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Relative Efficiency of Muriate and Sulphate of Potash for Wheat

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ABSTRACT

A pot experiment was conducted to check the relative effectiveness of muriate and sulphate of potash on chemical composition of wheat. A surface soil sample was collected and processed for chemical analysis. Ten kg of this soil was added to glazed pots. Potassium was applied @ 0, 100, 200, 300 and 400 kg ha^{-1} from each source. A basal dose of N and P_2O_5 and K_2O @ 200 and 100 kg ha^{-1}, respectively was also applied. Wheat variety Inqulab-91 was sown as a test crop. Whole of phosphorus and potash was applied at sowing along with one third N. The rest of N was applied in two splits after 35 and 55 days of sowing. Crop was harvested at maturity and dry matter yield was recorded. Grain and straw samples were analysed for N, P, K, S and Cl. Dry matter yield increased by K application. Nitrogen concentration remained unaffected in grain and straw while P in straw and K in grain increased significantly by the application of K.

Key Words: Muriate; Sulphur; Potash; Wheat

INTRODUCTION

Pakistan is situated in arid to semi-arid zone due to which its soils are inherently impregnated with chloride ion and therefore, use of chloride containing fertilizers may increase its concentration in the soil. Although, KCl is a cheaper source of K as compared to K_2SO_4 still it is not considered appropriated in our country due to the fear of adverse effect of Cl on plant growth. Khan (1985) compared efficiency of muriate of potash (MOP) and sulphate of potash (SOP) in a pot experiment on wheat and rice using normal and saline soils. He found both the sources equal in promoting growth and yield. There was no effect of MOP and SOP on the growth and yield of wheat over control and also there appeared no ill effect of Cl on plant growth (Ahmad, 1996). Krauss (1992) suggested that KCl should be considered as a K source and be used for various crops under good leaching conditions. Laughlin *et al.* (1971) found that P uptake was promoted by SOP applied in lower concentrations; whereas, higher concentration has antagonistic effect. There was a significant increase in Cl contents and decrease in K concentration of wheat grain and straw by applying MOP (Khan, 1985).

Keeping above in view, present study was conducted to see the relative efficiency of muriate and sulphate of potash on chemical composition of wheat.

MATERIALS AND METHODS

Sandy clay loam soil (ECe1.2 dS m^{-1}, pH_s 7.5, total N 0.041%, available P 6.9 mg kg^{-1} soil, extractable K 120 mg kg^{-1}) was collected from the field. It was air dried, ground and passed through a 2 mm sieve. Then the soil @ 10 kg soil per pot was added to glazed pots in three replications. The following treatments were applied:

Treatment	N kg ha^{-1}	P_2O_5 kg ha^{-1}	K_2O kg ha^{-1}
T_1	200	100	0
T_2	200	100	100 (SOP)
T_3	200	100	200 (SOP)
T_4	200	100	300 (SOP)
T_5	200	100	400 (SOP)
T_6	200	100	100 (MOP)
T_7	200	100	200 (MOP)
T_8	200	100	300 (MOP)
T_9	200	100	400 (MOP)

Whole of the P and K along with one third N was applied at sowing time while remaining two third N was applied in two splits i.e. 35 and 55 days after sowing. Wheat variety Inqulab-91 was sown which was harvested at maturity. Total dry matter yield was recorded, and grain and straw were analysed. The chemical analyses of soil were done according to the methods described by US Salinity Lab. Staff (1954), Mechanical analysis by Moodie *et al.* (1959), total N by Jackson (1962), available P by Watanabe and Olsen (1965), total sulphur in plants by Bardsley and Lancaster (1965) and chloride by Pitman (1965). The data were analysed by using completely randomized design (Steel & Torrie, 1980).

RESULTS AND DISCUSSION

Dry matter yield. The results indicated that dry matter yield increased significantly over control by the application of K from both the sources of K i.e. MOP and SOP (Table I). The rates of K application of both the sources did not increase it significantly. There was no ill effect of Cl noted on dry matter yield. The results are not in line with those of Khan (1985) who concluded that dry matter, straw and grain

yields of wheat were significantly increased with different levels of K while comparing MOP and SOP for wheat in normal and saline sodic soils. The reason for non-significant increase in dry matter yield in this study was that there was already abundant quantity of K (120 mg kg^{-1} soil) due to which wheat did not responded to K fertilization. Further the ill effect of Cl even applied at very high rate i.e 400 kg ha^{-1} was not observed due to the fact that a long period is required to develop Cl toxicity.

Table I. Dry matter yield of wheat

Treatment kg ha^{-1}			Dry matter yield (g pot^{1-})
N	P_2O_5	K	
200	100	0	41.57 b
200	100	100 (SOP)	43.28 ab
200	100	200 (SOP)	43.63 a
200	100	300 (SOP)	44.04 a
200	100	400 (SOP)	43.43 a
200	100	100 (MOP)	43.33 a
200	100	200 (MOP)	43.76 a
200	100	300 (MOP)	43.94 a
200	100	400 (MOP)	43.66 a

Nitrogen concentration. The nitrogen concentration (Table II) in wheat grain and straw remained non-significant by the application of K from MOP and SOP at different levels. It is obvious from the data that SOP improved the nitrogen percentage to some extent as compared to MOP at lower rates. At higher rates of K application, it decreased due to dilution effect. The small differences different SOP and MOP may be attributed to the fact that SO_4^{2-} is more important for protein synthesis in plants. Sulphur is the structural part of some amino acids like Cystein and S-S linkage is the binding force of many organic molecules including proteins. Chloride had no role in either proteins or protein synthesis. These results are in agreement with Tergas *et al.* (1988).

Phosphorus concentration. Phosphorus concentration (Table II) was non-significant in case of wheat grain and significant in case of straw. A close observation of the data indicated that in both the cases SOP was slightly better than MOP. It may be due to the reason that SO_4^{2-} ions can lower the activity of Ca^{2+} by forming $CaSO_4$, thus rendering phosphorus more available in case of SOP in comparison to MOP. Similar findings were noted by Laughlin *et al.* (1971).

Potassium concentration. Potassium concentration (Table II) was increased significantly by applying K as SOP up to 200 kg ha^{-1} in case of wheat grain while in straw it was non significant. The response of K only at lower level has been reported by many workers (Ranjha, 1988; Malik *et al.,* 1989) but at higher rates, the response was non-significant. In case of MOP, all the rates were non significant but significant over control and 100 kg ha^{-1} SOP only in case of grain. The reason might be that already abundant K (120 mg kg^{-1}soil) was present in the soil, which was sufficient for the needs of plants. Moreover in Pakistan soils there are K rich minerals (illite) and the weathering rate of these minerals is sufficient to replenish soil solution K (intensity) to meet the plant requirement (Ranjha *et al.,* 1990).

Sulphur concentration. Sulphur concentration (Table II) increased significantly by the application of K in grain and straw and was found more in SOP than MOP treated plots. Moreover, with the increasing rates of SOP, sulphur concentration was increased in both the parameters but at par with each other. This rise in S^{2-} concentration may be due to the reason that high concentration of applied sulphur was present in readily available form in the soil. Although enough sulphur already existed in the soil yet lower concentration was observed in MOP treated ones and it might be due to the antagonistic effect of Cl on sulphur uptake.

Chloride uptake. Chloride concentration (Table II) in grain and straw of wheat was significantly increased by the application of MOP rates over all the rates of SOP and control while control and all other rates of SOP were at par with each other. The increase in Cl concentration with increase in applied MOP may be due to the higher Cl concentration in soil solution resulting from high MOP levels. Since this experiment was conducted in pots. So there was no leaching that resulted in accumulation of Cl in soil as well as in plants. On the other hand, in SOP treatments since there was no application of Cl carrying material hence there was low Cl uptake and results were at par with control. The role of Cl in plant nutrition is so much that only traces of Cl are essential so plants tends to prohibit its entry to seed. These results are in agreement with those of Khan (1985) who reported increased Cl concentration in

Table II. Chemical Composition of wheat

Treatments (kg ha^{-1})			%Nitrogen		%Phosphorous		%Potash		%Sulphur		%Chloride	
N	**P_2O_5**	**K_2O**	**grain**	**straw**	**grain**	**straw**	**grain**	**straw**	**grain**	**straw**	**grain**	**straw**
200	100	0	1.33	0.79	0.32	0.14	0.30 b	1.58	0.160 c	0.100 c	0.130 d	0.363 c
200	100	100	1.38	0.77	0.33	0.17 a	0.39 ab	1.70	0.168 b	0.128 a	0.133 d	0.367 c
200	100	200	1.37	0.78	0.33	0.16 a	0.43 ab	1.75	0.179 a	0.128 a	0.135 d	0.367 c
200	100	300	1.37	0.78	0.33	0.17 a	0.47 ab	1.78	0.180 a	0.130 a	0.100 d	0.369 c
200	100	400	1.33	0.76	0.34	0.17 a	0.46 ab	1.75	0.183 a	0.132 a	0.130 d	0.366 c
200	100	100	1.35	0.77	0.33	0.15 b	0.41 ab	1.72	0.161 c	0.113 b	0.180 c	0.444 b
200	100	200	1.36	0.78	0.33	0.15 b	0.47 ab	1.79	0.160 c	0.112 b	0.192 c	0.486 b
200	100	300	1.37	0.76	0.33	0.15 b	0.47 ab	1.78	0.160 c	0.113 b	0.231 b	0.510 a
200	100	400	1.37	0.76	0.30	0.15 b	0.45 ab	1.81	0.161 c	0.102 c	0.290 a	0.534 a

wheat grain with increasing MOP rates in the soil.

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