YIELD AND YIELD ATTRIBUTES OF WHEAT AS INFLUENCED BY POTASSIUM APPLICATION IN IRRIGATED AREA OF AGRO ECOLOGICAL ZONE OF KAROR, PAKISTAN

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ABSTRACT; *Potassium (K) deficient soils of Pakistan are the foremost reason for the truncated yield of wheat.* ***.*** *Application of the recommended dose of K to get potential yield is a sustainable strategy to combat this issue. The present experiment was conducted to investigate the effect of Potassium (K) on the yield and yield factors of the wheat cultivar Shafaq-2008. This study, binge over the gap between the optimum level of K fertilizer and the wheat variety. By using Randomized Complete Block Design (RCBD), thrice replicated treatments K0:0 (control), K1:15, K2:30 and K3:45 Kg K ha^{-1}were tested. Results revealed that the highest grain yield of wheat was recorded as 4412.70 kg/ha with a dose of 45 Kg K ha^{-1}. Furthermore, 51.58 percent of the increased yield was observed as compared to control (3885.40 Kg K ha^{-1}) where no fertilizer was applied.*

Key Words: Wheat, potash, irrigated area, yield parameters, arid.

1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is an important food grain among all cereals in the world. It prevails the highest rank in world cereal production and meets the requirement of above one-third population of the globe. In Pakistan, wheat cultivation occupies the largest area (about 8.5 million hectares) during Rabi season, the majority of which is grown in Punjab [1].

Gradually expansion in population enhancing greater pressure on wheat consumption but the productivity of the wheat is low in Pakistan as compared to the rest of the world's average. This yield gap can be minimized by increasing per acre yield of the wheat.

Various factors are responsible for low yield of wheat but deprived crop nourishment keeps dominating the place. Fertilizers play a key role in boosting yield and advance the quality of the crop. Potassium (K) is one of the three essential macronutrients required for plant growth. Generally, deficiency of the potassium (> 35percent) in soils of Pakistan is reported which is shocking to the future [2]. Potassium deficiency in wheat causes many problems and shows symptoms of deficiency in plant growth, such as increased lodging of wheat straw and decreased growth [3].

Potassium fertilizer improves the photosynthesis and efficiency of water in plants [3]. It also enhances the biochemical procedures of the plant viz; protein synthesis, enzyme activation, carbohydrates and fats production, resistance to frost, improving tolerance against stress, disease, and pest attacks and lodging. [4,5,6] concluded that K application plays a pivotal role in the increase in plant height, number of tillers, 1000 grain weight, number of grains per spike, and grain yield of weight.

Keeping in view the importance of the fertilizer in wheat production, the present study was conducted to evaluate the effect of different k doses on the yield and yield parameters of weight under the irrigated area of the Karor district Layyah, Pakistan.

MATERIALS AND METHODS

The present experiment was conducted at the agro-ecological zone of Karor, district Layyah (Pakistan) during 2016-17. This region lies where annual rainfall receiving is below 25mm. Table 1 shows maximum and minimum temperate and rainfall records during the study period. Soil analysis portrays the land as sandy loam in texture (8.3pH), 0.42 percent organic matter, 6.00 ppm Phosphorus and 68 ppm Potash.

Randomized Complete Block Design (RCBD), with thrice replications, was employed. The plot size was 8.5m x 20.0m. Four different doses of potassium with one control treatment (no fertilizer applied) were used in the experiment. The potassium doses were K0:0 (control), K1:15Kg K ha^{-1}, K2:30 15Kg K $ha^{-1,}$ and K3:45 Kg K ha^{-1}were tested. The wheat cultivar (Shafaq-2008) was cultivated on well-developed seedbed during 1st week of November.

Potash and Phosphorus were applied at the time of seedbed preparation with ¼ application of Nitrogen. A leftover similar strip of Nitrogen was top-dressed with initial three irrigations. Source of Potash, Nitrogen, and Phosphorus was Single Super Phosphate (P_2O_5 18 percent), urea (46 percent N) and Sulphate of Potash (K_2O 50 percent) respectively. The crop was cultivated with a single-handed drill by maintaining line to line distance. Throughout the crop, period recommended production, as well as protection technology measures of Standard Wheat Management (SWM), were followed. Data recorded was germination, number of grain per spike, 1000 grain weight, and grain yield.

The data was undergone by statistical analyzed for the Analysis of Variance (ANOVA) [7] using statistical software Statistix version 8.1 (Analytical Software © 1985-2005). Least Significant Difference (LSD) test was employed to separate the treatment means at α=5 percent.

TABLE-1. Soil analysis report

EC	1.14 ds/m
Soil pH	8.3
Organic matter	0.42 %
Available phosphorus	6.00 ppm
Available potassium	68 ppm
Texture	Sandy Loamy

TABLE-2. Metrological data during crop period of the Experimental Area

Month	Tem. Min. (^{0}C)	Tem. Max. (^{0}C)	R.H (%)	Rain fall (mm)
Nov-2016	11.30	28.20	62.00	---
Dec-2016	06.00	22.00	82.00	---
Jan-2017	04.60	18.20	83.70	---
Feb-2017	08.50	23.13	84.40	13.50
Mar-2017	14.50	30.00	64.80	2.00
Apr-2017	24.20	34.90	63.00	20.00

RESULTS AND DISCUSSION

1. Germination (m^{-2})

Germination count is an important parameter affecting crop yield. The data (Table 1) showed that potassium fertilizer had a significant effect on wheat germination ($P < 0.05$). The maximum germination (171.67) was recorded from the treatment of 45 kg ha-1 K, which is statistically at par to the level of 30 kg ha-1 K. The lowest germination rate was observed where K application was absent. These results are consistent with the results obtained from Ojha and [5,8,9].

2. Productive Tillers (m^{-2})

Data of productive tillers (m^{-2}) (Table 1) showed that different levels of potassium were found to be significant ($P < 0.05$). When 45 Kg ha-1 K is applied, the maximum numbers of tillers (245) were obtained. By producing 242.67 tillers (m^{-2}), this result is statistically comparable to a fertilizer level of 30 Kg ha-1. In the absence of potassium, the minimum numbers of tillers m-2 (237) were obtained from the control treatment. These results were in line with [10, 11,12].

3. Number of grains Spike-1

The data for the number of grains per spike listed in Table 1 indicate that compared with other fertilizer levels, the number of grains per spike (44.67) produced by the fertilizer level 45Kg K ha-1 was significantly higher. The fertilizer level of 30 Kg ha-1 was statistically similar to that of treated K_2, producing 43.33 grains spike. The average value of different fertilizer levels for grains spike was significantly different. The least fertilized control recorded the lowest number of grains spike (37.66). Results consistent with these results were reported by [13,15,16,18] indicating a maximum number of grain per spike after using K fertilizer.

4. 1000- grains weight (g)

1000 grain weight (g) is an important yield-contributing parameter for cereal crops. The data for 1000 grain weights described in Table 1 indicate a significant ($P < 0.05$) effect of K fertilizer levels on 1000 grain weights. When the fertilizer level is 45 Kg K ha-1, the maximum grain weight was 44.33 g, which was higher than all other treatment methods, but the statistical yield was 42.66 g, which was equal to the fertilizer level of 30 K Kg ha-1. Minimum grain weight (37 g) was observed when no fertilizer was applied. An increase in 1000 grain weight was also conveyed by others [13,18,19,20].

5. Grain Yield (Kg ha^{-1})

The data regarding grain yield (Table 1) indicated a significant (P<0.05) difference among treatments. The highest wheat grain yield (4412.70 Kg ha^{-1}) was obtained where 45 Kg ha^{-1} K was applied. The lowest grain yield of 3885.40 Kg ha^{-1} was obtained from control (without K fertilizer). Others [14,18,21], also reported an increase in grain yield with an increase in K fertilizer levels.

TABLE-1: Influence of potash application on different yield parameters of wheat

Potash application (K)	Crop parameters				
	Germination (m^{-2})	Productive tillers (m^{-2})	No. of grains spike^{-1}	1000 grains wt. (g)	Grain yield (kg ha^{-1})
K_0 (Control)	154.00 c	237.00 c	37.66 c	37.00 c	3885.40 d
K_1 (15kg ha^{-1})	162.00 bc	240.33 b	41.66 b	40.50 b	4054.70 c
K_2 (30kg ha^{-1})	167.67 ab	242.67 ab	43.33 ab	42.66 ab	4230.00 b
K_3 (45kg ha^{-1})	171.67 a	245.00 a	44.67 a	44.33 a	4412.70 a
Means	163.84	241.25	41.83	41.12	4162.38
LSD value (0.05%)	8.34	2.68	2.51	2.54	173.66

The means in columns bearing the same letters do not differ significantly (p<0.05)

6. 1000-grain weight correlation with Potash Levels

Graphical representation exhibited a significant difference (P<0.05) for 1000 grains weight and grain yield recorded in all the treatments over control in Wheat. To produce a maximum of 1000 grain weight, 45 Kg of potassium ha^{-1} was sufficient. The said rate of K showed a gradual increase in the tested wheat genotype. These results concluded that 45 kg K ha^{-1} was an economical level to maximize the productivity of Wheat. Different studies highlighted the significance of K fertilizer as a yield enhancer of wheat, plays an imperative role in photosynthesis, osmoregulation, stomatal opening and closing, transpiration and synthesis of protein [2,20, 21,22, 26]. Growth of the crop may be disturbed when K fertilized is applied ineloquently [25]. While the increase in yield attributes by K fertilizer in 1000 grain weight of wheat are inconsistent with many others [24]. In appropriate response of wheat genotype beyond 45 kg might result in a disturbed balance of nutrient proportions or due to potential nutrients [17].

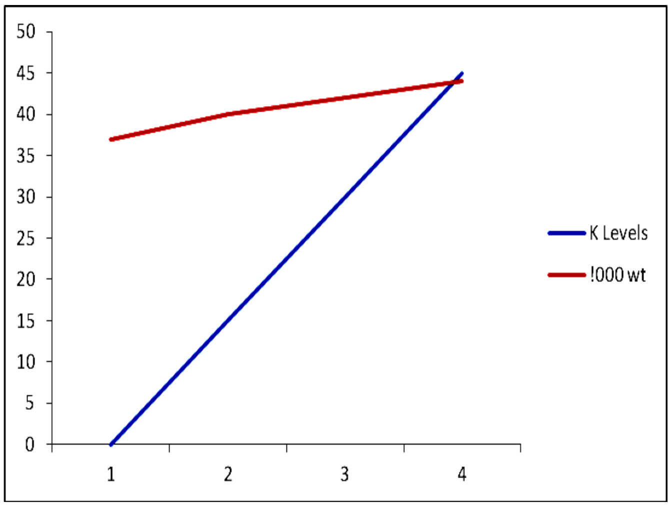

Figure 1: 1000-Grains weight correlation with K levels

CONCLUSION

The conclusion made from this experiment that different fertilizer levels responded significantly to the wheat variety Shafaq, 2008. By the increase of K beyond a certain level (K3) resulted in increased plant yield. It was also observed that 45 kg K ha^{-1} is an ideal dose to get potential yield for wheat under the irrigated agro-ecological conditions prevailing Karor zone.

REFERENCE

[1] Hashmi, A.A. and Shafiullah. 2003. NASSD background Paper: Agric. security IUCN Pakistan, northern areas program, Gilgit., 136pp.

[2] Akhtar, M. E., A. Sardar, M. Ashraf, M. Akhtar and M. Z. Khan. 2003. Effect of potash application on seed cotton yield and yield components of selected cotton varieties. Asian J. Plant Sci., 2: 602-604.

[3] Ross, M. K. 2001. Potassium as fertilizer for plants. J. Plant Nutr., 425-433.

[4] Marschner, H. 1995. Mineral nutrition of higher plants. 2nd edn. London: Academic Press.

[5] Cakmak, I. 2005. The role of potassium in alleviating the detrimental effects of abiotic stresses in plants. J. Plant Nutr. Soil Sci., 168: 521-530.

[6] Malghani, A. L., A. U. Malik, A. Sattarb, F. Hussaina, G. Abbasc and J. Hussain. 2010. Response of growth and yield of wheat to NPK fertilizer. Sci. Int. (Lahore), 24(2): 185-189.

[7] Steel, R. G. D., J. H. Torrie and D. A. Dickey. 1997. Principles and Procedures of Statistics. A Biometrical Approach, 3rd Ed. McGraw Hill Book Co., New York.

[8] Milford, G. F. J. and A. E. Johnston. 2007. Potassium and nitrogen interactions in crop production. Proceedings No. 615, International Fertiliser Society, York, UK.

[9] Arif, M., M. Arshad, H. N. Asghar and S. M. A. Basra. 2010. Response of rice (*Oryza sativa*) genotypes varying in K use efficiency to various levels of potassium. Int. J. Agric. Biol., 12: 926-930.

[10] Dunn, D. and G. Stevens. 2005. Rice potassium nutrition research progress (Missouri). Better Crops, 89: 15-17.

[11] Bahmaniar, M. A. and G. A. Ranjbar. 2007. Effects of nitrogen and potassium fertilizers on rice (*Oryza sativa* L.) genotypes processing characteristics. Pakistan J. Biol. Sci., 10: 829-1834.

[12] Damon, P. M. and Z. Rengel. 2007. Wheat genotypes differ in potassium efficiency under glasshouse and field conditions. Aust. J. Agric. Res., 58: 816-823.

[13] Ali, A., M. A. Choudhry, M. A. Malik, R. Ahmad and Saifullah, 2000. Effect of various doses of nitrogen on the growth and yield of two wheat (*Triticum aestivum* L.) cultivars. Pakistan. J. Biol. Sci., 3: 1004-5.

[14] Ali, A., M. S. Zia, F. Hussain, M. Salim, I. A. Mahmood and A. Shahzad. 2005. Efficacy of different methods of potassium fertilizer application on paddy yield, K uptake and agronomic efficiency. Pakistan J. Agric. Sci., 42: 27-32.

[15] Steingrobe, B. and N. Claassen. 2000. Potassium dynamics in the rhizosphere and k efficiency of crops. J. Plant Nutr. Soil Sci., 163: 101-106.

[16] Awan, T. H., Z. Manzoor, M. E. Safdar and M. Ahmad. 2007. Yield response of rice to dynamic use of potassium in traditional rice growing area of Punjab. Pakistan J. Agric. Sci., 44: 130-135.

[17] Awan, K. H., A. M. Ranjha, S. M. Mehdi, M. Sarfraz and G. Hassan. 2003. Response of rice line PB-95 to different NPK levels. J. Biol. Sci., 3: 157-166.

[18] Khan, A. and M. Aziz. 2013. influence of foliar application of potassium on wheat (*Triticum aestivum* L) under saline conditions. Sci., Tech. and Dev., 32 (4): 285-289.

[19] Hermans, C., J. P. Hammond, P. J. White and N. Verbruggen. 2006. How do plants respond to nutrient shortage by biomassallocation? Trends Plant Sci., 11: 610-617.

[20] Pettigrew, W. T. 2008. Potassium influences on yield and quality production for maize, wheat, soybean and cotton. Plant Physiol. 133:670-681.

[21] Safaa, R., L. El, T. Magdi, H. Abde and R. Fatma. 2013. Effect of Potassium Application on Wheat (*Triticum*

aestivum L.) Cultivars grown under salinity stress. World Appl. Sci. J., 26(7): 840-850.

[22] Rehman, O., M. A. Zaka, H. U. Rafa and N. M. Hassan. 2006. Effect of balanced fertilization on yield and phosphorus uptake in wheat-rice rotation. J. Agric. Res., 44: 105-112.

[23] Jabbar. A., T. Aziz, I. H. Bhatti, Z. A. Virk, M. M. Khan and Wasl-u-Din. 2009. Effect of potassium application on yield and protein contents of late sown wheat (*Triticum aestivum* L.) under field conditions. Soil Environment. 28(2): 193-196.

[24] Horie, T., T. Shiraiwa, K. Homma, K. Katsura, Y. Maeda and H. Yoshida. 2004. Can yields of lowland rice resume the increases that they showed in the 1980s. “New Directions for a Diverse Planet” Proc. Of the 4th International Crop Science Congress, 26th Sep-1st Oct, 2004. Brisbane, Australia.

[25] Hussain, M. I., shamshad h. Shah, sajjad hussain and khalid iqbal. 2002. Growth, yield and quality response of three wheat (*Triticum aestivum* L.) varieties to different levels of N, P and K, Int. J. Agri. Biol., 4(3): 362-364.

[26] Mengel, K. and E. A. Kirkby. 2001. Principles of Plant Nutrition. 5th ed., Kluwer Academic Publishers, Dordrecht.