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EFFECT OF TEXTURE, LIME AND TEMPERATURE ON FIXATION OF APPLIED POTASSIUM

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The effect of soil texture, $CaC0_3$, and temperature was studied on K fixation in the Kotli, the Pindorian and the Wazirabad soil series. These series were fine, medium and coarse textured, respectively. They were made calcareous by adding powdered $CaC0_3$. K was applied @ 0, 50, 100 mg K Kg^{-1} soil as K2S04. K fixation increased with increasing clay and CaC03 content and also with increasing amount of K applied. The effect of temperature, though was inconsistent but maximum K fixation was observed when 12% $CaC0_3$ and 100 mg K kg^{-1} were added and temperature was maintained at 60°C.

INTRODUCTION

Potassium release from soil particles is often viewed as "desirable" because it replenishes K available to crops, but potassium fixation is considered to be "undesirable" as it makes added K unavailable to plants. This fixation and release of potassium are part of the dynamic process controlled primarily by amount and type of clay minerals present and the K fixation increases with an increase of clay content (Ranjha *et al.* 1990). This process is also affected by soil structure, soil pH, liming, manuring, temperature, wetting & drying, freezing & thawing and the action of the plant roots (Goulding, 1987). Most of the soils of Pakistan are generally calcareous and increasing amount of CaC03 increases K fixation (Hussain *et al.* 1986, Quemner, 1986). The K fixation also increases with increasing temperature (Goswami and Bandyopadhya, Y. 1978, Inoue, 1983). But the information regarding K dynamic as a result of the combined effect of these factors in our soils has not been studied. The present investigations were undertaken to study K dynamics with the aim to contribute to K fertilizer use efficiency.

MATERIALS AND METHODS

Soils samples of three soil series *viz.* the Kotli (clay). the Pindorian (loam and the Wazirabad (Sandy loam) were collected from three different sites. The samples were air-dried, ground, passed through a 2 mm sieve and analysed for physical and chemical characteristics (Table 1).

Each of the soil was added @ 200 g in 400 ml plastic beakers. Effect of applied potassium, temperature and CaC03 was studied in all possible combinations. PotassiuIT was applied @ 0, 50 and 100 mg K kg^{-1} soil in the form of K2S04. There were three levels of CaC03 i.e. <1 (original), 6 and 12%. The latter two levels were developed by adding laboratory reagent grade CaC03 salt. Temperature was maintained at three levels i.e. 30, 45 and 60°C in the oven. Three alternate wetting and drying cycles were given to all sets of beakers. The experiment was laid out using factorial in completely randomized design with three repeats. After completion of wetting and drying cycles the soil samples were crushed, passed through 2 mm sieve and K was extracted with neutral normal ammonium acetate. The amount of K not extracted by this

extractant was taken as fixed and was calculated by the following formula:

Fixed K (mg kg^{-1}) = (Original K in soil + Applied K) - (Extracted K after Wetting Drying Cycles) (Shaviv *et al. 1986)*

.. All the analyses were done by the methods described in Hand Book No. 60 (D.S. Salinity Lab. Staff, 1954) except the mechanical analysis which were performed according to Moddie *et al.(1959),* total nitrogen by Jackson (1962) and available Phosphorus in soil by Watanabe and Olsen (1965). The data were analyzed statistically as suggested by Steel and Torrie (1980).

RESUL TS AND DISCUSSION

Effect of Amount of Clay

The results indicated that the amount of fixed K increased with the increase of its application rate but percentage fixed of the applied K decreased with the increased dose (Table 2). It was more prominent in fine textured soil (Kotli) followed by medium textured (Pindorian) and minimum in Coarse textured soil (Wazirabad). Ranjha *et al.* (1990), Raza and Muhammad (1971) and Hussain *et al* (1986) also have reported similar type of results. Further it seems that there is no effect of amount of clay on K fixation. Although K fixation is slightly high in Kotli than Pindorian and Wazirabad series, but it is not proportional to the amount of clay. This difference in K fixation may be due to difference in nature of clay in these series.

Effect of $CaC0_3$

The interaction between K rates and $CaC0_3$ levels (Table 3) also significantly affected K fixation in all the soil series. The maximum K fixation was recorded at 12% CaC03 and 100 mg K kg^{-1} soil rate. Further increase of K fixation (by alternate wetting and drying) by CaC03 (lime) addition was either due to increase in pH of the system by means of which more K was able to enter the complex rather than the calcium itself (Joffe & Levine, 1947, Hussain *et al.* 1986 and Gaultier & Mammy, 1990) or Ca blocks the release of cation from 2: I sheets especially K in this case or it may be due to other reasons that need to be investigated. When K fixation was calculated on percent basis of the applied K, in some cases at 50 mg kg^{-1} application rate it was more than 100% of the applied K. it showed that all applied K was fixed in addition to K component from original status due to which it exceeded 100%.

Effect of Temperature

The effect of temperature on K fixation was non-significant in the Pindorian soil series while in the Kotli and the Wazirabad soil series, it was significant but inconsistent i.e. in the Kotli it decreased K fixation while in the Wazirabad series it increased K fixation with its increasing levels (Table 4). Similarly the interaction between K rates and temperature was only significant in the Kotli soil series.

Combined effect of Temperature, $CaC0_3$ **& Applied K.**

The effect of different temperature, CaC03 levels and K rates on K fixation (Table 5,6 & 7) indicated that K fixation increased by increasing rates of K application and $CaC0_3$ levels, whereas temperature has inconsistent effect as already discussed. The interaction between these three factors also significantly affected the K fixation in all the soil series except Wazirabad where it was non-significant. Maximum fixation was observed at 100 mg K kg^{-1} soil rate combined with 12% $CaC0_3$ level at 60°C temperature in the Kotli and the Pindorian soil series while in the Wazirabad soil series it was again maximum but it differed non-significantly. As the effect of temperature was inconsistent, the increasing rate of K fixation might be due to the effect of $CaC0_3$ and texture because ,';ne texture when combined with 12% $CaC0_3$ at 30, 45 and 60°C in the Kotil soil series fixed much higher K than the amount at ~"e same treatment

Table 4:Effect of Temperature and Applied Potassium on Potassium Fixation in the Kotli, the Pindorian and the Wazirabad Soil Series

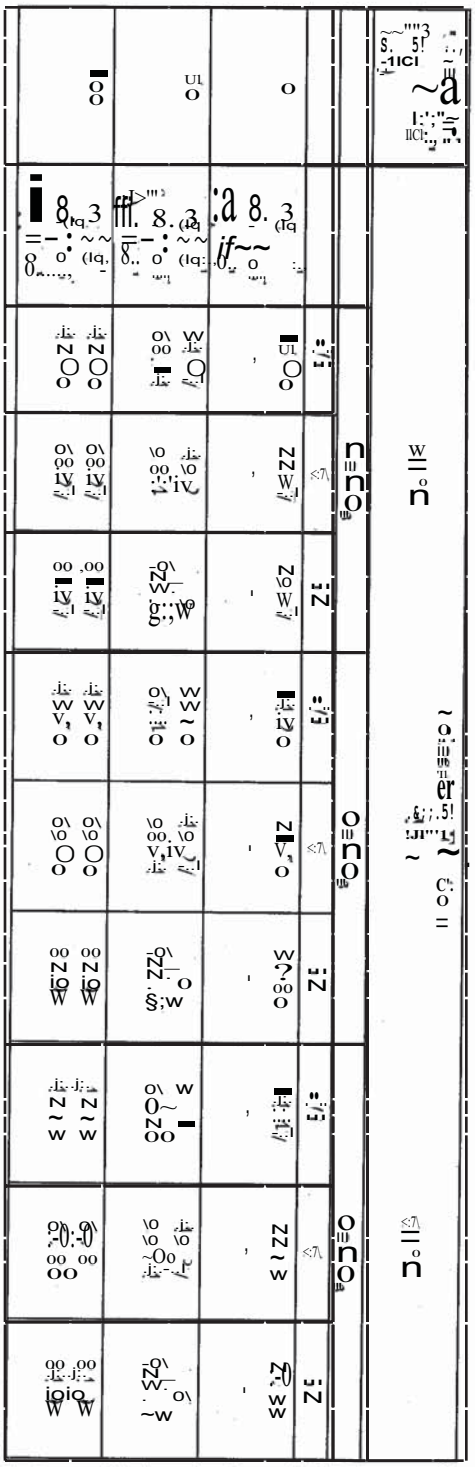
Table 5 Effect of Temperature, $CaCO_3$ and Applied Potassium on Potassium Fixation in the Kotli Soil Series.

Treatment (mg K kg^{-1} Soil)		Potassium Fixation 30°C			45 °C			60 °C		
		$CaCO_3$			$CaCO_3$			60 % $CaCO_3$		
		/1	6	12	<1	6	12	<1	6	12
0	mg kg^{-1} soil % of applied	[illegible]	29.40 p -	46.67 m -	17.13 q -	36.60 o -	[illegible]	16.93 q -	42.27 n -	47.33 m -
50	mg kg^{-1} soil % of Applied	47.10 m 92.86	61.53 k 123.06	76.87 h 153.74	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
100	mg kg^{-1} soil % of Applied	67.93 i 67.93	99.73 d 99.73	119.13 i 119.13	[illegible]	93.7 e 93.7	[illegible]	[illegible]	103.40 c 103.40	123.53 a 123.53

Table 6 Effect of Temperature, $CaCO_3$ and Applied Potassium on Potassium Fixation in the Pindorian Soil Series.

Treatment (mg K kg^{-1} Soil)		Potassium Fixation 30 °C			45 °C			60 °C		
		$CaCO_3$			$CaCO_3$			$CaCO_3$		
		/1	6	12	/1	6	12	/1	6	12
0	mg kg^{-1} soil % of applied	11.03 q -	16.47 -	19.43 no -	11.17 q -	18.43 op -	Z1.43 q -	11.03 q -	[illegible]	23.77 m -
[illegible]	mg kg^{-1} soil % of Applied	42.20 i 86.40	61.73 jk 123.46	79.77 g 159.54	44.37 i 88.74	[illegible]	83.73 f 167.46	43.90 i 87.80	64.07 hi 128.14	[illegible]
[illegible]	mg kg^{-1} soil % of Applied	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	110.50b 110.50	64.30h 64.30	[illegible]	113.47a 113.47

Table 7: Effect of Temperature, CaCO3 and Applied Potassium on Potassium Fixation in the Wazirabad Soil Series.



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