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Research Article

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The Effect of Hydropriming on Seed Quality, Growth and Yield of Wheat (*Triticum aestivum*)

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Abstract

A field experiment was conducted to study the "The effect of hydropriming on seed quality, growth and yield of wheat" at the Lovely professional university, University of Agricultural Sciences, Phagwara, Punjab on sandy loam soil under rainfed condition during 2021-2022. Theexperiment was laid out in randomized block design with seven treatment combinations replicated thrice. The treatments consisted of hydropriming control (non-primed), Soaking of seeds in water for 8 hours followed by 2 hours drying, soaking of seeds in water for 8 hours followed by 4 hours drying, the process of immersing seeds in water for a duration of 18 hours, afterwards followedby a period of 2 hours for desiccation. The process of immersing seeds in water for a duration of 18 hours, followed by a subsequent drying period of 4 hours, is examined in terms of its impact on the production and profitability of these seeds. The growth parameters considered inthis study are plant height, leaf area index, number of tillers, and total dry matter. Among these parameters, the maximum plant height was seen in treatment T_7, measuring 100.2 cm. The process of immersing seeds in water for a duration of 18 hours, afterwards followed by a period of 4 hours for the purpose of drying. However, for leaf area index found in highest in treatment T7 (141.7), while number of tillers and total dry matter found highest in treatment T7 (3.97) and (18.2). While in all growth parameters lowest was found in treatment T1 (controlled). Significantly higher grain yield (56.6 qt ha^{-1}) was found in treatment T7 (Soaking of seeds in water, for 18 hours followed by 4 hours of drying) compared to T6 (55.2 qt ha^{-1}) soaking of seeds in water for 18 hours followed by 2 hours drying. Soaking of seeds in water while lowest was observed in treatment T1 (48.7 qt ha^{-1}) control (non-primed).

Keywords

Treatment, Hydropriming, Parameter, Soaking, Wheat, Index, Control

Introduction

As the population is increasing day by day, the need for food is also increasing to maintain food security. To solve this kind of problem it is important to use various physiological tools [1]. This tool will be beneficial in the breeding programme if the crop is suffering from any type of environmental stress. Most of the cultivated area is under irrigation except 13% of the area which is under rainfed condition. These regions are Karnataka, Madhya Pradesh, Maharashtra, and Gujarat where only 1/3rd area is irrigated. Hence, adoption of physiological techniques will improve crop productivity and induce tolerance to abiotic stresses like water, salinity, and even heavy metal stress [2].

Cereals are a critical staple meal among all other crops on the earth. Among all the cereal crops, wheat is the world's most widely cultivated and consumed cereal by the majority of the world's populations. Hence it is also called the

king of cereals. Wheat (*Triticum aestivum* L.) is the major cereal crop of the world and is consumed as a staple food by two billion peoplein the world. The nutritional composition of wheat provides nearly 55% of carbohydrate and 20% of the food calories. It contains carbohydrates 78.10%, protein 14.70%, fat 2.10%, minerals 2.10% and considerable proportions of vitamins and minerals [3]. On a global scale, the cultivation of wheat spans an area of 219.0 million hectares, resulting in an output of 760.9 million metric tons and a productivity rate of 34.7 metric tons per hectare. India is ranked as the second biggest global producer of wheat, with a production volume of 107.6 million metric tons. This position is second only to China, which produces 134.2 million metric tons. However, India surpasses all other countries in terms of wheat cultivation area, with a total land area of 31.4 million hectares. Despite its vast cultivation area, India achieves an average productivity rate of 3431 kg per hectare [4]. In India over 5000 years ago the cultivation of wheat is started [5]. In India, the cultivated area of wheat is divided into six different mega zones. Wheat is cultivated all over the country except a few southern and northeastern states. Among all the states, Uttar Pradesh stands first with respect to area (31.88 metric tons) followed by Punjab and Madya Pradesh. However, productivity is highest in Punjab state (5090 kg ha^{-1}).

Wheat is a rabi season crop and is sown in the months of October and November and harvested in the month of April. Wheat can grow on different types of soils having different temperature conditions. It is mainly grown in tropical to sub-tropical regions. However, it is also grown in temperate regions [6]. It is a very hardy crop and can tolerate very low temperatures. 20 - 25 °C is the optimum temperature for its germination. Cool and moist temperature is required during the early stages of wheat growth for its optimum growth and development. Further dry and warm weather is congenial for late stage [7]. Crop growth and development is largely influenced by soil moisture and nutrient absorption of the plant. Crops will experience abiotic stresses under high evaporation conditions. Abiotic stresses such as salt and moisture stress are the limiting factors for wheat cultivation. Water absorption by plants depends on its root characteristics and soil properties. However, evapotranspiration of the crop is dependent on the crop characteristics and weather elements such as net solar radiation, relative humidity, and vapor pressure deficit. Under limiting soil moisture situation, less soil moisture absorption by root will lead to plant water stress. Further, the water deficiency may reduce the plant growth and development leading to reduction in crop yield and yield parameters. However, receiving rainfall or providing irrigation immediately after sowing can enhance the rate of germination [8].

Materials and Methods

The present investigation was carried out in the agricultural research farm of Lovely Professional University, located in Punjab, during the rabi season spanning from November 2021 to April 2021. The cumulative precipitation experienced throughout the agricultural season, spanning from October 2021 to April 2022, exhibited fluctuations in both quantity and severity. The overall amount of rainfall recorded during this time amounted to 209.9 mm, occurring over the course of 17 days characterized by precipitation. The experimental site was characterized by a soil type classified as loamy sandy soil. A soil sample was extracted from the experimental field at a depth of 30 cm, and afterwards subjected to chemical analysis to ascertain its chemical qualities. The soil had a slightly alkaline pH of 8.25, along witha normal electrical conductivity of 0.122 dS/m. It was found to have a low organic carbon content of 0.18%, while its accessible nitrogen, phosphorus, and potassium levels were measured to be 188.16 kg ha^{-1}, 18.27 kg ha^{-1}, and 170.24 kg ha^{-1}, respectively. The experiment was conducted using a randomized full block design, with a total of seven treatments and three replications. The experimental treatments employed in this study consisted of a control treatment (T1-Control treatment) and various combinations of soaking seeds in water for different durations, followed by drying for different time periods. Specifically, the treatments included soaking seeds in water for 8 hours followed by 2 hours of drying (T2), soaking seeds in water for 8 hours followed by 4 hours of drying (T3), soaking seeds in water for 12 hours followed by 2 hours of drying (T4), soaking seeds in water for 12 hours followed by 4 hours of drying (T5), soaking seeds in water for 16 hours followed by 2 hours of drying (T6), and soaking seeds in water for 16 hours followed by 4 hours of drying (T7).

The selected bold and healthy seeds of PBW-343 were sown manually in rabi season @ 100 kg ha^{-1} at a spacing of 22.5 cm x 5 cm. The recommended dose of fertilizer (120:60:40 ($N:P_2O_5:K_2O$) kg/ha) was applied as per the package of practices to all the treatments. Further, seeds soaked with water drying hours. At the time of sowing, applied 50% of recommended dose of nitrogen and full dose of P_2O_5 and K_2O was applied as basal dose remaining 50% nitrogen was applied in two splits at the time of 1st irrigation and at pre-flowering stage. First irrigation was applied 21 days after sowing, that is crown root initiation stage. A total of five plants were chosen in a random manner from a designated plot and subsequently labelled for the purpose of conducting observations on various growth and yield components. These components encompassed aspects such as seed emergence, plant population, duration until physiological maturity, duration until heading, plant height, leaf count, spike length, leaf area, leaf area index, as well as dry matter. Additionally, parameters related to yield were also assessed, including the number of tillers per plant, number of spikes per plant, number of spikelets per plant, number of grains per spike, grain weight per spike, and test weight. Furthermore, measurements were taken for seed yield, straw yield, biological yield, harvest index, net return, and benefit cost ratio. The laboratory data includes parameters such as germination %, seedling length, seedling dry weight, and seedling vigor indices 1 and 2. The collected experimental data was collated and analyzed using Fischer's technique of analysis of variance, as described by Gomez and Gomez [9]. The CD values provided were utilized at a significant threshold of 5%.

Results

Germination, seedling growth and plant population of

wheat

Statistical analysis of the results obtained during the present course of investigation was carried out to visualize a significant influence of hydropriming on wheat. The data revealed that, the earliest germination and significantly higher germination percentage (94.8%), seedling length (35 cm), seedling dry weight (0.21 g), seedling vigor index 1 (3313.2), seedling vigor index 2 (19.9), initial population (74.9 per m^2) and final plant population (72.6 per m^2) were observed when seeds were soaked with water for 18 hours followed by drying for 4 hours when compared to rest of the treatments. However, soaking of seeds in water for 18 hours and drying for 2 hours found on par (Table 1). The higher days taken to 50% germination (6.33 DAS), 50% emergence (66.7 DAS), 80% emergence (9.67 DAS) and 100% emergence (10.7 DAS) was observed with non-primed treatment (Figure 1). However, it was on parwith 8 hours of soaking and two and four hours drying.

Growth parameters of wheat

The hydropriming treatment significantly influenced the growth parameters of wheat (Table 2) such as higher plant height 30 days (14.93 cm), 60 days (49 cm), 90 days (84.9 cm) andat harvest (100.2 cm), leaf area 30 days (38.4 cm^2 $plant^{-1}$), 60 days (162.9 cm^2 $plant^{-1}$), 90 days (141.7 cm^2 $plant^{-1}$), leaf area index 30 days (0.341), 60 days (4.20), 90 days (3.26), were observed when seeds were soaked with water for 18 hours followed by drying for 2 and 4 hours when compared to rest of the treatments. However, soaking seeds in water for 12 hours and drying for 4 hours found on par. Similarly, the higher number of tillers at 30 days (3.40 $plant^{-1}$), 60 days (4.60 $plant^{-1}$), 90 days (4.73 $plant^{-1}$) and at harvest (3.97 $plant^{-1}$), dry matter at 30 days (4 g $plant^{-1}$), 60 days (8.5 g $plant^{-1}$), 90 days (15.6 g $plant^{-1}$) and at harvest (18.2 g $plant^{-1}$) were observed when seeds were soaked with water for 18 hours followed by drying for 2 and 4 hours when compared to rest of the treatments (Figure 2). However, soaking of seeds in water for 12 hours

Table 1: Germination, seedling growth and plant population of wheat.

Treatments	Germination percentage (%)	Seedling length (cm)	Seedling dry weight (g)	Seedling vigor index I	Plant population		
					Seedling vigor index II	Initial population (per m^2)	Final population (per m^2)
Control (non-primed)	88	21.8	0.16	1926.2	14.4	68.9	66.7
Soaking of seeds in water for 8 hours followed by 2 hours drying	90.7	22.7	0.18	2054.8	15.9	70.3	68.5
Soaking of seeds in water for 8 hours followed by 4 hours drying	91.3	25.2	0.18	2299.3	16.1	70.8	68.6
Soaking of seeds in water for 12 hours followed by 2 hours drying	92.3	27	0.18	2490.7	16.6	72.4	69.4
Soaking of seeds in water for 12 hours followed by 4 hours drying	93.7	28.5	0.19	2669.8	17.7	72.8	70.9
Soaking of seeds in water for 18 hours followed by 2 hours drying	94.7	31.8	0.2	3013.5	18.6	74.2	71.9
Soaking of seeds in water for 18 hours followed by 4 hours drying	94.8	35	0.21	3313.2	19.9	74.9	72.6
S.Em. ±	1	1.1	0.003	103.6	0.5	1	1
L.S.D. (0.05)	3.1	3.4	0.011	310.8	1.5	3.2	3.3

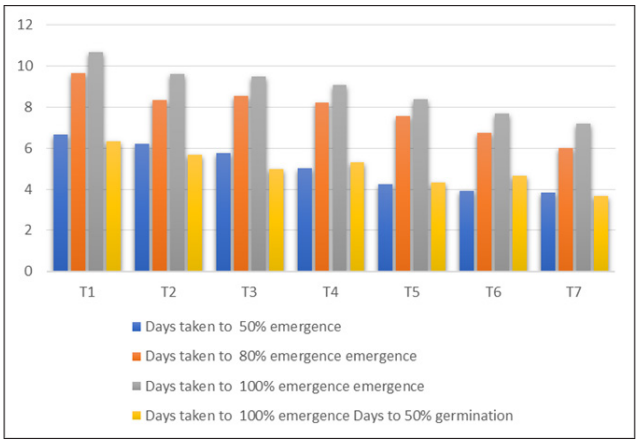

Figure 1: Effect of hydropriming on days taken to 50% germination and seed emergence of wheat.

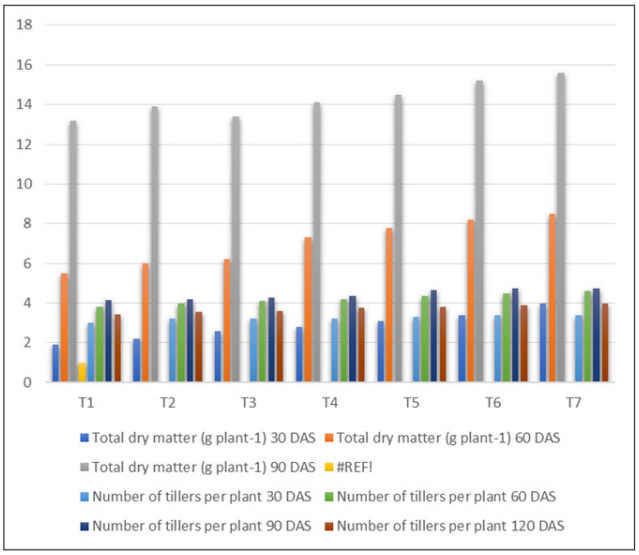

Figure 2: A number of tillers and total dry matter accumulation per plant of wheat as influenced by hydropriming.

and drying for 4 hours and 12 hours of soaking and 2 hours of drying found on par.

Physiological parameters

The hydropriming treatment significantly influenced the growth parameters of wheat (Table 3) such as lowest days to 50% flowering (80), days taken to heading (915)and days to physiological maturity (118.1) were observed when seeds were soaked with water for 18 hours followed by drying 4 hours when compared to rest of the treatments. However, soaking of seeds in water for 18 hours followed by 2 hours drying 50% flowering (80.33), heading (92.1), physiological maturity (118.5) found on par. Soaking of seeds in water for 12 hours and drying for 4 hours.

Yield and yield parameters of wheat

The effect of hydropriming on yield parameters (Table 4) of wheat such as higher number of spikes per plant (4.75), number of spikelets per spike (21.9), spike length (7.8 cm), number of grains per spike (34.7), grain weight per plant (5.2) and 1000 seed weight (43.7 g) was observedwhen seeds were soaked with water for 18 hours followed by drying for 4 hours when compared to rest of the treatments. However, soaking of seeds in water for 18 hours followed by 2 hours drying number of spikes per plant (4.71), number of spikelets per spike (21), spike length (7.5 cm), number of grains per spike (34.4), grain weight per plant (5.1) and 1000 seed weight (42.7 g) find on par. Further, soaking of seeds in water for 18 hours followed by 4 hours drying recorded significantly higher grain yield (56.6 q ha^{-1}), straw yield (58.6 q ha^{-1}) and biological yield (113.1 q ha^{-1}) as well as harvesting index (52.3) as compared to control

Table 2: Growth parameters of wheat.

Treatments	Plant height (cm)				Leaf area (cm^2 $plant^{-1}$)			Leaf area index		
	30 DAS	60 DAS	90 DAS	At harvest	30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS
Control (non-primed)	12.4	40.4	80.4	94.3	35.4	150.9	133.7	0.314	4.09	3.19
Soaking of seeds in water for 8 hours followed by 2 hours drying	12.93	42.1	81.5	95.6	35.8	154	136.3	0.318	4.12	3.21
Soaking of seeds in water for 8 hours followed by 4 hours drying	13.7	41.7	83.4	95.9	36	156.4	137.8	0.32	4.14	3.22
Soaking of seeds in water for 12 hours followed by 2 hours drying	14.23	43.3	84	97.2	36.3	158.2	138.5	0.322	4.16	3.23
Soaking of seeds in water for 18 hours followed by 2 hours drying	14.6	44.3	83.1	97.8	37	159.7	139.3	0.329	4.17	3.24
Soaking of seeds in water for 18 hours followed by 2 hours drying	14.9	46.4	84.5	99.5	37.9	161.2	140.9	0.336	4.18	3.25
Soaking of seeds in water for 18 hours followed by 4 hours drying	14.93	49	84.9	100.2	38.4	162.9	141.7	0.341	4.2	3.26
S.Em. ±	0.9	1.3	0.9	2.1	1.17	1.2	1.53	0.022	0.005	0.0029
L.S.D. (0.05)	NS	3.9	2.8	4.2	NS	4.1	3.4	NS	0.014	0.0087

Table 3: Days taken to 50% flowering, heading and physiological maturity of wheat as influenced by hydropriming.

Treatments	Days taken to		
	50% flowering	Heading	Physiological maturity
Control (non-primed)	85	96.5	126.7
Soaking of seeds in water for 8 hours followed by 2 hours drying	84.33	95.3	122.6
Soaking of seeds in water for 8 hours followed by 4 hours drying	84	95.1	122.2
Soaking of seeds in water for 12 hours followed by 2 hours drying	82.33	93.9	120.7
Soaking of seeds in water for 12 hours followed by 4 hours drying	82	93.2	120.3
Soaking of seeds in water for 18 hours followed by 2 hours drying	80.33	92.1	118.5
Soaking of seeds in water for 18 hours followed by 4 hours drying	80	91.5	118.1
S.Em. ±	1.9	0.9	1.5
L.S.D. (0.05)	NS	2.8	4.7

Table 4: Spike length, spike per plant, number of spikelets per spike, grains per spike, grain weight per plant and test weight of wheat as influenced by hydropriming.

Treatments	Spike length (cm)	Spike per plant	Number of spikelets per spike	Number of grains per spike	Grain weight per plant (g)	1000 seed weight (g)
Control (non-primed)	6.7	4.15	16.9	29	3.3	37.6
Soaking of seeds in water for 8 hours followed by 2 hours drying	7.2	4.22	18.4	28.3	4	38.8
Soaking of seeds in water for 8 hours followed by 4 hours drying	7.3	4.28	19.6	32.3	4	39.1
Soaking of seeds in water for 12 hours followed by 2 hours drying	7.4	4.57	20.1	33.7	4.4	40.8
Soaking of seeds in water for 12 hours followed by 4 hours drying	7.4	4.56	20.2	33.7	4.5	40.9
Soaking of seeds in water for 18 hours followed by 2 hours drying	7.5	4.71	21	34.4	5.1	42.7
Soaking of seeds in water for 18 hours followed by 4 hours drying	7.8	4.75	21.9	34.7	5.2	43.7
S.Em. ±	0.1	0.04	0.4	0.3	0.1	2.7
L.S.D. (0.05)	0.3	0.15	1.4	0.9	0.5	6.8

treatment (Figure 3). However, it was found on par with 18 hours of soaking and 2 hours of drying grain yield (55.2 q ha^{-1}), straw yield (56.2 q ha^{-1}) and biological yield (110 q ha^{-1}) as well as harvesting index (52.2).

Economics of wheat production

The effect of hydropriming on economic parameters of wheat such as higher gross return(114548 ₹ ha^{-1}), net return (67430 ₹ ha^{-1}) as well as B:C ratio (1.43) was observed with 18 hours of soaking and 4 hours of drying. 18 hours of soaking and 2 hours of drying when compared to the control treatment gross return (111713 ₹ ha^{-1}), net return (64651 ₹ ha^{-1}) and B:C ratio (1.37) (Figure 4).

Discussion

A statistical analysis was conducted to examine the data obtained in the current experiment, with the aim of observing the notable impact of hydropriming on wheat treatments T6 and T7. The observed increase in germination % during the early stages can likely be attributed to the stimulatory effects of priming on the germination process. This stimulation is believed to occur through the mediation of cell division in the seeds during germination [10]. According to McDonald [11], the process of priming has the potential to enhance germinationby expediting imbibition. This, in turn, can facilitate the emergence phase and promote the growth of radicle cells. The

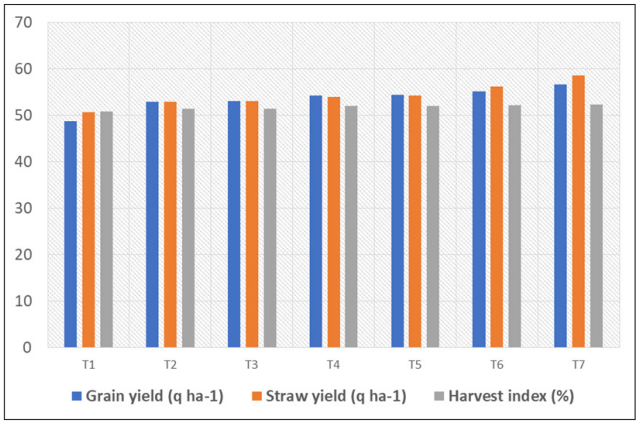

Figure 3: Grain yield, straw yield and harvest index of wheat as influenced by hydropriming.

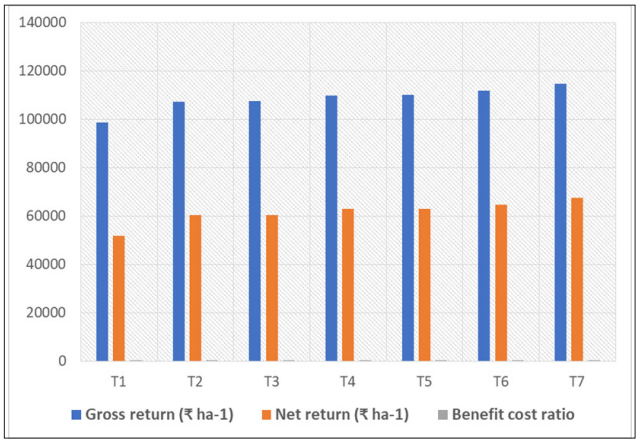

Figure 4: Gross return, net return and benefit cost ratio of wheat as influenced by hydropriming.

significance of this process is in its facilitation of the ensuing embryonic development, particularly in seeds that exhibit morphological dormancy, wherein the embryo is in an immature state. The findings presented here align as a greater percentage of germination in hydro-primed rice seeds. In a similar vein, Abbasdokht et al. [1] observed that the germination of hydro-primed seeds occurred earlier and with more uniformity compared to un-primed seedlings. The primary factor contributing to the early emergence seen in this study was the early germination, which was facilitated by an initial soaking period of 18 hours followed by a subsequent drying period of two to four hours (Figure 1). Upon rapid swelling of the embryo, it initiates the secretion of hormones that induce the activation of enzymes. The enzymes facilitate the hydrolysis of starch and protein reserves inside the seed, resulting in the conversion of these macromolecules into simpler forms such as sugars and amino acids. This metabolic process serves to supply the developing embryo with the necessary energy for growth and development. The primed seeds may have provided a higher quantity of carbohydrates and amino acids, resulting in a more expedited germination process due to the increased availability of food andenergy. If there is a lack of moisture, the seed will stay viable until the seed coat ruptures, evenif it dries out before the embryo begins to expand [10]. The observed increase in seedling length and dry weight might perhaps be attributed to the enhanced enzymatic activities of invertases (both alkaline and acid forms), amylase, sucrose phosphate synthase, and sucrose synthase, which were shown to be more pronounced in primed seedlings. The sucrose phosphate synthase-specific activity in the cotyledons of primed seedlings is also seen to be elevated. The increased enzymatic activity seen in the shoots of hydro-primed seedlings may have facilitated the rapid hydrolysis of transient starch. This phenomenon might have potentially resulted in increased glucose availability, hence facilitating the accelerated development of the seedlings, and subsequently leading to greater seedling length [12]. Rouhi et al. [13] and Navin-Pradhan et al. [14] conducted studies in which they observed significant improvements in germination, seedling development, and seedling vigor because of hydropriming. In a similar vein, the authors Grass and Burris [15] observed that seeds that had reached physiological maturity and were primed exhibited enhanced viability and improved seed quality. The observed phenomenon may be attributed to the influence of hydropriming, a process that determines the rate of plant development. Moreover, the growth of cells is regulated by the rates of cell division, their expansion, and the availability of organic and inorganic substances necessary to produce new protoplasm and cell wall materials. These findings exhibit similarities to the findings reported by Sharma et al. [16].

The hydropriming treatment significantly influenced the growth parameters of wheat. The effect of hydropriming on growth and development of wheat T6 and T7 treatments (Table 1). Under hydropriming germinating seeds might have increased respiration, radicle protrusion, cell division and cell expansion. This might have led to the quick establishment of seedlings with well-developed roots. Thereby, it has increased uptake of water and minerals by the plant leading to stem elongation, which virtually increased the plant height consistently and sooner produced a greater number of tillers under hydropriming (radicle) for longer hours (18hours) when compared to non-primed seeds. These results agree with results reported by Kant et al. [17]. Further, Bannayan et al. [18] noticed steady increase in number of tillers in wheat crop with increase in hours of hydropriming. Similar results were also observed in Lettuce [19]. This higher leaf area and leaf area index might be due to the higher plant height and a greater number of tillers and are also the major attributes of total dry matter accumulation. Leaf area index growth was found higher at the tillering stage and there after it was found constant during booting stage in all the hydropriming treatment. Similar results were obtained by Afzal [20] and Bishnoi [21]. Significantly the higher dry matter accumulation (Figure 2) was majorly due to superior assimilation area i.e., a greater number of leaves and leaf area and favorable environment condition. Higher assimilation area resulted in accumulation of more photosynthates in tillers, leaves, and stems and hence, leading to higher dry matter accumulation in the plants. This was coupled with the interception of more light and fixation of more carbon dioxide, which might have promoted anatomical and biochemical processes in the plant and led to synthesis of more photosynthates. Further, the utilization of more assimilated photosynthesis in growth of the plant parts instead of using more of them in respiratory maintenance was observed.

Hence, diversion of assimilates towards growth of the plant might have increased the growth parameters. The results are corroborated with Bishnoi [21], Pandey et al. [22] and Sandhu and Dhaliwal [23].

Physiological processes, such as the duration of time required for 50% blooming, heading, and physiological maturity, are outlined in table 3. The T5, T6, and T7 treatments have a significant impact on determining the duration of vegetative development and grain filling, thereby influencing crop growth and final yield. The accelerated progress of early flowering, heading, and physiological maturity may be attributed primarily to the notable enhancement in seed quality, characterized by enhanced germination percentage, germination speed, and field emergence percentage. These improvements have resulted in a reduction in the time required for flowering, heading, and maturity to occur. Moreover, it is plausible that rapidly established plants possessing robust root systems may have effectively assimilated and utilized a greater quantity of growth resources in the presence of optimal soil moisture and weather conditions. This, in turn, might have resulted in an abundant and protracted period of vegetative development, potentially augmenting the blooming mechanisms inside the plant. According to Murungu [24], the priming of wheat types led to a higher percentage of emergence at the final stage and a shorter duration for heading and physiological maturity, as compared to seeds that were not primed. The findings also indicated that hydropriming with freshwater was the most efficacious therapy. This treatment resulted in considerably accelerated seedling emergence, enhanced growth metrics, reduced time to maturity, and a substantial improvement in wheat grain yield.

This variation in the yield parameters among the treatments is attributed to variations in the growth parameters because of quick establishment due to priming. Increased leaf area and leaf area assimilation with a greater number of tillers had contributed to more accumulation of dry matter in the plant. Further, increased dry matter accumulation contributed to increased yield parameters. The results are in conformity with the findings obtained by Aslam et al. [25] and Spink et al. [26]. This superior grain and straw yield of wheat were attributed to the higher yield and growth parameters under prolonged hydropriming (18 hours of soaking followed by four and two hours of drying). Besides, it was mainly due to higher production ofphotosynthates by higher photosynthetically active vegetation of early established plants under hydropriming. Further, it might have supplemented by more total dry matter accumulation in plants with higher number of tillers, number of spikelets and test weight greater photosynthetic activity of the plant which in turn depends upon the assimilatory surface area mainly leaf area, leaf area index. The results are in conformity with the findings obtained by Farooq et al. [27], Beesanakoppa et al. [28] and Naz and Perveen [29].

This is mainly because of increased grain yield as well as low cost for cultivation under hydropriming in wheat crop. Similarly, the higher grain yield, net return, and B:C ratio with 18 hours hydropriming of wheat has been reported by Patra et al. [30] and Farooq et al.[31]. Beesanakoppa et al. [28] also reported the higher yield and gross return in hydropriming treatment. This view was further supported by Sime and Aune [32]. Further, priming improves plant stand and provides benefits in terms of maturity. Contrarily, the lower net return and B:C ratio was found in control treatment as compared to hydropriming were recorded with control treatment (non-primed). This was mainly because of lesser grain yield as well as high cost for cultivation under non-hydropriming in wheat crop. Similar results were reported by Patra et al. [30] and Kale and Takawale [33] and Farooq et al. [31].

Conclusion

Hydropriming is a zero-capital input to overcome late sown conditions and abiotic stress conditions. Owing its benefits, there is a need to adopt improved practices to overcome the effect of abiotic stresses and other factors like delayed sowing. Considering this, the experiment conducted clearly indicated that, soaking of wheat seeds in water for 18 hours followed by drying for two to four hours and soaking for 12 hours followed by drying for four hours found superior with respect to germination, emergence, seedling quality, growth, yield, and economics of wheat as compared to non-primed (control) treatment and other primed treatment.

Acknowledgements

None.

Conflict of Interest

None.

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