E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; 7(10): 187-191
Received: 15-08-2024
Accepted: 17-09-2024

Shravan Kumar
Research Scholar, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

A. L. Jatav
Professor, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

C. L. Maurya
Professor, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Ravi Dixit
Research Scholar, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Shailendra Pratap Singh
Research Scholar, Department of Soil Conservation & Water management, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Bhayankar
Research Scholar, Department of Agronomy, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Dhirendra Kumar
Research Scholar, Department of Plant Physiology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Omkar
Research Scholar, Department of Genetics & Plant Breeding, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Pradeep Kumar
Research Scholar, Department of Agronomy, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

Corresponding Author:
Shravan Kumar
Research Scholar, Department of Seed Science and Technology, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh, India

To the effect of seed priming treatments on growth parameters and seed quality of wheat (*Triticum aestivum* L.) under rainfed conditions

Shravan Kumar, A. L. Jatav, C. L. Maurya, Ravi Dixit, Shailendra Pratap Singh, Bhayankar, Dhirendra Kumar, Omkar and Pradeep Kumar

DOI: https://doi.org/10.33545/2618060X.2024.v7.i10c.1737

Abstract
The present study was conducted on wheat variety "K-1317"and was procured from Student instructional Farm, C.S. Azad University of Agriculture & Technology, Kanpur. The experiment was conducted in Rabi 2022-23 and 2023-24. The seeds were used for pre-sowing seed treatments, T_0 Control (Un soaking), T_1 Soaking with tap water for 12 hrs, T_2 Soaking with tap water for 24 hrs, T_3 Soaking with *Bacillus Subtilis* for 12 hrs, T_4 Soaking with *Bacillus subtilis* for 24 hrs, T_5 Soaking with Azotobacter for 12 hrs, T_6 Soaking with Azotobacter for 24 hrs, T_7 Soaking with NaCl @ 1% for 12 hrs, T_8 Soaking NaCl @ 1% for 24 hrs, T_9 Soaking with $ZnSo_4$ @ 1% for 12 hrs, T_{10} Soaking with $ZnSo_4$ @ 1% for 24 hrs, T_{11} Soaking with GA_3 @ (50 ppm) for 12 hrs, T_{12} Soaking with GA_3 @ (50 ppm) for 24 hrs & T_{13} Soaking Auxin (IAA) @ (50 ppm) for 12 hrs & T_{14} Soaking IAA @ (50 ppm) for 24 hrs. Pre-sowing seed treatment or priming was done by soaking of required quantity of seeds of wheat variety K- 1317 in tap water, biologicals, chemicals, and hormonals' treatments in given concentration for 12 hrs and 24 hrs in ratio of 1:1 (Kg of seeds/volume of solution) by using wet gunny bags. Then the treated or primed (soaked) seeds were dried in shade to maintain the seed moisture content approximately 12 or 13%. Seed dressing was done on primed and untreated (control) by Thiram (2.5%). Seeds priming was GA_3@ (50 ppm) for 12 hrs on wheat variety K-1317 significantly present results the growth attributes and seed quality. The best results in found under the treatment T_{11} Initiation of headings, Days to 50% headings, Days to maturity, Grain yield kg/plot Seed moisture content (%) at the time of sowing and Moisture content (%) in seed but the most superior result shown by T_{13} on Field moisture content (%) at the time of sowing in season 2022 and 2023. and the at par treatments T_3, T_{10}, T_{12}, T_{13} and T_{14}.

Keywords: Wheat crop, Auxin, GA_3 and *Bacillus subtilis*

Introduction

Wheat is an annual crop that belongs to the Poaceae family and is believed to have originated in South West Asia (Jenkins, 1966) [9]. The central Asia, Near East, Mediterranean and Ethiopian regions are the world's most important centers of diversity of wheat and its related species. Hindukush area is the Centre of diversity of hexaploid wheat (Kundu and Nagarajan, 1996) [12]. This crop played an indispensible role in ushering the "Green Revolution" in many developing countries including India. Globally, wheat annual production is 802.1 million tons recorded in 2022-23 (FAO, 2023) [2]. In India, total cultivated area of wheat is 31.86 million hectares in 2022-23 (DAFW, 2023) [1]. Which produces 109.52 million tons of grains and shares 13% of total wheat production of the world (Singh *et al.*, 2023) [16].

Unlike other cereals, wheat contains a high amount of gluten, the protein that provides the elasticity necessary for excellent bread making. It has good nutrition profile with 12.1 percent protein, 1.8 per cent lipids, 1.8 percent ash, 2.0 per cent reducing sugars, 6.7 percent pentose's, 59.2 percent starch, 70 percent total carbohydrates and provides 314KCal/100g of food. It is also a good source of minerals and vitamins *viz*., calcium (37 mg/100 g), iron (4.1 mg/100 g), thiamine (0.45mg/100g), riboflavin (0.13mg/100g) and nicotinic acid (5.4 mg/100 mg) (Lorenz and Kulp, 1991) [13]. Hard wheat had high protein (10-17%) and yields flour rich gluten, making it particularly suitable for yeast breads.

The low-protein (6 to 10%) softer type yields flour lower in gluten and therefore, suited better for tender baked products, such as biscuits, pastries and cakes. Micronutrient deficiency is also known as Hidden Hunger, is one of the most important challenges facing humanity today (White and Broadley, 2009) [17].

Seed is the most fundamental input required to sustain agriculture. Therefore, it is imperative to develop a cheap and eco-friendly seed production technology, which produces good quality seeds. Seed treatment is a prudent pest-management tactics, are becoming increasingly important as IPM-compatible measures. The process of treating seeds to provide the necessary nutrients and prevent pests and diseases involves the application of both beneficial microbes and chemical pesticides. In India, insect pests are responsible for 15.7 percent yield losses in wheat, (Dhaliwal *et al.*, 2015) [7] seed priming treatment, exhibited better results relative to other treatments; it indicates that both salts have a synergetic effect when apply as seed priming agents, improving the nitrogen-utilizing capacity of wheat crops. Accordingly, the result suggests that priming of seeds with Mg (NO3)2 and $ZnSo_4$ worked synergistically at varietal level and improved nitrogen metabolism. The combination of both salts enhanced the growth attributes in the wheat crop and combination of these salt concentrations can be used for wheat-growing areas. (Surendra Kumar C. *et al.*, (2021) [6].

Water scarcity is one of the major limiting factors for crop production and becomes a serious threat to food security1. Water stress was assumed to be a catalyst of severe starvation in history. The impact of drought severeness is categorized by the rate and interval of rainfall, soil evaporation losses, and lack of water harvesting approaches2. Soil moisture stress disrupted and induced the alteration in the various plant biochemical, physiological, and morphological processes including cell divisions, cell elongations, turgor pressure, photosynthetic assimilates translocation, anti-oxidant behavior, nutrient uptake, and grains settings.

The use of the seed priming approach is one of the cost-effective and sustainable smart agronomic techniques to mitigate the drastic impact of plant grain development phases under terminal irrigation drought stress. The treated primed seeds can upgrade the plant tolerance via germination potential, vigorous seedling establishments, and ameliorate the anti-oxidant defense system to protect the cellular oxidative damages. Seed priming is the procedure of soaking the seeds depending on the low water potential solution and duration. Different seed priming methods have been explored based on the utilization of priming agents and can be classified as hydro-priming, osmo-priming, Matri-priming, osmo-hardening, hardening, hormonal priming, etc. Seed priming increase the percent of germination and reduce the time of seedling emergence side by side improve the crop stand. A method to improve the rate and uniformity of germination is the priming or physiological advancement of the seed lot. Seed priming is the method of improve germinations and uniform emergence of seedlings in field conditions.

GA_3 are used as important seed priming agents to mitigate abiotic stresses in different crops. Although the beneficial effects of GAs on germination is relatively well documented, only few reports focused on GAs-priming-induced effects on seed reserves mobilization under saline condition (Iqbal & Ashraf, 2013) [8]. The seed priming with GA_3 enhance emergence, stand establishment, tillering, allometry, grain and straw yields, and harvest index by Assefa *et al.* (2010) [4]. The Bacillus subtilis MA17 showed the best vegetative growth-promotion effect in *Triticum turgidum* L. (Adil Hadj Brahim *et al.*, (2022) [5].

Materials and Methods

The experiment was conducted at Instructional Farm (SIF), Chandra Shekhar Azad University of Agriculture and Technology in Kanpur, which was served as the experimental site. Kanpur Nagar is a city in central Uttar Pradesh that is at a height of 125.9 meters above sea level on the alluvial tract of the Gangetic plains. The experiment was conducted on wheat variety 'K 1317', the good quality seed of wheat variety which procured in Rabi 2022-23 and 2023-24. The semi-arid climate and rich alluvial soil characterize this northern zone. About 935 mm of rain falls on the region each year on average. Relative humidity (7 am) is relatively constant at about 80-90% from July to the end of March, gradually declines to about 40-50% by the end of April, and remains at 80% until June, even though temperatures in May and June can reach 44 °C to 47 °C or higher. The seeds were used for pre-sowing seed treatments, T_0 Control (Un soaking), T_1 Soaking with tap water for 12 hrs, T_2 Soaking with tap water for 24 hrs, T_3 Soaking with Bacillus Subtilis for 12 hrs, T_4 Soaking with Bacillus subtilis for 24 hrs, T_5 Soaking with Azotobacter for 12 hrs, T_6 Soaking with Azotobacter for 24 hrs, T_7 Soaking with NaCl @ 1% for 12 hrs, T_8 Soaking NaCl @ 1% for 24 hrs, T_9 Soaking with $ZnSo_4$ @ 1% for 12 hrs, T_{10} Soaking with $ZnSo_4$ @ 1% for 24 hrs, T_{11} Soaking with GA_3 @ (50 ppm) for 12 hrs, T_{12} Soaking with GA_3 @ (50 ppm) for 24 hrs & T_{13} Soaking Auxin (IAA) @ (50 ppm) for 12 hrs & T_{14} Soaking IAA @ (50 ppm) for 24 hrs. Pre-sowing seed treatment or priming was done by soaking of required quantity of seeds of wheat variety K- 1317 in tap water, biologicals, chemicals, and hormonals' treatments in concentration for 12 hrs and 24 hrs in ratio of 1:1 (Kg of seeds/volume of solution) by using wet gunny bags. Then the treated or primed (Soaked) seeds were dried in shade to maintain the seed moisture content approximately 12 or 13%. Seed dressing was done on primed and untreated (Control) by Thiram (2.5%). Primed seeds along with control (Untreated) were sown in 25 November in rabi season 2022-23and 13 November in rabi season 2023-24 under rainfed conditions and apply the FYM @ 12 tonns,120kg N, 60kg P_2O_5 and 40 kg K per ha. There were 3 replications by using RBD design for field trail and CRD design for laboratory trial. The crop was raised by using all required agronomical practices. Mature crop was harvested in the last week of April 2023 & 2024. Processed seeds were examined for the quality parameters in three replications at Seed Testing Laboratory of C.S. Azad University of Agriculture & Technology, Kanpur. RBD design for field and CRD design for laboratory was used for statistical analysis. The following field observations were recorded. Initiation of headings, Days to 50% headings, Days to maturity, Grain yield kg/plot and laboratory observations were recorded Seed moisture content (%) at the time of sowing, Moisture content (%) and Field moisture content (%) at the time of sowing.

Results and Discussion

Initiation of headings (DAS)

Overall mean data presented in Table 1. reveal that all the treatments showed significant differences from T_0 (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs has showed superior (77.00) on Initiation of headings (DAS) followed by Priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs (78.00) and second followed by (T_7) $NaCl_2$ @ 2.5% (12 hrs) soaked for 12 hrs (78.33) while the least

Initiation of headings (DAS) was recorded in control (T_0) (85.00). From the analysis, it also perceptible that priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs and priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs increased the Initiation of headings (DAS) by 8.0 and 7.0 respectively over control. The find similar findings, it can be affirmed that the IAA priming showed more vigor growth with improved root length, seedling height, biomass and leaf photosynthesis capacity. IAA priming resulted in enhanced seed germination and seedling growth, along with increasing the cotton crop production by (Tianlun Zhao *et al.*, 2020) [18].

Days to 50% heading

Overall mean data presented in Table 1. reveal that all the treatments showed significant differences from T_0 (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs has showed superior (89.34) on days to 50% heading followed by Priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs (89.67) and second followed by (T_{10}) $ZnSo_4$ @ 2.5% soaked for 12 hrs (90.33) while the least days to 50% heading was recorded in control (T_0) (95.17). From the analysis, it also perceptible that priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs and priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs increased the days to 50% heading by 5.83 and 5.50 respectively over control. The find similar findings, it can be affirmed that the IAA priming showed more vigor growth with improved root length, seedling height, biomass and leaf photosynthesis capacity. IAA priming resulted in enhanced seed germination and seedling growth, along with increasing the cotton crop production by (Tianlun Zhao *et a.,*. 2020) [18].

Days to maturity (DAS)

Overall mean data presented in Table 1. Reveal that all the treatments showed significant differences from T_0 (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs has showed superior (120.88) on days to maturity followed by Priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs (121.75) and second followed by (T_{13}) IAA@ (50 ppm) soaked for 12 hrs (122.86) while the least days to maturity was recorded in control (T_0) (127.18). From the analysis, it also perceptible that priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs and priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs increased the days to maturity by 6.30 and 5.43 respectively over control. The find similar findings, it can be affirmed that IAA priming showed more vigor growth with improved root length, seedling height, biomass and leaf photosynthesis capacity. IAA priming resulted in enhanced seed germination and seedling growth, along with increasing the cotton crop production by (Tianlun Zhao *et al*,. 2020) [18].

Grain yield kg plot^{-1}

Overall mean data presented in Table 1. reveal that all the treatments showed significant differences from T_0 (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs has showed superior (5.08) on grain yield kg plot-1 followed by Priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs (4.98) and second followed by (T_{13}) IAA@ (50 ppm) soaked for 12 hrs (4.84) while the least Grain yield kg plot-1 was recorded in control (T_0) (4.08). From the analysis, it also perceptible that priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs and priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs increased the Grain yield kg plot-1by 1.00 and 0.90 respectively over control. The find similar findings, it can be affirmed that the Seed yield per plant (13.55 g), seed yield per plot (2.45 kg) during both the years followed by GA_3 (50 ppm) primed seeds which recorded at par values for almost all the seed yield attributes by (Avinash karjule *et al.*, 2019) [10] and Assefa *et al*., (2010) [4].

Table 1: Effect of seed priming treatments on Initiation of headings, Days to 50% headings, Days to maturity (DAS) and Grain yield kg plot^{-1} in Wheat variety K-1317 under rainfed Condition

Treatments	Initiation of headings			Days to 50% headings			Days to maturity (DAS)			Grain yield kg plot^{-1}		
	2022-23	2023-24	Pooled	2022-23	2023-24	pooled	2022-23	2023-24	pooled	2022-23	2023-24	pooled
T_0 Control	86.00	85.67	85.83	95.33	95.00	95.17	127.86	126.50	127.18	4.07	4.08	4.08
T_1 Tap water (12 hrs)	83.67	83.33	83.50	94.33	93.33	93.83	127.01	125.98	126.50	4.28	4.50	4.39
T_2 Tap water (24 hrs)	83.33	83.00	83.17	91.33	91.00	91.17	126.56	125.56	126.06	4.23	4.36	4.30
T_3 Bacillus subtilis (12 hrs)	81.33	80.33	80.83	92.67	92.67	92.67	126.00	125.32	125.66	4.62	4.75	4.69
T_4 Bacillus subtilis (24 hrs)	85.33	84.00	84.67	93.33	93.67	93.50	125.89	124.56	125.23	4.65	4.74	4.70
T_5 Azotobacter (12 hrs)	84.33	84.00	84.17	92.33	93.00	92.67	125.00	124.30	124.65	4.49	4.56	4.52
T_6 Azotobacter (24 hrs)	80.67	81.67	81.17	90.33	90.33	90.33	125.63	124.00	124.82	4.43	4.48	4.46
T_7 $NaCl_2$ @ 2.5% (12 hrs)	77.67	79.00	78.33	89.67	92.66	91.17	124.65	124.65	124.65	4.40	4.46	4.43
T_8 $NaCl_2$ @ 2.5% (24 hrs)	83.33	82.33	82.83	92.67	91.67	92.17	123.67	123.00	123.33	4.28	4.30	4.29
T_9 $ZnSo_4$ @ 2.5%(12 hrs)	82.33	82.00	82.17	92.33	92.67	92.50	124.20	123.17	123.68	4.78	4.85	4.82
T_{10} $ZnSo_4$ 2.5% (24 hrs)	80.33	81.67	81.00	89.33	91.00	90.17	123.67	122.95	123.31	4.74	4.80	4.77
T_{11} GA_3 @ 50 ppm (12 hrs)	77.33	76.67	77.00	89.00	89.67	89.34	121.67	120.10	120.88	5.06	5.10	5.08
T_{12} GA_3 @ 50 ppm (24 hrs)	78.33	77.67	78.00	89.33	90.00	89.67	122.00	121.50	121.75	4.98	4.98	4.98
T_{13} IAA @ 50 ppm (12 hrs)	80.67	81.00	80.83	92.33	91.88	92.11	122.56	122.00	122.28	4.80	4.88	4.84
T_{14} IAA @ 50 ppm (24 hrs)	81.33	81.67	81.50	92.67	92.10	92.38	123.00	122.50	122.75	4.72	4.83	4.78
C.D.	4.99	4.25	4.62	3.79	2.86	3.33	NS	2.77	2.77	0.28	0.176	0.23
C.V.	3.63	3.10	3.37	2.46	1.85	2.15	2.65	1.33	1.99	3.66	2.253	2.96

Field moisture content (%) at the time of sowing (0-15 cm depth)

Overall mean data presented in Table 2.0 reveal that all the treatments showed significant differences from T_0 (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T_{13}) IAA @ (50 ppm) soaked for 12 hrs has showed superior (26.99%) on field moisture content at the time of sowing (0-15 cm depth). followed by Priming with (T_{14}) IAA @ (50 ppm) soaked by 24 hrs (28.33%) and second followed by (T_5) Azotobacter soaked for 12 hrs (28.58%) while the least field moisture content at the time of sowing (0-15 cm depth). was recorded in control (T_0)

(28.88%). From the analysis, it also perceptible that priming with (T_{11}) IAA @ (50 ppm) soaked for 12 hrs and priming with (T_{14}) IAA @ (50 ppm) soaked by 24 hrs increased the field moisture content at the time of sowing (0-15 cm depth) by 1.89 and 0.55 respectively over control. The find similar findings, it can be affirmed that seed priming improves germination and seedling growth of aged seeds and protects sunflower seeds from seed deterioration during aging. Furthermore, it is clearly revealed that the benefits of priming after aging outweigh those of priming before aging by (Mehmet D. K. *et al.*, 2024) [11].

Seed moisture content (%) at the time of sowing

Overall mean data presented in Table 2. reveal that all the treatments showed significant differences from T_0 (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs has showed superior (15.35%) on Seed moisture content at the time of sowing (%) followed by Priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs (15.67%) and second followed by (T_3) Tap water soaked for 24 hrs (16.57%) while the least Seed moisture content at the time of sowing (%) was recorded in control (T_0) (13.79%). From the analysis, it also perceptible that priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs and priming with (T_{12}) GA_3 @ (50 ppm) soaked by 24 hrs increased the Seed moisture content at the time of sowing) by 1.56% and 1.88% respectively over control. The find similar findings, it can be affirmed that the seed priming improves germination and seedling growth of aged seeds and protects sunflower seeds from seed deterioration during aging. Furthermore, it is clearly revealed that the benefits of priming after aging outweigh those of priming before aging by (Mehmet D. K. *et al.*, 2024) [11].

Moisture content (%) of seed

Overall mean data presented in Table 2. reveal that all the treatments showed significant differences from T_0 (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs has showed superior (11.97%) on Moisture content (%) of seed followed by Priming with (T_3) *Bacillus Subtilis* soaked by 12 hrs (12.01%) and second followed by (T_9) $ZnSo_4$ @ 2.5% soaked for 12 hrs (12.44%) while the least Moisture content (%) of seed was recorded in control (T_0) (13.87%). From the analysis, it also perceptible that priming with (T_{11}) GA_3 @ (50 ppm) soaked for 12 hrs and priming with (T_3) Bacillus Subtilis soaked by 12 hrs increased the Moisture content (%) of seed by 1.90 and 1.86 respectively over control. The find similar findings, it can be affirmed that the impact of priming, biofertilizers with different nitrogen levels on growth, yield and nutrient uptake of late sown wheat Bhanupriya Patra *et al.*, (2018) [15].

Table 2: Effect of seed priming treatments on Field moisture content (%), Seed moisture content (%) at the time of sowing and Moisture content (%) of seed Wheat variety K-1317 under rainfed condition

Treatments	Field moisture content (%) at the time of sowing (0-15 cm depth)			Seed moisture content (%) at the time of sowing			Moisture content (%) of seed		
	2022-23	2023-24	pooled	2022-23	2023-24	pooled	2022-23	2023-24	pooled
T_0 Control	29.00	28.77	28.88	13.56	14.02	13.79	13.94	13.80	13.87
T_1 Tap water (12 hrs)	31.62	30.00	30.81	20.41	21.87	21.14	13.74	13.24	13.49
T_2 Tap water (24 hrs)	30.00	29.00	29.50	21.57	22.79	22.18	13.70	13.66	13.68
T_3 Bacillus subtilis (12 hrs)	30.00	28.13	29.06	18.71	19.88	19.30	12.10	11.93	12.01
T_4 Bacillus subtilis (24 hrs)	29.84	28.67	29.25	17.58	21.58	19.58	12.47	12.43	12.45
T_5 Azotobacter (12 hrs)	28.83	28.33	28.58	21.10	18.25	19.68	13.23	13.10	13.17
T_6 Azotobacter (24 hrs)	30.19	29.67	29.93	19.86	20.65	20.25	13.46	13.51	13.49
T_7 $NaCl_2$ @ 2.5% (12 hrs)	29.08	29.28	29.18	20.55	20.14	20.34	13.16	13.18	13.17
T_8 $NaCl_2$ @ 2.5% (24 hrs)	31.13	30.16	30.64	21.47	20.58	21.03	13.54	13.01	13.28
T_9 $ZnSo_4$ @ 2.5%(12 hrs)	28.33	29.48	28.91	19.25	17.49	18.37	12.54	12.34	12.44
T_{10} $ZnSo_4$ 2.5% (24 hrs)	31.07	30.67	30.87	18.02	17.24	17.63	12.95	13.04	13.00
T_{11} GA_3 @ 50 ppm (12 hrs)	30.81	29.32	30.07	14.99	15.71	15.35	11.84	12.11	11.97
T_{12} GA_3 @ 50 ppm (24 hrs)	28.98	29.89	29.43	15.32	16.02	15.67	12.33	12.05	12.19
T_{13} IAA @ 50 ppm (12 hrs)	26.33	27.65	26.99	15.62	17.52	16.57	12.68	12.74	12.71
T_{14} IAA @ 50 ppm (24 hrs)	28.67	28.00	28.33	16.23	17.84	17.04	12.41	12.59	12.50
C.D.	2.38	1.77	2.07	0.55	0.52	0.53	0.50	0.38	0.44
C.V.	4.79	3.61	4.20	2.11	1.93	2.02	2.68	2.06	2.37

Summary and Conclusion

Seed priming with GA_3 @ 50 ppm also showed significant improvement over unprimed seeds for the best result found treatment T_{11} Initiation of headings, Days to 50% headings, Days to maturity, Grain yield kg/plot Seed moisture content (%) at the time of sowing and Moisture content (%) in seed but the most superior result shown by T_{13} on Field moisture content (%) at the time of sowing in 2022 (77.33, 89.00, 121.67, 5.06, 26.33, 14.99 and 11.84). and 2023 (76.67, 89.67, 120.10, 5.10, 27.65, 15.71 and 12.05) and pooled (77.00, 89.34, 120.88, 5.08, 26.99, 15.35 and 11.97) respectively.

References

1. Anonymous. DAFW. Department of Agriculture & Farmers Welfare, Govt. of India; c2022-23a.
2. Anonymous. FAO cereal supply and demand brief. FAO (Food and Agriculture Organization of the United Nations); c2023. 2022-23b.
3. Adhikari B, Olorunwa OJ, Barickman CT. Seed priming enhances seed germination and morphological traits of *Lactuca sativa* L. under salt stress. Seeds. 2022;1:74–86. doi:10.3390/seeds1020007.
4. Assefa MK, Hunje R, Koti RV. Enhancement of seed quality in soybean following priming treatment. Karnataka J Agric Sci. 2010;23:787-789.
5. Brahim AH, Ali MB, Daoud L, Jlidi M, Akremi I, Hmani Z, *et al*. Biopriming of durum wheat seeds with endophytic diazotrophic bacteria enhances tolerance to Fusarium head blight and salinity. Microorganisms. 2022;10(5):970. doi:10.3390/microorganisms10050970.

6. Choudhary SK, Kumar V, Singhal RK, Bose B, Chauhan J, Alamri S, *et al*. Seed priming with Mg(NO3)2 and $ZnSo_4$ salts triggers the germination and growth attributes synergistically in wheat varieties. Agronomy. 2021;11.
7. Dhaliwal GS, Jindal V, Mohindru B. Crop losses due to insect pests: Global and Indian scenario. Indian J Entomol. 2015;77(2):165-168.
8. Iqbal M, Ashraf M. Gibberellic acid mediated induction of salt tolerance in wheat plants: Growth, ionic partitioning, photosynthesis, yield and hormonal homeostasis. Environ Exp Bot. 2013;86:76-85. doi:10.1016/j.envexpbot.2010.06.002.
9. Jenkins JA. The origin of cultivated wheat. Can J Genet Cytol. 1966;8(2):220-232.
10. Karjule A, Kalyanrao S, Sasidharan N, Patel DA. Effect of different seed priming treatments on yield attributes of wheat (*Triticum aestivum*). Indian J Agric Sci. 2019. doi:10.56093/ijas.v89i10.94597.
11. Kaya MD, Ergin N, Harmancı P, Kulan EG. Seed priming as a method of preservation and restoration of sunflower seeds. OCL. 2024. doi:10.1051/ocl/2024003.
12. Kundu S, Nagrajan S. Distinguishing characters of Indian wheat varieties. Research Bulletin No. 4. Directorate of Wheat Research; Karnal, India; c1996.
13. Lorenz K, Kulp K. Breakfast cereals. In: Handbook of Cereal Science and Technology. New York: Library of Congress; c1991. p. 8247-8258.
14. Mal D, Verma J, Levan A, Reddy MR, Avinash AV, Velaga PK. Seed priming in vegetable crops: A review. Int J Curr Microbiol App Sci. 2019;8(6):128-143. doi:10.20546/ijcmas.201980105.
15. Patra B, Singh J. Effect of priming, biofertilizers and nitrogen levels on yield and nutrient uptake by wheat. Int. J Curr Microbiol App Sci. 2018;7(7):1101-1110.
16. Singh S, Singh Mor V, Kumar ABR, Singh G, Digamber. Evaluating the effect of various seed treatment approaches on seed quality of wheat (*Triticum aestivum* L.). The Pharma Innovation Journal. 2023;12(10):2439-2444.
17. White PJ, Broadley MR. Biofortification of crops with seven mineral elements often lacking in human diets: iron, zinc, copper, calcium, magnesium, selenium and iodine. New Phytol. 2009;182:49-84.
18. Zhao T, Deng X, Xiao O, Han Y, Zhu S, Chen J. IAA priming improves the germination and seedling growth in cotton (*Gossypium hirsutum* L.) via regulating the endogenous phytohormones and enhancing the sucrose metabolism. J Ind Crops Prod. 2020. doi:10.1016/j.indcrop.2020.112788.