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Beneficial effects of foliar application of potassium nitrate in late-sown wheat in village Gaurahi of district Sonbhadra

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Abstract
Heat stress reduces the economics of wheat production. The present study was aimed to view the effect of foliar application of potassium nitrate in heat stressed condition for local variety of wheat in Gaurahi village Sonbhadra. Our experiment had been laid up with three treatments and eight replications in randomized block design. Second treatment (i.e. application of 0.5% potassium nitrate at booting stage & anthresis stage) opts highest grain yield (3.4 t/ha) with B:C ratio 1.72. The entire collected yield attributing characters are positive significantly correlated with yield. Thus, we deduced that the second treatment gives us the best approximation.

Keywords: Stress, KNO_3, wheat, yield, economics

Introduction
Wheat (*Triticum aestivum* L.), is the second staple food crop in India after rice. Annually, rice cultivated in 29.55 mha with production 101.20 mt grains and productivity of 3,424 kg/ha [2]. Wheat sowing is normally delayed due to late harvesting of long-duration transplanted rice and longer turn around period required for seed bed preparation, results wheat production with poor grain quality due to terminal heat stress at grain filling stage. The well-known threshold temperature for the growth of wheat is 20 ˚C [15]. The intensity, duration and rate of increase temperature cause irreversible damage to the plant growth and its development. The Intergovernmental Panel on Climatic Change (IPCC) had already announced the global increase in temperature by 0.5 ˚C per decade in 1995 and will reach to 1 ˚C by 2025, 3 ˚C by 2050 and 5 ˚C by 2080, thus causes Global Warming at alarming rate [1]. The increase in 1-2 ˚C temperature from the threshold level causes heat stress [13].
Heat stress disables water molecules to participate in metabolic reaction in plants thus affects crop cycle, pollen abortion, kernel shrinkage, anther indehiscence, reduced development of the pollen tube, reduction in the rate of photosynthesis and respiration, development of spikelet, grains and ultimately reduces biomass production [10, 16]. The grain development stage of irrigation should be free from all kinds of biotic stress if not then gradually, the detrimental decline effects on the yield and its attributing characters had been seen [7]. These physiological abnormalities occurs naturally in dry land thus various strategies had been adopted to mitigate the heat stress such as adoption of suitable agronomic practices, application of chemical fertilizers or in combination of both which reduces the rate of transpiration or increase the level of water content.
Potassium is well known nutrient as stomatal regulator and proline producer. Hence, potassium fertilizers would be the suit to mitigate the heat stress by reducing water loss and ultimately decreases the effect of Reactive Oxygen Species (ROS) [4, 5, 11, 14, 17]. In spite of stress saver, potassium rich plants are disease resistant due to salt rich concentration in its cellular part [8, 18]. Therefore, an experiment was laid out with potassium nitrate as a complex fertilizer. The yield and its attributes (*viz.*, number of tillers/mt^2, number of grains/spikes, 1000 grain weight and harvesting index) along with its economics were compared with farmers practice (i.e. heat stressed).

Materials and Methods
The study on the farmer's fields at Gaurahi village under the jurisdiction of KVK, Sonbhadra, Uttar Pradesh in 2018 with three treatments and eight replications in a Randomized Block

Design was conducted. The crop was sown during late December, 2018 and harvested in late April, 2019. The uniform application of NPK @120 kg/ha, 60 kg/ha and 40 kg/ha was applied in all treatments with urea, di-ammonium phosphate and muriate of potash. One-third of nitrogen with full phosphorous and potassium was applied as basal and rest of two third was applied after first and second irrigations. Well rotten compost @ 0.68 t/ha was applied one week before sowing to maintain the physico-chemical status of soil. Need-based weed control and plant protection measures were taken. Crops were irrigated at 21and 68 days after sowing.

The data collected from middle portion of plots for number of effective tillers/mt^2, number of grain/spike, seed weight (1000-grain weight), grain yield (t/ha), straw yield (t/ha), harvest index (%) whereas for the economical properties, cost of cultivation, gross returns, net returns and B:C ratio were calculated.

The significant differences between treatments were analyzed by variance (ANOVA) using Excel sheet. Critical Difference (CD) and Standard Error of Mean (SEM±), correlation matrix and economics were also calculated using excel sheet.

Result and Discussion

The highest grain yield (3.4t/ha), effective tillers/mt^2 (298), grains/spike (55.63), straw yield 5.03 t ha^{-1}, seed index (40.8) and harvesting index (40.26%) obtained from second treated plot (Table 1). The increase in the grain yield might be due to the fact that this fertilizer containing nutrients (potassium and nitrate) accumulates continuously throughout the growing period in second treatment i.e. at flowering & anthresis results higher photosynthetic rate [3, 6, 9, 12]. Similar results were also observed by Niwas and Khichar (2016) [13] at foliar application of KNO_3 0.5% and 1% at flowering and anthresis stage.

The correlation matrix (Table 2) signifies that grain yield is positive significantly correlated with number of effective tillers/mt^2, number of grain/spike, seed weight and straw yield with correlation coefficient 0.46, 0.54, 0.52 and 0.7 respectively at 5% level of significance.

The net fixed cost in each treatment (i.e. farmers practice) worth Rs 24,004/ha (INR) (Table 1) however, the variation in the cost is mainly due to labor, machinery and chemicals. The maximum cultivation cost (Rs 26808/ha), gross returns (Rs 47354), monitory returns (Rs 20546) INR and B:C ratio (1.77) were recorded from T_2 treatment.

Yield and economics is the two main pillar of Indian agricultural system at farmer's level. The maximum yield (3.4 t/ha) of net monitory return (Rs 20546/ha) with highest B:C ratio (1.77) gives remarkable results when 0.5% Potassium Nitrate were sprayed at booting and anthresis stages respectively. The application of potassium nitrate at these stages was thus to give practically convenient as well as economical feasible from yield corner of view.

Table 1: Yield, its attributes and economics

	Treatment description	No of effective tillers/m^2	No. of grain/spike	1000-grain weight (g)	Straw yield (t/ha)	Grain yield (t/ha)	Harvesting index (%)	Cost of cultivation (Rs/ha) (INR)	Gross returns (Rs/ha) (INR)	Net returns (Rs/ha) (INR)	B:C ratio
T1	Control (Farmers Practice)	205	40.2	36.58	4.68	2.95	38.49	24,004	41,250	17,246	1.72
T2	0.5% application of potassium nitrate at booting stage and anthresis stage.	298	55.63	40.8	5.03	3.4	40.26	26,808	47,354	20,546	1.77
T3	Foliar application of 1% potassium nitrate at anthresis stage.	272	51.47	39.63	5.01	3.32	44.15	25,494	44,012	18,518	1.73
	SEm (±)	4.68	1.76	0.93	0.09	0.10	0.75	-	-	-	-
	CD (p = 0.05)	14.33	5.39	2.85	0.30	0.32	2.29	-	-	-	-

Table 2: Correlation matrix

	No. of effective tillers/m^2	No. of grain/spike	1000-grain weight	Straw yield (t/ha)	Grain yield (t/ha)
No. of effective tillers/m^2	1				
No. of grains/spike	0.8*	1			
1000-grain weight	0.47*	0.57*	1		
Harvest index	0.37	0.58*	0.44	1	
Grain yield	0.46*	0.54*	0.52*	0.7*	1

(*) significance at 5%

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