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INTERACTIVE FEFFECT OF LIGHT INTENSITY AND HYDRO- AND HALO-PRIMING, USING SOME K- AND Mg-SALTS, ON FLORAL ATTRIBUTES AND PRODUCTIVITY OF TWO GENOTYPES OF WHEAT (*Triticum aestivum* L.)

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ABSTRACT

Seed priming cause invigoration of seeds in this process the seed grains are allowed to soak moisture till a period before protrusion of radicle (safe limit). When soaking medium is water it is called hydropriming and when salt solutions is used it called halopriming. In priming, the seeds are dried back to original moisture content after soaking till safe limit. In present study, a comparative study on the effect of interaction of hydro- and halo-priming on two genotypes (WR-544 and DBW-187) of wheat were studied for impact on floral attributes and productivity. Distilled water was used for hydro-priming and 0.5, 1.0 and 1.5% of KCl, KH_2PO_4, $Mg(NO_3)_2$ and $MgSO_4$ salt solutions were used for hydro-priming. The study revealed that floral initiation took in just 43 days in 'WR-544' under 1.5% $Mg(NO_3)_2$ + 100% light treatment and 1.5% $MgSO_4$ + 50% light treatment; whereas it took place in 60 days under 1.0% KH_2PO_4 + 50% light treatment. In genotype 'DBW-187', flowering took place in 56 days under hydro-priming + 100% light as well as 50% light interacted with hydro-priming or halo-priming with 0.5% KCl. In genotype 'WR-544' the viable grains in 1.5% $Mg(NO_3)_2$ + 100% light treatment were 377. In both genotypes halo-priming improved productivity. In genotype WR-544, 388 spikelets were produced under 100% light + 1.5% $Mg(NO_3)_2$ treatment. The genotype WR-544 appeared better performer than DBW-187 under both priming conditions.

Keywords: Floral initiation, hydropriming, halopriming, interaction, spikelets, viable grains

INTRODUCTION

Wheat in India is generally grown during November-December as a *rabi* crop. It is a staple food crop which is not only grown in several states of India but also grown throughout Asian, African and several other countries. Wheat is used in several forms such as flour, maida, suji, roasted grain, sprouted grain, dalia and is used for preparing a variety of food items. Wheat production in Jharkhand and several other states in India is far below its consumption (Alam *et al.*, 2013; Sendhin *et al.*, 2014). In Jharkhand several production constraints *viz*., undulating and slopy land, hard rocky areas, water scarcity, acidic soils, low soil fertility, low agricultural input availability due to the prevailing poverty among farmers, etc. have contributed to the low crop production.

Seed priming with suitable techniques reportedly improves the seedling establishment, plant growth and productivity, salt and other stress tolerance and seed weight, etc. (Rathod *et al.*, 2016; Das *et al.*, 2022; Sarath *et al.*, 2022). Several workers have studied the impact of light intensities on various growth and productivity parameters in different plants (Raai *et al.*, 2020). But, scanty information is available on the interactive effect of seed priming and light intensities on the floral attributes and productivity in wheat or any other crops. In the process of priming, seed grains are partially hydrated so that pre-germination metabolic activities proceed, while the radicle protrusion is prevented (safe limit) and then the seed is dried back to the original moisture level. The present study was aimed to assess the effect of low cost priming techniques in association with appropriate light intensity on the floral attributes and productivity of two wheat genotypes under Jharkhand conditions of India.

MATERIALS AND METHODS

The seeds of two genotypes of wheat namely 'WR-544' and 'DBW-187' were selected out of the six wheat varieties on the basis their preliminary screening for performance with respect to the germination and early seedling growth when primed with variable salt solutions of KCl, KH_2SO_4, $MgSO_4$ and $Mg(NO_3)_2$. The seeds were procured from Birsa Agriculture University, Ranchi (India). The salt concentrations of 0.5% KCl, 1.0% KH_2PO_4, 1.5% $MgSO_4$ and 1.5% $Mg(NO_3)_2$ were considered for halo-priming in present study on the basis of comparatively better performance with respect to the above parameters.

The hydro-priming of seeds was done by soaking the seeds in distilled water; while for halo-priming wheat seeds were soaked in a specific concentration of a particular salt which varied from 5-8 h upto a safe limit. The unprimed seeds served as control. The earthen pots (20 cm high and 15 cm dia. at top) were filled with a mixture of powdered field soil, sandy soil and farm yard manure in 5:2:3 ratio (v/v). The unprimed, hydro-primed and halo-primed seeds of two wheat genotypes were sown in pots in November, 2019. The earthen pots were kept in open field under natural conditions at protected place for plant growth in a completely randomized block design. Five replicates for each treatment were maintained. One week after seed sowing the seedlings were thinned out to maintain one plant per earthen pot. The plants were watered regularly at four days interval to the field capacity with tap water till maturity. Full sunlight under natural conditions was considered 100% light (30,000 lux) intensity. For 70% light (21,000 lux) a mosquito net and for 50% light (15,000 lux) a muslin cloth, covered over iron frame of 2 m x 1 m x 1.5 m, were used. The pots were kept inside iron frame covered over by mosquito net (for 70% light) and muslin cloth (for 50% light). The pots were kept in open for measuring the effect of 100% light intensity on control, hydro-primed and halo-primed seeds for floral attributes and productivity.

The floral attributes were recorded and productivity was measured at harvest. The floral initiation was counted in days from the date of seed sowing to the date of appearance of 1st flower primordia. The number and length of spikes plant^{-1} and the number of viable and non-viable grains and their dry weights were measured after the full maturity of plants. The pots were kept in arranged groups under natural conditions and five replicates were taken for each measurement. The data was statistically analysed wherever required as per Evans (1972).

RESULTS AND DISCUSSION

The data on the appearance of 1st flower primordia in two test wheat genotypes 'WR-544' and 'DBW-187' under the effect of interaction of hydro-priming and halo-priming with 100, 70 and 50% light intensities are given in Table 1. The minimum duration of 43 days was recorded in treatment 100% light intensity + 1.5% $Mg(NO_3)_2$ halo-priming in genotype WR-544 which was similar to control. Similar result was observed when hydro-primed seeds and the seeds halo-primed with 1.5% $MgSO_4$

Table 1: Effect of hydro-and halo-priming with K- and Mg-salts under variable light intensities on the floral attributes of two wheat genotypes

Treatment → ↓ Light intensity (lux) Genotype ↓	Days of appearance of flower primodia after seed sowing					
	Control (Unprimed)	Hydro-priming	Halo-priming (salt conc.)			
			0.5% - KCl	1.0% - KH_2PO_4	1.5% - $MgSO_4$	1.5% - $Mg(NO_3)_2$
100% WR-544	43	45	45	46	47	43
DBW-187	56	56	57	58	64	63
70% WR-544	45	48	46	47	47	47
DBW-187	60	58	58	66	64	66
50% WR-544	44	43	44	60	43	44
DBW-187	57	56	56	65	58	58

100% light = 30,000 lux (kept in open natural condition); 70% light = 21,000 lux (kept inside mosquito net cover over iron frame); 50% light = 15,000 lux (kept inside muslin cloth cover iron frame)

under 50% light intensity condition. The genotype DBW-187 took a minimum of 56 days for the appearance of first flower primordia in control, hydro-priming + 100% light treatment and 0.5% KCl + 50% light intensity treatment. In genotype WR-544, 1.0% KH_2PO_4 interacted with 50% light caused delay in floral initiation (60 days). Maximum delay in floral initiation was observed in genotype DBW-187 wherein floral initiation took in 66 days in 1.0% KH_2PO_4 and 1.5% $Mg(NO_3)_2$ interacted with 70% light treatments. In almost all priming conditions, the appearance of first flower primordia in genotype 'WR-544' took lesser time than genotype 'DBW-187'. The findings are in consonance with those of Mazed *et al.* (2015) who reported significant variations in days of first flowering in chickpea among the seed primed with GA_3 interacted with hydro-priming. The present variation is in line with Bhateshwar *et al*. (2020) who reported almost similar observations in lentil in treatments hydro-priming and priming with onion extract.

Wheat genotype 'WR-544' yielded maximum number of spike plant^{-1} (11) in interaction of 1.5% $Mg(NO_3)_2$ and 100% light intensity (Table 2). The minimum number of spike plant^{-1} in genotype 'WR-544' was observed to be 4 in unprimed seeds and in 1.0% KH_2PO_4 as well as in 1.5% $MgSO_4$ interacted with 50% light treatments. In genotype 'DBW-187' the hydro-priming and halo-priming did not appear to favour the production of spikes. The plants of genotype 'WR-544' produced more spikes as compared to genotype 'DBW-187', except under unprimed condition interacted with 100% light. The number and length of spikes in a plant are important indicators of yield and productivity. The differences in response between the two varieties of wheat appear due to the genotypic differences. The response of genotype 'WR-544' as regards the production of spikes were similar to Jamshidian and Talat (2017) who reported an increase in umbels in coriander when the seeds were treated with hormonal priming with GA_3. Our findings are in conformity with Riadi *et al*. (2020) who reported improved panicle length in rice varieties seed-primed with NaCl and other salts. The genotype

Table 2: Effect of hydro-and halo-priming with K and Mg-salts under variable light intensities on floral attributes of two wheat genotypes

Treatment→ ↓ Light intensity Genotype ↓	Number of spike/plant					
	Control (Unprimed)	Hydro-priming	Halo-priming (salt conc.)			
			0.5% - KCl	1.0% - KH_2PO_4	1.5% - $MgSO_4$	1.5% - $Mg(NO_3)_2$
100% WR-544	6	8	5	6	7	11
DBW-187	7	5	4	3	3	4
70% WR-544	4	6	6	5	7	9
DBW-187	4	5	4	4	3	5
50% WR-544	4	5	5	4	4	6
DBW-187	4	4	3	3	3	5

Table 3: Effect of hydro-and halo-priming with K and Mg-salts under variable light intensities on floral attributes of two wheat genotypes

Treatment→ ↓ Light intensity Genotype ↓		Length of spike plant^{-1} (cm)					
		Control (unprimed)	Hydro-priming	Halo-priming (% salt conc.)			
				0.5% KCl	1.0% KH_2PO_4	1.5% $MgSO_4$	1.5% $Mg(NO_3)_2$
100%	WR-544	7.7	8.0	8.0	7.0	9.0	9.8
	DBW-187	8.8	8.3	7.5	8.0	8.3	7.2
70%	WR-544	7.5	8.0	8.0	8.1	8.0	8.7
	DBW-187	7.5	8.2	7.4	8.7	8.7	6.5
50%	WR-544	6.0	6.0	7.8	8.0	7.8	8.3
	DBW-187	6.8	7.1	7.6	7.6	6.8	5.8

'DBW-187' did not appear to be influenced by hydro- or halo-priming; whereas genotype 'WR-544' showed visible response in spike production in 1.5% $Mg(NO_3)_2$ under 100% light interaction.

The 1.5% $Mg(NO_3)_2$ treatment under 100% light intensity yielded maximum spike length (9.8 cm) while minimum spike length of 6.0 cm was found in unprimed and hydro-primed seeds in genotype 'WR-544' (Table 3). In DBW-187, the maximum spike length obtained was 8.80 cm in unprimed seeds at 100% light intensity, while minimum spike length (5.8 cm) was observed in 1.5% $Mg(NO_3)_2$ at 50% light intensity. The genotype 'WR-544' appeared to be a better performer as compared to genotype 'DBW-187' with respect to the spike growth. In genotype 'WR-544', 1% $Mg(NO_3)_2$ under 100% light interaction was able to allocate more photosynthate in its reproductive parts as compared to genotype 'DBW-187' which is evident from the spike number and length. However, hydro-priming appeared more favouring in genotype 'DBW-187' than genotype 'WR-544' under all the three light intensity conditions. The results were similar to Riadi *et al*. (2020) who reported improvement in panicle length of rice plants due to priming with NaCl and table salt.

The maximum viable grains (377) in genotype 'WR-544' were produced when the seeds were primed with 1.5% $Mg(NO_3)_2$ under 100% light intensity; while it was minimum (110) in hydro-primed seeds at 50% light intensity (Table 4). In genotype 'DBW-187', a maximum of 248 viable grains plant^{-1} was recorded in unprimed seeds in 100% light intensity which indicated that hydro- and halo-priming has no or little impact in genotype 'DBW-187' as regards to the production of viable grains. The observations in genotype 'WR-544' were in line with Tiwari *et.al. (*2014), Mazed *et al*. (2015), and Sowjany and Dutta (2020). As regards the total number of spikelets plant^{-1}, the genotype 'WR-544' exhibited maximum value of 388 in 1.5% $Mg(NO_3)_2$ + 100% light intensity treatment whereas in genotype 'DBW-187' the maximum production of spikelets of 268 was recorded under unprimed condition. Hydro- and halo-priming did not appear to benefit the plants of "DBW-187' in improving

Table 4: Effect of hydro-and halo-priming with K and Mg-salts under variable light intensities on floral attributes of two wheat genotypes

Treatment→ Genotypes ↓	Control (Unprimed)			Hydro-priming			Halopriming (Salt conc.)											
							0.5% - KCl			1.0%- KH_2PO_4			1.5%- $MgSO_4$			1.5%- $Mg(NO_3)_2$		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Number of filled (viable) grains plant^{-1}																		
WR-544	218	142	98	116	194	110	220	260	156	142	186	142	260	250	122	377	291	127
DBW-187	248	128	128	186	126	119	130	125	118	170	161	75	116	199	132	119	131	129
Number of unfilled (nonviable) grains plant^{-1}																		
WR-544	14	17	8	18	13	19	11	8	13	17	12	22	13	21	21	11	27	13
DBW-187	20	11	6	9	7	9	16	5	18	10	11	32	11	19	11	9	22	9
Total number of spikelets plant^{-1}																		
WR-544	232	159	106	134	207	129	231	268	169	159	198	164	273	271	143	388	318	140
DBW-187	268	139	134	195	133	128	146	130	136	180	172	107	127	218	143	128	153	138

A, B and C represent 100, 70 and 50% light intensities, respectively.

Table 5: Effect of hydro-and halo-priming with K and Mg-salts under variable light intensities on floral attributes of two wheat genotypes

Treatment→ ↓ Light intensity	Genotype ↓	Dry weight of 25 grains (mg)					
		Control (unprimed)	Hydro-priming	Halo-priming (% salt conc.)			
				0.5% KCl	1.0% KH_2PO_4	1.5% $MgSO_4$	1.5% $Mg(NO_3)_2$
100%	WR-544	1132 ± 3.12	1099 ± 3.67	1025 ± 3.54	1025 ± 3.54	901 ± 1.84	828 ± 2.19
	DBW-187	1021 ± 2.35	931 ± 1.31	906 ± 2.16	1121 ± 4.48	1007 ± 3.34	1055 ± 7.36
70%	WR-544	830 ± 5.94	870 ± 4.08	912 ± 3.39	918 ± 3.67	805 ± 3.09	1023 ± 3.75
	DBW-187	949 ± 3.18	1076 ± 2.16	873 ± 1.78	1047 ± 2.48	1063 ± 2.72	909 ± 1.48
50%	WR-544	949 ± 4.14	904 ± 2.25	1052 ± 4.16	921 ± 2.61	1046 ± 1.41	932 ± 3.27
	DBW-187	791 ± 1.35	803 ± 1.08	966 ± 1.25	1343 ± 1.55	919 ± 1.63	1022 ± 2.68

the spikelet production. The results of genotype 'WR-544' are in consonance with those of Yasmeen *et al*. (2013) and Rehman *et al*. (2015) who found increased grain yield when spring maize seeds were primed with salicylic acid, $CaCl_2$ and *Moringa* leaf extract. This may be attributed to the stimulated early seedling growth, better growth rate and increased seed capacity for grain filling, better utilization of water and nutrients due to better establishment of root system and greater translocation of biomass in plant grains in primed grains. The results of genotype 'DBW-187' were not in conformity with the earlier findings (Basu *et al.*, 2005), who found that hydro-priming had a little effect on grain yield on maize. The variation observed between two genotypes may be attributed to the genotypic differences. The plants differ in response to hydro- and halo-priming with respect to various growth, reproductive and yield attributes.

Conclusions: The wheat genotype 'WR-544' appeared more responsive to hydro- and halo-priming and the treatment caused remarkable improvement over unprimed seeds treatments. The wheat genotype ''DBW-187' was less responsive to hydro- and halo-priming and genotype 'WR-544' appeared to be a better performer as compared to the genotype 'DBW-187'

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