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STUDIES ON FOLIAR APPLICATION OF POTASSIUM NITRATE ON MORPHO-PHYSIOLOGICAL AND YIELD POTENTIAL IN DIFFERENT WHEAT [*TRITICUM AESTIVUM* L.] CULTIVARS UNDER TWO CONDITION CONDITIONS

Swati Agrawal[1], Vinaya Kumar Yadav[1]*, A. K. Verma[2] and R.C. Mishra[1]

[1]Swami Vivekanand University, Sagar (M.P.) India
[2]Government P.G. College, Saidabad, Prayagraj (U.P.) India

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ABSTRACT

The field experiments were conducted at Student Instructional Farm of SVNU Sagar, during Rabi 2018-19 and 2019-20. The objective of investigation was to study the effect of foliar applied potassium nitrate with different doses on plant traits (morphological, yield and its components) of two wheat varieties under drought and irrigated condition. It was designed in split-split plot design with three replications. The two conditions i.e., drought (I_0) and irrigated (I_1) conditions were allocated in the main plots and two wheat varieties i.e., V_1 (K-402) and V_2 (K-607) in sub plot and for each five chemical treatments were applied as foliar spray at heading stages by 0.5% potassium nitrate (T_1), 1.0% potassium nitrate (T_2)along with control (T_0) in sub-sub plots.The significantly higher grain yield (5.84 & 5.88 g) with morpho-physiological, phenological and biochemical traits can be obtained by foliar application of 0.5% potassium nitrate (T_1) with both conditions of i.e., drought (I_0) and irrigated (I_1) of wheat crop. In this were represent 0.5% potassium nitrate (T_1) i.e., 5.31 & 5.27 g, 1.0% potassium nitrate (T_2)as compare to control (T_0) i.e., 4.39 & 4.35 g.with both concerning experimental years.

Keywords: Growth parameter, yield parameter, foliar spray on thio-urea, drought and irrigated conditions.

INTRODUCTION

Wheat [*Tritium aestivum*L.] is one of the most important cereal crops of the world. Bread wheat is the major staple food source for a large part of global population. It is second most important cereal crop after maize and plays an important role in national food security. It has originated from the Levant region of the New East and Ethiopian Highlands, but now cultivated worldwide. 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). Wheat consumption worldwide is estimated to 817 million tons by 2030 and production would need to increase at 22.6-43.6% in different countries at the current production level to meet the estimated consumption demand. 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 107.86 million tonnes in 2019-20. The productivity has witnessed an increase by 473 per cent *i.e.* from 670 kg/ha to 3172 kg/ha during the above period. Despite delayed sowing, the country recorded 38.99 million hectares. (Anonymous, 2019-20), clearly indicates the strength of systematic and planned wheat research in the country.

Drought is the most prevailing problem and the factor known to be serious for its impacts on crop limitations

*Corresponding author: *vinayakumaryadav@svnuniversity.co.in*

(Souza *et al*., 2004). This kind of abiotic stress often occurred as consequence of the reduction of the water level that reaches earth due to extreme atmospheric conditions which frequently cause water loss via transpiration and evaporation. Generally, water scarcity resulted from either drought or soil salinity influenced crop plant's morphology, physiology and could lead to cellular and organelles deformation. Specific impacts of drought on biochemical and molecular processes lead to stomata closure with consecutive decrease in rates of transpiration, pigment content, photosynthesis, caused protein alterations and ended with growth inhibition.

MATERIAL AND METHODS

All facilities related to study were available at the Experimental Research Student Instructional Farm of S. V. N. University Sagar. Geographically Sagar is located of 23.83^0 N Longitude of 78.71^0 E and above 427 meters sea level. It lies in the sub-tropical regions where wheat is grown in the Rabi seasons. A total dose of 150 kg/ha Nitrogen, 80 kg/ha Phosphorus and 60 kg/ha Potash, through urea.

The experiment consisted of two conditions in main plot, drought (I_0) and irrigated (I_1), two varieties in sub plot (V_1) K-402 and (V_2) K-607, three treatments in sub-sub plot (T_0) control, (T_1) 0.5% potassium nitrate and (T_2) 1.0% potassium nitratefoliar spray at heading stage. These three treatment combinations were replicated in three replications in split-split plot design. Observations were recorded on growth characteristics viz. plant height (cm) and productive tiller per plant at heading stage, yield and yield attributes viz. main spike length (cm), grain number per spike, grain weight per spike (gm) and grain yield per plant (gm). All the data on growth parameter and yield attributes characters were statically analyzed by the methods suggested by Fisher (1937).

RESULTS AND DISCUSSION

The morphological traits were presented by Tables in 1. According to both the years significantly higher plant height was recorded at heading stage. In wheat variety K-607 treated with potassium nitrate at 0.5% and potassium nitrate1.0% plant height was observed 110.5 cm and 107.5cm as compared to control 79.0cm., productive tillers per plant was recorded 21.0 and 19.0 in comparison to control 13.0 and dry matter production was estimated 333.5 and 283.6gm at least to control 116.7gm. These increases may be ascribed to the role of foliar spray with potassium nitrate on increasing photosynthetic activity which accounts much for high translocations of photo assimilates from leaves to the grains. The other studies have shown that the application of potassium fertilizer mitigates the adverse effect of drought on plant growth in faba beans and sugarcane that confirmed results of this study by Sudama*et al*. (1998).

In present study plant height was decreased under water deficit condition; as reported by (Freeha*et al.*, 2011). Plant height may be reduced due to dehydration of protoplasm; decrease in relative turgidity associated with turgor loss and decreased cell expansion and cell division (Pal *et al.*, 2012). During vegetative stage the growth means, the growth of the leaves and tillers mainly, while the stem

Table 1: Effect on foliar application of potassium nitrate on growth parameter.

Treatments		2018-19						2019-20					
		Plant Height (cm)			Productive Tillers/Plants			Plant Height (cm)			Productive Tillers/Plants		
		Control (T_0)	0.5% Potassium nitrate (T_1)	0.1% Potassium nitrate (T_2)	Control (T_0)	0.5% Potassium nitrate (T_1)	0.1% Potassium nitrate (T_2)	Control (T_0)	0.5% Potassium nitrate (T_1)	0.1% Potassium nitrate (T_2)	Control (T_0)	0.5% Potassium nitrate (T_1)	0.1% Potassium nitrate (T_2)
I0	V^1	79.0	87.0	84.0	13.0	15.0	14.0	79.5	87.5	85.0	14.0	16.0	15.0
	V^2	81.7	87.7	83.3	12.0	16.0	15.0	82.0	88.0	84.0	13.0	15.0	14.0
I1	V^1	103.0	107.7	106.7	16.0	20.0	18.0	104.0	108.0	107.0	15.0	19.0	17.0
	V^2	103.0	106.7	110.3	17.0	20.0	19.0	103.5	107.0	110.5	16.0	20.0	18.0
Factors		I	V	T	I	V	T	I	V	T	I	V	T
SE (d)		1.45	1.00	1.83	0.24	0.41	0.72	1.18	0.66	0.44	0.13	0.13	0.16
C.D. at 5%		6.24	NS	5.09	1.04	NS	1.46	5.07	NS	1.22	0.57	NS	0.32

Table 2: Effect on foliar application of potassium nitrate on yield parameter.

		2018-19						2019-20					
Treatments		**Main Spike length (cm)**			**Grain Number/Spike**			**Main Spike length (cm)**			**Grain Number/Spike**		
		Control (T_0)	**0.5% Potassium nitrate (T_1)**	**0.1% Potassium nitrate (T_2)**	**Control (T_0)**	**0.5% Potassium nitrate (T_1)**	**0.1% Potassium nitrate (T_2)**	**Control (T_0)**	**0.5% Potassium nitrate (T_1)**	**0.1% Potassium nitrate (T_2)**	**Control (T_0)**	**0.5% Potassium nitrate (T_1)**	**0.1% Potassium nitrate (T_2)**
I0	V^1	8.5	9.1	8.8	39.9	41.1	40.4	8.7	9.4	9.0	40.0	41.4	40.7
	V^2	8.9	9.5	9.2	40.5	41.9	41.2	9.0	9.6	9.4	40.8	42.2	41.5
I1	V^1	9.8	10.5	10.3	40.9	42.0	41.7	9.9	10.6	10.5	41.2	42.9	42.0
	V^2	9.3	9.9	9.8	40.0	41.4	41.2	9.5	10.3	10.1	40.5	41.8	41.6
Factors		**I**	**V**	**T**	**I**	**V**	**T**	**I**	**V**	**T**	**I**	**V**	**T**
SE (d)		0.22	0.12	0.07	0.19	0.23	0.24	0.09	0.10	0.16	0.04	0.02	0.19
C.D. at 5%		0.95	NS	0.15	NS	NS	0.48	0.41	0.28	0.33	0.17	0.04	0.39

Table 3: Effect on foliar application of potassium nitrate on yield parameter.

		2018-19						2019-20					
Treatments		**Grain Wt./Spike (gm)**			**Grain Wt./Spike (gm)**			**Main Spike length (cm)**			**Grain Yield/Plants (gm)**		
		Control (T_0)	**0.5% Potassium nitrate (T_1)**	**0.1% Potassium nitrate (T_2)**	**Control (T_0)**	**0.5% Potassium nitrate (T_1)**	**0.1% Potassium nitrate (T_2)**	**Control (T_0)**	**0.5% Potassium nitrate (T_1)**	**0.1% Potassium nitrate (T_2)**	**Control (T_0)**	**0.5% Potassium nitrate (T_1)**	**0.1% Potassium nitrate (T_2)**
I0	V^1	2.03	2.15	2.09	4.13	4.36	4.23	2.06	2.18	2.12	4.15	4.40	4.25
	V^2	2.03	2.16	2.10	4.30	4.51	4.41	2.07	2.20	2.15	4.35	4.55	4.45
I1	V^1	2.19	2.55	2.49	4.50	5.26	5.08	2.22	2.60	2.54	4.55	5.30	5.12
	V^2	2.17	2.53	2.47	4.46	5.08	5.03	2.20	2.55	2.50	4.50	5.12	5.08
Factors		**I**	**V**	**T**	**I**	**V**	**T**	**I**	**V**	**T**	**I**	**V**	**T**
SE (d)		0.15	0.19	0.06	0.21	0.31	0.13	0.02	0.02	0.03	0.02	0.04	0.07
C.D. at 5%		NS	NS	0.12	NS	NS	0.26	0.9	NS	0.07	0.09	NS	0.14

elongates very slowly and it gains its maximum height at the time of onset of floral initiation. A possible reason for much reduced plant height with drought at flowering stage than at vegetative or grain filling. The drought affected plant height due to hormonal imbalance (cytokinin, abscisic acid) which effect growth due to changes in cell wall extensibility, reported by (Zhao *et al.*, 2006). The adverse effect of water stress may also be decreased by increasing the availability of water to the plant due to reduction in transpiration by partial closure of stomata (Abida*et al.*, 2013). It has been suggested that plant mineral nutrient status plays a vital role in improving the resistance of plant to stress conditions Nadim*et al.* (2013).

The phenological traits were found non-significantly observed by 0.5% and potassium nitrate 1.0% in this study heading, anthesis and maturity during year 2018-19 and 2019-20. The days to heading stage was recorded in 85.0 and 84.0 as compared to control 74.0 days, the days to anthesis was observed in 92.0 and 90.0 at least control 81.0 days and the days to maturity was recorded in 127.0 and 125 as compared to control 119.0 days. Early physiological maturity was observed when potassium nitrate was applied as foliar spray and delayed physiological maturity, the results showed in previous chapter. The same results were also corroborated in wheat by Lakshman*et al.,* (2005) and Singh *et al.,* (2013).

The data pertaining on yield and its attributes as presented in Tables (in experimental finding) and Figure 5.6.5., revealed that it varied significantly and non- significantly higher in potassium nitrate 0.5% and 1.0% during both the years. The main spike length 10.9 and 10.8 cm and compared to control 8.5cm, grain number per spike 43.8 and 43.0 and least in control 39.9, grain weight spike^{-1} 2.98 and 2.85 g lowest in control 2.03 g, grain yield per plant 5.88 and 5.56 g minimum in control 4.13, test weight 42.92 and 42.60 g at least control 40.13 g, at lowest control 3.667, in minimum drought and maximum in irrigated condition both years of experimentation.The spike length was adversely affected by water deficit between stem elongation and ear formation stage. The reduced ear length at anthesis is due to reduced number of nodes and less node to node distance on the rachis. Moreover it was also observed by **Taban and Erdal (2000)** that under environmental stress conditions the spike length remains stable.

Reduced canopy was developed when crop faced water stress before grain filling or at flowering stage that can be improved by enhancing plant stress tolerance by CMS (cell membrane stability). The decrease in number of spikelet per spike at flowering stage was highest; it may be due to reduced root growth about the time of spike formation that resulted in reduced nutrient uptake. The reduced number of spikelet per year may be due to limited photosynthetic activity before spike emergence because spikelet per spike are determined before spike emergence Drought stress at flowering or grain filling stage adversely affected the plant production by causing drastic decrease in number of grains per spike. The numbers of grains per spike were decreased adversely under water stress. The flowering stage proved to be the most sensitive to water deficit and produced the decreased number of grains per spike and less number of flowers to set seed. The reduced number of grains may be due to low number of spikelet per spike and spike length under drought. Drought stresses either at vegetative or flowering stage considerably decreased grain yield and yield components in wheat. Plant fresh and dry biomass reduced under water deficit conditions. This reduced biomass may create the disorder in the remobilization of the assimilates from source to mature grain (sink) resulted in short and shriveled kernel or it may be due to disturbed grain growth pattern or its improper position between and within the spikelet under drought stress showing assimilate limitation as reported by **Bavita*et al.,* (2015)**.

CONCLUSION

The results summarised as irrigated condition (I_1), variety K-607 (V_2) among varieties, 0.5% potassium nitrate (T_1) among treatments were found significantly superior for most of morphological *i.e.,* plant height (cm), productive tillers plant^{-1}, and yield potential. The summarised as irrigated condition (I_1), variety K-402 (V_1) among varieties, 0.5% potassium nitrate (T_1) among treatments were found significantly superior for most of yield components *i.e.,* main spike length (cm), grain number spike^{-1}, grain weight spike^{-1} (g), grain yield plant^{-1} (g), test weight (g), biological yield plot^{-1}, economical yield plot^{-1}, harvest index (%) after harvesting were examined significant also for irrigated condition (I_1) and 0.5% potassium nitrate (T_3) but variety K-607 (V_2) for yield perpose and other traits in (V_1) K-402 variety during both corresponding years*i.e.,* irrigated (I_1) and drought (I_0) of wheat crop. Next to this were 1.0% potassium nitrate (T_2) *i.e.,* 5.05 and 5.03 g,as compare to control (T_0) *i.e.,* 4.39 and 4.35 g.Among cultivars, maximum responsive was K-607 (V_2) in most of traits and gave significantly higher grain yield 4.80 and 4.76 g minimum in K-402 (V_1) *i.e.,* 4.77 and 4.73 g with both concerning experimental years.

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