International Journal of Agriculture Innovations and Research
Volume 9, Issue 1, ISSN (Online) 2319-1473
Manuscript Processing Details (dd/mm/yyyy):
Received: 14/08/2020 | Accepted on: 02/09/2020 | Published: 05/09/2020

Effect of Seed Priming on Growth and Yield of Different Wheat Varieties in Madhupur Tract of Bangladesh

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Abstract **– Seed priming of wheat is an effective pre-sowing treatment having positive influence on wheat growth and seed yield. Effectiveness of seed priming depends on seed size and priming duration. Seed priming at different time duration and its impact on growth and yield of wheat varieties still unknown. A field study was carried out at Sher-e-Bangla Agricultural University, Dhaka during Rabi season of 2012-13 in Madhupur tract (AEZ-28) of Bangladesh. The experiment was carried out with two wheat varieties (i) BARI Gom-25 and (ii) BARI Gom-26 and five hydro priming treatments e.g. (i) No priming (ii) 3hrs priming (iii) 6hrs priming (iv) 9hrs priming (v) 12hrs priming under split-plot design with three replications to study the effect of priming on wheat varieties. The results revealed that, seed priming had no statistically significant effect on varieties. But, priming for 6hrs and 9hrs significantly influences emergence count than non-primed seeds. The highest emergence count can be observed from 9hrs priming at 10 and 15 DAS (4.5 and 41.67, respectively). The highest number of effective tiller was demonstrated by both 6hrs and 9hrs of priming. Seed priming for 9hrs exhibited the highest number of leaves/tiller (8.30 at 30 DAS), LAI (7.28 at 60 DAS) and number of tiller (53.17 at 60 DAS). Seed priming for 9hrs also exhibited the highest number of spike (38.67), spikelets/spike (20.15), 1000 grain weight (46.61g) and grain yield (2.86 t/ha) whereas the lowest from non-primed seeds. Interaction of variety and priming treatments indicated the advantage of seed priming over non-primed seeds. Emergence count was the highest for 6hrs and 9hrs primed BARI Gom-26 seeds (5), 9hrs BARI Gom-25 seeds (5). The highest number of spike (42) was produced by BARI Gom-26 with 9hrs of priming whereas the maximum spikelet/spike (21.18), 1000 grain weight (49.82g) and grain yield (2.88 t/ha) was produced by BARI Gom-25 with 9hrs of priming. For interaction effects, statistically identical grain yield (2.83 t/ha) can be observed from BARI Gom-26 with 9hrs of priming. Non primed wheat seeds showed the lowest yield (2.72 t/ha) for BARI Gom-25.**

Keywords **– Seed Priming, Variety, Emergence, Growth, Yield.**

I. INTRODUCTION

Wheat (Triticum spp.) is a cereal grain, originally from the Levant region of the Near East but now cultivated worldwide. It is the most important cereal crop in the world as well as in Bangladesh that provides about 20 % of total food calories. About two third of the total world's population consume wheat as staple food [1]. It contains carbohydrate (78.1%), protein (14.7%), minerals (2.1%), fat (2.1%) and considerable proportion of vitamins [2]. The crop is grown under different environmental condition ranging from humid to arid, subtropical to temperate zone [3]. Germination and seedling establishment are critical stages in the plant life cycle and can contribute in increasing total crop production. Once sown, seeds spend a great deal of time just absorbing water from the soil. If this time is minimized by soaking seeds in water before sowing (seed priming), seed germination and seedling emergence is more rapid. It also causes higher seedling establishment. The three early phases of germination are: (i) imbibition, (ii) lag phase, and (iii) protrusion of the radical through the testa [4].

Priming is a procedure that partially hydrates seed, followed by drying of seed, so that germination processes begin, but radicle emergence does not occur. Priming of wheat seed in osmoticum or water may improve germination and emergence [5] and promote vigorous root growth [6]. Simply soaking seeds in plain water before sowing could increase the speed and homogeneity of germination and emergence, leading to better crop stands, and stimulated seedlings to grow much more vigorously [7].

Good establishment increases competitiveness against weeds, increases tolerance to abiotic stress especially dry spells and ultimately maximizes the yields [8]. Direct benefits due to seed priming includes, faster emergence, better and more uniform stands, more vigorous plants, better drought tolerance, earlier flowering and higher grain yield in many crops [9], [10].

An attempt was therefore, desired to undertake a study on the influence of seed priming on emergence, growth and yield of wheat with the following objectives:

1. To find out the effect of seed priming on emergence and yield of wheat.

2. To find out the interaction between varieties and seed priming on emergence and yield of wheat.

II. MATERIALS AND METHODS

Climate and Soil:

The experimental field was located at 90.335^0 E longitudes and 23.774^0 N latitudes at an altitude of 8.6 meters above the mean sea level. The climate was subtropical with low temperature and minimum rainfall during December to March that was the main feature of the Rabi season. The annual precipitation of the site was around 2200 mm and potential evapotranspiration was 1300 mm. The average mean temperature was 25.17^0C. The humidity varies from 55% to 79%. The day length was 10.5-11.0 hours only. The soil of the experimental field belongs to the Tejgaon soil series of the Madhupur Tract (AEZ-28). The general soil type of the experimental field was Deep Red Brown Terrace Soil. Topsoil was silty clay loam in texture. Organic matter content was very low (1.34 %) and soil pH varies from 5.8 – 6.

Experimental Layout:

The experiment was laid out in split-plot design with three replications where variety was assigned in the main plot and seed priming in sub-plots.

The treatments included Factor A: Variety (2); V_1 = BARI Gom-25 and V_2 = BARI Gom-26, Factor B: Seed priming levels (5); P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming. Seeds were collected from seed technology division of Bangladesh Agricultural Research Institute. Water was used as a media of seed priming. Similar amount of seeds for both varieties per plot was soaked in water for different durations as per treatment and removed from the water about 30 minutes before sowing.

Land Preparation

The experimental field was ploughed thoroughly with a power tiller and then laddering was done to obtain a desirable tilth. Weeds, stubbles and crop residues were cleaned from the land. Fertilizers were applied at the rate of 100, 80, 25 and 20 kg ha^{-1} of NPK and S, respectively and 5 t ha^{-1} cowdung. The $2/3^{rd}$ urea and whole

amount of other fertilizers were applied as basal dose during last ploughing and rest 1/3rd urea was applied at crown root initiation stage (21 DAS) followed by an irrigation. Seeds were treated with Vitavax 200 @ 3 g kg^{-1} of seeds and sown in line on 16 November 2012 as per treatments. The recommended seed rates (120 kg ha^{-1}) of wheat variety were used. The seeds were placed in 20 cm apart lines as per treatments. Weeds were controlled through two weeding at 25 and 45 days after sowing (DAS). After emergence three irrigations were given at crown root initiation (20 DAS), maximum tillering stage (40 DAS) and heading stages (53 DAS).

Data Collection

At full maturity, ten plants were marked randomly and those plants from each plot were harvested. Crop of each plot was harvested from 5m ×1.5m area, separately leaving the border lines to record the seed yield which was converted into t ha^{-1} basis. Data on the different growth, yield and yield contributing parameters were collected from the experimental field.

Leaf Area Index

Leaf area index was determined by counting number of leaves/plant, leaf length & breadth & then multiplying leaf area per m^2 and finally multiply by the constant number 0.75 as below: LAI= $\frac{\text{Total leaf area m}-2}{\text{Ground area (1m2)}}\times 0.75$

Harvest Index (%)

Harvest index was determined by dividing the economic yield (seed yield) to the biological yield (seed + straw yield) from the same area and then multiplied by 100. Harvest Index (%) = $\frac{\text{Seed yield (t/ha)}}{\text{Seed yield (t/ha)+ Straw yield(t/ha)}}$ × 100

Shelling Percentage (%)

Shelling percentage was determined by dividing wt. of grain to wt. of grain with shell and then multiplied by 100, Shelling Percentage (%) = $\frac{\text{Grain wt.}}{\text{Grain wt.+Shell wt.}}\times 100$

Statistical Analysis

Data collected from different parameters were compiled and tabulated in proper form. Appropriate statistical analysis was made by MSTAT-C computer package program and the treatment means were compared by least significance difference (LSD) at 5% level of significance [11].

III. Results and Discussion

Effect of Varieties on Priming:

No statistically significant influence of varieties was recorded for emergence and yield data of wheat. The varieties exhibited statistically identical relationship for all the characters of wheat varieties.

Effects of Seed Priming:

Priming significantly influenced emergence count at both 10 DAS and 15 DAS. At 10 DAS, the highest number of emergence (4.50) was recorded at P_4 *i.e.* 9hrs priming and the lowest were recorded at no priming (1.33). In case of 15 DAS, the highest result (41.67) was observed at 9hrs priming and the lowest was at no

priming (23.33) (Table-1). Primed seeds produced higher germination rate and percentage [12]. 9hrs priming (P_4) gave the highest plant height (28.68 cm, 67.15 cm, 95.44 cm and 96.33 cm) at 30, 60, 90 DAS and at harvest. The lowest plant height was found in case of no priming at 30, 60, 90 DAS and at harvest. (Table-1).

Table 1. Effect of priming on emergence and plant height of wheat.

Treatments	Emergence (No.)		Plant height (cm)			
	10 DAS	15 DAS	30 DAS	60 DAS	90 DAS	Harvest
P_1	1.33c	23.33e	25.95c	64.75c	93.44c	92.17d
P_2	3.67b	25.83d	27.15bc	65.63bc	93.50c	93.00c
P_3	4.17a	28.50c	27.51ab	65.95b	93.67c	94.00bc
P_4	4.50a	41.67a	28.68a	67.15a	95.44a	96.33a
P_5	3.50b	31.50b	28.61ab	66.67ab	94.56b	94.67b
$LSD_{(0.05)}$	0.37	0.50	1.204	1.04	0.57	1.12
CV(%)	8.82	1.35	6.25	11.20	4.01	4.09

P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming.

Seeds primed for 9 hrs gave the highest number of leaves (8.30 and 5.41, respectively) at 30 DAS and 60 DAS and the lowest was recorded when seeds were not primed (6.53 and 4.72, respectively). Priming significantly influenced leaf area index at both 30 and 60 DAS. At 60 DAS the highest LAI (7.28) was recorded at 9 hrs priming of seed which was statistically similar with 6 hrs priming of seeds (7.01) (Table-2). LAI was the lowest (5.00) when seeds were not primed. In case of 90 DAS, the highest LAI was recorded at 9 hrs priming (4.54) which was statistically similar with 6 hrs & 12 hrs priming of seeds. The lowest (3.78) LAI was recorded at no priming of seeds which was also statistically similar with 3hrs, 6 hrs & 12 hrs priming of seeds (Table-2). At 60 DAS and 90 DAS the highest number of tillers was recorded at 9 hrs priming (53.17 and 45, respectively). Number of tillers was recorded lowest at no priming of seeds (43.17) (Table-2). Seeds primed for 9 hrs also gave the highest number of leaves leading to higher photosynthesis rate and higher number of tillers. On the other hand, no priming of seeds caused lower emergence, poor establishment, lower number of leaves and the lowest number of tillers.

Table 2. Effect of priming on number of leaves tiller-1. Number of tiller from ten preselected plants and leaf area index of wheat at different days after sowing.

Treatments	Leaves/tiller (No.)			LAI		No. of tiller	
	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS	60 DAS	90 DAS
P_1	6.53c	4.72d	2.99	5.00c	3.78b	43.17c	38.33c
P_2	7.30b	4.87cd	3.03	6.45b	3.80b	46.17bc	42.17b
P_3	7.60b	5.07bc	3.05	7.01a	4.17ab	46.83bc	42.17b
P_4	8.30a	5.41a	3.12	7.28a	4.54a	53.17a	45.00a
P_5	7.63b	5.26ab	3.07	6.27b	4.31ab	48.33ab	38.50c
$LSD_{(0.05)}$	0.57	0.25	NS	0.50	0.54	5.01	2.79

Treatments	Leaves/tiller (No.)			LAI		No. of tiller	
	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS	60 DAS	90 DAS
CV(%)	12.80	9.67	7.56	6.33	10.71	8.61	6.95

P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming.

The number of effective tillers and ineffective tiller varied significantly with the effect of different priming hrs. The highest effective tillers (37.67) were found at 9 hrs priming of seeds which was statistically similar with 6 hrs priming of seeds (37.17). Effective tillers were the lowest (32.83) at no priming of seed. The 12 hrs priming of seed also gave the similar statistical result (33.33) with no priming of seeds. The highest number (4.83) of ineffective tillers was recorded at no priming and the lowest were recorded at 9 hrs and 12 hrs priming of seeds (1.83). The highest number of effective tillers at 9 hrs priming might be because of the better benefit of light, nutrient, air etc. due to early emergence. The highest ineffective tillers were revealed in no priming treatment (Table 3). Number of fertile tillers was increased by different priming techniques [13]. Filled grain gave statistically significant result to different priming treatments. The highest filled grain (59.41) was recorded at P_4 (9 hrs priming) and the lowest (53.96) was recorded at no priming. In case of unfilled grain significantly the highest result was recorded at P_1 (1.22 g) and the lowest was recorded at P_4 (0.54g). The highest number of spike (38.67) was found in case of 9 hrs priming which was statistically similar with 3 hrs (36.00) and 12 hrs (37.50) priming of seeds. No priming gave the lowest number of spikes (32.67) which was statistically similar with 6 hrs priming (34.00) of wheat seeds (Table-3). The 9 hrs priming of seeds showed the highest spike length (19.28cm) which was statistically similar with 6 hrs seed priming (18.82cm). The lowest spike length (17.39 cm) was observed when seeds were not primed which was also statistically similar with seeds primed at 3 hrs and 12 hrs (17.54 cm and 17.48 cm, respectively). The highest number of spikes, spike length & number of spikelets/spike were found at 9 hrs priming which was might be because of highest number of leaves leading to higher photosynthesis rate & higher number of effective tillers. The lowest was found at no priming treatment. The highest significant result in case of number of spikelets/spike was found when seeds were primed for 9 hrs (20.15) and the lowest was found when seeds were not primed (19.53) (Table-3).

Table 3. Effect of priming on yield and yield contributing characteristics of wheat.

Treatment	Effective tiller	Ineffective tiller	Filled grains spike^{-1}	Unfilled grains spike^{-1}	Number of spike	Spike length (cm)	No. of spikelets/spike
P_1	32.83c	4.83a	53.96d	1.22a	32.67c	17.39b	19.53c
P_2	36.33ab	2.67b	56.68c	1.12b	36.00ab	17.54b	19.78b
P_3	37.17a	2.67b	56.81bc	0.64c	34.00bc	18.82a	19.90b
P_4	37.67a	1.83c	59.41a	0.54d	38.67a	19.28a	20.15a
P_5	33.33bc	1.83c	57.55b	1.05b	37.50a	17.48b	19.88b
$LSD_{(0.05)}$	3.12	0.62	0.80	0.10	3.23	0.94	0.16
CV(%)	7.20	18.37	7.95	8.71	7.38	8.88	5.08

P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming.

In case of 1000 grain wt. the highest grain wt. (46.61g) was recorded at 9 hrs priming (P_4) and the lowest grain wt. (41.28 g) was recorded at no priming (P_1). There was significant variation observed on grain yield of wheat for the effect of different priming treatments. The highest grain yield (2.86t ha^{-1}) was observed at 9 hrs priming and the lowest was observed at no priming (2.61t ha^{-1}). The lowest grain yield was also statistically similar with 2 hrs, 6 hrs and 12 hrs (2.62, 2.63 & 2.66 t ha^{-1}) priming respectively. The highest straw yield (2.98 tha^{-1}) was recorded at P_4 (9 hrs priming) which was statistically similar with 12 hrs priming of seed (2.93tha^{-1}) (Table-4). Straw yield was the lowest (2.81tha^{-1}) at no priming which was also statistically similar with 3hrs priming (2.83 t ha^{-1}) of seeds. Priming also gave significant influence on both harvest index and shelling (%). The highest harvest index was obtained from 9 hrs priming (49.98) and the lowest was obtained from no priming (47.22). Highest shelling percentage was recorded at 9 hrs priming (81.75) and the lowest was recorded at no priming of seeds (78.25) (Table-4). Grain yield & straw yield were maximum at 9 hrs priming might be because of highest number of effective tillers, highest spike length and spikelets/spike, highest number of filled grain & lowest number of unfilled grain. Hydro-primed and pre germinated seeds established earlier than dry seeds leading to better crop establishment under optimum, sub optimum soil moisture as well as dry soil conditions leading to higher tillering and grain yield [14]. Higher numbers of productive tillers, filled spikelets, leaf area index, crop growth rate, net assimilation rate, grain yield, biomass yield, and harvest index were recorded in response to planting pre-germinated seeds followed by soaked seeds [15]. Priming had positive effects on yield and yield attributing parameters both under non-flooding and early flooding conditions [16].

Table 4. Effect of priming on 1000 grain wt., Grain Yield, Straw Yield, Harvest Index and Shelling percentage of wheat.

Treatments	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Harvest index (%)	Shelling (%)
P_1	41.28d	2.61b	2.81c	47.22d	78.25e
P_2	43.39c	2.62b	2.83c	47.60c	80.45c
P_3	43.48c	2.63b	2.89b	47.89c	80.73b
P_4	46.61a	2.86a	2.98a	49.98a	81.75a
P_5	45.05b	2.66b	2.93ab	48.44b	80.03d
$LSD_{(0.05)}$	0.96	0.089	0.06	0.33	0.17
CV(%)	8.08	7.89	9.90	3.57	3.91

P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming.

Interaction Effects:

Interaction of variety and priming showed statistically significant influence on emergence. At 10 DAS, the highest emergence (5.00) was recorded at 9 hrs priming for both BARI Gom-25 and BARI Gom 26 and 6 hrs priming for BARI Gom-26.The lowest emergence (0.67) at 10 DAS was observed at no priming of BARI gom-25. At 15 DAS, the highest emergence was recorded at 9 hrs priming of BARI Gom 26 (44.67) and the lowest (20.00) was recorded at no priming of BARI Gom-25 (Table-5). Optimum soaking time for wheat should be less than 12 hrs. Germination and early growth conditions improve by seed priming technique [17]. Hydro priming clearly improved the final germination percentage (FGP) and mean germination time (MGT) [18].

Table 5. Interaction effects of variety and priming on emergence and plant height of wheat at different days after sowing.

Treatments	Emergence count		Plant Height (cm)			
	10DAS	15DAS	30 DAS	60 DAS	90 DAS	Harvest
V_1P_1	0.67e	20.00j	25.68e	63.40e	93.78de	92.67ef
V_1P_2	2.33d	21.33i	27.53cd	64.30e	93.78de	94.00cde
V_1P_3	4.00b	27.67f	28.31bc	64.33e	94.56cd	94.00cde
V_1P_4	5.00a	38.67b	31.20a	68.50a	95.89a	96.67a
V_1P_5	3.00c	34.00d	29.66ab	64.83de	95.78ab	95.00bc
V_2P_1	2.00d	24.00h	25.99de	64.67e	92.78f	91.67f
V_2P_2	3.33c	26.67g	26.12de	66.22cd	93.11ef	93.00def
V_2P_3	5.00a	35.67c	26.23de	66.97bc	93.22ef	94.00cde
V_2P_4	5.00a	44.67a	27.56cd	69.00a	95.00bc	96.00ab
V_2P_5	4.00b	29.00e	27.49cd	68.08ab	93.22ef	94.33cd
$LSD_{(0.05)}$	0.53	0.71	1.70	1.48	0.81	1.58
CV(%)	8.82	1.35	6.25	11.20	4.01	4.09

V_1 = BARI Gom-25 and V_2 = BARI Gom-26, P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming.

In case of interaction of variety and priming the highest plant height at 30 DAS, 60 DAS, 90 DAS and at harvest was recorded at BARI Gom- 25 with 9 hrs priming (31.24 cm). The lowest plant height was found at no priming of BARI Gom-25 (25.68cm) which was statistically similar with plant height at no priming, 3 hrs priming and 6 hrs priming of BARI Gom-26 (25.99 cm, 26.12 cm and 26.23 cm) respectively (Table-6). The highest plant height in almost all cases was found at 9 hrs priming of seed with both varieties and the lowest at no priming. It might be because of 9 hrs priming of seed gave the highest emergence rate & better establishment whereas no priming showed lower emergence rate & poor establishment leading to lower plant height (Table-6). Primed seeds possessed higher emergence and growth rate than control [19]. At different growth stages, the number of leaves of wheat was significantly influenced by the effect of different varieties and different seed priming treatments except at 90 DAS (Table-6). Seeds of BARI Gom-25 primed at 9hrs gave the highest number of leaves (8.87) at 30 DAS and the lowest was recorded at BARI Gom-25 which were not primed (6.13). Non primed seeds of BARI Gom-26 (6.93) also showed statistically similar result. The highest LAI at 60 DAS and 90 DAS was recorded at 9hrs priming of BARI Gom-26 (8.61) which was statistically similar with 6hrs priming of BARI Gom-26 (8.26). The lowest LAI was observed when seeds of BARI Gom-26 were not primed (4.53) which was also statistically similar with no priming of BARI Gom-25 (5.20) (Table-6). The highest number of tillers at 60 DAS and 90 DAS (63.33) were recorded when BARI Gom-26 was primed for 9hrs and the lowest (39.00) was recorded when BARI Gom-25 seeds were not primed. At 90 DAS, the highest tillers (50.67) were also observed when BARI Gom-26 was primed for 9 hrs. The lowest tiller number (36.67) was recorded when BARI Gom-25 seeds were not primed which was also statistically similar with BARI Gom-25 primed for 3 hrs and 12 hrs (37.33, 39.33) and BARI Gom-26 when not primed (39.67) and primed for 3 hrs (40.00) (Table-6). Optimum soaking time for wheat may be less than 12hrs [20].

Table 6. Interaction effects of variety and priming on Leaves/Plant, LAI and No. of tiller of wheat seeds.

Treatments	Leaves/plant (No.)			LAI		No. of tiller	
	30 DAS	60 DAS	90 DAS	60 DAS	90 DAS	60 DAS	90 DAS
V_1P_1	6.13d	4.87bc	3.04	5.20fg	4.00bc	39.00e	36.67e
V_1P_2	7.00c	4.97b	3.08	5.76d-f	4.01bc	44.67de	37.33de
V_1P_3	7.27bc	5.18ab	3.08	5.96cde	4.28a-c	43.00de	41.00b-d
V_1P_4	8.87a	5.52a	3.19	6.28cd	4.29a-c	45.67de	42.00bc
V_1P_5	8.00b	5.32a	3.13	5.46ef	4.11bc	40.67e	39.33c-e
V_2P_1	6.93cd	4.51d	2.84	4.53g	3.56c	41.67de	39.67b-e
V_2P_2	7.20bc	4.57cd	2.99	6.62c	3.58bc	48.00cd	40.00b-e
V_2P_3	7.60bc	5.20ab	3.01	8.26a	4.05bc	56.00b	43.33b
V_2P_4	8.00b	5.30a	3.11	8.61a	4.97a	63.33a	50.67a
V_2P_5	7.73bc	5.27a	3.04	7.33b	4.33ab	53.33bc	42.33bc
$LSD_{(0.05)}$	0.80	0.35	Ns	0.70	0.76	7.08	3.95
CV(%)	12.80	9.67	7.56	6.33	10.71	8.61	6.95

V_1 = BARI Gom-25 and V_2 = BARI Gom-26, P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming.

Interaction effects have significant influence on number of effective tillers. The treatment BARI Gom-26 with 9hrs priming gave the highest number of effective tillers (39.33). The lowest number of effective tillers (30.00) was found in BARI Gom-25 with no priming. The treatment no priming of BARI Gom- 26 showed the higher number of ineffective tillers (Table-7). Among the treatments, the highest effective tillers were recorded at 9hrs priming of BARI Gom-26 which might be because of earlier emergence of BARI Gom-26 and 9hrs seed priming treatment that utilized maximum benefits of light, nutrients. The highest ineffective tiller was at no priming of BARI Gom-26 which might be because of lower number of leaves and lower number of tillers. The highest spike length (20.95) was observed at 9hrs priming of seeds of BARI Gom-26. The 6hrs priming of BARI Gom-26 also gave statistically similar spike length (19.81). Spike length was the lowest (16.56 cm) when seeds of BARI Gom-26 were not primed. Similar statistical results were observed in case of no priming and 12hrs priming of BARI Gom-25(17.62 cm and 17.82 cm), 3hrs and 12hrs priming of BARI Gom-26 (16.61cm and 17.03 cm) respectively (Table-7). Interaction of variety & priming significantly influenced the filled grain number spike^{-1}. Among all the combinations 9hrs priming of BARI Gom-26 gave the highest filled grain number spike^{-1} (60.90) which was statistically similar with 12hrs priming of BARI Gom-26 (60.12). The lowest filled grains (52.72) were observed at no priming of BARI Gom-25 which was also statistically similar with no priming of BARI Gom-26 (53.34). Unfilled grains also significantly influenced by interaction effects. The highest unfilled grains (2.07) were found at no priming of BARI Gom-26 and the lowest (0.27) was found at 9hrs priming of BARI Gom-26 which was statistically similar with 9hrs priming of BARI Gom -25 (0.37) (Table-7).

Table 7. Interaction effects of variety and priming on number effective and ineffective tillers, spike length, filled grains/spike and unfilled grains/spike of wheat.

Treatments	Effective tiller (No.)	Ineffective tiller (No.)	Spike length (cm)	Filled grains spike^{-1} (No.)	Unfilled grains spike^{-1} (No.)
V_1P_1	30.00d	2.33c	17.62c-f	52.72f	1.37b
V_1P_2	33.33b-d	2.33c	17.92c-e	54.59e	1.27b
V_1P_3	37.67ab	0.67d	18.17cd	55.40e	0.60e
V_1P_4	37.67ab	0.67d	18.52bc	58.70cd	0.37fg
V_1P_5	32.67cd	1.00d	17.82c-f	55.60e	1.02c
V_2P_1	34.00b-d	7.33a	16.56f	53.34f	2.07a
V_2P_2	36.67a-c	3.00c	16.61ef	57.77d	0.87d
V_2P_3	37.67ab	3.00c	19.81ab	59.70bc	0.48ef
V_2P_4	39.33a	2.67c	20.95a	60.90a	0.27g
V_2P_5	35.67a-c	4.67b	17.03d-f	60.12ab	0.83d
$LSD_{(0.05)}$	4.42	0.88	1.32	1.13	0.13
CV(%)	7.20	18.37	8.88	7.95	8.71

V_1 = BARI Gom-25 and V_2 = BARI Gom-26, P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming.

BARI Gom-26 when primed for 9hrs gave the highest number of spikes (42.00) which was statistically similar with 9hrs priming of BARI Gom-25(39.00) and 6hrs priming of BARI Gom-26 (38.33). The lowest number of spikes were found in no priming of BARI Gom-25 (31.67) which was statistically similar with 3hrs and 12hrs priming of BARI Gom-25(33.00, 34.67), no priming, 3hrs and 12hrs priming of BARI Gom-26 (33.33, 33.667, 35.00) respectively (Table-8). Statistically significant influence of interaction effects on number of spikelets spike^{-1} were found. The highest number of spikelets (21.12) was recorded at 9hrs priming of BARI Gom-25 and the lowest (17.88) was recorded at not primed seeds of BARI Gom-26 (Table-8). In case of 1000 grain weight the maximum weight was observed at 9hrs priming of BARI Gom-25 (49.82 g) and the lowest grain weight was observed at no priming of BARI Gom-26 (38.64 g). The highest grain yield (2.88 t ha^{-1}) was recorded at 9hrs priming of BARI Gom-25 which was statistically similar with 9hrs priming of BARI Gom-26 (2.83 t ha^{-1}). The lowest yield (2.553 t ha^{-1}) was recorded at no priming and 3hrs priming of BARI Gom-25 which was statistically similar with 6hrs priming of BARI Gom-25 (2.59 t ha^{-1}), no priming, 3hrs and 6hrs priming of BARI Gom-26 (2.57, 2.66, 2.65 t ha^{-1}) respectively (Table-8). Straw yield was highest (3.01 t ha^{-1}) at 9hrs priming of BARI Gom-25 which was statistically similar with 12hrs priming of BARI Gom-25 (2.98 t ha^{-1}) and 9hrs priming of BARI Gom-26 (2.97 t ha^{-1}). The lowest straw yield (2.72 t ha^{-1}) was recorded at no priming of BARI Gom-25 which was statistically similar with 3hrs priming of BARI Gom-25 (2.77 t ha^{-1}) (Table-8). In case of harvest index the highest result was recorded at 9hrs priming of BARI Gom-25 (50.08) which was statistically similar with 9hrs priming of BARI Gom-26 (49.88). The lowest harvest index was recorded at no

priming of BARI Gom-26 (46.39). Shelling % was highest at 9hrs priming of BARI Gom-25 (82.59) and the lowest (75.78) was at no priming of BARI Gom-26. Variety might have not affected the yield of crop because highest grain yield was recorded at 9hrs priming of BARI Gom-25 which was statistically similar with 9hrs priming of BARI Gom-26 (Table-8). Grain yield at 9hrs priming was highest might be because of higher number of effective tillers, number of spikes, spikelets spike^{-1} and filled grain. Priming had positive effects on yield and yield attributing parameters both under non-flooding and early flooding conditions.

Table 8. Effect of interaction of variety and priming on yield and yield contributing characteristics of wheat.

Treatments	Number of spike	No. of spikelets/spike	1000 grain wt. (g)	Grain yield (t ha^{-1})	Straw yield (tha^{-1})	Harvest index	Shelling %
V_1P_1	31.67d	19.67d	43.93cd	2.55e	2.72g	47.64de	79.86d
V_1P_2	33.00cd	20.00c	44.98bc	2.55e	2.77fg	47.87c-e	80.68c
V_1P_3	37.00bc	20.83b	45.13bc	2.59de	2.85de	48.05cd	80.72c
V_1P_4	39.00ab	21.18a	49.82a	2.88a	3.01a	50.08a	82.59a
V_1P_5	34.67b-d	20.76b	45.74b	2.76bc	2.98ab	48.56b	80.68c
V_2P_1	33.33cd	17.88f	38.64f	2.57e	2.85ef	46.39f	75.78f
V_2P_2	33.67cd	18.80e	41.22e	2.66cde	2.89cde	47.91c-e	79.38e
V_2P_3	38.33ab	19.57d	41.80e	2.65cde	2.90cde	47.57e	80.78c
V_2P_4	42.00a	20.13c	44.97bc	2.83ab	2.97abc	49.80a	81.04b
V_2P_5	35.00b-d	19.47d	43.40d	2.71bcd	2.93bcd	48.32bc	80.91bc
$LSD_{(0.05)}$	4.57	0.22	1.36	0.12	0.08	0.46	0.24
CV(%)	7.38	5.08	9.90	8.08	7.89	3.57	3.91

V_1 = BARI Gom-25 and V_2 = BARI Gom-26, P_1 = No priming, P_2 = 3 hours priming, P_3 = 6 hours priming, P_4 = 9 hours priming, P_5 = 12 hours priming.

IV. Conclusion

According to the results of the experiment, the following conclusions can be made:

1. Varieties do not have very significant influence on yield & yield contributing characteristics for priming.
2. The highest emergence count can be observed from nine hours of hydro priming for both varieties.

Nine hours priming of BARI Gom-25 gave the highest grain yield (2.88 tha^{-1}) which is statistically similar to BARI Gom-26 with nine hours of priming than control & other treatments.

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