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Evaluation of phenological traits and grain growth rate to foliar applied boron thiourea doses on wheat varieties at timely and late sown conditions

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Abstract
Two years field experiment in rabi season 2013-14 and 2014-15 designed in split-split plot design within three replication to effect of foliar applied boron (T_1- 0.2%, T_2- 0.5%) and thiourea (T_3- 500ppm, T_4- 1000ppm) with control T_0- water spray in sub-sub plot on four varieties (V_1: K- 607, V_2: K-402, V_3: K-7903, V_4: K-9533) in subplot in two sowing dates (D_1- Timely sowing, D_2- Late sowing) in main plot at Experimental Research Farm, Nawabganj of Chandra Shekhar Azad University of Agriculture and Technology Kanpur, India. By this total treatment were 40. The results showed that effect of used treatments with variety in sowing date and these combinations were in days to 75% heading, days to 75% anthesis and days to 75% maturity (T_3- 74.1, 80.5, 117.7; V_1- 75.8, 82.4, 122.0; D_1-76.1, 82.9, 122.1; D_1V_2- 78.4, 86.4, 126.5 as well as grain growth rate were significant in T_2- 14.5, V_2- 14.1, D_1- 14.6, D_1V_2- 15.5, D_1T_2- 15.7, V_2T_2- 15.1, $D_1V_2T_2$-16.5 against control (T_0). We can say by above results that all observations were found mostly high significant in sowing season 213-14.

Keywords: Days to 75% heading, days to 75% and thesis, and days to 75% maturity, grain growth rate, boron (0.2% and 0.5%), thiourea (500ppm and 1000ppm).

1. Introduction
Wheat [*Triticum aestivum* L.] is one of the most important cereal crops of the world. Bread wheat is an allohexaploid (2n = 42) and the major staple food source for a large part of global population. Wheat is a long day crop and requires relatively low temperature and photoperiod play a key role in determining duration of different phenophases, which affect the vegetative and reproductive development and yield (Slefer and Rawson 1994) [17]. The major effects of high temperature on the vegetative stage of crop leading damage to components of leaf, photosynthesis, reducing carbon dioxide assimilation rates compared with environment having more optimal temperature. Higher temperature (>28^{0}C) during grain development is the single most important factor that limits productivity of wheat in India. Due to intensive cropping system farmers by and large delay wheat sowing, particularly, in wheat grown belt of northern India which ultimately results in exposure of plants to extreme high temperature. This increased temperature hastens the phenological development of crop, reduces total duration of crop growth, grain filling and finally lowering the grain yield and its quality (Wang *et al.* 1992) [22]. In 1923, it was first time reported that Boron is essential for cell structure of plants (Warington, 1923) [24]. Boron is essential in trace amounts. The systems of boron deficiency in plants are variable for different species of plants. The growth of pollen tube requires boron in sufficient amounts as the length of pollen tube is also affected by external boron supply which usually provided by the stigma. Boron is absorbed by roots as un-dissociated boric acid [$B(OH)_3$ or H_3BO_3], among the elements required by plants that are taken up from the soil, Boron is the only element that is taken up by plants not as an iron, but as an uncharged molecule (Marschner, 1995). Thiourea (TU) derivatives have a long history as a legend in coordination chemistry and coordinate to a metal via both sulphur and oxygen (Burrows *et al.* 1999) [5]. These hard and soft donor atoms provide a multitude of bonding possibilities (Hederson *et al.*, 2002) [7]. Hydrogen bonding behaviours of some thioureas have been investigated and it is found that the intermolecular hydrogen bond between the sulphur and a hydrogen atom on N is common (Arslan *et al.*, 2006) [1].

Materials and Methods
To find out the results of foliar applied boron and thiourea doses at tillering and booting stages on days to 75% heading, days to 75% anthesis and days to 75% maturity and grain

growth rate of four varieties in two sowing dates. In Rabi season 2013-14 and 2014-15, two field experiments was laid out in split-split plot design in it two sowing date (D_1- Timely sowing: 21 November and D_2- Late sowing: 23 December) put in main plot, four varieties (V_1: K-607, V_2: K402, V_3: K-7903 and V_4: K-9533) put in sub plot and five treatments boron (T_1- 0.2% and T_2- 0.5%) and thiourea (T_3-500ppm and T_4- 1000ppm) with T_0- control in sub-sub plot and their combinations were sowing dates and variety (DxV), sowing dates and treatment (DxT), variety and treatment (VxT), sowing date and variety and treatment (DxVxT), so total combinations were 40 in these experiments. This experiment was conducted at experimental Research Farm, Nawabganj of Chandra Shekhar Azad University of Agriculture and Technology Kanpur, India. Geographically Kanpur is located of 26.30^0 N Longitude of 80.15^0 E and above 127 meters sea level. It lies in the sub-tropical regions where wheat is grown in the Rabi seasons. During experimentations, temperature was cool during vegetative growth while it was hot during grain filling stages in both years of experimentations. The soil of experimental plot was sandy loam of medium fertility and neutral pH and plot size was 3.0 x 1.38 m^2 in both seasons. A total dose of 150 kg/ha Nitrogen, 80 kg/ha Phosphorus and 60 kg/ha Potash, through urea, single super phosphate (SSP) and murate of potash (MOP) were used in the experiment. Half does of nitrogen, total Phosphorus and Potash were given as basal dose before sowing of seed; remaining half dose of nitrogen was given in two equal split doses, one at tillering and other at the time of spike initiation. Days to 75% heading: Number of days to 75% heading under each treatment was assessed by counting the number of days taken from sowing to the day when 75% plants show ear emergence. Days to 75% Anthesis: Number of days to 75% anthesis under treatment was assessed by the counting the number of days taken from sowing to the days when 75 plants show anthers emergence. It is also termed as days to 75% heading. Days to 75% Maturity: The maturity duration of the crop for each treatment was assessed by visual appearance of grains and color of leaves. The crop is mature when stem and leaf become yellowish and the other leaves too has lost its green chlorophyll colour and have turned brown. Number of days to 75% maturity under treatment was assessed by the counting the number of days taken from sowing to the days when 75 plants show maturating character. It is also termed as days to 75% maturity. Grain Growth Rate (g m^{-2} day^{-1}): The fresh weight of 10 grains collected from central spikeletes of spikes of tagged plants was taken and similarly their dry weight was measured after keeping them at 60^0 C for 24 hrs and expressed as mg/grain/day. It was taken time interval after anthesis. The value of grain growth rate was calculated as; Grain growth rate= Grain Yield/ Grain filling duration.

Results and discussion

Days to 75% Heading

The data regarding on days to 75% heading as presented in Table No.1 revealed that days to heading affected by sowing dates, varieties, foliar spray of boron, thio-urea and their interactions.

Table 1: Effect of foliar applied boron and thio-urea on Days to 75% heading of wheat cultivars under timely and late sown condition:

Treat.		2013-14							2014-15						
		V_1	V_2	V_3		V_4	Mean		V_1	V_2	V_3		V_4	Mean	
D_1		77.8	78.4	71.5		76.6	76.1		76.4	77.1	69.2		75.2	74.5	
D_2		73.8	72.9	64.7		66.8	69.6		71.8	70.1	62.4		64.4	67.2	
Mean		75.8	75.6	68.1		71.7			74.1	73.6	65.8		69.8		
Treat.		T_0	T_1	T_2	T_3	T_4	Mean		T_0	T_1	T_2	T_3	T_4	Mean	
D_1		75.1	75.7	76.5	77.4	75.7	76.1		72.8	74.2	75.2	75.9	74.3	74.5	
D_2		68.2	69.1	70.0	70.9	69.5	69.6		65.5	66.5	67.6	68.8	67.3	67.2	
Mean		71.6	72.4	73.3	74.1	72.6			69.2	70.4	71.4	72.3	70.8		
V_1		74.6	75.1	75.8	77.2	76.3	75.8		72.5	73.5	74.5	75.6	74.5	74.1	
V_2		74.1	75.5	76.1	77.0	75.5	75.6		72.1	73.1	74.3	74.8	73.6	73.6	
V_3		67.0	67.8	68.6	69.5	67.6	68.1		64.1	65.5	66.5	67.5	65.6	65.8	
V_4		70.8	71.3	72.6	72.8	71.1	71.7		68.0	69.5	70.5	71.5	69.5	69.8	
Mean		71.6	72.4	73.3	74.1	72.6			69.2	70.4	71.4	72.3	70.8		
Treat.		T_0	T_1	T_2		T_3	T_4		T_0	T_1	T_2		T_3	T_4	
D_1	V_1	77.0	77.3	77.6		79.2	77.6		75.0	76.0	77.0		78.0	76.3	
	V_2	77.3	78.6	79.0		79.3	78.0		76.0	77.0	78.0		77.6	77.0	
	V_3	70.3	71.0	72.0		73.0	71.3		67.3	69.0	70.0		71.0	69.0	
	V_4	75.6	76.0	77.6		78.0	76.0		73.0	75.0	76.0		77.0	75.0	
D_2	V_1	72.3	73.0	74.0		75.0	75.0		70.0	71.0	72.0		73.3	72.7	
	V_2	71.0	72.3	73.3		75.0	73.0		68.3	69.3	70.6		72.0	70.3	
	V_3	63.6	64.6	65.3		66.0	64.0		61.0	62.0	63.0		64.0	62.3	
	V_4	66.0	66.6	67.6		67.7	66.3		63.0	64.0	65.0		66.0	64.0	
Factors		D	V	D*V	T	D*T	V*T	D*V*T	D	V	D*V	T	D*T	V*T	D*V*T
SE(d)		0.3	0.3	0.4	0.2	0.3	0.4	0.5	0.2	0.3	0.5	0.1	0.2	0.3	0.4
C.D. at 5%		1.2	0.7	1.0	0.4	NS	NS	NS	0.8	0.7	1.0	0.3	NS	NS	0.8

Effect of sowing dates

Since, both experimental years timely sowing dates *i.e.,* D_1 (76.1 and 74.5 days) counted significantly maximum days to heading as compared to late sowing date *i.e.,* D_2 (69.6 and 67.2 days).

Effect of varieties

The wheat varieties V_1 *i.e.,* 75.8 and 74.1 days at par with V_2 *i.e.,* 75.6 and 73.6 days followed by V_4 *i.e.,* 71.7 and 69.8 days took significantly higher days to 75 % heading while, lowest days to 75 % heading was counted in V_3 *i.e.,* 68.1 and 65.8 days with both years of experimentation.

Effect of treatment

Among the treatments, significantly more mean value of days to 75 % heading found in treatment T_3 with 74.1 and 72.3 days at par with T_2 with 73.3 and 71.4 days followed by T_4

with 72.6 and 70.8, T_1 with 72.4 and 70.4 while, less in T_0 with 71.6 and 69.2 days for both corresponding years.

Interaction effect between sowing dates and varieties
The interaction effect of sowing dates and varieties was recorded significant effect for days to 75% heading for both years. The statistically maximum number of days to heading was in combination D_1V_2 (78.4 and 77.1 days) and combination D_1V_1 with 77.8 (year 2013-14) and 76.4 days at par in year 2014-15 followed by all other combinations as well as, minimum in combination D_2V_3 (64.7 and 62.4 days).

Interaction effect of sowing dates and treatments
Though, non-significant effect of days to heading indicated that interaction between sowing dates and treatments while, numerically more data of days to 75 % heading observed in combination D_1T_3 *i.e.,* 77.4 and 75.9 days and less in D_2T_0 *i.e.,* 68.2 and 65.5 days for both experimental years.

Interaction effect of varieties with treatments
The data of interaction effect of varieties and treatment was evolved non-significant on days to 75 % heading for both years of experimentation in (Table No.1) however, numerically highest days to 75 % heading counted in combination V_1T_3 with 77.2 and 75.6 while lowest in combination V_3T_0 with 67.0 and 64.1 days, respectively.

Interaction effect of sowing dates, varieties and treatments
In the first year, non-significantly higher value of interaction effect among sowing dates, varieties and treatments was showed in combination $D_1V_2T_3$ (79.3 days) and lower in $D_2V_3T_0$ (63.6 days). However, the second year significantly maximum value of days to 75 % heading elucidated in combination $D_1V_1T_3$ (78.0 days) at par with $D_1V_2T_3$ (77.6 days) followed by other combinations and minimum in combination $D_2V_3T_0$ (61.0 days).

Days to 75% Anthesis
The data evolved (Table 2) on the effect of foliar sprayed boron and thio-urea with four varieties in two sowing dates and their interaction for days to 75% anthesis:

Effect of sowing dates
It is visualized that the mean value of both experimental years of the sowing dates statistically influenced the days to 75% anthesis. The significantly higher mean value observed in D_1 *i.e.,* 82.9 and 80.8 days and lower in D_2 *i.e.,* 74.6 and 72.4 days to 75 % anthesis.

Effect of varieties
The effects of varieties on days to 75 % anthesis were found statistically significant. Among the varieties, V_1 was recorded significantly superior (82.4 and 80.4 days) at par with V_2 (81.9 and 79.7 days) followed by V_4 (77.7 and 75.4 days) and inferior in V_3 (73.2 and 71.0 days) during both years *i.e.,* 2013-14 and 2014-15, respectively.

Effect of treatments
The significantly maximum value on days to 75% anthesis counted in the treatment T_3 with 80.5 and 78.2 days as compared to treatment T_2 with 79.4 and 77.2 days and treatment T_4 with 78.5 and 76.4 days and treatment T_1 with 78.3 and 76.2 days to 75% anthesis for both yeas of experimentation as well as T_0 with 77.2 and 75.2 days was low in same years.

Interaction effect of sowing dates and varieties:
Statistically more value of sowing dates with varieties for days to 75% anthesis stated in combination D_1V_2 *i.e.,* 86.4 and 84.1 days meantime combination D_1V_1 for first year (85.4 days) but at par with second year (83.4 days) followed by other combinations. On the other hand, least in combination D_2V_3 *i.e.,* 69.0 and 66.6 days during both experimental years.

Interaction effect between sowing dates and treatments
Although, effect of sowing dates and treatments value did not probe significant for days to 75% anthesis during both years while numerically maximum value noted in the combination D_1T_3 with 84.7 and 82.5 days but minimum in the combination D_2T_0 with 73.0 and 71.0 days for same years of experimentation, respectively.

Interaction effect of varieties with treatments
Though, in the first year value between varieties and treatments was recorded non-significant but numerically maximum value was in the combination V_1T_3 (84.0 days) and minimum value in the combination V_3T_0 (71.5 days). On the other hands, statistically higher value for days to 75% anthesis noted also in the combination V_1T_3 (82.0 days) followed by V_2T_3 (81.3) compared to other combinations and lower in the combination V_3T_0 (69.5 days) during second year of experimentation.

Interaction effect among sowing dates, varieties and treatments
The data on the effect of sowing dates, varieties and treatments did not predicate statistically significant but numerically higher days to 75% anthesis was in the combination $D_1V_2T_3$ *i.e.,* 88.0 and 85.7 days as well as least in the combination $D_2V_3T_0$ *i.e.,* 67.0 and 65.0 days with both experimental years.

Table 2: Effect of foliar applied boron and thio-urea on Days to 75 % Anthesis of wheat cultivars under timely and late sown condition:

Treat.	2013-14						2014-15					
	V_1	V_2	V_3		V_4	Mean	V_1	V_2	V_3		V_4	Mean
D_1	85.4	86.4	77.4		82.6	82.9	83.4	84.1	75.4		80.5	80.8
D_2	79.5	77.4	69.0		72.7	74.6	77.4	75.4	66.6		70.4	72.4
Mean	82.4	81.9	73.2		77.7		80.4	79.7	71.0		75.4	
Treat.	T_0	T_1	T_2	T_3	T_4	Mean	T_0	T_1	T_2	T_3	T_4	Mean
D_1	81.5	82.5	83.5	84.7	82.5	82.9	79.4	80.4	81.4	82.5	80.5	80.8
D_2	73.0	74.2	75.3	76.2	74.5	74.6	71.0	72.0	73.0	74.0	72.3	72.4
Mean	77.2	78.3	79.4	80.5	78.5		75.2	76.2	77.2	78.2	76.4	
V_1	81.0	82.0	83.1	84.0	82.1	82.4	79.0	80.0	81.0	82.0	80.1	80.4
V_2	80.5	81.5	82.5	83.5	81.6	81.9	78.3	79.3	80.3	81.3	79.5	79.7
V_3	71.5	72.8	73.8	74.8	73.0	73.2	69.5	70.5	71.5	72.5	71.1	71.0

V_4		76.0	77.1	78.1	79.6	77.5	77.7	74.0	75.0	76.0	77.3	75.0	75.4		
Mean		77.2	78.3	79.4	80.5	78.5		75.2	76.2	77.2	78.2	76.4			
Treat.		T_0	T_1	T_2		T_3	T_4	T_0	T_1	T_2		T_3	T_4		
D_1	V_1	84.0	85.0	86.0		87.0	85.0	82.0	83.0	84.0		85.0	83.0		
	V_2	85.0	86.0	87.0		88.0	86.0	82.7	83.7	84.7		85.7	84.0		
	V_3	76.0	77.0	78.0		79.0	77.0	74.0	75.0	76.0		77.0	75.0		
	V_4	81.0	82.0	83.0		85.0	82.3	79.0	80.0	810		82.0	80.0		
D_2	V_1	78.0	79.0	80.0		81.0	79.0	76.0	77.0	78.0		79.0	77.3		
	V_2	76.0	77.0	78.0		79.0	77.3	74.0	75.0	76.0		77.0	75.0		
	V_3	67.0	68.0	69.0		70.0	69.0	65.0	66.0	67.0		68.0	67.0		
	V_4	71.0	72.3	73.3		74.3	72.6	69.0	70.0	71.0		72.0	70.0		
Factors		D	V	D*V	T	D*T	V*T	D*V*T	D	V	D*V	T	D*T	V*T	D*V*T
SE(d)		0.2	0.1	0.2	0.1	0.2	0.2	0.3	0.2	0.3	0.4	0.1	0.1	0.1	0.2
C.D. at 5%		0.6	0.3	0.3	0.2	NS	NS	NS	0.8	0.7	1.0	0.1	NS	0.3	NS

Days to 75% Maturity

The data overlooked on the effect of foliar spray of boron and thio-urea on sowing dates, varieties, treatments and their interaction for Days to 75% maturity in Table 3.

Effect of sowing dates

The mean value of days to 75% maturity counted statistically maximum in timely sowing dates *i.e.,* D_1 (122.1 and 120.2) and minimum in late sowing dates *i.e.,* D_2 (111.3 and 109.2 days) during both experimental years.

Effect of varieties

The significantly higher mean value of days to 75 % maturity recorded in the variety V_2 with 122.3 and 120.3 days at par V_1 with 122.0 and 119.6 days followed by V_4 with 112.2 and 110.5 days but least in V_3 with 110.2 and 108.3 for experimental years *i.e.,* 2013-14 and 2014-15, respectively.

Effect of treatments

Among the treatments, statistically highest mean value of days to 75% maturity probed in treatment T_3 *i.e.,* 117.7 and 115.7 days at par with T_2 *i.e.,* 117.4 and 115.4 days followed by T_4 *i.e.,* 116.5 and 114.5 days, T_1 *i.e.,* 116.4 and 114.4 days while lowest in the treatment T_0 *i.e.,* 115.4 and 113.3 days with the both years of experimentation, respectively.

Interaction effect of sowing dates and varieties

It is visualized that the value of days to 75% maturity was showed significantly more in combination D_1V_1 with 126.7 and 124.3 days at par in combination D_1V_2 with 126.5 and 124.1 followed by other combinations of sowing dates and varieties while less in combination D_2V_3 with 103.3 and 101.4 days for both corresponding years, respectively.

Interaction effect between sowing dates and treatments

though, first year data on sowing dates with treatments was recorded non-significant on days to 75% maturity. But, numerically higher was in combination D_1T_3 *i.e.,* 123.1 days and lower in combination D_2T_0 *i.e.,* 110.0 days. Meanwhile second year, these value stated significantly maximum in combination D_1T_2 *i.e.,* 121.2 days at par with D_1T_3 *i.e.,* 121.0 days followed by other tested combination and minimum in combination D_2T_0 *i.e.,* 107.7 days.

Table 3: Effect of foliar applied boron and thio-urea on Days to 75 % Maturity of wheat cultivars under timely and late sown condition:

Treat.		**2013-14**						**2014-15**					
		V_1	**V_2**	**V_3**	**V_4**	**Mean**	**V_1**	**V_2**	**V_3**	**V_4**	**Mean**		
D_1		126.7	126.5	117.2	118.1	122.1	124.3	124.1	115.2	117.2	120.2		
D_2		117.3	118.1	103.3	106.4	111.3	114.9	116.8	101.4	103.7	109.2		
Mean		122.0	122.3	110.2	112.2		119.6	120.5	108.3	110.5			
Treat.		T_0	T_1	T_2	T_3	T_4	Mean	T_0	T_1	T_2	T_3	T_4	Mean
D_1		120.8	121.9	123.0	123.1	121.8	122.1	119.0	120.0	121.2	121.0	119.8	120.2
D_2		110.0	111.0	111.9	112.4	111.1	111.3	107.7	109.0	109.6	110.5	109.1	109.2
Mean		115.4	116.4	117.4	117.7	116.5		113.3	114.4	115.4	115.7	114.5	
V_1		121.0	122.0	122.8	123.5	122.3	122.3	119.1	120.3	121.0	121.8	120.1	120.5
V_2		120.6	121.8	123.0	123.0	121.6	122.0	118.1	119.5	120.3	120.5	119.5	119.6
V_3		109.0	110.0	111.0	111.5	109.8	110.2	107.0	108.0	109.0	109.5	108.0	108.3
V_4		111.0	112.0	113.0	113.1	112.1	112.2	109.1	110.1	111.5	111.3	110.3	110.5
Mean		115.4	116.4	117.4	117.7	116.5		113.3	114.5	115.4	115.7	114.5	
Treat.		T_0	T_1	T_2		T_3	T_4	T_0	T_1	T_2		T_3	T_4
D_1	V_1	125.0	126.0	127.0		128.0	126.7	123.0	124.0	125.0		125.7	123.3
	V_2	125.3	126.7	128.0		127.7	126.0	123.0	124.0	125.3		125.0	124.0
	V_3	116.0	117.0	118.0		118.3	116.7	114.0	115.0	116.0		116.0	115.0
	V_4	117.0	118.0	119.0		118.3	118.0	116.0	117.0	118.7		117.6	117.0
D_2	V_1	117.0	118.0	118.7		119.0	118.0	115.3	116.7	117.0		118.0	117.0
	V_2	116.0	117.0	118.0		118.3	117.3	113.0	115.0	115.3		116.0	115.0
	V_3	102.0	103.0	104.0		104.7	103.0	100.0	101.0	102.0		103.0	101.0
	V_4	105.0	106.0	107.0		107.7	106.3	102.3	103.3	104.3		105.0	103.7
Factors		D	V	D*V	T	D*T	V*T	D*V*T	D	V	D*V	T	D*T	V*T	D*V*T
SE(d)		0.1	0.3	0.4	0.2	0.3	0.4	0.5	0.1	0.2	0.3	0.2	0.2	0.3	0.5
C.D. at 5%		0.3	0.6	0.9	0.4	NS	NS	NS	0.5	0.5	0.6	0.3	0.5	NS	NS

Interaction effect of varieties with treatments
Although, data on varieties and treatments was recorded non-significant but numerically maximum days to 75% maturity was in the combination V_1T_3 (123.5 and 121.8 days) and minimum in the combination V_3T_0 (109.0 and 107.0 days) during years *i.e.,* 2013-14 and 2014-15, respectively.

Interaction effect of sowing dates, varieties and treatments
The value did not show statistically significant for both years of experimentation while, numerically higher and similar value of days to 75% maturity in the combination $D_1V_1T_3$ and $D_1V_2T_2$ with 128.0 days in the year 2013-14. In year 2014-15, was only higher in combination $D_1V_1T_3$ with 125.7 days followed by other tested combinations. On the other hands, combination $D_2V_3T_0$ with 102.0 and 100.0 days to 75% maturity were lower for both concerning years.

Grain Growth Rate (g m^{-2} day)
The data elucidated in Table 4 for grain growth rate as affected due to sowing dates, varieties, and treatments of foliar applied boron, thio-urea and their interaction effects.

Effect of sowing dates
The mean value of sowing dates evolved that late sowing date (D_2) statistically decreased grain growth rate *i.e.,* 12.5 and 11.7 over timely sowing date (D_1) *i.e.,* 14.6 and 13.8 days during the year 2013-14 and year 2014-15, respectively.

Effect of varieties
The significantly higher mean value of varieties to grain growth rate was recorded in variety V_2 with 14.1 and 13.2 followed by V_1 and V_4 with 13.7, 12.8 and 13.4, 12.7 but lowest in variety V_3 with 13.0 and 12.3 for both years of experimentation, respectively.

Effect of treatments
The mean value of grain growth rate was significantly influenced by treatments in both years. Among the treatments, T_2 (14.5 and 13.5) had showed statistically maximum grain growth rate followed by T_3 (14.0 and 13.2), T_4 (13.5 and 12.7) and also T_1 (13.2 and 12.5) while, T_0 was minimum (12.5 and 11.9) during both concerning experimental years.

Table 4: Effect of foliar applied boron and thio-urea on Grain Growth Rate (mg m^{-1} day^{-1}) after harvesting of wheat cultivars under timely and late sown condition:

Treat.		2013-14						2014-15					
		V_1	V_2	V_3		V_4	Mean	V_1	V_2	V_3		V_4	Mean
D_1		14.8	15.5	13.8		14.2	14.6	14.0	14.5	13.0		13.5	13.8
D_2		12.6	12.6	12.2		12.6	12.5	11.6	11.8	11.5		12.0	11.7
Mean		13.7	14.1	13.0		13.4		12.8	13.2	12.3		12.7	
Treat.		T_0	T_1	T_2	T_3	T_4	Mean	T_0	T_1	T_2	T_3	T_4	Mean
D_1		13.4	14.3	15.7	15.1	14.5	14.6	12.7	13.5	14.7	14.3	13.7	13.8
D_2		11.6	12.2	13.3	12.9	12.4	12.5	11.0	11.5	12.3	12.0	11.7	11.7
Mean		12.5	13.2	14.5	14.0	13.5		11.9	12.5	13.5	13.2	12.7	
V_1		12.5	13.3	14.9	14.3	13.6	13.7	12.1	12.7	13.7	13.1	12.5	12.8
V_2		12.7	13.9	15.1	14.6	14.1	14.1	12.0	13.0	13.8	13.8	13.3	13.2
V_3		12.4	12.6	13.8	13.3	12.9	13.0	11.4	11.8	13.0	12.7	12.3	12.3
V_4		12.6	13.0	14.3	13.8	13.3	13.4	11.9	12.5	13.5	13.0	12.8	12.7
Mean		12.5	13.2	14.5	14.0	13.5		11.9	12.5	13.5	13.2	12.7	
Treat.		T_0	T_1	T_2		T_3	T_4	T_0	T_1	T_2		T_3	T_4
D_1	V_1	13.4	14.5	16.4		15.4	14.5	13.2	13.9	15.3		14.4	13.5
	V_2	14.0	15.5	16.5		16.2	15.7	13.1	14.5	15.1		15.3	14.7
	V_3	13.1	13.4	14.8		14.0	13.7	12.0	12.5	14.1		13.7	13.0
	V_4	13.3	13.8	15.2		14.7	14.1	12.6	13.2	14.3		13.9	13.7
D_2	V_1	11.6	12.2	13.4		13.2	12.7	11.1	11.6	12.1		11.8	11.5
	V_2	11.9	12.4	13.7		13.0	12.5	11.0	11.5	12.5		12.3	11.8
	V_3	11.4	12.0	12.8		12.5	12.1	10.8	11.2	12.0		11.7	11.6
	V_4	11.7	12.3	13.5		13.0	12.5	11.2	11.7	12.8		12.2	11.9
Factors		D	V	D*V	T	D*T	V*T	D*V*T	D	V	D*V	T	D*T	V*T	D*V*T
SE(d)		0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.2
C.D. at 5%		0.5	0.3	0.4	0.1	0.2	0.3	NS	0.4	0.3	0.5	0.1	0.2	0.3	0.4

Interaction effect of sowing dates and varieties
It is visualized that significantly higher value of sowing dates and varieties was in combination D_1V_2 *i.e.,* 15.5 and 14.5 followed by D_1V_1 *i.e.,* 14.8, 14.0 and D_1V_4 *i.e.,* 14.2, 13.5 while lower in combination D_2V_3 *i.e.,* 12.2, 11.5 and D_2V_4 *i.e.,* 12.6, 12.0 with season 2013-14 and 2014-15, respectively.

Interaction effect of sowing dates with treatments
It is revealed from interaction effect between sowing dates and treatments that statistically highest value of grain growth rate in combination D_1T_2 with 15.7 and 14.7 followed by D_1T_3 with 15.1 and 14.3 as compared to other combination but least in combination D_2T_0 with 11.6 & 11.0 and D_2T_1 with 12.2 & 11.5 for both years of experimentation, respectively.

Interaction effect between varieties and treatments: The Interaction effects of varieties with treatments have indicated significant effect on grain growth rate. The statistically maximum value was recorded in combination V_2T_2 (15.1) at par with V_1T_2 (14.9) followed by other treatments in year 2013-14. Meanwhile, in year 2014-15 statistically higher interaction value also calculated in combination V_2T_2 (13.8), similar to V_2T_3 and at par with V_1T_2 (13.7) followed by other combination. During both concerning years, lower value was in combination V_3T_0 and V_3T_1 (12.4 & 11.4 and 12.6 & 11.8).

Interaction effect among sowing dates, varieties and treatments
During first year, sowing dates, varieties and treatments have shown non-significant effect on grain growth rate. The higher

value was in combination $D_1V_2T_2$ (16.5) followed by $D_1V_1T_2$ (16.4). While, the statistically maximum interaction value for grain growth rate was in combination $D_1V_1T_2$ similar $D_1V_2T_3$ (15.3) at par with $D_1V_2T_2$ (15.1) during second year. For both years of experimentation $D_2V_3T_0$ (11.4 and 10.8) was lowest to all other combinations.

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