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Original Research Article

Effect of Potassium and Manganese of Yield and Uptake of Nutrients by Wheat (*Triticum aestivum* L.)

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Keywords

Potassium, Manganese, Yield and uptake, Nutrients

A B S T R A C T

A field experiment was conducted to study the effect of potassium and manganese on yield and their uptake by wheat. The soil application of K_2O @ 90 kg ha-^{1} and 20 kg ha-^{1} manganese as manganese chloride is recommended to the farmers for getting better production of wheat crop. Application of potassium improved the content and uptake of nitrogen, phosphorus, potassium and manganese by wheat crop. Similarly the content and uptake of these nutrients increased with higher level of manganese application.

Introduction

Potassium and Manganese are the principal plant nutrients normally used for wheat fertilization. Potassium is an indispensable nutrient and plant needs quite large quantities of it. Potassium helps in translocation of metabolites from vegetative parts to reproductive ones, increase plant resistance to drought and frost. The plant taken up about same amount of potassium as nitrogen or even more. Manganese one of the essential micronutrients is involved in plants respiratory process such as oxidation of carbohydrates to carbon dioxide and water. It activates the enzyme which is directly involved in the synthesis of chlorophyll. The deficiency of manganese under semi-arid climate has emerged as a serious limitation to crop production. Manganese deficiency is being widely expressed in the light textured soils. The soils of Agra region vary in texture form sandy to clay loam, alluvial in nature, low in organic carbon content and generally quite low in fertility status. All these factor lead to the deficiency of manganese and other nutrients in soils, crops grown on these soils invariably suffer from nutritional disorders (N, Ca, Mn and Na toxicity) resulting in lower yields. The investigation was therefore, undertaken to study the effect of different doses of Mn along with K on yield, nutrient uptake by wheat.

Materials and Methods

The field experiments were conducted at the research farm of R.B.S. College, Bichpuri,

Agra during rabi of 2016-2017. The soil used in the experiment was sandy loam in texture having pH(1:2.5 soil water suspension) 8.2, organic carbon (%) 0.44, available N 173.20 (kg ha-^{1}), P 9.8 (kg ha-^{1}), K 90.5 (kg ha-^{1}) and Zinc 0.52 (ppm). The treatments consisted of four level of each of K (0,30,60 and 90 kg ha-^{1}) and Mn (0,5,10 and 20 kg ha-^{1}) in combination. These treatment combinations were replicated thrice in randomized block design. Variety of wheat crop is LOK-1. Potassium was given through muriate of potash and manganese was given through $MnCl_2$. The basal dressing of nitrogen and phosphorus was applied to every plot through urea and single super phosphate, respectively. The wheat crop was grown up to maturity. After harvesting the plants sample were first dried in the sun finally in over at 70^0 C. After grinding in a Wiley mill, the sample was stored in wide mouth glass stopped bottle with proper labeling. N content analyzed by Snell and Snell (1955), P by Jonson and Ulrich (1959), K by flam photometer, Mn by atomic absorption spectrometer.

Results and Discussion

The grain and straw yields of wheat increased significantly with potassium application over control (Table-1). The percent increases in grain yield over control were 15.09 , 20.0 and 23.39 for 30 , 60 and 90 kg ha-^{1} respectively. The corresponding figures for straw yield were 16.14, 20.96 and 27.47 percent over control. Similar results were observed by Chandel (2010).

Application of manganese to the soil enhanced the grain yield of wheat by 14.50, 22.90 and 27.86 % for 5, 10 and 20 Mn kg ha-^{1}, respectively. The corresponding figures for straw yield were 16.27, 20.67 and 31.60 % over control respectively. These results are in favour of Mishra (2006), Chandel (2010).

Nitrogen content of wheat significantly affected by the doses of potassium. The K_3 level of potassium proved better in case of nitrogen content of wheat. It is also clear that nitrogen content of wheat increased with increasing doses of potassium. These results are in favour Kumar (2008). It might be due greater availability if nutrients under adequate supply of available nutrients by potassium application. The beneficial influence of applied potassium has been reported by Nayak (2006).

Table-2 indicates that the manganese levels significantly affect the nitrogen content of wheat. However, the nitrogen content of wheat increased with increasing levels of manganese as compared to each preceding lower level of manganese. The maximum nitrogen content of wheat was noted with highest level of manganese (20 kg ha-^{1}). Similar results were reported by Kumar (2008).

It is evident apparent from table-2 that phosphorus of wheat increased significantly with application of potassium over control, similar to these findings Singh (2009) Verma (2010). A perusal of data given in table-2 indicated that the phosphorus content of wheat increased significantly with increasing levels of manganese in comparison to control. The significant higher potassium content was observed at highest level of Mn_3 (20 kg ha-^{1}) over control. Similar results were reported by majority of worker such as Mishra (2006) Singh (2007). K_3 gave significantly better response over K_0 (control) with respect of potassium content of wheat. Further the table-2 shows that the potassium content of wheat increased significantly with increasing levels of potassium tried in the present investigation. Similar findings were also reported by Nayak (2006). Each higher level

of manganese significantly resulted higher potassium content of wheat in comparison to preceding lower levels of manganese. The maximum potassium content was noted at highest levels of manganese Mn_3 @ 20 kg ha-^{1}. There findings are in accordance with those Singh (2009) and Chauhan (2011).

An evaluation of data given in table-2 that the highest level of potassium (K_3) proved more significantly beneficial over K_0(control) in case of manganese content of wheat during throughout the experimentation, similar results were also reported by Mishra (2006). Manganese composition of wheat significantly enhanced with increasing levels of manganese as compare to control. It is also evidence that each higher level of manganese resulted significantly higher manganese content of wheat in comparison to preceding lower levels of manganese. The maximum enhancement in manganese content was noted at higher Mn_3 (20 kg ha-^{1}) level of manganese. Similar findings were also reported by Singh (2007), Chandel (2010).

The uptake of nitrogen by wheat crop increased significantly with increasing levels of potassium. The potassium level K_3 @ 90 kg ha-^{1} significantly increased the highest nitrogen utilization by wheat crop. Similarly Mn application has a beneficial effect on N uptake. The maximum significantly enhancement in nitrogen uptake by wheat crop was recorded at highest level of manganese Mn_3 @ 20 Kg ha-^{1}. Similar results were observed by Singh *et al.*, (2009), Verma et al.,(2010), Chauhan (2011) and Lal *et al.*, (2012) reported that the application of nitrogen @ 120 kg ha^{-1} significantly higher nutrients content and their uptake by oat crop.

Table.1 Effect of K and Mn levels on grain and straw yield (t ha-^{1}) of wheat

Treatment	Grain yield	Straw yield
Potassium levels		
K_0	2.55	3.40
K_1	2.95	3.97
K_2	3.10	4.15
K_3	3.15	4.35
S.EM+-	0.024	0.048
C.D. at 5%	0.07	0.14
Manganese levels		
Mn_0	2.60	3.40
Mn_1	2.98	4.00
Mn_2	3.20	4.19
Mn_3	3.31	4.50
S.EM+-	0.38	0.69
C.D. at 5%	0.11	0.20

Table.2 Effect of K and Mn levels on nitrogen, phosphorus, potassium (%)and manganese content (ppm) of wheat

Treatment	Nitrogen		Phosphorus		Potassium		Manganese	
	Grain	straw	Grain	straw	Grain	straw	Grain	straw
Potassium levels								
K_0	2.38	0.401	0.54	0.041	0.41	1.49	12.2	10.6
K_1	2.53	0.430	0.56	0.046	0.48	1.85	14.1	12.2
K_2	2.65	0.458	0.59	0.051	0.52	2.16	16.6	13.6
K_3	2.86	0.469	0.63	0.054	0.58	2.44	20.3	16.4
S.EM+-	0.052	0.0031	0.59	0.0010	0.010	0.076	0.65	0.54
C.D. at 5%	0.15	0.009	0.17	0.003	0.03	0.22	1.88	1.55
Manganese levels								
Mn_0	2.38	0.398	0.53	0.042	0.41	1.49	12.6	10.9
Mn_1	2.52	0.430	0.57	0.046	0.49	1.88	14.9	12.1
Mn_2	2.66	0.454	0.61	0.050	0.54	2.18	18.0	13.4
Mn_3	2.82	0.464	0.65	0.56	0.60	2.50	20.3	15.1
S.EM+-	0.041	0.002	0.76	0.0006	0.010	0.087	0.59	0.47
C.D. at 5%	0.12	0.007	0.022	0.002	0.03	0.25	1.70	1.35

Table.3 Effect of K and Mn levels on nitrogen, phosphorus, potassium (kg ha^{-1})and manganese uptake (g ha^{-1}) by wheat

Treatment	Nutrients Uptake			
Potassium levels	Nitrogen	Phosphorus	Potassium	Manganese
K_0	74.63	15.16	51.33	34.04
K_1	91.70	18.07	68.63	48.43
K_2	101.15	20.40	84.90	54.44
K_3	110.49	22.18	105.90	71.34
S.EM+-	0.54	0.118	3.05	0.019
C.D. at 5%	1.55	0.340	8.77	5.50
Manganese levels				
Mn_0	75.41	15.20	54.05	39.52
Mn_1	92.29	18.82	73.05	50.75
Mn_2	104.12	21.61	95.04	58.78
Mn_3	114.22	24.03	110.86	70.99
S.EM+-	0.48	0.133	3.53	2.17
C.D. at 5%	1.38	0.384	10.15	6.25

The potassium levels significantly increased the phosphorus uptake by wheat crop. The highest level of K_3 (90 kg ha^{-1}) proved better in case of phosphorus uptake by

wheat as compared to control. Similar to these findings Singh (2009). The maximum utilization of phosphorus by wheat crop was recorded at Mn @ 20 kg ha-^{1} level of manganese similar observation were also recorded by Verma *et al.,* (2010), and Singh et al.,(2011). A further study of table-3 revels that the potassium uptake by wheat crop increased significantly with increasing levels of potassium as compared to control. Each higher level of manganese Mn_3 (20 kg ha-^{1}) resulted more significantly utilization of K in comparison to control. Similar the significantly maximum enhancement in manganese uptake was recorded with highest level of potassium (90 kg ha-^{1}) and manganese Mn_3 @ 20 kg ha-^{1}. Similar findings were also reported by Mishra (2006) and Singh (2007), Chandel (2010).

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