD-1. It is seen from the results that maximum (7.67 cm) root length was observed when seed prime under 24 hours as compared to seed primed at 12 hours which was recorded (6.77 cm) root length, whereas, the lowest (6.20 cm) seed root length was observed when seed primed under 6 hours. Previous studies indicated positive influences of hydro-priming on radicle length [18]. Better performance in root length of hydro primed seeds could be attributed to earlier mobilisation of major nutrient reserves. Freshly harvested seeds, however, were negatively influenced by hydro-priming; this could be due to nutrient leakage [19]. The resultant effect of priming depends on duration of seed soaking [14;12,13] found safe maximum lengths of time for which seed should be primed, beyond which it could be damaging to the seed or seedling. Recommended safe limits were 24 h for maize and rice, 10 h for chickpeas and 8 h for pearl millet. The results revealed that wheat variety Mehran-89 was recorded maximum (3811.90 mg) shoot fresh weight as compared to wheat variety TJ-83 which was recorded (3425.80 mg) shoot fresh weight. The lowest (3258.00 mg) shoot fresh weight was observed in wheat variety TD-1. The results further revealed that the maximum (3194.30 mg) shoot fresh weight was observed under 24 hours seed priming periods as compared to under 12 hours seed priming period which was recorded (3401.70 mg) shoot fresh weight. The lowest (3178.00 mg) shoot fresh weight was observed under 6 hours' seed priming periods. The results revealed that wheat variety Mehran-89 was observed maximum (330.89 mg) root fresh weight as compared to wheat variety TJ-83 which was recorded (305.31mg) root fresh weight. However the lowest (303.22 mg) root fresh weight was observed in wheat variety TD-1. The results indicated that the maximum

(326.11 mg) root fresh weight was observed under 24 hours seed priming periods as compared to seed primed under 12 hours which was recorded (305.56mg) root fresh weight. The lowest (307.76 mg) root fresh weight was observed under 6 hours' seed priming periods. [20] reported that hydro priming resulted to be a valid physiological treatment that germination rate and uniformity, as well as soil emergence of seedling. The potential of using seed hydro priming technology significantly improves the vigor of birdsfoot trefoil (*Lotus corniculatus* L) seeds, since it allowed increase to achieve rapid germination and enhanced establishment was demonstrated for three out of four annual cover crop species tested. The results indicated that the wheat variety Mehran-89 was observed maximum (235.67 mg) shoot dry weight as compared to wheat variety TJ-83 which was recorded (212.78 mg) shoot dry weight. The lowest (220.89 mg) shoot dry weight was observed in wheat variety TD-1. It is noted from the results the maximum (231.00 mg) shoot dry weight was observed under 24 hours priming period as compared to seed primed at 12 hours which was recorded (218.56 mg) shoot dry weight. It is seen from the results that the lowest (219.78 mg) shoot dry weight was observed at 6 hours seed priming periods. The results revealed that wheat variety Mehran-89 produced maximum (116.56 mg) root dry weight as compared to wheat variety TJ-83 which was observed (107.56 mg). The results further indicated that the lowest (105.40 mg) root dry weight was observed in wheat variety TD-1. The results showed that the maximum (117.11 mg) root dry weight was observed under 24 hours priming period as compared to seed primed at 12 hours which was recorded (106.73 mg) root dry weight. However, the lowest (105.67 mg) root dry weight was observed under 6 hours seed priming periods. The results revealed that wheat variety Mehran-89 produced maximum (1182.00) seed vigor index as compared to wheat variety TJ-83 which was recorded (703.30) seed vigor index. The lowest (530.80) seed vigor index was observed in wheat variety TD-1. The seed priming period had statistically significant effects on seed vigor index. The results indicated that the maximum (850.00) seed vigor index was observed when seed prime under 24 hours as compared to seed primed at 12 hours which was recorded (820.12) seed vigor index. The lowest (746.01) seed vigor index was observed under 6 hours seed priming periods. It was observed that hydro priming practically ensured rapid and uniform germination accompanied with low abnormal seedling percentage [21].

CONCLUSIONS

It is concluded that the 24 hours priming period in wheat variety Mehran-89 produced higher seed germination percentage and related traits as compared to wheat varieties TJ-83 and TD-1. All the germ inability traits, seed priming periods, varieties and their interaction (priming x varieties) were significant.

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