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DISTRIBUTION OF DIFFERENT K FRACTIONS IN INCEPTISOLS OF EASTERN UTTAR PRADESH

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Abstract: *The present investigation was done to study distribution of different K fractions in Inceptisol of Eastern U.P. The soils were low to medium in available K content. High correlation between exchangeable and non- exchangeable K content were observed. It is concluded that non- exchangeable K can be major contributor of crops in soils and that some measure of this fraction must be included in soil fertility evaluation. Low to medium available K in this study and low reserve K indicate the need to relock into K fertility management for obtaining higher productivity of intensive cropping in these soils.*
Key words: *available K, exchangeable K, total k, fixed K, Inceptisols*

Introduction: Potassium is one of the three major plant nutrient element, its importance in India agriculture has increased with intensification of agriculture .The consumption of potassium fertilizer in India was 0.2 MT in 1970-71 which increased to 2.11 MT in 2003-04 yet, it is estimated that there was a net negative balance of 7.05 MT of K_20 in Indian soils during the year 2011-12 [1]. The gap between removal of K and its application to crops was widening.

The removal of soil K is likely to vary appreciably in different agro-climatic features, parent materials and cropping systems due to variation in the requirement, rooting pattern and plant population. Cropping system as rice-wheat system removes large amount of K (300-500 kg ha^{-1}) every year. If the K removal is not replenished, there will be gradual decline in over all K reserve of the soils [2]. The K uptake during plant growth is a dynamic process in which period depletion of K occurs in the root zone with concomitant release of non-exchangeable K to exchangeable and solution fraction by K bearing minerals.

The information of these aspects is scant in alluvial soils of Jaunpur and hence the study was undertaken to evaluate the different forms of potassium in soil.

Materials and Methods

The present investigation was carried out at Department of Agricultural Chemistry & Soil Science. T D P G College, Jaunpur (UP). The details of experimental material used and method followed are presented under the following subheading: The fields of twenty village of Jaunpur were selected for this study. The list of villages corresponding soil samples are in table-1.Soils are sandy clay loam to clay loam in texture. The important physico-chemical properties of soil are listed in Table-1.

Table-1: Physico-chemical properties of soil

S.No.	Soil Properties	Range
1	Bulk density (Mg m^{-3})	1.27-1.43
2	Particle density (Mg m^{-3})	2.22-2.66
3	Porosity (%)	35.8-50.4
4	pH	7.35-8.06
5	Organic Carbon (g Kg^{-1})	1.95-7.2
6	Available N (Kg ha^{-1})	178.5-354.0
7	Available P (Kg ha^{-1})	9.0-18.0
8	Available K (Kg ha^{-1})	200.6-300.8

Soil sample were taken from surface layer (0-15cm) from each village. Collected soil samplers were air dried in shade and crushed with wooden mortar and passed through 2mm

sieve and stored in plastic bags for physical & chemical analysis.Bulk density and particle density and porosity were determined by standard methods [3]**.** pH of soils was determined by using glass electrode in 1:2.5 soil suspension.EC of soils was determined by using digital E.C. meter in 1:2.5 soil suspension. Organic carbon in soil samples was determined by wet digestion method [4]**.** Available Nitrogen was determined by alkaline potassium permagnate method [5]. Available Phosphorus was determined colorimetrically in 0-5 M $NaHCo_3$ (pH 8.5) extract of soil (Olsen, 1954). Available Potassium was determined by Flame potometrically in (Neutral ammonium acetate of the soil [6]. Non Exchangeable K It is calculated by subtracting available K from HNO_3 extractable K [7]. Total K was estimated in digest of soil with $HClO_4$ [7].Fixed K was estimated by 10 minutes boiling 1N HNO_3 [7].

Results

Exchangeable Potassium: The exchangeable potassium ranges from 225.8 kg.ha^{-1} with mean value 256.2kg.ha^{-1}. All the soil samples were observed in medium in available K. This may be due to excessive leaching of water soluble form and also due to crop removal and intensive cultivation under assured irrigations without much supplementation of potassic fertilizers. The contribution of exchangeable K towards total K ranged 1.40% to 1.54%

Table -2: Different K Fractions in alluvial soils of Jaunpur

S.No.	Non Ex-change K kgha^{-1}	Contribution (%)	Non Ex-change K	Contribution (%)	Mineral K kgha^{-1}	Contribution (%)	Total K kg ha^{-1}
1	250.9	1.52	1029.8	6.28	15119	92.2	16398
2	260.6	1.50	1255.6	7.20	15924	91.3	17440
3	275.8	1.52	1126.0	6.38	16256	92.1	17649
4	233.0	1.52	1054.6	6.88	14641	91.6	15328
5	250.6	1.50	1113.2	7.10	14332	91.4	15680
6	249.0	1.40	1056.5	6.20	15545	92.4	16824
7	254.4	1.50	1135.3	7.10	14616	91.4	15990
8	246.6	1.55	1097.8	6.95	14558	91.5	15910
9	258.6	1.50	1215.8	7.10	15652	91.4	17125
10	260.2	1.54	1135.0	6.96	15008	91.5	16402
11	269.3	1.54	1241.5	7.10	16053	91.4	17487
12	229.0	1.50	1034.2	6.90	13710	91.6	14967
13	268.5	1.50	1271.8	7.20	16127	91.3	17664
14	225.8	1.48	1062.6	6.92	13974	91.6	15256
15	233.4	1.56	1114.4	7.20	14111	91.3	15456
16	276.2	1.53	1234.8	6.84	16535	91.6	18052
17	272.6	1.50	1287.7	7.10	16610	91.4	18173
18	268.8	1.54	1203.5	6.96	15950	91.5	17442
19	272.2	1.48	1324.2	7.22	16790	91.3	18392
20	268.4	1.49	1304.2	7.24	16447	91.3	18014
mean	256.2		1165.0		15368.0		16783

The exchangeable K fraction indicated highly significant and positive relationship with non- exchangeable (R=0.93) and total K (R=0.92). The high correlation between exchangeable and non-exchangeable and total K was indicative of existence of dynamic equilibrium between these forms of K. Reported similar relationship between exchangeable and non-exchangeable and non- exchangeable K similar observation were reported for available K and non exchangeable observed that exchangeable K contributed 1.39% towards total soil K of soil [8, 9, 10].

Non Exchangeable Potassium: The soil had non exchangeable K content ranging between 1029.8 kg.ha^{-1} to 1324.2 kg.ha^{-1} and averaging 1164.95 kg ha^{-1}. These soils are categorized as medium in potassium status since they contained less than 2000 kg.ha^{-1} exchangeable k [11]. This Potassium fraction contributed towards total K to ranged from 6.28 to 7.21%. Non–exchangeable K had significant relationship with all other K fractions indicating that there exists equilibrium between these forms of K and a depletion of one is replenished by other forms of K [12]. Non–exchangeable K showed positive relationship with soil properties viz E.C., organic Carbon and negative relationship with pH.

Mineral K: Mineral K content of soil ranged from 13710 kg.ha^{-1} to 16790kgha^{-1} with average value 1536.8 kg.ha^{-1}. Laltic K contributed form 91.3 to 92.40% to total K and highly significant relationship with total K indicating that the majority of total K was in the Laltic K form. Similar results were reported [13]. Reported that lattic K contributed 94.61 percent to total K.

Laltic K showed positive correlation with total k [10]. The data further revealed that laltic K showed significant positive relationship with pH and significant negative relationship with organic carbon.

Total Potassium: Total potassium content had a mean value of 16782.45 kgja^{-1} lowest content of total K content in soil samples was 15910kgha^{-1} while highest content of total K content was 18392 kg.ha^{-1}. Lower content & total K. in soil samples under study may be due to insufficiency of K. Bearing minerals as supported [14]. The total K showed positive significant relationship with E.C. and negative significant correlation with pH. The negative relationship of all the fractions of soil K with pH may probably be attributed to ion competition effect and entrapment of K in the given range of soil pH.It is concluded that non- exchangeable K can be major contributor of crops in soils and that some measure of this fraction must be included in soil fertility evaluation. Low to medium available K in this study and low reserve K indicate the need to relock into K fertility management for obtaining higher productivity of intensive cropping in these soils.

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