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Response of Wheat to Applied Soil Potassium

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Abstract: Response of wheat to applied potassium was studied on Peshawar valley soil. Different levels of potassium @ 0, 30, 60, 90, 120 and 150 kg K_2O ha^{-1} along with a basal dose of nitrogen and phosphorus @ 150 kg N and 100 kg P_2O_5, respectively were applied to wheat. Results showed that yield and yield components of wheat were not significantly affected with potassium fertilization, because the test soil had already sufficient potassium for plant growth and might be some of K^+ released from non-exchangeable sources. However, 60 kg K_2O ha^{-1} gave maximum fresh, dry, straw and grain yields and indicated initial level of K_2O supplemented with 60 kg K_2O ha^{-1} was sufficient for maximum yields of wheat for the test soil. Potassium uptake by leaves and potassium content of soils at pre heading and post harvesting stages was significantly increased in a linear fashion with increasing applied potassium levels in soil.

Key words: yield, yield components, potassium uptake, exchangeable K^+, non-exchangeable K^+

Introduction

Potassium plays an important role in the growth and development of crops. In Pakistan due to intensive cropping system, use of high yielding cultivars and unbalanced use of nitrogen and phosphorus lack of potassium is increasing and now becoming a limiting factor on soils that were previously considered to have sufficient potassium. Most of Pakistani soils are considered sufficient in potassium (Bajwa and Rehman, 1996) but the problem with potassium is not its total supply but its availability to crops and it becomes necessary to supplement it with the commercial fertilizers (Rehman *et al.*, 1982). In the literature the release and fixation of potassium and contribution of non-exchangeable sources to its bioavailability have been reported for potassium responsive soils (Ganeshamurthy and Biswas, 1985 and Rao *et al.*, 1993) but very few studies have been reported for calcareous, alkaline and semi-arid soils like that of NWFP where responses to potassium are seldom observed due to native high exchangeable potassium levels (Perveen *et al.*, 1992; Bajwa and Rehman, 1996). Keeping in view the importance of potassium, the experiment was carried out to study the response of wheat to applied potassium on Peshawar valley soils, so as to get an optimum level of potassium for wheat crop.

Materials and Methods

A field experiment was carried out to test the response of wheat to applied potassium at NWFP Agricultural University, Peshawar. Wheat CV. *Sonalika* was sown in each 5 x 3m^2 treatment plot with 3 replications employing Randomized Complete Block Design. Different levels of potassium @ 0, 30, 60, 90, 120 & 150 kg K_2O ha^{-1} were applied along with a basal dose of nitrogen (150 kg N ha^{-1}) and phosphorus (100 kg P_2O_2 ha^{-1}) as potassium sulphate, urea and single superphosphate, respectively. Half of nitrogen and full dose of phosphorus and potassium were applied at sowing time, while the remaining half nitrogen was applied at knee high stage. Before sowing, a composite soil sample from 0-25 cm depth was collected for the determination of physico-chemical properties of the experimental site. Soil samples were also collected from each treatment plot to estimate the available K^+ (Knudsen *et al.*, 1982) at pre heading and harvesting stages. Similarly, the upper most four leaves were collected randomly from each treatment plot at pre heading stage to determine the K^+ concentration in leaves using wet acid digestion method (Isaac and Kerber, 1971). All the data collected during field and laboratory studies were statistically analyzed and the means were compared by New Duncan's Multiple Range test of significance (Steel and Torrie, 1980).

Results and Discussion

The soil of the experimental site was silty clay loam, moderately calcareous, low in organic carbon, alkaline in reaction, non saline in nature and adequate in exchangeable K^+ (Table 1).

Yield and yield components: Results showed that the yield and yield components of wheat are non-significantly affected with the application of potassium (Table 2). Comparing the influence of different potassium levels on the yield and yield components, it was found that 60 kg K_2O ha^{-1} produced maximum fresh matter, dry matter, straw and grain yields than other levels of potassium. Similar results were reported by Perveen *et al.* (1992). The reasons for the ineffectiveness of applied potassium may be attributed to the sufficient initial exchangeable K^+ content of test soil. The non significant response of wheat to potassium is further supported by high K status of soils (Khattak and Bhatti, 1982-86) according to them if initial soil level K^+ is higher than 114 mg kg^{-1} response to applied potassium will seldom occur. The soil under study contained more than 114 mg kg^{-1} exchangeable K^+ and this might explain the non-significant response of wheat to the addition of potassium fertilizer. Secondly, no or little response to applied potassium might be due to high buffering capacity of the test soil to meet the potassium demand of wheat crop. This speculation is supported by the amount of K^+ contributed to plant requirements by the non-exchangeable K^+ (Havlin and Westfall, 1985).

Potassium concentration in soils and leaves: Potassium concentrations of soil at pre heading and harvesting stage were significantly affected by potassium fertilization (Table 3). The K^+ concentrations in soil at both stages were linearly increased with each increment of potassium application. These results are in agreement with the findings of Lixandru *et al.* (1979) and Perveen *et al.* (1992). Results also showed that the concentrations of K^+ in soil at pre heading stage were more than the harvesting

Table 1: Physico-chemical properties of test soil

Properties	Values
Clay (%)	35.0
Silt (%)	50.0
Sand (%)	15.0
Textural class	silty clay loam
$CaCO_3$ eq %	12.75
pH_s (1:5)	08.20
EC_s (1:5) at 25 °C dS m^{-1}	00.25
Organic C %	00.72
Exchangeable K mg kg^{-1}	140.0

Table 2: Effect of applied potassium (kg ha^{-1}) on the yield and yield components (kg ha^{-1}) of wheat

K_2O	Fresh matter	Dry matter	Straw	Grain
0	15833	10221	2867	7350
30	16283	10500	2883	7617
60	16700	10833	2933	7900
90	16583	10723	2917	7800
120	16333	10583	2905	7650
150	16333	10567	2900	7667

Table 3: Effect of applied potassium (Kg ha^{-1}) on the concentration of K^+ in soils and leaves of wheat

K_2O	K in soil at pre-heading stage (mg Kg^{-1})	K in soil at harvesting stage (mg Kg^{-1})	K in leaf at pre heading stage (g kg^{-1})
0	129.0f	097.7f	18.0f
30	145.3e	128.3e	20.7e
60	164.3d	144.0d	22.2d
90	186.7c	146.0c	23.4c
120	206.7b	160.3b	24.0b
150	227.3a	175.0a	25.2a

Means followed by different letter (s) are significant at 1% level of probability

stage, because at latter stage the wheat utilized K^+ .

Potassium concentrations of wheat leaves at pre heading stage were also significantly affected (Table 3) and showed a linear increase with increasing the potassium application, indicating K^+ concentration of plant was function of applied soil K^+. These results are supported by the previous work of Lixandru *et al.* (1979) and Perveen *et al.* (1992). They reported that K^+ concentration of leaf was directly related to the rate of applied potassium.

It can be concluded from the overall results that the test soil had already sufficient potassium for plant growth though the effect was statistically non-significant, yet 60 kg K_2O resulted maximum yield.

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