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Effect of foliar application of thio-urea on biochemical parameters in Wheat (*Triticum aestivum* L.) cultivars

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Abstract

These experiments have been conducted in order to study the effect of foliar application of thio-urea doses on biochemical of two varieties in two sowing conditions at Student Instructional Farm of C. S. Azad University of Agriculture and Technology, Kanpur during the *Rabi* season of 2017-18 and 2018-19. The experimental design was split-split plot design in which sowing conditions was in main plot (D₁ timely sowing, D₂ late sowing), two cultivars (V₁: K- 607, V₂: K- 402) in subplot while five treatments in these one doses thio-urea (T₁ 500ppm, T₂ 750ppm, T₃ 1000ppm, T₄ 1500ppm) with control T₀ water spray in sub-sub plot with three replications. Results showed high significantly effect of sowing condition, variety and treatment on Chlorophyll (SPAD) Value-sown condition (D₁ over late sown condition D₂ with 42.1 and 41.8; 41.6 and 41.8), effect of treatment- T₁ (2.3 and 2.3) followed by T₂ (2.2 and 2.2), T₃ (2.2 and 2.1) while, least chlorophyll value was in treatment T₄ (2.1 and 2.0) and T₀ (1.8 and 1.8) in both years of experimentation. Fat Content (%) timely sown condition (D₁ *i.e.*, 0.98 and 0.97 as compare to late sown condition D₂ *i.e.*, 0.97 and 0.96), effect of variety (V₁ with 0.98 and 0.97 g and V₂ with 0.97 and 0.96) and effect of treatment T₂ (1.04 and 1.03) had showed statistically higher fat content followed by T₄ (0.98 and 0.96), T₃ (0.96 and 0.93) and T₁ (0.94 and 0.96) while lowest in treatment T₀ (0.93 and 0.97) during both year of experimentation. Protein content (%) effect of condition (Maximum protein content (11.5%) accumulated in D₁ while, minimum (11.0%) in D₂), effect of variety highest (11.5%) protein content numerically recorded in V₁ and lowest in V₂ (11.1%) and effect of treatment T₂ gave statistically maximum mean value T₀ (11.7 and 11.8) protein content (%) during these experimentation were found significantly with sowing conditions, varieties, treatments and their interaction in both years. Totally conclusion that timely sowing date (D₁), cultivar (V₁), and treatment (T₂ thio-urea 750ppm) were superior to others.

Keywords: Thio-urea, chlorophyll, fat content, protein content

Introduction

Wheat (*Triticum aestivum* L.) is the second most important staple food crop of the world on account of its wide adaptability to different agro-climatic and soil conditions. Wheat is the world's most outstanding crop that excels all other cereals both in area and production, known as king of cereals. It is also one of the most nutritious cereals and its contribution to human diet puts it in the first rank of plants that feed the world (Costa *et al.*, 2013) [3]. India is the largest wheat producing country in the world after China. The wheat production has increased manifold from 6.60 million tonnes at the time of independence to 97.44 million tons (Anonymous, 2017-18) [1]. Thio-urea, also called thiocarbamide, an organic compound that resembles urea but contains sulphur instead of oxygen; *i.e.*, the molecular formula is CS (NH₂)₂, while that of urea is CO (NH₂)₂. Like urea, it can be prepared by causing a compound with the same chemical composition to undergo rearrangement, as by heating ammonium thiocyanate (NH₄SCN). A method of preparation more commonly used consists of the addition of hydrogen sulphide to cyanamide. Thio-urea, a sulphhydryl compound is known to improve pulse productivity and its role as a drought ameliorant is well established under the arid and semi-arid regions (Sahu *et al.*, 1993) [10]. This is depended on the efficiency of photosynthetic translocation in crop during grain filling period when developing grains are the storing sink. Nishi *et al.* (2006) [8] results revealed that thio-urea application showed favorable effects of on

net photosynthesis and levels of leaf metabolites *viz.* total chlorophyll, starch, reducing sugars and soluble protein as well as nitrate reductase activity. Bavita *et al.* (2015) also evaluated the potential of thio-urea in improving the terminal heat resistance in bread wheat. Thio-urea application also increased the total soluble proteins, amino acids and chlorophyll contents in all the tested genotypes.

Materials and Methods

The present study was carried out at the Experimental Students Farm, Nawabganj of Chandra Shekhar Azad University of Agriculture and Technology Kanpur, India, during Rabi season 2017-18 and 2018-19. Geographically Kanpur is located of 26.30° N Longitude of 80.15° E and above 127 meters sea level. The experimental design was split-split plot design in which sowing conditions was in main plot (D₁ Timely sowing, D₂ Late sowing), two cultivars (V₁: K- 607, V₂: K-402) in subplot while five treatments in these

one doses thio-urea (T₁ 500ppm, T₂ 750ppm, T₃ 1000ppm, T₄ 1500ppm) with control T₀ water spray in sub-sub plot with three replications. According to each plot size 4.0m×3.0m a total dose of 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), respectively 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.

Results & Discussion

[1] Chlorophyll Value (SPAD)

The data elaborated on chlorophyll value (SPAD) fresh leaf at heading stage as predicated in Table 1, affected due to foliar applied thio-urea with two varieties on two condition and their interactions.

Table 1: Effect on foliar application of thio-urea on Chlorophyll (SPAD) value at heading stage of wheat cultivars under timely and late sown conditions

Varieties/Conditions	2017-18						2018-19							
	V ₁		V ₂		Mean		V ₁		V ₂		Mean			
D ₁	42.1		42.0		42.1		41.3		42.2		41.2			
D ₂	42.3		40.9		41.6		41.7		42.0		41.8			
Mean	42.2		41.4				41.5		42.1					
Treatment/Conditions	2017-18						2018-19							
	T ₀	T ₁	T ₂	T ₃	T ₄	Mean	T ₀	T ₁	T ₂	T ₃	T ₄	Mean		
D ₁	42.0	42.0	41.7	42.6	42.0	42.1	41.3	42.5	41.6	41.9	41.6	41.8		
D ₂	42.3	42.0	41.9	40.6	41.1	41.6	40.9	42.0	42.1	42.4	41.9	41.8		
Mean	42.2	42.0	41.8	41.6	41.5		41.1	42.3	41.8	42.1	41.7			
Treatment/Varieties	2017-18						2018-19							
	T ₀	T ₁	T ₂	T ₃	T ₄	Mean	T ₀	T ₁	T ₂	T ₃	T ₄	Mean		
V ₁	42.7	41.5	41.8	42.4	42.6	42.2	40.5	42.3	41.4	41.7	41.4	41.5		
V ₂	41.6	42.5	41.8	40.8	40.4	41.4	41.7	42.2	42.2	42.6	42.0	42.1		
Mean	42.2	42.0	41.8	41.6	41.5		41.1	42.3	41.8	42.1	41.7			
Combinations	T ₀		T ₁		T ₂		T ₃		T ₄					
	V ₁	42.0	41.3	41.2	42.5	43.7	40.5	42.2	41.2	41.3	41.4			
D ₁	V ₂	42.0	42.6	42.3	42.6	40.3	42.1	42.8	42.1	42.5	41.8			
D ₂	V ₁	43.3	41.7	42.4	42.2	41.6	40.5	42.5	41.7	42.1	41.5			
D ₂	V ₂	41.3	42.3	41.3	39.0	40.5	41.3	41.6	42.4	42.7	42.2			
Factor	D	V	T	DxV	DxT	VxT	DxVxT	D	V	T	DxV	DxT	VxT	DxVxT
SE (d)	0.7	0.2	0.8	0.3	1.1	1.1	1.6	0.05	0.1	0.6	0.2	0.8	0.8	1.2
C.D. at 5%	NS	0.78	NS	NS	NS	NS	NS	NS	0.50	NS	NS	NS	NS	NS

Effect of condition: The mean value of conditions showed that chlorophyll value (SPAD) statistically reduce in timely sown condition (D₁) over late sown condition (D₂) with 42.1 and 41.8; 41.6 and 41.8 during concerning years (2017-18 and 2018-19), respectively.

Effect of varieties: The both years mean value of chlorophyll value (SPAD) (fresh tissue) observed significantly highest in the variety V₁ *i.e.*, 42.2, 41.5 and less than V₂ *i.e.*, 41.4 and 42.1, respectively.

Effect of treatments: The significantly higher mean value of chlorophyll content in mg g⁻¹ fresh tissue with treatment T₁ (2.3 and 2.3) followed by T₂ (2.2 and 2.2), T₃ (2.2 and 2.1) while, least chlorophyll value was in treatment T₄ (2.1 and 2.0) and T₀ (1.8 and 1.8) in both years of experimentation, respectively.

Interaction effect between condition and varieties: The data on conditions with varieties did not show significant effect on chlorophyll value (SPAD) (Fresh tissue), however

maximum value of chlorophyll value was found in combination D₁V₁ (42.1, 41.3) and minimum in D₂V₂ (42.9, 40.9) for both years.

Interaction effect of condition and treatments: It is visualized that the value of chlorophyll content fresh leaf of both experimental years was not significant effect but numerically maximum value showed in combination D₁T₃ with 42.6 and 41.9 followed by D₂T₁ with 42.0 while minimum in D₁T₀ with 42.0 and 41.3 fresh tissue, respectively.

Interaction effect of varieties and treatments: The interaction effect of varieties and treatments to chlorophyll value (SPAD) fresh leaf did not give significant effect for both years, but numerically higher value was in combination V₂T₂ (42.2, 42.5) followed by V₁T₃ 42.4, 41.7 chlorophyll value and while least in V₂T₀ (41.6, 41.7).

Interaction effect among condition, varieties and treatments: Although, the interaction of sowing dates,

varieties and treatments have shown non-significant effect on chlorophyll value (SPAD) during both years. But numerically maximum $D_1V_1T_2$ i.e., 42.3, 42.1 over $D_1V_1T_3$ i.e., 42.5, 41.3 and minimum in $D_1V_2T_0$ i.e., 41.3, 40.5 respectively. Saleem *et al.*, (2011)^[11] and El-Yazied and Mady (2012)^[4]

[2] Fat content (%)

The data on Fat content is overlooked from Table 2, which affected due to condition, varieties, foliar applied thio-urea and their interactions.

Table 2: Effect on foliar application of thio-urea on Fat content in grain of wheat cultivars under timely and late sown conditions

Varieties/Conditions	2017-18						2018-19							
	V ₁		V ₂		Mean		V ₁		V ₂		Mean			
D ₁	0.97		0.98		0.97		0.94		0.98		0.96			
D ₂	0.96		0.96		0.96		0.98		0.98		0.98			
Mean	0.97		0.97				0.94		0.98					
Treatment/Conditions	2017-18						2018-19							
	T ₀	T ₁	T ₂	T ₃	T ₄	Mean	T ₀	T ₁	T ₂	T ₃	T ₄	Mean		
D ₁	0.93	0.95	1.04	0.98	0.98	0.98	0.98	0.94	1.01	0.94	0.94	0.97		
D ₂	0.94	0.93	1.03	0.94	0.99	0.97	0.97	0.98	1.05	0.93	0.97	0.96		
Mean	0.93	0.94	1.04	0.96	0.98		0.97	0.96	1.03	0.93	0.96			
Treatment/Varieties	2017-18						2018-19							
	T ₀	T ₁	T ₂	T ₃	T ₄	Mean	T ₀	T ₁	T ₂	T ₃	T ₄	Mean		
V ₁	0.93	0.93	1.04	0.94	0.99	0.98	0.97	0.98	1.05	0.90	0.94	0.96		
V ₂	0.94	0.95	1.03	0.98	0.98	0.97	0.98	0.94	1.06	0.97	0.97	0.96		
Mean	0.93	0.94	1.04	0.96	0.98		0.97	0.96	1.03	0.93	0.96			
Combinations	T ₀		T ₁		T ₂		T ₃		T ₄					
	T ₀	T ₁	T ₂	T ₃	T ₄	T ₀	T ₁	T ₂	T ₃	T ₄				
D ₁	V ₁	0.93	0.93	1.04	0.97	0.99	0.98	0.97	0.99	0.88	0.90			
	V ₂	0.94	0.97	1.05	0.99	0.98	0.98	0.91	1.03	1.00	0.99			
D ₂	V ₁	0.94	0.94	1.05	0.91	1.00	0.97	0.99	1.04	0.93	0.91			
	V ₂	0.94	0.93	1.02	0.97	0.98	0.98	0.97	1.09	0.94	0.96			
Factor	D	V	T	DxV	DxT	VxT	DxVxT	D	V	T	DxV	DxT	VxT	DxVxT
SE (d)	0.014	0.006	0.01	0.008	0.026	0.026	0.037	0.006	0.01	0.02	0.01	0.02	0.02	0.03
C.D. at 5%	NS	NS	0.04	NS	NS	NS	NS	NS	NS	0.04	NS	NS	NS	NS

Effect of condition: The mean value of Fat content (%) statistically non-significantly increase in Timely sown condition D₂ i.e., 0.98 and 0.97 as compare to late sown condition D₂ i.e., 0.97 and 0.96 for year 2017-18 and second year 2018-19, respectively.

Effect of varieties: The non-significantly highest mean value of fat content was in variety V₁ with 0.98 and 0.97 g and V₂ with 0.97 and 0.96 for both years of experimentation.

Effect of treatments: The mean value of Fat content significantly influenced by treatments in both experimental years. Among the treatments T₂ (1.04 and 1.03) had showed statistically higher fat content followed by T₄ (0.98 and 0.96), T₃ (0.96 and 0.93) and T₁ (0.94 and 0.96) while lowest in treatment T₀ (0.93 and 0.97) with both experimental years.

Interaction effect between condition and varieties: Though, the data on the Fat content found non-significant effect but numerically maximum test weight in combination D₁V₂ with 0.98 and D₂V₂ at IInd position with 0.98 and 0.97 as well as minimum in combination D₂V₁ with 0.96 and 0.98 during both years of experimentation.

Interaction effect of condition and treatments: It is visualized that the fat content did not show significant effect

during both year, respectively. In combination D₁T₂ i.e., 42.0 and 41.5 g followed by D₁T₄ i.e., 41.9 and 41.1 g however, lowest in combination D₂T₀ i.e., 40.5 and 39.9 g, non-significant effect during second year respectively.

Interaction effect of varieties and treatments: The interaction effects of varieties and treatments have noted non-significant effect on test weight (g). The non-significantly highest value in combination D₁T₂ (41.7 and 41.6) followed by V₂T₄ (41.1 and 41.2) at par V₁T₄, V₂T₂ (40.6) and least in V₁T₀ (40.5 and 40.4) for both experimental years.

Interaction effect among condition, varieties and treatments: Since, interaction effect of conditions, varieties and treatments on test weight was not significant but numerically more value of combination in D₁V₁T₂ (41.9 and 41.7 g) followed by D₁V₂T₁ (42.0 and 41.4 g) and D₂V₁T₁ (42.60 and 40.5 g) while, least in combination D₁V₂T₀ (39.3 and 40.3 g) for both corresponding years, respectively. Pelikan *et al.*, (1993)^[9] and Shubhra (2006)^[13]

[3] Protein content in grain (%):

The data elucidated for protein content (%) as affected by condition, varieties, treatments of foliar applied and thio-urea and their interaction effects are presented in Table. 3.

Table 3: Effect on foliar application of thio-urea on protein content in grain (%) of wheat cultivars under timely and late sown conditions

Varieties/Conditions	2017-18						2018-19								
	V ₁		V ₂		Mean		V ₁		V ₂		Mean				
D ₁	10.9		11.3		11.1		11.3		11.1		11.2				
D ₂	11.6		10.9		11.3		11.7		10.9		11.3				
Mean	11.3		11.1				11.5		11.0						
Treatment/Conditions	2017-18						2018-19								
	T ₀	T ₁	T ₂	T ₃	T ₄	Mean	T ₀	T ₁	T ₂	T ₃	T ₄	Mean			
D ₁	10.2	11.6	11.8	11.1	10.8	11.1	11.0	11.7	11.5	10.9	10.8	11.2			
D ₂	10.9	11.5	11.6	11.0	11.5	11.3	10.9	11.5	12.1	10.8	11.2	11.3			
Mean	10.6	11.5	11.7	11.1	11.1		10.9	11.6	11.8	10.9	11.0				
Treatment/Varieties	2017-18						2018-19								
	T ₀	T ₁	T ₂	T ₃	T ₄	Mean	T ₀	T ₁	T ₂	T ₃	T ₄	Mean			
V ₁	10.7	11.6	11.6	11.2	11.3	11.3	11.3	11.7	12.1	11.2	11.2	11.5			
V ₂	10.4	11.5	11.7	10.9	11.0	11.1	10.6	11.5	11.6	10.6	11.9	11.0			
Mean	10.6	11.5	11.7	11.1	11.1		10.9	11.6	11.8	10.9	11.0				
Combinations		T ₀	T ₁	T ₂	T ₃	T ₄	T ₀	T ₁	T ₂	T ₃	T ₄				
D ₁	V ₁	10.2	10.8	11.8	10.9	11.0	11.2	11.7	11.9	11.1	10.7				
	V ₂	10.3	12.4	11.8	11.4	10.6	10.7	11.7	11.3	10.8	11.0				
D ₂	V ₁	11.2	12.4	11.5	11.6	11.6	11.4	11.7	12.4	11.3	11.6				
	V ₂	10.6	10.6	10.7	10.5	11.4	10.4	11.3	11.9	10.4	10.8				
Factor		D	V	T	DxV	DxT	VxT	DxVxT	D	V	T	DxV	DxT	VxT	DxVxT
SE (d)		0.07	0.05	0.12	0.07	0.17	0.17	0.24	0.02	0.04	0.08	0.05	0.11	0.11	0.16
C.D. at 5%		NS	0.14	0.20	0.20	0.40	NS	0.57	NS	0.11	0.19	0.16	0.27	0.27	0.38

Effect of condition: Though statistically mean value of conditions indicated non-significant effect but numerically maximum protein content (11.5%) accumulated in D₁ while, minimum (11.0%) in D₂ during both year.

Effect of varieties: The first year mean value of protein content examine significant effect on varieties. Although, highest (11.5%) protein content numerically recorded in V₁ and lowest in V₂ (11.1%) for year 2017-18 and 2018-19.

Effect of treatments: The treatment significantly influence on protein content during both years. Among the treatments, T₂ gave statistically maximum mean value T₀ (11.7 and 11.8) protein content (%) during both year of experimentation. But minimum value both years of experimentation untreated control T₀ *i.e.*, 10.6 and 10.9.

Interaction effect of condition and varieties: Though the interaction of conditions and varieties was non-significant with regards to protein content, but combination D₂V₂ had produced high (11.6 and 11.7%) for both year and D₁V₁ numerically less (10.9 and 11.3%) with years *i.e.*, 2017-18 and 2018-19 experiment.

Interaction effect of condition and treatments: Interaction of sowing dates with treatments has conditions significant effect on protein content. Numerically, the combination D₁T₂ *i.e.*, 11.8 and 11.5% accumulated highest protein content and lowest in D₁T₀ (10.2 and 11.0%) in the year 2017-18 and 2018-19.

Interaction effect of varieties and treatments: The interaction effect of varieties with treatments has indicated non-significant effect on protein content (%). The combination V₁T₀ showed lowest (10.7 %) and highest protein content combination V₂T₂ (11.6 %) in first year and significant in V₁T₂ *i.e.*, 12.1 % and V₂T₀ (10.6 %) during both years.

Interaction effect of condition, varieties and treatments: The interaction effect of sowing dates, varieties and

treatments have indicated whether Significant effect in both years. The maximum protein content *i.e.*, D₁V₁T₁ (11.8 & 11.8 %) which was exhibited by combination D₁V₂T₀ (10.3 & 10.7 %). Gupta *et al.*, (2013)^[5] and Kanani *et al.*, (2013)^[7], Sharma *et al.*, (1991)^[12], RiZwan *et al.*, (2011), Sridhar *et al.*, (2005)^[14].

Conclusion

Finally, it may be concluded that significantly biochemical traits can be obtained by foliar application of 750ppm thio-urea (T₂) with both condition of sowing in the both years *i.e.*, timely sown (D₁) and Late sown condition (D₂) of wheat crop. Next to this were (T₃) *i.e.*, 5.3 and 5.1 g, 500ppm thio-urea (T₁) *i.e.*, 5.2 and 5.4 g, 1500ppm thio-urea (T₄) *i.e.*, 5.2 and 5.7 g as compare to control (T₀) *i.e.*, 4.39 and 4.35 g. Among cultivars, maximum responsive was K-402 (V₂) in most of traits and gave significantly biochemical traits 5.5 and 5.9 g minimum in K-607 (V₁) *i.e.*, 5.0 and 4.9 g with both concerning experimental years.

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