Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2582-2845.8831

ISSN: 2582 – 2845

Ind. J. Pure App. Biosci. (2021) *9*(6), 38-42

Indian Journal of Pure & Applied Biosciences

Peer-Reviewed, Refereed, Open Access Journal

Research Article

Effect of Nitrogen and KSB Levels on Growth and Yield of Wheat (*Triticum aestivum* L.)

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Received: 12.10.2021 | Revised: 19.11.2021 | Accepted: 3.12.2021

ABSTRACT

To study the effect of nitrogen and KSB levels on growth and yield of wheat, an experiment was conducted at the Instructional Farm of Department of Agronomy, Faculty of Agriculture, AKS University, Sherganj, Satna (M.P.) during rabi season of 2020-21. The experiment consisted of randomize block design having Factorial arrangement with three replications. In this experiment, 12 treatment combinations including four levels of nitrogen and three levels of KSB were involved such as N_0- 0 kg/ha, N_1- 80 kg/ ha, N_2- 100 kg/ ha and N_3- 120 kg/ha, while KSB levels were tested are K_1- 0.5 lit/ ha, K_2- 1.0 lit/ ha and K_3- 1.5 lit/ ha. Other yield attributes such as Higher plant height (84.09 cm), number of leaves per plant (255.53), number of tillers per meter row length (74.87) at maximum crop growth stage of 90 DAS were also affected favourably and therefor use of nitrogen @ 120 kg/ha.+1.5 lit. of KSB may be concluded for the use in production of wheat crop.

Keywords: *nitrogen, KSB, tillers, spike, test weight.*

INTRODUCTION

Wheat (*Triticum aestivum* L.) is also called as 'King of Cereals'. It is the third most produced cereal after maize and rice in the world. It is the second most important crop grown in India after rice, both in terms of area and production. In India, wheat is grown in an area of 30.79 million hectare with an annual production of about 98.51 million tones and productivity of 3200 kg /ha (Anonymous, 2018). Also, wheat contributes 13.3 % towards national production from 9 % area of the country (Kumar et al., 2012). It is consumed mostly in the form of bread as "Chapati". Wheat straw is used for feeding cattle. It is basically concerned in providing the characteristics substance "Glutin" which is very essential for bakers.

Plant nutrient management is one of the key components of intensive agriculture. Intensive agriculture involves the dwarf varieties of wheat having great potential but due to exhaustive nature they require more nutrients and have posed a great threat to long-term sustainability of crop production.

Cite this article: Kamde, U., & Singh, T. (2021). Effect of Nitrogen and KSB Levels on Growth and Yield of Wheat (*Triticum aestivum* L.), *Ind. J. Pure App. Biosci.* *9*(6), 38-42. doi: http://dx.doi.org/10.18782/2582-2845.8831

Nitrogen is an essential macro nutrient among the fertilizer elements, after nitrogen and if a plant suffers from nitrogen deficiency, it can't produce good yield. Further, only when required amount of nitrogen is supplied, there will be an optimum response to added nitrogen. Nitrogen plays a very important role in plants tissues that are living. No any other element has that tremendous effect on endorsing vital plant growth. Plentiful of protein keeps increasing the span of the leaves, & in like manner to generate carbohydrate synthesis.

In soil, potassium found mostly in soil mineral form (90-98%), which is unavailable to crop. The potassium solubilizing bacteria can made it available by slow solubilization or weathering. Mineral potassium solubilization by microbes which enhances crop growth and yield when applied with a cheaper source of rock potassium; it may be agronomically more useful and environmentally more feasible than soluble potassium. Potassium solubilizing bacteria (KSB) are able to solubilize potassium rock through production and secretion of organic acids (Han & Lee, 2005). Potassium is one of the major nutrients required by all crops and it is found mostly in soil mineral form which can be made available by using K solubilizers. The present study was planned to estimate the exact application rates of nitrogen and KSB and its impact on growth and yield of wheat.

MATERIALS AND METHODS

The experiment was carried out at Instructional Farm, Faculty of Agriculture, AKS University, Satna (M.P.) during *rabi* season of 2020-21. The experiment was conducted in randomize complete block design having Factorial concept with three replications. Different rates of nitrogen and KSB will be allocated to the plots as per treatments. Net plots size was 4.0 x 3.0 m^2. Seed rate used as 100 kg/ha for sowing with 22.5 cm x 5.0 cm distance. The four levels of nitrogen and treatments were N_0- 0 kg/ha, N_1- 80 kg/ ha, N_2- 100 kg/ ha and N_3- 120 kg/ha, while KSB levels were tested are K_1- 0.5 lit/ ha, K_2- 1.0 lit/ ha and K_3- 1.5 lit/ ha. The fertilizers grades were applied as per treatments. Whole dose of P and K was applied as basal dose at the time of sowing. Full recommended dose of phosphorus and potassium at the rate of 60 kg P_2O_5 /ha and 40 Kg K_2O /ha, respectively and half dose of nitrogen (as per treatment) was uniformly applied to each plot (except control plots) as basal dose before sowing. Remaining half dose of nitrogen was applied in two equal splits at 30 and 60 DAS i.e., at tillering and late jointing stage. All the other agronomic practices were applied uniformly to all the treatments.

RESULTS AND DISCUSSION

Data regarding plant height, number of leaves per plant and number of tillers per meter row length at maximum crop growth stage of 90 DAS are reported in (Table 1). Statistical analysis of the data revealed that maximum plant height (81.59 cm), number of leaves per plant (238.89) and number of tillers per meter row length (66.22) at maximum crop growth stage of 90 DAS were recorded with the application of nitrogen @ 120 kg/ha while, lowest values were observed in plot that received no nitrogen. However, application of KSB @ 1.5 lit/ha gave maximum plant height (77.58 cm), number of leaves per plant (191.65) and number of tillers per meter row length (50.77). Whereas, the significantly higher plant height (84.09 cm), number of leaves per plant (255.53), number of tillers per meter row length (74.87) of wheat was recorded under the treatment combination consisting that the treatment combination of nitrogen @ 120 kg/ha with application of KSB @ 1.5 lit/ha.

The growth parameters recorded periodically have exhibited interesting architectural variation due to different concentration of nitrogen. Nitrogen as an essential constituent of protein is associated in all the vital process in the plants, which is taken in inorganic form by crop plants. Therefore, to obtain maximum crop yield, addition of nitrogen in form of chemical fertilizer is important. Nitrogen enhances cell division and elongation, which results in better

vegetative growth while P, improves the root growth and reproduction ability of the crop. On the other hand, increased cell division due to proper availability of nutrients, increased the plant height at later stages of the crop growth. The higher number of tillers associated with optimum levels of NPK fertilizer at later stages might be due to enhanced cell expansion and various metabolic processes in the presence of abundant supply of nutrients which resulted into increased tillering. However, at initial stage these activities were very slow and had a little effect on number of tillers under various levels of NPK fertilizer. Similar findings have been reported by several research workers viz., Kaur and Kumar (2018), Keerthi et al. (2018) and Singh et al. (2019).

The use of potassium solubilizing bacteria (KSB) able to convert insoluble form of soil potassium into soluble form. These potassium solubilizing bacteria are able to solubilize rock potassium through production and secretion of organic acids. They can enhance mineral dissolution rate by producing and excreting metabolic by-products that interact with the mineral surface and these potassium solubilizing bacteria are also capable of solubilizing mineral powder such as mica, illite and orthoclases through production and excretion of organic acids. This might be due to positive effect of potassium which enhances the higher plant growth and canopy due to augment cell division and cell expansion. These results already in agreement with those reported by Gundala et al. 2016, Meena et al. 2014 and Saha et al. 2016.

Data regarding length of spike, number of grains per spike, test weight, grain & stover yield of wheat are reported in Table 1 and maximum values were observed when crop fertilized with increasing rate of nitrogen @ 120 kg/ha as well as KSB application @ 1.5 lit/ha. Statistical analysis of the data revealed that highest length of spike (9.96 cm), number of grains per spike (38.27), test weight (41.79 g), grain yield/ha (49.03 q/ha) and stover yield/ha (76.64 q/ha) recorded under the treatment combination of nitrogen @ 120 kg/ha with application of KSB @ 1.5 lit/ha. While, lowest values were observed in plot that received no nitrogen with application of KSB @ 0.5 lit/ha.

The yield of crop largely depends upon the source-sink relationship i.e. mobilization of photosynthates from the synthesis sites and temporary storage organs towards the developing grains. Availability of essential plant nutrients resulted in a production of superior yield attributes. The higher number of productive tillers were in line with higher number of total tillers, and increase in 1000- grain weight was due to increased accumulation of photosynthates in sink (grain) owing to higher LAI and dry matter production with its translocation to reproductive plant parts (Kumar, 2013). Spike length indicates the number of spikelets, which in return affect the number of grains. Ear differentiation and development would depend on the availability of carbohydrates in the early stages of growth when there was competition with strong sinks like tillers, leaf and stem. The sink capacity of grains is the product of number of grains set and growth characteristics of individual grains (Reddy, 2004). These results are in line with many findings of Mukherjee (2019), Singh et al. (2019) and Amani and Behzad (2020).

Further, increase in grain yield due to KSB application in the soil could possibly be due to its requirement in carbohydrate synthesis and translocation of photosynthesis from source to sink and its involvement in protein and fat synthesis which increases yield. Similar observations were also recorded by Basak and Biswas (2010) and Min et al. (2013).

Potassium is a major plant nutrient which his absorbed by plants and its significant place for the production of high yield. The increase in yield might be due to the solubilization of nutrients in the soil by producing organic acids by potassium solubilising bacteria (KSB). These findings are in close agreement with the results obtained by Goud et al. (2014) and Kumar et al. (2014).

Table 1: Effect of Nitrogen and KSB Levels on Growth and Yield of Wheat

Treatment	Plant height (cm)	Number of leaves per plant	Number of tillers/ m row length	Length of spike (cm)	Number of grains per spike	Test weight (g)	Grain yield (q/ha)	Stover yield (q/ha)
	Effect of nitrogen							
N_0	69.68	117.11	28.82	3.16	27.27	32.80	26.84	43.74
N_1	74.72	159.71	39.27	5.34	33.49	35.44	38.78	57.55
N_2	77.68	197.93	49.47	6.90	35.78	37.63	44.00	66.94
N_3	81.59	238.89	66.22	8.98	37.51	39.94	47.51	75.18
S. Em±	0.94	3.77	2.15	0.37	0.71	0.62	0.90	0.84
CD(P=0.05)	2.77	11.05	6.31	1.08	2.08	1.83	2.65	2.47
	Effect of KSB							
K_1	74.02	163.60	41.02	5.43	30.85	35.47	35.50	56.06
K_2	76.15	179.98	46.05	6.16	34.33	36.43	40.61	61.66
K_3	77.58	191.65	50.77	6.69	35.35	37.46	41.74	64.85
S. Em±	1.09	4.35	2.48	0.43	0.82	0.72	1.04	0.97
CD(P=0.05)	3.19	12.76	7.28	1.25	2.40	2.12	3.06	2.85
	Interaction effect between nitrogen and KSB							
N_0K_1	66.45	96.73	23.93	2.71	18.40	31.90	18.89	40.15
N_0K_2	73.18	147.20	36.53	4.39	32.73	34.36	33.50	46.31
N_0K_3	76.85	185.13	46.33	6.56	35.33	36.62	43.61	63.41
N_1K_1	79.60	225.33	57.27	8.07	36.93	39.00	46.00	74.35
N_1K_2	70.68	125.33	29.53	3.30	31.27	33.01	30.53	45.45
N_1K_3	75.06	155.67	38.47	5.45	33.20	35.68	40.56	63.06
N_2K_1	77.81	203.13	49.67	6.97	35.53	38.00	43.86	63.57
N_2K_2	81.06	235.80	66.53	8.90	37.33	39.02	47.50	74.56
N_2K_3	71.93	129.27	33.00	3.45	32.13	33.49	31.11	45.63
N_3K_1	75.93	176.27	42.80	6.17	34.53	36.28	42.28	63.28
N_3K_2	78.38	205.53	52.40	7.16	36.47	38.26	44.53	73.85
N_3K_3	84.09	255.53	74.87	9.96	38.27	41.79	49.03	76.64
S. Em±	0.54	2.18	1.24	0.21	0.41	0.36	0.52	0.49
CD(P=0.05)	1.13	4.51	2.57	0.44	0.85	0.75	1.08	1.01

CONCLUSION

Based upon this experiment it is concluded that the application of nitrogen @ 120 kg N/ha with KSB application @ 1.5 lit/ha recorded the maximum and significantly higher grain yield (49.03 q/ha), gross return (₹ 159365.00/ ha), net returns (₹ 132380.00/ ha) as well as highest B: C ratio of 4.91: 1. Hence, it can be concluded that the application of nitrogen @ 120 kg N/ha with KSB application @ 1.5 lit/ha with B:C ratio >4.5, can be used as a remunerative strategy.

Acknowledgment

First authors is thankful to Dr. T. Singh Prof and Head Agronomy, for very kindly providing all the experimental facilities and suggestions for successful conduct of the experiment and preparation of manuscript.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Conflict of Interest

The author(s) declares no conflict of interest.

Author Contribution

All authors contributed equally to establishing the topic of the research and design experiment.

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