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

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 (Unsoaking), **T_1** Soaking with tap water for 12hrs, **T_2** Soaking with tap water for 24hrs, **T_3** Soaking with Bacillus Subtilis for 12hrs, **T_4**Soaking with Bacillus subtilis for 24hrs, **T_5** Soaking with Azotobacter for 12hrs**, T_6** Soaking with Azotobacter for 24hrs, **T_7**Soaking with NaCl @1% for 12hrs**, T_8** Soaking NaCl @1% for 24hrs, **T_9** Soaking with ZnSo4 @1% for 12hrs, **T_{10}**Soaking with ZnSo4 @1% for 24hrs, **T_{11}**Soaking with GA3 @(50ppm) for 12hrs, **T_{12}** Soaking with GA3 @(50ppm) for 24hrs &**T_{13}**Soaking Auxin (IAA) @(50ppm) for 12hrs &**T_{14}** Soaking IAA @(50ppm) for 24hrs. 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 12hrs and 24hrs 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 GA3@ (50ppm) for 12hrs on wheat variety K-1317 significantly present results the yield and quality of seed. The best results in found under the treatment **T_{11}**Soaking with GA3 @(50ppm) for 12hrs, in productive tillers, number seeds/spike, number of spikelet's/spikes, spike length, grain yield and harvest index, protein content in 2022-2023. and the at par treatments **T_{10}, T_{12}, T_{13}**and **T_{14}.**

Key Words: -Wheat crop, Auxin, GA3, Bacillus *subtilis*.

1. Introduction

Wheat (*Triticum aestivum* L.) is a self-pollinated crop belonging to the *Poaceae* family and one of the most leading cereals of many countries of the world including India. It has been described as the **'King of cereals'** because of the acreage it occupies, high productivity and the prominent position it holds in the international food grain trade. It is the most important food crop of India and is a main source of protein and energy. According to the earliest historic records, wheat was an important cultivated cereal in South-Western Asia, its geographical centerof origin. 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 center of diversity of hexaploid wheat **(Kundu and Nagarajan, 1996).**

In India, during 2020-21 production of wheat was recorded to 109.52mt with average productivity of 35.00q/ha from an area of 31.61 million ha which constitute 36 percent of the country's total food grain production 308.65mt. (**Anonymous, 2021a).** In Uttar Pradesh, the total wheat production was 35.50mt and average productivity was 32.42q/ha., with the area of 9.78 million ha. The perusal of state wise production indicates that Uttar Pradesh tops the list with 35.50 mt, followed by Madhya Pradesh (17.62 mt), Punjab (17.14mt). These top three states together contributed about 64 per cent of the total production **(Anonymous, 2021b).**

Micronutrient deficiency is also known as **Hidden Hunger,** is one of the most important challenges facing humanity today **(White and Broadley, 2009)**. or reported the seed priming with GA3 enhance emergence, stand establishment, tillering, allometry, grain and straw yields, and harvest index by **Assefa *et. al.* (2010).** Seed priming showed positive response to different priming treatments recorded significantly higher pooled average field emergence (96.42%), number of effective tillers (7.75), spike length (12.99 cm), seed yield per plant (13.55 g), seed yield per plot (2.45 kg) during both the years followed by GA3 (50 ppm) primed seeds which recorded at par values for almost all the seed yield attributes by **Avinash karjule*et. al.* (2019).**

The wheat grown in India is spring type belong to species *Triticumaestivum* (bread wheat). 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/100g), iron (4.1 mg/100g), thiamine (0.45mg/100g), riboflavin (0.13mg/100g) and nicotinic acid (5.4mg/100mg) **(Lorenz and Kulp, 1991).** 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.

Priming levels of Zn (0% ZnSO4-water soaking, 1% ZnSO4, 2% ZnSO4 and 3% ZnSO4) and three priming durations (4 hours, 8 hours and 12 hours) were compared with basal dose of recommended NPK + ZnSO4 and farmers' practice (absolute control). The yield of green peas, maize equivalent yield was maximum due to priming with 1% ZnSO4 for 12 hours duration, however, yield of maize grains was highest with treatment combination of 2% ZnSO4 priming for 12 hours duration by **Munish Sharma and D. K. Parmar (2018).**

Seedprimingisone of the advanced methods for accelerating the germination by which, it is possible to increasethe ability of seeds to germinate, grow and enhance to yield under moisture stress condition.Farmer's faces moisture stress during early plant growth stages which were resulted in less plantpopulation and the Seed priming is commonly used to reduce the time between seed sowing and seed lingemergence and to synchronize seed ling emergence. The rationale is that sowing the soaked seedde creases the time needed for germination and may al low the seed lings to escape from thedeteriorating soil physical conditions.Keeping in view the above facts, the experiment is planned to carry out with thefollowing objectives: -

- Tofindoutthesuitableseedprimingtreatmentforassuringbetterfieldemergence.
- Tostudytheeffectofseedprimingtreatmentonplantgrowthrelatedparameters.
- Toassesstheeffectofseedprimingtreatmentforgettinghigheryieldandqualityattributing parameters.
- Toseetheeffectofprimingtreatmentsonseedqualityofwheat.
- Effectofseed primingtreatments onseedhealth.

2. Materials and Method

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 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 (Unsoaking), **T_1** Soaking with tap water for 12hrs, **T_2** Soaking with tap water for 24hrs, **T_3** Soaking with Bacillus Subtilis for 12hrs, **T_4** Soaking with Bacillus subtilis for 24hrs, **T_5** Soaking with Azotobacter for 12hrs, **T_6**Soaking with Azotobacter for 24hrs, **T_7**Soaking with NaCl @1% for 12hrs**, T_8** Soaking NaCl @1% for 24hrs, **T_9** Soaking with ZnSo4 @1% for 12hrs, **T_{10}** Soaking with ZnSo4 @1% for 24hrs, **T_{11}** Soaking with GA3 @(50ppm) for 12hrs, **T_{12}** Soaking with GA3 @(50ppm) for 24hrs &**T_{13}** Soaking Auxin (IAA) @(50ppm) for 12hrs &**T_{14}** Soaking IAA @(50ppm) for 24hrs. 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 12hrs and 24hrs 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 Novemberin rabi season 2022-23and 13 November in rabiseason 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** forfield trail. 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 was used for statistical analysis. The following field observed recorded,Number of productive tillers/ plot, number of seeds/spike, number of spikelet's/spike, spike length, grain yield kg/hac, harvest index and protein content.

3. Result and discussion

3.1 Number of productive tillers m^{-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 observed among all treatments. Priming with **(T_{11})** GA3 @(50ppm) soaked for 12hrs has showed superior (284.33) on number of productive tillers followed by Priming with **(T_{12})** GA3 @(50ppm) soaked by 24hrs (283.50) and second followed by **(T_{13})** IAA@ (50ppm) soaked for 12hrs (282.83) while the least number of productive tillers was recorded in control **(T0)** (273.50). From the analysis, it also perceptible that priming with **(T_{11})** GA3

@(50ppm) soaked for 12hrs and priming with **(T_{12})** GA3 @(50ppm) soaked by 24hrs increased the number of productive tillers by 10.83 and 10.00 respectively over control**.**The find similar findings, it can be affirmed that the (Azotobacter and PSB) applied seed treatment was recorded in **T_3** CG2006 was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield**, Gayatri *et.al.*, (2022) & Avinash karjule*et. al.*, (2019).**

3.2.Number of seeds spike^{-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}) GA3 @(50ppm) soaked for 12hrs has showed superior (44.65) on number of seeds per spike followed by Priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs (44.53) and second followed by (T_{13}) IAA@ (50ppm) soaked for 12hrs (43.72) while the least number of seeds per spike was recorded in control (T_0) (39.38). From the analysis, it also perceptible that priming with (T_{11}) GA3 @(50ppm) soaked for 12hrs and priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs increased the number of productive tillers by 5.27 and 5.19 respectively over control. The find similar findings, it can be affirmed that the (Azotobacter and PSB) applied seed treatment was recorded in T_3 CG2006 was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield, **Gayatri *et. al.*, (2022) & Avinash karjule*et. al.*, (2019).**

3.3.**Number of spikelet's spike^{-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}) GA3 @(50ppm) soaked for 12hrs has showed superior (18.82) on number of spikelet's per spike followed by Priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs (18.27) and second followed by (T_{13}) IAA@ (50ppm) soaked for 12hrs (117.80) while the least number of spikelet's per spike was recorded in control (T_0) (14.67). From the analysis, it also perceptible that priming with (T_{11}) GA3 @(50ppm) soaked for 12hrs and priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs increased the number of productive tillers by 4.15 and 3.6 respectively over control. The find similar findings, it can be affirmed that (Azotobacter and PSB) applied seed treatment was recorded in T3 CG2006 was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield, **Gayatri *et. al.*, (2022) & Avinash karjule*et. al.*, (2019).**

3.4.Spike length (cm):

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}) GA3 @(50ppm) soaked

for 12hrs has showed superior (11.33) on spike length followed by Priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs (11.05) and second followed by (T_{13}) IAA@ (50ppm) soaked for 12hrs (10.13) while the least spike length was recorded in control (T_0) (8.00). From the analysis, it also perceptible that priming with (T_{11}) GA3 @(50ppm) soaked for 12hrs and priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs increased the number of productive tillers by 3.33 and 3.05 respectively over control. The find similar findings, it can be affirmed that (Azotobacter and PSB) applied seed treatment was recorded in T_3 CG2006 was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield**, Gayatri *et. al.*,(2022)& Avinash karjule*et. al.*, (2019).**

Table No. 1. Effect of seed priming treatments on Number of productive tillers per square meter, Number of seeds spike^{-1} Number of spikelet's per spike and Spike length (cm) in Wheat variety K-1317 under rainfed Condition.

Treatments	Number of productive tillers per square meter			Number of seeds spike^{-1}			Number of spikelet's per spike			Spike length (cm)		
	2022-23	2023-24	Pooled	2022-23	2023-24	pooled	2022-23	2023-24	pooled	2022-23	2023-24	pooled
T_0 Control	273.33	273.67	273.50	39.21	39.55	39.38	14.137	15.21	14.67	7.90	8.10	8.00
T_1 Tap water (12hrs)	274.00	274.33	274.17	40.28	40.98	40.63	15.40	15.54	15.47	8.47	8.70	8.58
T_2 Tap water (24hrs)	273.33	274.00	273.67	40.12	41.01	40.57	15.31	15.49	15.40	8.76	9.12	8.94
T_3 Bacillus subtilis (12hrs)	278.23	279.50	278.87	41.14	41.65	41.40	16.39	16.78	16.59	8.83	9.27	9.05
T_4 Bacillus subtilis (24hrs)	277.86	278.98	278.42	40.65	41.35	41.00	15.80	16.88	16.34	8.40	8.63	8.52
T_5 Azotobacter (12hrs)	276.33	276.67	276.50	40.98	41.00	40.99	15.99	16.08	16.04	9.09	9.74	9.42
T_6 Azotobacter (24hrs)	275.67	276.00	275.83	40.39	41.00	40.70	16.11	16.58	16.35	8.50	7.63	8.07
T_7 NaCl2 @2.5% (12hrs)	276.33	275.96	276.15	40.26	40.59	40.42	15.61	15.78	15.70	8.57	8.60	8.58
T_8 NaCl2 @2.5% (24hrs)	276.00	275.33	275.67	40.01	40.45	40.23	15.57	15.69	15.63	8.85	9.30	9.08
T_9 ZnSo4 @2.5% (12hrs)	282.33	282.67	282.50	42.23	42.86	42.55	16.71	17.21	16.96	9.53	9.87	9.70
T_{10} ZnSo4 2.5% (24hrs)	282.00	282.33	282.17	42.03	43.00	42.52	16.50	15.60	16.05	8.98	9.07	9.02
T_{11} GA3 @50ppm (2hrs)	284.00	284.67	284.33	44.17	45.12	44.65	18.50	19.13	18.82	11.03	11.62	11.33
T_{12} GA3 @50ppm (24hrs)	283.33	283.67	283.50	44.07	44.98	44.53	18.03	18.50	18.27	10.89	10.63	10.76
T_{13} IAA @50ppm (12hrs)	282.67	283.00	282.83	43.54	43.89	43.72	17.37	18.23	17.80	9.70	10.03	9.87
T_{14} IAA @50ppm (24hrs)	281.33	281.67	281.50	43.38	43.01	43.20	16.60	17.23	16.92	8.94	8.90	8.92
C.D.	7.68	7.56	7.62	2.09	2.101	2.10	1.10	1.07	1.08	0.99	0.79	0.89
C.V.	1.64	1.62	1.63	3.00	2.948	2.97	4.01	3.82	3.92	6.50	5.06	5.78

3.5.Grain yield kg/hac:

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 @(50ppm) soaked for 12hrs has showed superior (5104.88) on grain yield kg /hac. followed by Priming with (T_{12}) GA_3 @(50ppm) soaked by 24hrs (4998.98) and second followed by (T_{13}) IAA@ (50ppm) soaked for 12hrs (4889.56) while the least grain yield kg/hac. was recorded in control (T_0) (4199.56). From the analysis, it also percentible that priming with (T_{11}) GA_3 @(50ppm) soaked for 12hrs and priming with (T_{12}) GA_3 @(50ppm) soaked by 24hrs increased the number of productive tillers by 9.05 and 7.99 respectively over control. The find similar findings, it can be affirmed that the seed priming for 8 h provided higher seed yield by 12.0% in the first year and by 5.9% in the second year compared with non-primed control.**Christos A. D. *et. al.*, (2019**) and (Azotobacter and PSB) applied seed treatment was recorded in T_3 CG2006was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield,***Gayatri et. al.*, (2022)& Avinash karjule*et. al.*, (2019).**

3.6.Harvest index:

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}) GA3 @(50ppm) soaked for 12hrs has showed superior (46.24) on harvest index followed by Priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs (44.80) and second followed by (T_{14}) IAA@ (50ppm) soaked for 24hrs (43.26) while the least harvest index was recorded in control (T_0) (35.47). From the analysis, it also perceptible that priming with (T_{11}) GA3 @(50ppm) soaked for 12hrs and priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs increased the number of productive tillers by 10.77 and 8.79 respectively over control**.** The find similar findings, it can be affirmed that the and (Azotobacter and PSB) applied seed treatment was recorded in T_3 CG2006was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield and harvest index**& Avinash karjule*et. al.*,(2019).**

3.7.Protein content (%):

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}) GA3 @(50ppm) soaked for 12hrs has showed superior (42.81) protein content followed by Priming with (T_{12}) GA3 @(50ppm) soaked by 24hrs (42.09) and second followed by (T_{13}) Auxin (IAA) @(50ppm) soaked for 12hrs (41.63) while the least protein content was recorded in control (T_0) (38.06). From the analysis, it also perceptible that priming with (T_{11}) GA3 @(50ppm) soaked for 12hrs and priming with (T_{12}) GA3 @(50ppm) soaked for 24hrs increased the number of productive tillers by 4.75 and 4.03 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 **Bishnupriya Patra *et al.*, (2018) & Avinash karjule*et. al.*, (2019)** and Similar results were also obtained for protein content in grain (12.95 to 13.22 %) and protein yield (632.7 to 678.0 kg ha^{-1}) with Azotobacter inoculation by **P.K. Jaga *et. al.*, (2017).**

Table No. 2. Effect of seed priming treatments onGrain Yield, Harvest index and Protein content in Wheat variety K-1317 under rainfed condition.

Treatments	Grain Yield kg /hac.			Harvest index			Protein content (%)		
	2022-23	2023-24	pooled	2022-23	2023-24	pooled	2022-23	2023-24	pooled
T_0 Control	4,142.89	4,199.56	4171.22	35.05	35.88	35.47	10.20	10.29	10.25
T_1 Tap water (12hrs)	4,309.00	4,309.21	4309.11	36.30	36.50	36.40	10.34	10.39	10.37
T_2 Tap water (24hrs)	4,221.01	4,148.98	4184.99	35.98	36.20	36.09	10.09	10.20	10.14
T_3 Bacillus subtilis (12hrs)	4,685.40	4,756.26	4720.83	41.87	42.57	42.22	11.32	11.57	11.44
T_4 Bacillus subtilis (24hrs)	4,659.68	4,731.11	4695.39	40.15	40.89	40.52	11.32	11.52	11.42
T_5 Azotobacter (12hrs)	4,498.56	4,593.25	4545.90	38.97	39.57	39.27	10.68	10.74	10.71
T_6 Azotobacter (24hrs)	4,435.56	4,489.25	4462.41	38.57	38.97	38.77	10.30	10.54	10.42
T_7 NaCl2 @2.5% (12hrs)	4,375.40	4,456.89	4416.14	36.99	37.58	37.28	10.19	10.38	10.28
T_8 NaCl2 @2.5% (24hrs)	4,286.85	4,302.79	4294.82	36.76	36.98	36.87	10.37	10.35	10.36
T_9 ZnSo4 @2.5%(12hrs)	4,861.82	4,856.56	4859.19	41.98	42.35	42.16	10.45	10.67	10.56
T_{10} ZnSo4 2.5% (24hrs)	4,742.56	4,800.23	4771.40	40.79	41.86	41.33	10.32	10.51	10.42
T_{11} GA3 @50ppm (2hrs)	5,077.16	5,104.88	5091.02	45.89	46.59	46.24	11.33	11.41	11.37
T_{12} GA3 @50ppm (24hrs)	4,941.16	4,998.98	4970.07	44.57	45.02	44.80	11.30	11.37	11.33
T_{13} IAA @50ppm (12hrs)	4,849.56	4,889.56	4869.56	42.88	43.21	43.05	10.35	10.53	10.44
T_{14} IAA @50ppm (24hrs)	4,805.25	4,835.27	4820.26	43.01	43.50	43.26	10.21	10.40	10.30
C.D.	288.526	256.403	272.46	2.76	2.44	2.60	0.44	0.36	0.40
C.V.	3.737	3.293	3.52	4.10	3.59	3.85	2.89	2.33	2.61

Summary and conclusion

Seed priming with GA_3 also showed significant improvement over unprimed seeds for the best result found treatment**T_{11}** in Number of productive tillers $1m^2$ area, number of seeds/spike, number of spikelet's/spikes, spike length (cm), grain yield kg/hac, harvest index and protein content (%), in 2022 (284.0, 44.27, 18.50, 11.03, 5077.16, 45.89 and 11.33). and 2023 (284.67, 45.12, 19.13, 11.62, 5104.88, 46.59 and 11.41) and pooled (284.33, 44.65, 18.82, 11.33, 5091.02,46.24 and 11.37) respectively. Whereas seed yield is concerned, GA3 soaking for 12hrs (50 ppm) primed seed application most suitable to the farmers for harvesting the highest grain yield, yield attributes and for enhancing the value of all quality seed parameters. But the application of GA3 hormone more costly to farmers for commercial cultivation which is more profitable by increasing the yield and quality of seed and a most common limitsto lack of knowledge about these applicable techniques. Significantly positive as well as negative desired traits associated with yield as might be used to improve the yield and seed quality and quality parameters.

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