

Influence of seed priming treatments on plant growth parameters of Barley (*Hordeum vulgare* L.)

Abstract

The effects of different seed priming treatments, namely tap water, KNO₃ @ 2.5%, Thiourea @ 1000 ppm, CaCl₂ @ 2%, NaCl₂ @ 2%, ZnSO₄ @ 1%, KH₂PO₄ @ 1% and Salicylic acid @ 100 ppm solutions, on plant growth parameters of Barley cv. K-1055 and K-409 in Factorial Randomized Block Design with three replications were investigated during Rabi 2022-23 and 2023-24 at Chandra Shekhar Azad University of Agriculture & Technology, Kanpur. Analysis of variance revealed that the plant growth parameters were significantly affected by various seed priming treatments. Priming with Thiourea @ 1000 ppm significantly increased the plant growth parameters.

Key words:- Barley, Priming, Thiourea, Plant growth parameters

Introduction

Barley (*Hordeum vulgare*L.) is a versatile cereal grain worldwide, ranking fourth in acreage and production after wheat, rice and maize (USDA 2023). Barley belongs to the grass family Poaceae, tribe *Triticeae* and genus *Hordeum*, comprising nearly 350 species. *Hordeum* consists of about 32 species, including wild and cultivated ones. Barley is a diploid with 2n=14 chromosomes.

The production of barley worldwide was estimated at around 142.22 million metric tons. Globally, the top barley-producing countries are Russia, Australia, Canada and the United Kingdom. Russia shares 13% of the world's total barley production, with an area 9 million hectares and a production of 19.03 million metric tons. Australia shares 8% of world's total barley production, with an area of 3.2 million hectares and production of 11.5 million metric tons. Canada shares 6% of world's total barley production, with an area of 2.7 million hectares and production of 9.6 million metric tons (USDA 2023). Nowadays, barley accounts for 15 percent of world coarse grains in use. Approximately 70 % of barley grown worldwide is utilized for animal feed, 20 % for malting, and 5 % for direct human food consumption (FAO 2020). Nearly all temperate

regions of the world cultivate barley as an important industrial crop, including North Africa, Europe, South and North America, Asia and Australia. The area under barley cultivation in India is approximately 0.62 million hectares, with an annual production of 1.9 million metric tons (USDA 2023). Barley is mostly farmed in the northern plains of India, specifically in Uttar Pradesh, Rajasthan, Madhya Pradesh, Haryana and Punjab.

Barley grains have smothering and cooling properties that facilitate easy digestion. Barley is a healthy grain that has several advantages. It is an excellent source of minerals, vitamins, and dietary fiber. Barley, which is high in antioxidants, may help decrease cholesterol and promote heart health (Bartlomiej, S *et al.* 2012). It is also appropriate for managing diabetes it has a lower glycemic index than certain other grains and provides important amino acids (Thondre, P. S., and Henry., C. J.K. 2009).

Strategies for improving the growth and development of crop species have been investigated for many years. Seed priming is a pre-sowing procedure that creates a physiological condition that is more favorable for successful seed germination. Before the radical protrudes, seed priming regulates

hydration, which initiates the regular metabolic process during the early stages of germination (Johnson and Puthur, 2021).

One study by E L Tayeb (2006) investigated the effect of thiourea priming on barley seeds under high-temperature stress. The results indicated that thiourea priming significantly improved the germination percentage, seedling growth and physiological attributes of barley under high-temperature conditions. Thiourea enhances growth in many plant species irrespective of the growth stage at which it is applied. Thiourea has long been known to break innate or environmentally imposed seed and bud dormancy (Patadeet al. 2020).

Materials and methods

The experiment was carried out to determine the effect of various seed priming treatments on Barley yield attributes, seed yield and economic returns during the Rabi (winter) season in 2022-23 and 2023-24 at the Students Instructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, U.P. The experiment was comprised of two Barley cultivars viz, cv. K-409 (V₁) and K-1055(V₂) with seed rate 100 kg ha⁻¹. Both varieties were primed with control (T₀), tap water(T₁), KNO₃ @ 2.5% (T₂), Thiourea 1000 @ ppm(T₃), CaCl₂@ 2%(T₄), NaCl₂@ 2%(T₅), ZnSO₄@ 1%(T₆), KH₂PO₄@ 1% (T₇), Salicylic acid @ 100 ppm(T₈) solutions. The crop was sown in the second fortnight of November, 2022-23 and 2023-24. Full doses of P and K, along with one-third of N, were applied as a basal dose at the time of sowing using inorganic sources of nutrients, such as DAP, MOP and Urea respectively. The remaining two-thirds of N were applied in two equal splits doses. Individual data from the various plant growth parameters studied in the experiment were statistically analyzed. The standard error of the mean, a critical difference (C.D.) at 5% level of probability and coefficient of variance were calculated using standard procedures. The soil of the experimental plot was analyzed for its various physical and chemical characteristics in the Soil Testing Laboratory of the C. S. Azad University of Agriculture and Technology, Kanpur, in accordance with the accepted.

Results and Discussion

The data presented in the table revealed that both varieties of Barley when treated with various seed priming treatments, showed significant effects on plant growth parameters. The variety K-1055 scored more in the number of plant stands m⁻²(42.57), plant height (102.87cm), number of tiller plant⁻¹(8.02), number of ears m⁻²(239.97) as compared to the variety K-409 which may be due to differential response of variety and their genotype. Kaczmarek has reported similar results, Met al. (2017), Tahira tabassum et al. (2018) and Kurubaret al. (2021) in Barley.

Pooled data of priming treatments also presented in Table 1 to table-5 revealed that among the priming treatments, priming with thiourea @ 1000 ppm (T₃) was significantly superior in terms of the number of plant stands m⁻²(43.83) followed by hydropriming (T₂) and in terms of plant height (106.91cm), number of tiller plant⁻¹(8.60) and number of ears m⁻²(257.25) followed by priming with KNO₃ @ 2.5 % (T₂) while all the plant growth parameters were minimum in control(T₀). These results conform with Jalal et al. (2014) and Dhiman et al. (2022) in barley, Subedi et al.(2015) in rice. The interaction effect of varieties and treatments was presented in table-1 to table -5. Table revealed that the variety K-1055 and priming with Thiourea @ 1000 ppm (V₂×T₃) showed significant increased in plant height (108.74 cm), number of ears m⁻²(260.17), followed by variety K-1055 priming with KNO₃ @ 2.5 % (T₂) (V₂×T₂). The interaction effect of varieties and treatments showed non significant effect on number of plant stands m⁻² and number of tiller plant⁻¹ however maximum number of plant stands m⁻²(43.83) and number of tiller plant⁻¹(8.60) were observed in variety K-1055 priming with Thiourea @ 1000 ppm (V₂×T₃). The minimum plant stands m⁻², plant height, number of tiller plant⁻¹ number of ears m⁻² were observed in variety K-409 in control (V₁×T₀). These results are in conformity with Patra et al. (2016) in wheat, Jalal et al. (2014) and Dhiman et al. (2022) in barley, Subedi et al.(2015) in rice.

Table 1- Effect of priming treatments for 6 hours on Plant Stand m² in Barley varieties K-409 and K-1055

Treatments	2022-23			2023-24			Pooled		
	V ₁	V ₂	Mean	V ₁	V ₂	Mean	V ₁	V ₂	Mean
T ₀	35.67	38.33	37.00	37.33	40.67	39.00	36.50	39.50	38.00
T ₁	39.67	43.33	41.50	42.33	45.33	43.83	41.00	44.33	42.67
T ₂	38.33	42.33	40.33	41.33	44.67	43.00	39.83	43.50	41.67
T ₃	41.33	44.33	42.83	43.33	46.33	44.83	42.33	45.33	43.83
T ₄	40.67	41.33	41.00	40.33	43.67	42.00	40.50	42.50	41.50
T ₅	37.33	40.33	38.83	39.33	42.33	40.83	38.33	41.33	39.83
T ₆	38.67	41.67	40.17	40.67	43.67	42.17	39.67	42.67	41.17
T ₇	37.67	40.67	39.17	39.67	42.67	41.17	38.67	41.67	40.17
T ₈	38.33	41.33	39.83	40.33	43.33	41.83	39.33	42.33	40.83
Mean	38.63	41.51	40.07	40.51	43.63	42.07	39.57	42.57	41.07
Factors	SE(d)	CD 5%		SE(d)	CD 5%		SE(d)	CD 5%	
V	0.19	0.39		0.20	0.41		0.20	0.40	
T	0.41	0.84		0.43	0.88		0.42	0.86	
V×T	0.58	1.19		0.61	NS		0.60	NS	
CV(%)	4.18			4.06			4.12		

Table 2- Effect of priming treatments for 6 hours on Plant height (cm) in Barley varieties K-409 and K-1055

Treatments	2022-23			2023-24			Pooled		
	V ₁	V ₂	Mean	V ₁	V ₂	Mean	V ₁	V ₂	Mean
T ₀	93.42	96.19	94.81	94.38	97.05	95.72	93.90	96.62	95.26
T ₁	94.38	97.31	95.84	95.66	98.17	96.91	95.02	97.74	96.38
T ₂	101.35	106.45	103.90	102.64	107.52	105.08	101.99	106.99	104.49
T ₃	104.46	108.55	106.50	105.71	108.94	107.32	105.08	108.74	106.91
T ₄	100.29	104.36	102.33	101.78	105.18	103.48	101.04	104.77	102.90
T ₅	98.54	101.41	99.97	100.36	102.47	101.42	99.45	101.94	100.69
T ₆	100.85	105.47	103.16	102.36	106.16	104.26	101.61	105.82	103.71
T ₇	99.19	103.27	101.23	100.42	104.35	102.39	99.81	103.81	101.81
T ₈	95.68	99.28	97.48	96.86	99.62	98.24	96.27	99.45	97.86
Mean	98.68	102.47	100.58	100.01	103.27	101.64	99.35	102.87	101.11
Factors	SE(d)	CD 5%		SE(d)	CD 5%		SE(d)	CD 5%	
V	0.038	0.078		0.11	0.23		0.07	0.15	
T	0.081	0.16		0.24	0.49		0.16	0.33	
V×T	0.11	0.23		0.34	0.70		0.23	0.47	
CV(%)	3.88			3.87			3.88		

Table 3- Effect of priming treatments for 6 hours on number of tiller plant⁻¹ in Barley varieties K-409 and K-1055

Treatments	2022-23			2023-24			Pooled		
	V ₁	V ₂	Mean	V ₁	V ₂	Mean	V ₁	V ₂	Mean
T ₀	6.67	6.93	6.80	6.93	7.27	7.10	6.80	7.10	6.95
T ₁	6.87	7.33	7.10	7.13	7.67	7.40	7.00	7.50	7.25
T ₂	7.93	8.27	8.10	8.27	8.80	8.53	8.10	8.53	8.32
T ₃	8.27	8.40	8.33	8.60	9.13	8.87	8.43	8.77	8.60
T ₄	7.40	7.73	7.57	7.73	8.60	8.17	7.57	8.17	7.87
T ₅	7.27	7.60	7.43	7.47	7.93	7.70	7.37	7.77	7.57
T ₆	7.87	8.13	8.00	8.13	8.27	8.20	8.00	8.20	8.10
T ₇	7.67	7.87	7.77	7.87	8.13	8.00	7.77	8.00	7.88
T ₈	7.73	8.07	7.90	8.07	8.20	8.13	7.90	8.13	8.02
Mean	7.52	7.81	7.67	7.80	8.22	8.01	7.66	8.02	7.84
Factors	SE(d)	CD 5%		SE(d)	CD 5%		SE(d)	CD 5%	
V	0.08	0.16		0.09	0.19		0.09	0.18	
T	0.17	0.34		0.20	0.41		0.19	0.38	
V×T	0.24	NS		0.29	NS		0.27	NS	
CV(%)	6.43			6.8			6.62		

Table 4 - Effect of priming treatments for 6 hours on number of ears m⁻² in Barley varieties K-409 and K-1055

Treatments	2022-23			2023-24			Pooled		
	V ₁	V ₂	Mean	V ₁	V ₂	Mean	V ₁	V ₂	Mean
T ₀	219.33	221.67	220.50	221.67	223.67	222.67	220.50	222.67	221.58
T ₁	223.33	226.33	224.83	227.33	229.33	228.33	225.33	227.83	226.58
T ₂	246.33	250.67	248.50	251.33	255.33	253.33	248.83	253.00	250.92
T ₃	250.33	257.67	254.00	258.33	262.67	260.50	254.33	260.17	257.25
T ₄	229.67	233.67	231.67	234.33	236.67	235.50	232.00	235.17	233.58
T ₅	225.33	228.67	227.00	229.67	231.33	230.50	227.50	230.00	228.75
T ₆	247.33	252.33	249.83	246.33	249.67	248.00	246.83	251.00	248.92
T ₇	230.67	232.67	231.67	233.67	236.33	235.00	232.17	234.50	233.33
T ₈	242.33	245.33	243.83	242.67	245.33	244.00	242.50	245.33	243.92
Mean	234.96	238.78	236.87	238.37	241.15	239.76	236.67	239.96	238.31
Factors	SE(d)	CD 5%		SE(d)	CD 5%		SE(d)	CD 5%	
V	0.12	0.24		0.14	0.28		0.13	0.26	
T	0.25	0.52		0.31	0.61		0.28	0.57	
V×T	0.36	0.74		0.42	0.86		0.39	0.80	
CV(%)	5.19			5.21			5.20		

Conclusion

. Based on the results of this study, it was determined that seed priming with 1000 ppm of Thiourea for six hours considerably improved the plant development characteristics of barley. Variety K-1055 outperformed the other varieties evaluated, suggesting that it may have use at the farmer level.

- Bartłomiej, S., Justyna, R. K., & Ewa, N. (2012).** Bioactive compounds in cereal grains—occurrence, structure, technological significance and nutritional benefits—a review. *Food science and technology international*, *18*(6), 559-568.
- Dhiman, K. C., Thakur, A., Kanwar, R., & Kapila, R. K. (2022).** Use of different seed priming tools to enhance the planting value and seed quality in barley. *Journal of Cereal Research*, *14*(3).
- El-Tayeb, M. A. (2006).** Differential response of sugar beet and barley genotypes to salt stress: growth, osmotic adjustment, and photosynthesis. *Acta Agriculturae Scandinavica, Soil & Plant Science*, 293–300.
- FAO** <https://www.fao.org> > ...PDF World Food and Agriculture - Statistical Yearbook 2020
<https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.fao.org/3/cb1329en/CB1329EN.pdf&ved=2ahUKEwjbGfKr5rWFAXWy8jgGHUjpBOEQFnoECBgQAQ&usg=AOvVaw1Z00sSDOMkz2eU4O3JmfJs>
- Jalal, J., Razieh, K., & Edris, K. (2014).** Improving of barley seedling growth by seed priming under water deficit stress. *Journal of Stress Physiology & Biochemistry*, *10*(2), 125-134.
- Johnson, R., & Puthur, J. T. (2021).** Seed priming as a cost effective technique for developing plants with cross tolerance to salinity stress. *Plant Physiology and Biochemistry*, *162*, 247257.
- Kaczmarek, M., Fedorowicz-Strońska, O., Glowacka, K., Waśkiewicz, A., & Sadowski, J. (2017).** CaCl₂ treatment improves drought stress tolerance in barley (*Hordeum vulgare* L.). *Acta Physiologiae Plantarum*, *39*, 1-11.
- Kurubar, S. A., Bhuker, A., & Kumar, Y. (2021).** Effect of priming and storage containers on seed quality of barley (*Hordeum vulgare* L.). *Journal of Cereal Research 13 (Spl-1)*: 67-76. <http://doi.org/10.25174/2582-2675/2021,114866>.
- Patade, V. Y., Nikalje, G. C., & Srivastava, S. (2020).** Role of thiourea in mitigating different environmental stresses in plants. *Protective chemical agents in the amelioration of plant abiotic stress: biochemical and molecular perspectives*, 467-482.
- Patra, S.S., Mehera, B., Rout, S., Tomar, S.S., Singh, M. and Kumar, R. (2016).** Effect of hydropriming and different sowing dates on growth and yield attributes of wheat (*Triticum aestivum* L.). *Journal of Applied and Natural Science*. *8* (2): 971-980
- Subedi, R., Maharjan, B.K. and Adhikari, R. (2015).** Effect of different priming methods in rice (*Oryza sativa*), *Journal of Agriculture and Environment*. *16*: 156-160.
- Tahira Tabassum, T. T., Riaz Ahmad, R. A., Muhammad Farooq, M. F., & Basra, S. M. A. (2018).** Improving the drought tolerance in barley by osmopriming and biopriming.
- Thondre, P. S., & Henry, C. J. K. (2009).** High-molecular-weight barley β-glucan in chapatis (unleavened Indian flatbread) lowers glycemic index. *Nutrition Research*, *29*(7), 480-486.
- USDA Barley Production** Foreign Agricultural Service
<https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://fas.usda>

ov/data/production/commodity/0430000&ved=2ahUKEwiJ18HQ4bWFAxUV7jgGHcXPA08

QFnoECA4QBQ&usg=AOvVaw3engcjmo160gDcNqqlojMj