

Effect of seed priming on crop establishment and yield of late sown wheat (*Triticum aestivum*)

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Late sowing of wheat (*Triticum aestivum* Linn. emend. Fiori & Paol.) is a common practice in northern India. The area under late sown wheat is likely to increase further due to increase in cropping intensity to meet the foodgrain demand for ever-increasing population. There are several reasons for low productivity of late sown wheat, including poor crop establishment coupled with long time taken for seedling emergence due to low temperature at the time of sowing. Wheat productivity under late-sown condition can be increased if uniform and early seedling establishment is achieved. The primed seeds, when planted in field may show faster rate of germination and uniform emergence because they are in a metabolically advanced state [1]. These benefits are more obvious under abiotic stress conditions.

A large number of reports published on the effect of seed priming suggest that there is improvement in germination and seedling vigour in several crops under laboratory conditions but studies on their effects in the field performance and yield are meager. It is, therefore, hypothesized that good and healthy plant population can be achieved through priming, leading to higher crop yield. Taking all these points into consideration, the present study was conducted to study the effect of priming treatments on crop establishment in wheat.

The experiment was conducted during *rabi*

season of 2009-10 at Crop Research Centre, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar. Wheat variety DBW-16 was sown on 16 December 2009 and harvested on 26 April 2010. The size of gross plot was 8 m², whereas size of plot was 4.8 m². The experiment was laid out in a randomized block design replicated three times. Four priming treatments were tested against the control. For hydro-priming and GA₃ priming, seeds were soaked in distilled water and 500 ppm GA₃ solution, respectively, for 18 hr at 20°C and kept in an incubator. Low temperature hardening was carried out by soaking seeds in water for 18 hr at 20°C then kept at chilling temperature in freezer (5±2°C) for 24 hr. All the primed seeds were dried at room temperature of 12±0.5% seed moisture content. Whereas, osmo-priming was done in polyethylene glycol (PEG 6000) for 96 hr at 20°C with an osmotic potential of -3.0 bar, followed by surface drying before sowing. The PEG solution was prepared according to Michel and Kaufmann [2]. In each priming treatment, quantity of solution added to seed kept in beaker was approximately 1:2 (seed : water ratio). Standard cultural practices were followed.

The data were recorded from the day when a few emerged seedlings were seen. For taking all field observation, 2 m row length in third row of each plot leaving 1.5 m from one end was marked with the help of rope and wooden sticks were placed in those points. Then daily

counting was continued to the stage when number of seedlings became constant and it was expressed as number of plants (m^2). The number of days to 80% emergence was calculated back on the basis of total number of seedlings emerged out. When 80% tillers were formed in marked area, then number of days taken to first tiller formation was calculated by counting days from sowing to date of first tiller formation. The total number of shoots from marked area was counted 20, 35 and 50 days from sowing and expressed as number of shoots/ m^2 . For determining shoot dry weight (mg), 10 main shoots were harvested from field at 20 days interval up to 100 days from sowing. Then shoots were dried in a hot air oven for 72 hr at $70 \pm 2^\circ C$ and weighed. Grain yield (tonnes/ha) was recorded from bet harvested area and 1000-grain weight (g) was calculated by drawing the sample of 500 grains from the produce in four replicates.

The data showed that priming treatments significantly improved seedling emergence and plant stand (Table 1). Low temperature hardening produced significantly higher plant stand than all other priming treatments. Low temperature hardening might have induced the mechanism of low temperature tolerance in seed, leading to improved seed germination as mean daily temperature at the time of crop emergence varied between $11.5^\circ C$ and $16.1^\circ C$ 15 days from sowing. It was much lower than optimum for wheat germination. It was followed by GA_3 and hydropriming treatments which were at par with the control. Addition of gibberellic acid in priming medium stimulated the activity of enzymes responsible for breakdown of starch [3]. The lowest plant population in osmopriming treatments may be due to long period of priming or low osmotic potential (lower than critical potential) [4]. The seeds were primed in a PEG solution with a water potential -3.0 bars for 96 hr. The process might have damaged internal system.

Low temperature hardened seeds not only emerged earlier (10.4 days) but also reduced the time to first tiller formation (32.2 days) than the control with 12.3 and 34.5 days, respectively for days to emergence and first tiller formation. It

may be because of repairing of DNA and mitochondria during priming improved enzymatic activity in cells, which increased the level of soluble sugars in primed seeds, thus leading to early seedling emergence. The seedlings which emerge early are expected to start their development early through photosynthetic carbon assimilation. However, control seeds showed statistically similar values (34.5 days) to hydro-priming (35.0 days) and osmo-priming (35.1 days) for days to first tiller formation. The maximum value 35.1 days was noticed with osmo-primed seed. Maximum duration for 80% emergence was recorded with non-primed control seed. It was significantly higher than GA_3 priming and at par with hydro-primed (12.0 days) and osmo-primed seeds (11.9 days).

Number of shoots/ m^2 was significantly affected by priming treatments at early stage of growth but it did not show significant difference at its establishment. The highest number of shoots was observed in low temperature hardening both 20 and 35 days from sowing. The lowest number of shoots was noticed in osmo-primed seed which were significantly inferior to all priming treatments including the control. Earliest emergence of seedlings in low temperature hardened seed might have resulted in its highest shoot dry weight 20 days from sowing but thereafter due to better growth of low number of seedling produced in osmoprimed seed due to less inter-plant competition might have led to highest shoot dry weight in osmoprimed treatment 80 days from sowing though the difference between low temperature hardening and osmoprimed treatment was not significant for shoot dry weight. According to Salehzade *et al.* [5], osmopriming significantly increased the seedling dry weight in wheat.

Low temperature hardening followed by GA_3 priming showed promising results at the time of seedling emergence and its early stage of growth and development but the advantage could not be converted into yield gain because the advantage of seed priming was nullified 50 days from sowing, leading to similar number of effective shoots at maturity. These findings were similar to those of Kibite and Harker [6]. The

Table 1. Effect of priming treatments on crop establishment and yield of late sown wheat crop

Treatment	Plant population	Days taken to		No. of shoots/m ²				Shoots dry weight (mg/shoot)				1000-seed weight (g)	Yield (tonnes/ha)
		80% emergence	First tiller formation	20 DFS	35 DFS	50 DFS	20 DFS	60 DFS	80 DFS	100 DFS			
Hydro-priming	169	12.0	35.0	178	231	426	13.66	420.50	1451.83	1669.83	32.57	3.46	
GA ₃ priming	173	11.1	32.8	188	216	419	13.54	429.00	1323.58	1649.08	31.17	3.39	
Low temperature hardening	188	10.4	32.2	200	256	441	15.75	438.25	1471.25	1779.92	31.55	3.51	
Osmo-priming	144	11.9	35.1	154	205	424	13.58	430.42	1507.58	1765.33	32.31	3.46	
Control	167	12.3	34.5	177	236	405	12.91	408.50	1391.67	1692.66	32.86	3.43	
SEM ±	3	0.3	0.6	3	11	0.52	12.91	40.59	56.27	0.61	0.08		
CD (5%)	10	0.9	1.8	7	10	NS	1.97	NS	110.15	NS	NS	NS	

DFS: Days from sowing

effect of different priming treatments was also not significant on 1,000-grain weight which is one of the most important yield attribute. Low temperature hardening showed maximum grain yield (3.51 tonnes/ha), followed by osmo-priming, hydro-priming, non-primed control and the minimum with GA₃ priming (3.39 tonnes/ha), however, these difference were non-significant. Thus, it can be summarized that low temperature seed hardening in tillering crop like wheat is beneficial for crop establishment and early crop growth but their effect could not be translated into crop yield.

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