

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

Comment [U1]: 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, **T₀** Control (Unsoaking), **T₁** Soaking with tap water for 12hrs, **T₂** Soaking with tap water for 24hrs, **T₃** Soaking with *Bacillus Subtilis* for 12hrs, **T₄** Soaking with *Bacillus subtilis* for 24hrs, **T₅** Soaking with *Azotobacter* for 12hrs, **T₆** Soaking with *Azotobacter* for 24hrs, **T₇** Soaking with NaCl @1% for 12hrs, **T₈** Soaking NaCl @1% for 24hrs, **T₉** Soaking with ZnSo₄ @1% for 12hrs, **T₁₀** Soaking with ZnSo₄ @1% for 24hrs, **T₁₁** Soaking with GA₃ @(50ppm) for 12hrs, **T₁₂** Soaking with GA₃ @(50ppm) for 24hrs & **T₁₃** Soaking Auxin (IAA) @(50ppm) for 12hrs & **T₁₄** 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 hormonal 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 were GA₃@ (50ppm) for 12hrs on wheat variety K-1317 significantly present results the yield and quality of seed. The best results were found under the treatment **T₁₁** Soaking with GA₃ @(50ppm) for 12hrs, in productive tillers, number seeds/spike, number of spikelets/spikes, spike length, grain yield and harvest index, protein content in 2022-2023. and the at par treatments **T₁₀**, **T₁₂**, **T₁₃** and **T₁₄**.

Key Words: -Wheat crop, Auxin, GA₃ and *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 centre of 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 centre 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 **Avinashkarjuleet. al. (2019)**.

Wheat has relatively high content of niacin and thiamin which are principally concerned in providing the special protein called 'Gluten'. Wheat proteins are of special significance because *Gluten* provides the framework of spongy cellular texture of bread and baked products. 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 were 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)**.

Please add statement of the problem? Why you did this experiment? Also add your objective here_____?

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

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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, **T₀** Control (Unsoaking), **T₁** Soaking with tap water for 12hrs, **T₂** Soaking with tap water for 24hrs, **T₃** Soaking with Bacillus Subtilis for 12hrs, **T₄** Soaking with Bacillus subtilis for 24hrs, **T₅** Soaking with Azotobacter for 12hrs, **T₆** Soaking with Azotobacter for 24hrs, **T₇** Soaking with NaCl @1% for 12hrs, **T₈** Soaking NaCl @1% for 24hrs, **T₉** Soaking with ZnSo₄ @1% for 12hrs, **T₁₀** Soaking with ZnSo₄ @1% for 24hrs, **T₁₁** Soaking with GA₃ @(50ppm) for 12hrs, **T₁₂** Soaking with GA₃ @(50ppm) for 24hrs & **T₁₃** Soaking Auxin (IAA) @(50ppm) for 12hrs & **T₁₄** 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 hormonal 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 November in rabi season 2022-23 and 13 November in rabi season 2023-24 under rainfed conditions and apply the FYM @ 12 tons, 120kg N, 60kg P₂O₅ and 40 kg K per ha. There were 3 replications by using **RBD design** for field 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 was used for statistical analysis. The following field observations were 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 **T₀** (control). The critical analysis of data revealed that significant differences were observed among all treatments. Priming with (**T₁₁**) GA₃ @(50ppm) soaked for 12hrs has showed superior (284.33) on number of productive tillers followed by Priming with (**T₁₂**) GA₃ @(50ppm) soaked by 24hrs (283.50) and second followed by (**T₁₃**) 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 (**T₁₁**) GA₃ @(50ppm) soaked for 12hrs and priming with (**T₁₂**) 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 **T₃** CG2006 was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield, **Gayatri et.al., (2022) & Avinashkarjuleet. al., (2019).**

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3.2.Number of seeds spike⁻¹:

Overall mean data presented in Table 1. reveal that all the treatments showed significant differences from T₀ (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T₁₁) GA3 @(50ppm) soaked for 12hrs has showed superior (44.65) on number of seeds per spike followed by Priming with (T₁₂) GA3 @(50ppm) soaked by 24hrs (44.53) and second followed by (T₁₃) IAA@ (50ppm) soaked for 12hrs (43.72) while the least number of seeds per spike was recorded in control (T₀) (39.38). From the analysis, it also perceptible that priming with (T₁₁) GA3 @(50ppm) soaked for 12hrs and priming with (T₁₂) 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 T₃ CG2006 was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield, **Gayatri et. al., (2022) &Avinashkarjuleet. 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 T₀ (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T₁₁) GA3 @(50ppm) soaked for 12hrs has showed superior (18.82) on number of spikelets per spike followed by Priming with (T₁₂) GA3 @(50ppm) soaked by 24hrs (18.27) and second followed by (T₁₃) IAA@ (50ppm) soaked for 12hrs (117.80) while the least number of spikelet's per spike was recorded in control (T₀) (14.67). From the analysis, it also perceptible that priming with (T₁₁) GA3 @(50ppm) soaked for 12hrs and priming with (T₁₂) 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) &Avinashkarjuleet. al., (2019).**

3.4.Spike length (cm):

Overall mean data presented in Table 1. reveal that all the treatments showed significant differences from T₀ (control). The critical analysis of data revealed that significant differences were observe among all treatments. Priming with (T₁₁) GA3 @(50ppm) soaked for 12hrs has showed superior (11.33) on spike length followed by Priming with (T₁₂) GA3 @(50ppm) soaked by 24hrs (11.05) and second followed by (T₁₃) IAA@ (50ppm) soaked for 12hrs (10.13) while the least spike length was recorded in control (T₀) (8.00). From the analysis, it also perceptible that priming with (T₁₁) GA3 @(50ppm) soaked for 12hrs and priming with (T₁₂) 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 T₃ CG2006 was recorded,

which performed well in plant height, spike length, number of seeds per spike, and grain yield, Gayatri *et. al.*,(2022)&Avinashkarjule*et. al.*, (2019).

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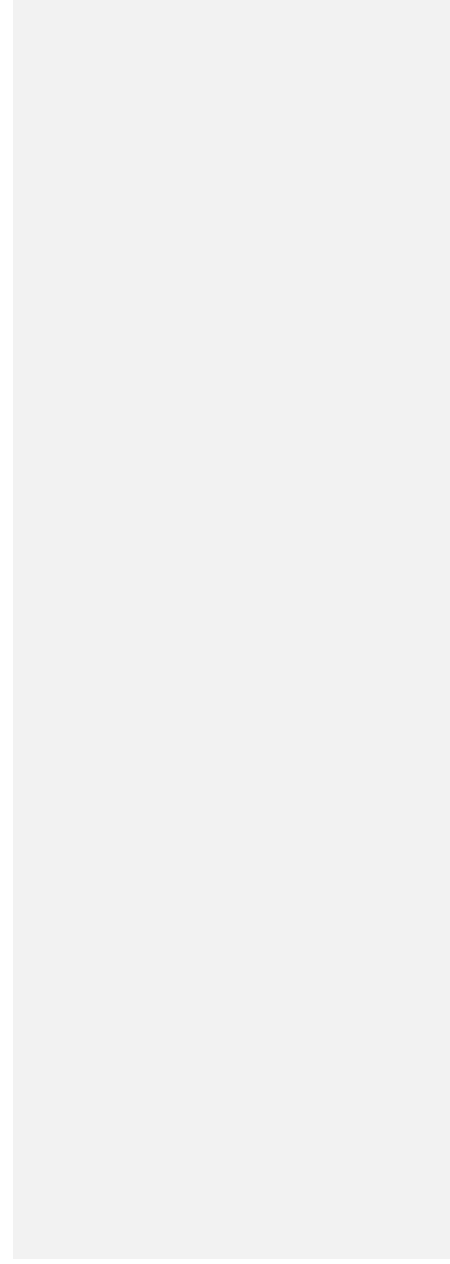
Table No. 1. Effect of seed priming treatments on Number of productive tillers per square meter, Number of seeds spike⁻¹ Number of spikelet's per spike and Spike length (cm) in Wheat variety K-1317 under rainfed Condition.

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

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3.5. Grain yield kg/hac:

Overall mean data presented in Table 1 reveal that all the treatments showed significant differences from T₀ (control). The critical analysis of data revealed that significant differences were observed among all treatments. Priming with (T₁₁) GA₃ @ (50ppm) soaked for 12hrs has showed superior (5104.88) on grain yield kg /hac. followed by Priming with (T₁₂) GA₃ @ (50ppm) soaked by 24hrs (4998.98) and second followed by (T₁₃) IAA@ (50ppm) soaked for 12hrs (4889.56) while the least grain yield kg/hac. was recorded in control (T₀) (4199.56). From the analysis, it is also perceptible that priming with (T₁₁) GA₃ @ (50ppm) soaked for 12hrs and priming with (T₁₂) GA₃ @ (50ppm) soaked by 24hrs increased the number of productive tillers by 9.05 and 7.99 respectively over control. The 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 T₃ CG2006 was recorded, which performed well in plant height, spike length, number of seeds per spike, and grain yield, **Gayatri et al., (2022)** & **Avinashkarjuleet. al., (2019)**.

3.6. Harvest index:

Overall mean data presented in Table 2. reveal that all the treatments showed significant differences from T₀ (control). The critical analysis of data revealed that significant differences were observed among all treatments. Priming with (T₁₁) GA₃ @ (50ppm) soaked for 12hrs has showed superior (46.24) on harvest index followed by Priming with (T₁₂) GA₃ @ (50ppm) soaked by 24hrs (44.80) and second followed by (T₁₄) IAA@ (50ppm) soaked for 24hrs (43.26) while the least harvest index was recorded in control (T₀) (35.47). From the analysis, it is also perceptible that priming with (T₁₁) GA₃ @ (50ppm) soaked for 12hrs and priming with (T₁₂) GA₃ @ (50ppm) soaked by 24hrs increased the number of productive tillers by 10.77 and 8.79 respectively over control. The similar findings, it can be affirmed that the (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 and harvest index & **Avinashkarjuleet. al., (2019)**.

3.7. Protein content (%):

Overall mean data presented in Table 2. reveal that all the treatments showed significant differences from T₀ (control). The critical analysis of data revealed that significant differences were observed among all treatments. Priming with (T₁₁) GA₃ @ (50ppm) soaked for 12hrs has showed superior (42.81) protein content followed by Priming with (T₁₂) GA₃ @ (50ppm) soaked by 24hrs (42.09) and second followed by (T₁₃) Auxin (IAA) @ (50ppm) soaked for 12hrs (41.63) while the least protein content was recorded in control (T₀) (38.06). From the analysis, it is also perceptible that priming with (T₁₁) GA₃ @ (50ppm) soaked for 12hrs and priming with (T₁₂) GA₃ @ (50ppm) soaked for 24hrs increased the number of productive tillers by 4.75 and 4.03 respectively over control. The 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)** & **Avinashkarjuleet. 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).**

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Table No. 2. C Grain Yield, Harvest index and Protein content in Wheat variety K-1317 under rainfed condition.

Treatments	Grain Yield kg /ha.c.			Harvest index			Protein content (%)		
	2022-23	2023-24	pooled	2022-23	2023-24	pooled	2022-23	2023-24	pooled
T₀ Control	4,142.89	4,199.56	4171.22	35.05	35.88	35.47	10.20	10.29	10.25
T₁ Tap water (12hrs)	4,309.00	4,309.21	4309.11	36.30	36.50	36.40	10.34	10.39	10.37
T₂ Tap water (24hrs)	4,221.01	4,148.98	4184.99	35.98	36.20	36.09	10.09	10.20	10.14
T₃ Bacillus subtilis (12hrs)	4,685.40	4,756.26	4720.83	41.87	42.57	42.22	11.32	11.57	11.44
T₄ Bacillus subtilis (24hrs)	4,659.68	4,731.11	4695.39	40.15	40.89	40.52	11.32	11.52	11.42
T₅ Azotobacter (12hrs)	4,498.56	4,593.25	4545.90	38.97	39.57	39.27	10.68	10.74	10.71
T₆ Azotobacter (24hrs)	4,435.56	4,489.25	4462.41	38.57	38.97	38.77	10.30	10.54	10.42
T₇ NaCl2 @2.5% (12hrs)	4,375.40	4,456.89	4416.14	36.99	37.58	37.28	10.19	10.38	10.28
T₈ NaCl2 @2.5% (24hrs)	4,286.85	4,302.79	4294.82	36.76	36.98	36.87	10.37	10.35	10.36
T₉ ZnSo4 @2.5%(12hrs)	4,861.82	4,856.56	4859.19	41.98	42.35	42.16	10.45	10.67	10.56
T₁₀ ZnSo4 2.5% (24hrs)	4,742.56	4,800.23	4771.40	40.79	41.86	41.33	10.32	10.51	10.42
T₁₁ GA3 @50ppm (2hrs)	5,077.16	5,104.88	5091.02	45.89	46.59	46.24	11.33	11.41	11.37
T₁₂ GA3 @50ppm (24hrs)	4,941.16	4,998.98	4970.07	44.57	45.02	44.80	11.30	11.37	11.33
T₁₃ IAA @50ppm (12hrs)	4,849.56	4,889.56	4869.56	42.88	43.21	43.05	10.35	10.53	10.44
T₁₄ 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

Comment [U7]: Use caption modify the title of the table as follow "Effect of seed priming treatments on seed yield and related attributes of Bread wheat"

Summary and conclusion

Seed priming with GA₃ also showed significant improvement over unprimed seeds for the best result found treatment T₁₁ in Number of productive tillers/ plot, number of seeds/spike, number of spikelets/spike, spike length, 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.

Comment [U8]: Please add interpretation, what is your recommendation put it clearly and also what was the limitation of the study?

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