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Effect of different seed priming treatments on yield attributes of wheat (*Triticum aestivum*)

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ABSTRACT

The effect of different priming treatments were evaluated during 2015–16 and 2016–17 with two wheat (*Triticum aestivum* L.) varieties V_1: GW 496 and V_2: Lok 1. The seeds of both the varieties were primed with different priming treatments, viz. P_1, GA_3 (50 ppm); P_2, IAA (100 ppm); P_3, KNO_3 (3%); P_4, KCl (2%); P_5, *Tricoderma harzianum* @10 g/kg and P_6, *Tricoderma viride* @10 g/kg along with unprimed seeds as a control (P_7). The variety Lok 1 (V_2) showed positive response to different priming treatments and seeds of Lok 1 primed with KNO_3 (3%) 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 GA_3 (50 ppm) primed seeds which recorded at par values for almost all the seed yield attributes. The unprimed seeds of wheat variety GW 496 recoded significantly lower values for all the observed characters for both the experimental years.

Key words: Effective tillers, Field emergence, Harvest Index, Priming, Yield attributes

Wheat (*Triticum aestivum* L.) is the second most important crop in India next to rice and having a special significance on account of its utilization as food, feed and fodder. One of the main requirements of achieving the highest potential yield of crops is rapid and uniform germination in the field. This stage of growth is greatly influenced by environmental factors, especially temperature and soil moisture (Basra *et al.* 2004). Germination is one of the most sensitive stages in plant life cycle. For achieving the highest yield, rapid and uniform germination in the field is most essential. Farmer's faces moisture stress during early plant growth stages which were resulted in less plant population. Seed priming is one of the advanced methods for accelerating the germination by which, it is possible to increase the ability of seeds to germinate and to grow under moisture stress condition.

Priming improves root growth and water use efficiency as well as uniform germination in wide range of temperature. To break seed dormancy, better competition with weed by faster seedling growth and early maturity accompanying with higher grain yield in wheat and seed priming with different chemicals, bio agents is also very beneficial. In view of these aspects the experiment was conducted for evaluation of different priming treatments and varieties effect on yield attributes of wheat.

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MATERIALS AND METHODS

An experiment was conducted at research farm of Anand Agricultural University, Anand (Gujarat) during *rabi* seasons of 2015–16 and 2016–17 with two wheat varieties V_1: GW 496 and V_2: Lok 1. The object of determination of priming effects on yield attributes was evaluated by the seeds of both varieties primed with different priming treatments, viz. P_1, GA_3 (50 ppm) for 24 h; P_2, IAA (100 ppm); P_3, KNO_3 (3%); P_4, KCl (2%); P_5, *Tricoderma harzianum* @10 g/kg and P_6, *Tricoderma viride* @10 g/kg for 12 h at room temperature. The unprimed seeds were used as a control (T_7). The primed seeds were shade dried up to their original moisture content and sown in the field with four replications in split plot.

Statistical analysis: The results are illustrated as the means and standard deviation of four replications with pooled analysis. Statistical analyses were performed by two way analyses ANOVA with Factorial RBD design with the significance level set at $P < 0.05$. The dry soft software for Windows was used for statistical analyses.

RESULTS AND DISCUSSION

Among the varieties significantly higher field emergence (92.02%), (93.71%) and (92.87%), number of effective tillers (6.46), (6.71) and (6.59), spike length (10.75 cm), (11.45 cm) and (11.10 cm), seed yield per plant (11.16 g), (11.90 g) and (11.53 g), seed yield per plot (2.07 kg), (2.13 kg) and (2.10 kg) as well as higher harvest index (43.05), (44.08)

Table 1 Effect of different seed priming treatments on field emergence (%), numbers of effective tillers and spike length (cm) of wheat

Treatment	Field emergence (%)									Number of effective tillers									Length of spike (cm)								
	2015–16			2016–17			Pooled			2015–16			2016–17			Pooled			2015–16			2016–17			Pooled		
	Varieties			Varieties			Varieties			Varieties			Varieties			Varieties			Varieties			Varieties			Varieties		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
T1	93.33	95.25	94.29	93.59	95.79	94.69	93.46	95.52	94.49	5.55	7.35	6.45	5.65	7.60	6.63	5.60	7.48	6.54	11.51	11.68	11.59	12.28	12.41	12.35	11.89	12.05	11.97
T2	89.87	89.92	89.89	90.25	92.29	91.27	90.06	91.10	90.58	4.95	6.40	5.68	5.15	6.80	5.98	5.05	6.60	5.83	8.88	10.71	9.79	9.58	11.42	10.50	9.23	11.06	10.14
T3	95.13	96.96	96.04	95.92	96.42	96.17	95.52	96.69	96.10	5.70	7.55	6.63	6.05	7.75	6.90	5.88	7.65	6.76	12.26	12.29	12.28	12.88	12.99	12.93	12.57	12.64	12.60
T4	91.58	92.25	91.92	92.67	94.88	93.77	92.12	93.56	92.84	5.30	7.25	6.28	5.30	7.50	6.40	5.30	7.38	6.34	9.97	11.04	10.51	11.01	11.76	11.38	10.49	11.40	10.94
T5	90.29	91.29	90.79	91.54	94.50	93.02	90.92	92.90	91.91	5.05	7.00	6.03	5.15	7.35	6.25	5.10	7.18	6.14	9.03	10.94	9.98	9.72	11.68	10.70	9.37	11.31	10.34
T6	86.83	89.33	88.08	89.91	91.63	90.77	88.37	90.48	89.43	4.65	5.05	4.85	4.95	5.10	5.03	4.80	5.08	4.94	8.21	10.37	9.29	8.99	11.04	10.02	8.60	10.70	9.65
T7	80.17	89.17	84.67	80.63	90.50	85.56	80.40	89.83	85.12	4.50	4.65	4.58	4.90	4.85	4.88	4.70	4.75	4.73	8.18	8.22	8.20	8.93	9.00	8.97	8.56	8.61	8.58
Mean	89.60	92.02	90.81	90.64	93.71	92.18	90.12	92.87	91.49	5.10	6.46	5.78	5.31	6.71	6.01	5.20	6.59	5.89	9.72	10.75	10.23	10.50	11.45	10.98	10.11	11.10	10.61
	SEm ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*	
V	0.47	2.13		0.58	2.61		0.37	1.30		0.15	0.69		0.17	0.78		0.12	0.40		0.17	0.75		0.19	0.86		0.13	0.44	
T	0.98	2.80		0.98	2.82		0.69	1.95		0.19	0.55		0.20	0.56		0.14	0.38		0.31	0.88		0.31	0.90		0.22	0.62	
V × T	1.38	3.96		1.39	3.99		0.98	NS		0.27	0.77		0.28	0.79		0.19	0.54		0.44	1.25		0.44	1.27		0.31	NS	
CV %	3.04			3.02			3.03			9.34			9.20			9.27			8.52			8.04			8.27		

Varieties: V1: GW 496, V2: Lok 1. Priming treatments: T1: GA3 (50 ppm), T2: IAA (100 ppm), T3: KNO3 (3%), T4: KCl (2 %), T5: Tricoderma harzianum @10 g/kg, T6: Tricoderma viride @10 g/kg, T7: Control (without priming).

Table 2 Effect of different seed priming treatments on seed yield per plant (g), per plot (kg) and harvest index of wheat

Treatment	Seed yield per plant (g)									Seed yield per plot (kg)									Harvest index								
	2015–16			2016–17			Pooled			2015–16			2016–17			Pooled			2015–16			2016–17			Pooled		
	Varieties			Varieties			Varieties			Varieties			Varieties			Varieties			Varieties			Varieties			Varieties		
	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean	V1	V2	Mean
T1	9.32	11.73	10.53	10.38	12.76	11.57	9.80	12.20	11.00	2.12	2.22	2.17	2.25	2.33	2.29	2.18	2.27	2.23	42.92	45.40	44.16	43.38	46.06	44.72	43.15	45.73	44.44
T2	7.18	11.50	9.34	8.26	12.24	10.25	7.72	11.87	9.80	2.00	1.99	1.99	2.09	2.02	2.06	2.04	2.00	2.02	40.30	42.76	41.53	40.94	43.51	42.23	40.62	43.13	41.88
T3	10.13	12.94	11.53	11.02	13.55	12.29	10.58	13.25	11.91	2.26	2.40	2.33	2.34	2.45	2.39	2.30	2.44	2.37	43.57	47.08	45.32	44.77	48.25	46.51	44.17	47.66	45.92
T4	8.91	11.65	10.28	9.65	12.37	11.01	9.28	12.01	10.65	1.98	2.11	2.04	2.10	2.15	2.12	2.04	2.13	2.08	41.53	44.72	43.12	42.52	45.65	44.09	42.03	45.18	43.61
T5	7.31	11.62	9.46	8.48	12.30	10.39	7.89	11.96	9.93	2.03	2.02	2.02	2.06	2.07	2.06	2.04	2.04	2.04	40.91	44.15	42.53	41.83	45.73	43.78	41.37	44.94	43.16
T6	6.64	11.07	8.85	7.50	12.22	9.86	7.07	11.65	9.36	1.73	1.92	1.82	1.81	2.03	1.92	1.77	1.97	1.87	40.06	40.94	40.50	41.17	42.15	41.66	40.62	41.54	41.08
T7	6.47	7.68	7.07	7.45	7.85	7.65	6.96	7.76	7.36	0.93	1.82	1.37	1.07	1.85	1.46	1.00	1.83	1.42	36.33	39.95	38.14	37.22	41.01	39.11	36.77	40.48	38.63
Mean	7.98	11.16	9.57	8.96	11.90	10.43	8.47	11.53	10.00	1.86	2.07	1.97	1.96	2.13	2.04	1.91	2.10	2.00	41.31	43.05	42.19	42.23	44.08	43.16	41.77	43.57	42.67
	SEm ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*		*SEm* ±	*CD @ 5%*	
V	0.11	0.48		0.19	0.87		0.11	0.38		0.03	0.15		0.02	0.09		0.02	0.07		0.37	1.65		0.36	1.64		0.26	0.89	
T	0.35	1.00		0.27	0.77		0.22	0.62		0.07	0.20		0.07	0.20		0.05	0.14		0.82	2.35		0.80	2.28		0.57	1.61	
V × T	0.49	1.41		0.38	1.09		0.31	0.87		0.10	0.29		0.10	0.28		0.07	0.20		1.16	3.32		1.12	3.23		0.81	NS	
CV %	10.26			7.29			8.78			10.14			9.65			9.88			5.48			5.21			5.35		

Varieties: V1: GW 496, V2: Lok 1. Priming treatments: T1: GA3 (50 ppm), T2: IAA (100 ppm), T3: KNO3 (3%), T4: KCl (2 %), T5: Tricoderma harzianum @10 g/kg, T6: Tricoderma viride @10 g/kg, T7: Control (without priming).

and (43.57) were recorded by the variety Lok 1 for the year 2015–16, 2016–17 and in pooled analysis respectively as compared with GW 496 (Table 1,2). This indicates that the wheat variety Lok 1 is genetically superior over GW 496. Lowest yield attributes were observed in the variety GW 496 during both the experimental years.

The varietal differences in yield attributes in response to different priming treatments proved their yield potential variation. The distinguishing behavior of these varieties could be attributed to genotypic differences, diverse genetic makeup, and differential response to priming treatments and seed size which is positively correlated with seedling vigour (Cookson *et al.* 2001). Seed mass has a strong influence on seedling establishment. The varied varietal response to the different priming components was reported by Giri and Schillinger (2003). Genotypes with greater yield potential recorded higher biological yield and harvest index was mainly contributed to increased plant height, number of tillers per plant, spike length, seeds per spike and seed index values. The relation of seed size on yield attributes as well as differential response to the priming methods were also reported by Al-Qasem *et al.* (2011), Nik *et al.* (2011), Zareian *et al.* (2012), Keerio (2013) and Shahwani *et al.* (2014) in wheat crop.

Primed seeds grow faster with rapid and uniform emergence with better crop growth and net assimilation rate as well as proper dry matter partitioning which resulted in greater yield potential. The observations on yield attributes in wheat recorded significant variation indicated the influence of different seed priming treatments irrespective of varieties during both years and on pooled basis. The significantly higher yield attributing characters, viz. field emergence (96.04%), (96.17%) and (96.10%), number effective tillers (6.63), (6.90) and (6.76), spike length (12.28 cm), (12.93 cm) and (12.60 cm), seed yield per plant (11.53 g) , (12.29 g) and (11.91 g), seed yield per plot (2.33 kg), (2.39 kg) and (2.37 kg) as well as higher harvest index (45.32), (46.51) and (45.92) were recorded by the KNO_3 (3%) primed seeds for the year 2015–16, 2016–17 and pooled basis respectively followed by the seed priming with GA_3 (50 ppm) and recorded at par values for almost all the observed characters.

It was evident from the data that the field emergence and yield attributes of wheat were greatly influenced by combined effect of varieties and priming treatments during both the experimental years. The wheat variety Lok 1 seeds primed with KNO_3 (3%) recorded significantly higher field emergence (96.96%), (96.42%) and (96.69%), number of effective tillers (7.55), (7.75) and (7.65), spike length (12.29 cm), (12.99 cm) and (12.34 cm), seed yield per plant (12.94 g), (13.55 g) and (13.25 g), seed yield per plot (2.40 kg), (2.45 kg) and (2.44 kg) as well as significantly higher harvest index (47.08), (48.25) and (47.66) for the year 2015-16 and 2016-17 and in pooled analysis respectively. At par values were recorded in most of seed yield attributes by the wheat variety Lok 1 primed with GA_3 (50 ppm) during both the years and pooled data respectively. The seeds of wheat variety without any priming treatment (control) recorded the lowest yield attributes for the same experimental duration

The probable reason for higher field emergence and yield attributes of the primed seed might be completion of pre-germination metabolic activities which makes the seeds ready for radical protrusion. Priming could also activate the response of the antioxidant system, making the primed seeds more prepared for possible stresses (Kalpana *et al.* 2015 and Singh *et al.* 2017). Primed seeds recorded early plant establishment and faster vegetative growth. Timely completion of the tillering facilitate sufficient period for other developmental and reproductive stages of wheat. Potassium nitrate (KNO_3) is the most common known chemical for promoting seed germination. The absorbed nitrate (NO_3) are used in the metabolism of seed embryo through the enzyme nitrate reductase (NR) resulted in increased activity of total amylase and proteases in germinating seeds and exhibited improvement in proteins, free amino acid and soluble sugars during germination ultimately stimulates faster growth. The presence of K^+ and NO_{3^-} ions played their beneficial role from the first phase, i.e. germination followed by seedling stand, consequently changed the phonological events like maximum tillering and better assimilate area. The positive correlation has been observed in number of effective tillers and seed yield. The higher leaf area index facilitate higher conversion rate of radiant energy to photosynthates finally resulted in better grain yield (Ghobadi *et al.* 2012).

Higher values for yield attributes in GA_3 primed seeds might be attributed to improved photosynthetic activities, synthesis of hydrolytic enzymes and improved the growth criteria (Shaddad *et al.* 2013). GA_3 priming resulted in higher cell division and stimulates the mitotic activities at apical meristem which facilitate more canopy development (Mirshekari 2014) and also improves the photosynthetic pigment activity as well as chemical constituents like carbohydrates, proteins, amino acids and proline content. The higher seed weight, more seeds per spike, harvest index and higher seed yield with hormonal priming of GA_3 was also reported by Ulfat *et al.* (2017).

Among the wheat varieties, Lok 1 showed positive response to different priming treatments and recorded higher yield attributes. The seeds primed with KNO_3 (3%) for 12 h recorded significantly higher field emergence and yield attributes, viz. number of effective tillers, spike length, number seeds per spike, and seed yield per plant during both the years followed by seeds primed with GA_3 (50 ppm) for 24 h recorded at par values for almost all the seed yield attributes.

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