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Soil potassium release characteristics in terms of constant rate k and step k in vegetable growing soils of Ranga Reddy and Mahaboobnagar districts of Telangana

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Abstract
In the present investigation potassium release characteristics of the soils in terms of constant rate k and step k were studied in vegetable growing soils of Ranga reddy and Mahaboobnagar districts of Telangana. Rangareddy and Mahaboobnagar soils were slightly acidic to moderately alkaline in reaction, non saline in nature, organic carbon was low to high, low CEC. The texture of the soils of Ranga Reddy were loamy sand, loam and sandy loam and Mahaboobnagar were sandy loam, loam, loamy sand and sandy clay loam. The soils of Ranga Reddy and Mahaboobnagar districts were light textured with sand as dominant fraction. The step K, which is supposed to be plant utilizable non- exchangeable K varied from 1.5 to 5.43 me $100g^{-1}$ with an average of 3.09 me $100g^{-1}$ in soils of Ranga Reddy and it varied from 1.62 to 4.48 me $100g^{-1}$ with an average of 2.84 me $100g^{-1}$ in soils of Mahaboobnagar. The constant rate K varied from 0.6 to 0.83 me $100g^{-1}$ with an average of 0.68 me $100g^{-1}$ in soils of Ranga Reddy. It varied from 0.88 to 1.02 me $100g^{-1}$ with an average of 0.92 me $100g^{-1}$ in soils of Mahaboobnagar. A significant and positive correlation of step K with different forms of K indicates that these are dynamic and reflect the dependence on each other. The step K and constant rate K were positively correlated with CEC, clay and silt, which might be due to clay content containing non-exchangeable K in the fixed form.

Keywords: Vegetable growing soils, Constant rate K and Step K

Introduction
Potassium is an essential nutrient for crops and plays an important role in several physiological processes in plant. There are about 50 enzymes, responsible for energy transfer and formation of sugars, starch and protein that are influenced by the presence of potassium in plants. It is the fourth most abundant element, constituting about 2.5 per cent of the lithosphere. However, actual soil concentrations of this element vary widely, ranging from 0.04 to 3 per cent. Potassium content in soils depends on the type of parent material and degree of mineral weathering. Soil K exists in four forms viz., water soluble, exchangeable, non exchangeable (fixed) and mineral K, that are in equilibrium, each differing in its availability to crops. The equilibrium and kinetic reactions between K forms are governed by applied potassium, plant uptake, leaching and conversion into un-available forms (Sparks and Huang, 1985) [10]. Srinivasa Rao *et al.* (2007) [12] have clearly indicated the substantial contribution of non exchangeable K in plant nutrition, especially under continuous cropping.

Potassium releasing and supplying power of the soil are often used as synonyms. Knowledge of the rate of potassium release from soil might play an important role for comparing capacities of soil to supply potassium to plants (Srinivasa Rao *et al*., 2001) [11].

The capacity of soils to supply K from exchangeable and non-exchangeable forms is not easily determined because of the reversible transformation from one form to other that is assumed to occur in soil. Owing to the complexity that exists in soil system, none of the methods is universally applicable for all the soils. Hence, Haylock (1956) [2] introduced the long term potassium release characteristics of the soils in terms of constant rate K and step K using boiling 1N HNO_3. Constant rate K and Step K are the measures of plant utilizable non-exchangeable potassium reserves in the soil. Step K, it represents that part of potassium in non-exchangeable form which will become available to crop in due coarse of time, thus the knowledge about the rate of K release from soil might play an important role for comparing capacity of soil to supply K to plants (Srinivasa Rao *et al.*, 2001) [11].

The release of non-exchangeable K occurs when levels of exchangeable-K are decreased by crop removal and leaching. Very little work have been reported on suitability of K-tests procedures to measure the K-release from the vegetable growing soils of Ranga Reddy and Mahaboobnagar. Hence the Step K and constant rate K were studied to measure the K-release from the vegetable growing soils of Ranga Reddy and Mahaboobnagar.

Material and Methods

Vegetable growing soils (0-15cm) of Ranga Reddy and Mahaboobnagar districts of Telangana were collected and analysed for physical properties by using methods described by Piper (1966) [7] and physicochemical, chemical properties by using methods described by Jackson (1973) [3]. Thirty two vegetable growing soils each sixteen surface soils (0-15cm) of Ranga Reddy and Mahaboobnagar districts of Telangana were selected and analysed the following parameters *i.e*., Water soluble and exchangable potassium by Jackson (1973) [3], available potassium as described by Hanway and Heidal (1952) [1], Non-exchangable and mineral potassium described by Wood and DeTurk (1941) [15] and the total potassium by Page *et al*. (1982) [6]. The estimation of potassium in all the cases was done flame photometrically.

Step K: The procedure given by Haylock (1956) [2] and modified by Mac Lean (1961) [5] was followed, for determination of step K. 2.5g of 2 mm sieved soil was boiled with 1N HNO_3 for 10 minutes (1:10 ratio) and filtered. The soil and filter paper were washed with 4 lots of 15 ml each of 0.1N HNO_3 and filtrate was made upto 100 ml. potassium in filtrate was determined by flame photometer. Repeated extractions with boiling 1N HNO_3 were done till the release of K was constant. Haylock (1956) [2] described this as constant rate K. The step K was obtained by subtracting the constant rate K from the amount of K released in each step of successive extractions.

Results and Discussion

1. Salient characteristics of vegetable growing soils

Rangareddy and Mahaboobnagar soils were slightly acidic to moderately alkaline (pH 5.3 to 8.4) in reaction, non saline (EC 0.02 to 0.167 dS m^{-1}) in nature, available potassium (71 to 1199 kg/ha), organic carbon (0.3 to 1.2%), CEC (3.9 to 34.8 cmol (p+) kg^{-1}). The texture of the soils of Ranga Reddy were loamy sand, loam and sandy loam and Mahaboobnagar were sandy loam, loam, loamy sand and sandy clay loam. The data revealed that the soils of Ranga Reddy and Mahaboobnagar districts were light textured with sand as dominant fraction. Salient soil characteristics were given in table 1 and 2.

The different forms of potassium *viz*., water soluble, exchangeable, available, non exchangeable, mineral and total forms of potassium were determined in selected soils of Ranga Reddy and Mahaboobnagar districts and they were presented in the tables 3 and 4 respectively.

In the soils of Ranga Reddy district water soluble potassium content varied from 8 mg kg^{-1} to 22 mg kg^{-1}, with an average of 15 mg kg^{-1}. The available potassium (1N NH_4OAc extractable K) varied from 68 to 446 mg kg^{-1} with a mean value of 222 mg kg^{-1} (Table 3).

The exchangeable potassium content varied from 54 to 431 mg kg^{-1} with a mean value of 208 mg kg^{-1}, whereas non-exchangeable potassium ranged between 782 to 1894 mg kg^{-1} with a mean value of 1241 mg kg^{-1}. The mineral K varied from 7100 to 36260 mg kg^{-1} with a mean of 20985 mg kg^{-1}. The total potassium found to be in the range of 8400 to 38600 mg kg^{-1} with a mean of 22381 mg kg^{-1}.

The different forms of potassium *viz.*, water soluble, exchangeable, non-exchangeable and mineral K constituted to 0.07, 0.93, 5.5 and 93.7 per cent of total K, respectively, in soils of Ranga Reddy district.

In soils of Mahaboobnagar district, water soluble potassium content varied from 6 to 21 mg kg^{-1}, with an average of 12 mg kg^{-1}. The available potassium varied from 27 to 381 mg kg^{-1} with a mean value of 154 mg kg^{-1}. The exchangeable potassium content varied from 18 to 366 mg kg^{-1} with a mean value of 142 mg kg^{-1}, whereas non-exchangeable potassium ranged between 937 to 1832 mg kg^{-1} with a mean value of 1305 mg kg^{-1}. The mineral K in the selected soils varied from 6600 to 36630 mg kg^{-1} with a mean of 21054 mg kg^{-1}. The total potassium content varied from 8700 to 37600 mg kg^{-1} with a mean value of 22513 mg kg^{-1}.

The different forms of potassium *viz.*, water soluble, exchangeable, non-exchangeable and mineral K constituted to 0.05, 0.63, 0.68, 5.79 and 93.52 per cent of total K, respectively, in soils of Mahaboobnagar district.

In Ranga Reddy and Mahaboobnagar soils the mineral K was more than ninety per cent of the total K followed by non-exchangeable, available, exchangeable and water soluble K. As the contribution of slowly available forms of K is very less compared to non-exchangeable or mineral K, the available potassium content in soils alone cannot be considered for rating the soils into low, medium and high categories. The replenishing capacity of available K from non-exchangeable or mineral K also plays an important role in indicating K status of soils. Similar observations were also made by Sharma *et al.* (2009) [9].

2. Step K and Constant rate K

The capacity of soils to supply K from exchangeable and non-exchangeable forms is not easily determined because of the reversible transformation from one form to other that is assumed to occur in soil. Owing to the complexity that exists in soil system, none of the methods is universally applicable for all the soils. Hence, Haylock (1956) [2] introduced the long term potassium release characteristics of the soils in terms of constant rate K and step K using boiling 1N HNO_3. Constant rate K and Step K are the measures of plant utilizable non-exchangeable potassium reserves in the soil. Step K, it represents that part of potassium in non-exchangeable form which will become available to crop in due coarse of time, thus the knowledge about the rate of K release from soil might play an important role for comparing capacity of soil to supply K to plants (Srinivasa Rao *et al.*, 2001) [11].

Constant rate K and Step K values were given in tables 5 and 6 for soils of Ranga Reddy and Mahaboobnagar districts.

The step K, which is supposed to be plant utilizable non-exchangeable K varied from 1.5 to 5.43 me $100g^{-1}$ with an average of 3.09 me $100g^{-1}$ in soils of Ranga Reddy and it varied from 1.62 to 4.48 me $100g^{-1}$ with an average of 2.84 me $100g^{-1}$ in soils of Mahaboobnagar. Haylock (1956) [2] and Mac Lean (1961) [5] categorized soils as low (< 0.3 me $100g^{-1}$), medium (0.3 to 0.5me $100g^{-1}$) and high (> 0.5me $100g^{-1}$). Based on step K values as per these limits, all the soils of Ranga Reddy and Mahaboobnagar districts are high in the K reserves from the study.

The constant rate K was obtained after repeated boilings with 1N HNO_3. It varied from 0.6 to 0.83 me $100g^{-1}$ with an average of 0.68 me $100g^{-1}$ in soils of Ranga Reddy. It varied

from 0.88 to 1.02 me $100g^{-1}$ with an average of 0.92 me $100g^{-1}$ in soils of Mahaboobnagar.

The results revealed that the release of non-exchangeable K in general was very poor in these soils due to less clay and silt contents. The step K value was 1.5 me $100g^{-1}$(Masireddypalli) in soil with low clay content compared to other soils.

The correlation studies among constant rate K, step K, sand, silt and clay fractions revealed a positive and significant correlation with clay (0.430**) and significantly negative correlation with sand (-0. 40). The release of water soluble and exchangeable K was there at initial 2 to 3 steps and later there was constant release indicating slow release or no release of non-exchangeable K indicating poor supplying capacity of K from these soils. This was also observed through significant positive correlation of step K with water soluble (r = 0.495**), available K (r = 0.911**) and with non-exchangeable K (r = 0.908**). Also positive and significant correlation of constant rate K values with non-exchangeable K (r = 0.425**) indicate that the K reserve for release of potassium over a period of time is through non-exchangeable K. Kareem (1990) [4] also stated that non-exchangeable K contributed more towards the long term K release. Significant and positive correlations of step K with different forms of K indicate that these are dynamic and reflect the dependence on each other. Similar results were recorded by Subhash Chand (2010) [14].

The step K and constant rate K were positively correlated with CEC, clay and silt, which might be due to clay content containing non-exchangeable K in the fixed form. From the constant rate K release, it could be predicted that the soils not only have high reserves of K but also release it for a longer time. Subba Rao *et al.* (1983) [13] reported that the soils with high clay content and high CEC maintained high rate of release. Sekhon and Subba Rao (1985) [8] felt that the presence of micaceous minerals like hydrous mica (illite) and biotite in clay and silt fractions contribute to the higher step K and constant rate K values.

Table 1: Salient characteristics of the vegetable growing soils of Ranga Reddy district

S. No	Mandal	Village Name	pH	EC (dS m^{-1})	CEC cmol (p^{+}) kg^{-1}	OC (g kg^{-1})	Available N (kg ha^{-1})	Available P (kg P_2O_5 ha^{-1})	Available K (kg K_2O ha^{-1})	sand (%)	silt (%)	clay (%)	Textural class
1	Moinabad	Kothireddypalli	7.1	0.118	4.6	9	138.0	10.8	322.6	92	4	4	Sand
2	Chevella	Chenvelli	8.2	0.170	27.7	13	200.7	24.4	505.3	63	24	13	Sandy loam
3	Chevella	Lakshmiguda	8.0	0.253	21.3	10	188.2	26.4	732.5	74	16	10	Sandy loam
4	Pudur	Pothireddyguda	8.4	0.237	32.6	9	175.6	11.5	1116.9	74	20	6	Sandy loam
5	Pudur	Changomul	8.0	0.150	18.0	9	200.7	12.8	829.2	65	24	11	Sandy loam
6	Parigi	Narayanpur	7.6	0.135	31.0	6	163.1	11.0	428.7	68	16	16	Sandy loam
7	Parigi	Ragapur	7.9	0.174	21.8	13	200.7	37.2	1092.7	62	24	14	Sandy loam
8	Doma	Wootpally	6.3	0.086	4.2	7	175.6	10.3	224.4	86	4	10	Loamy sand
9	Doma	Sivareddypalli	7.6	0.156	17.9	13	200.7	29.0	1618.2	62	22	16	Sandy loam
10	Shankarpally	Parveda	7.9	0.220	34.8	13	188.2	17.2	1182.7	64	20	16	Sandy loam
11	Shankarpally	Mahalingapuram	8.0	0.205	29.0	7	175.6	22.3	599.4	63	20	17	Sandy loam
12	Nawabpet	Nawabpet	7.6	0.172	24.7	8	175.6	33.6	289.0	76	16	8	Sandy loam
13	Nawabpet	Chittigadda	8.0	0.163	22.1	7	175.6	12.3	725.8	74	14	12	Sandy loam
14	Vikarabad	Kathagadi	7.7	0.104	29.6	10	175.6	10.0	419.3	82	12	6	Loamy sand
15	Vikarabad	Girgidpalli	6.9	0.397	18.0	10	250.9	43.1	295.7	72	20	8	Sandy loam
16	Shabad	Antharam	7.5	0.202	15.8	11	213.2	54.9	595.4	69	18	13	Sandy loam
17	Shabad	Kakkuluru	7.6	0.173	15.2	11	213.2	64.1	408.6	82	12	6	Loamy Sand
18	Medchal	Railapur	7.8	0.184	14.3	12	200.7	50.3	1856.1	76	14	10	Sandy loam
19	Medchal	Masireddypalli	6.1	0.054	8.9	13	163.1	10.0	182.8	86	4	10	Loamy sand
20	Shameerpet	Adraspally	7.4	0.157	12.5	12	200.7	64.9	979.8	69	16	15	Sandy loam
21	Basheerabad	Muduchinthalapalli	6.4	0.143	14.6	9	213.2	50.5	1198.8	81	6	13	Sandy loam
22	Keesara	Keesara	7.9	0.141	8.5	8	175.6	10.5	672.0	76	12	12	Sandy loam
23	Keesara	Bogaram	6.9	0.108	7.1	5	150.5	11.0	338.7	86	6	8	Loamy sand
24	Manchal	Arutla	7.6	0.222	16.8	12	250.9	64.1	1729.7	69	18	13	Sandy loam
25	Manchal	Manchal	7.6	0.137	13.9	10	200.7	48.0	337.3	84	10	6	Loamy sand
26	Ibrahimpatnam	Kappapahad	7.8	0.233	16.5	12	213.2	61.6	930.0	82	12	6	Loamy sand
27	Ibrahimpatnam	Kongarakonal	7.8	0.132	11.9	8	188.2	11.8	606.1	84	8	8	Loamy sand
28	Maheshwaram	Ravirala	7.4	0.219	14.8	13	188.2	60.3	1120.9	84	6	10	Loamy sand
29	Shamshabad	Kocharam	6.2	0.353	16.0	13	213.2	58.5	438.1	82	6	12	Sandy loam
30	Shamshabad	Malkaram	7.4	0.225	14.1	10	200.7	40.0	934.1	82	10	8	Loamy sand
31	Moinabad	Venkatapur	7.4	0.108	19.3	4	175.6	15.6	426.0	83	14	3	Loamy sand
32	Rajendranagar	College farm	7.9	0.286	15.9	8	175.6	20.5	419.3	78	10	12	Sandy loam
Mean			7.5	0.18	17.92	10	191.0	31.5	736.1	76	14	10	
Range			6.1-8.4	0.054 - 0.397	4.2 - 34.8	4 - 13	138 - 250.9	10 - 64.9	182.8 - 1856.1	62 - 92	4 - 24	3 - 17	

Table 2: Salient characteristics of the vegetable growing soils of Mahaboobnagar district

S. No	Mandal	Village Name	pH	EC (dS m^{-1})	CEC cmol (p^+) kg^{-1}	OC (g kg^{-1})	Available N (kg ha^{-1})	Availabl P (kg P_2O_5 ha^{-1})	Available K (kg K_2O ha^{-1})	sand %	silt %	clay %	Textural Class
1	Kothur	Penjerla	7.7	0.087	11.8	6	138.0	46.7	532.2	83	8	9	Loamy sand
2	Kothur	Kodicherla	7.7	0.102	10.5	4	188.2	52.1	172.0	86	4	10	Loamy sand
3	Keshampet	Papireddy Gudem	6.1	0.042	15.8	6	250.9	65.2	268.8	68	10	22	Sandy clay loam
4	Keshampet	Pomalapally	7.8	0.094	12.9	7	188.2	17.2	598.1	83	6	11	Loamy sand
5	Farookhnagar	Farookhnagar	8.1	0.091	19.9	7	313.6	12.1	224.4	71	12	17	Sandy loam
6	Farookhnagar	Mogiligidda	7.6	0.129	14.7	7	200.7	24.9	272.8	77	14	9	Sandy loam
7	Balanagar	Ammapally	6.1	0.123	14.7	11	288.5	59.0	794.3	73	10	17	Sandy loam
8	Balanagar	Chinna Revalli	7.7	0.059	10.3	4	250.9	15.1	71.2	85	4	11	Loamy sand
9	Jedcharla	Gangapuram	7.7	0.105	12.9	10	301.1	20.5	349.4	69	16	15	Sandy loam
10	Midjil	Midjil	8.0	0.056	4.3	3	125.4	17.2	96.8	90	4	6	Sand
11	Midjil	Vurukonda	5.7	0.023	10.5	3	276.0	11.0	139.8	83	4	13	Sandy loam
12	Kalwakurthy	Kalwakurthy	5.3	0.02	3.9	3	100.4	10.0	90.0	87	6	7	Loamy sand
13	Veldanda	Kotra	7.1	0.037	7.1	3	200.7	11.5	104.8	90	2	8	Sand
14	Amangal	Kadthal	8.1	0.091	13.8	8	188.2	32.8	266.1	78	6	16	Sandy loam
15	Kodangal	Kodangal	8.2	0.106	22.4	8	200.7	13.6	306.4	70	20	10	Sandy loam
16	Tadoor	Indrakal	8.0	0.097	13.1	11	163.1	23.6	358.8	79	8	13	Sandy loam
17	Tadoor	Yatamatapur	8.4	0.171	28.7	9	200.7	11.0	448.9	68	16	16	Sandy loam
18	Nagurkurnool	Nagarkurnool	8.3	0.126	15.8	9	313.6	32.1	370.9	67	18	15	Sandy loam
19	Nagurkurnool	Uyalawada	7.6	0.180	18.0	12	175.6	22.3	532.2	77	12	11	Sandy loam
20	Bijinapalle	Bijinapalle	8.5	0.117	16.2	12	276.0	10.3	380.4	73	14	13	Sandy loam
21	Bijinapalle	Mahadevnipet	7.0	0.073	11.3	11	200.7	55.7	184.1	77	6	17	Sandy loam
22	Waddepalli	Waddepalli	8.1	0.215	24.6	13	225.8	15.4	916.6	67	22	11	Sandy loam
23	Waddepalli	Jilledidinne	8.1	0.236	27.5	11	213.3	23.1	1022.8	64	22	14	Sandy loam
24	Alampur	Koneru	8.3	0.250	21.2	12	200.7	14.6	1002.6	72	16	12	Sandy loam
25	Alampur	Utkur	8.1	0.258	28.7	13	175.6	11.8	971.7	64	22	14	Sandy loam
26	Manopadu	Kalukuntla	8.1	0.252	29.8	7	138.0	13.6	1016.1	62	28	10	Sandy loam
27	Manopadu	A.Budidapadu	8.1	0.243	19.4	12	200.7	10.8	731.1	61	24	15	Sandy loam
28	Itikyal	Duvasipalli	8.2	0.260	19.1	10	200.7	10.5	1022.8	64	22	14	Sandy loam
29	Itikyal	Jinkalapalli	8.1	0.249	19.0	10	188.2	11.0	903.2	67	24	9	Sandy loam
30	Balmoor	Kandanagula	8.1	0.094	7.3	10	138.0	10.0	176.1	84	4	12	Loamy sand
31	Balmoor	Ghattuthumen	8.2	0.108	11.8	10	150.5	13.3	375.0	85	4	11	Loamy sand
32	Achampet	Nadimpally	7.9	0.146	14.5	12	200.7	42.3	224.4	76	12	12	Sandy loam
33	Achampet	Pulijala	8.2	0.065	10.9	5	188.2	12.6	246.0	76	10	14	Sandy loam
34	Uppunutala	Uppunutala	8.3	0.128	13.6	11	200.7	43.1	655.9	68	10	22	Sandy clay loam
35	Uppunutala	Molgara	8.6	0.067	8.7	10	163.1	21.0	279.6	84	4	12	Loamy sand
36	Kodangal	Udimeshwaram	7.1	0.030	8.0	9	75.3	10.3	130.4	93	4	3	Sand
37	Bomraspeta	Yenkepalli	8.4	0.168	14.9	9	213.3	10.3	255.4	89	4	7	Sand
38	Bomraspeta	Vadicherla	7.8	0.159	22.7	13	288.5	10.3	793.0	65	20	15	Sandy loam
39	Kosigi	Nacharam	6.9	0.138	15.0	12	200.7	10.0	240.6	81	8	11	Sandy loam
40	Kosigi	Kosigi	7.9	0.316	14.4	12	175.6	11.5	416.6	77	10	13	Sandy loam
Mean			7.7	0.133	15.5	9	202.0	21.7	448.6	76	12	12	
Range			5.3 -8.6	0.020 - 0.316	3.9 -29.8	3 - 13	75.3 - 313.6	10.0 - 65.1	71.2 -1022.8	61 -93	2 - 28	3 - 22	

Table 3: Forms of potassium (mg kg^{-1} soil) in soils of Ranga Reddy district

S. No	Village Name	Water soluble K	Available K	Exchangeable K	Non Exchangeable K	Mineral K	Total K
1	Chenvelli	8	188	181	912	10000	11100
2	Pothireddyguda	21	416	395	1785	7100	9300
3	Wootpally	11	84	73	817	26600	27500
4	Parveda	10	440	431	1860	8500	10800
5	Kathagadi	10	156	147	844	7400	8400
6	Kakkuluru	19	152	134	918	16330	17400
7	Masireddypalli	15	68	54	782	15550	16400
8	Muduchinthalapalli	21	446	425	1894	36260	38600
9	Keesara	15	250	235	1450	24700	26400
10	Bogaram	16	126	111	1084	31990	33200
11	Manchal	15	126	111	1015	29860	31000
12	Kongarakonal	22	226	204	1075	29700	31000
13	Ravirala	22	417	396	1783	35300	37500
14	Kocharam	15	163	148	1527	19810	21500
15	Venkatapur	9	159	150	972	16870	18000
16	Rajendranagar	14	156	142	1144	18700	20000
	Mean	15	223	208	1241	20985	22381
	Range	8- 22	68 - 446	54 - 431	782 - 1894	7100 - 36260	8400 - 38600

Table 4: Forms of potassium (mg kg^{-1} soil) in soils of Mahaboobnagar district

S. No	Village Name	Water soluble K	Available K	Exchangeable K	Non Exchangeable K	Mineral K	Total K
1	Penjerla	16	198	182	1232	21570	23000
2	Papireddy Gudem	21	100	79	1200	16500	17800
3	Mogiligidda	9	102	93	1139	24460	25700
4	Chinna Revalli	9	27	18	1084	31690	32800
5	Midjil	8	36	29	984	33180	34200
6	Kalwakurthy	9	34	25	937	36630	37600
7	Kotra	9	39	31	1031	23330	24400
8	Kadthal	12	99	87	1181	20720	22000
9	Indrakal	21	134	113	1267	19900	21300
10	Nagarkurnool	14	138	124	1832	17530	19500
11	Koneru	14	373	359	1727	9300	11400
12	Duvasipalli	15	381	366	1720	6600	8700
13	Jilledidinne	15	381	366	1630	9390	11400
14	Uppunutala	15	244	230	1796	20560	22600
15	Pulijala	8	92	84	1159	25750	27000
16	Nacharam	6	90	84	961	19750	20800
	Mean	12	154	142	1305	21054	22513
	Range	6 - 21	27 - 381	18 - 366	937 - 1832	6600 - 36630	8700 - 37600

Table 5: Assesment of K release by constant rate and step K values (me $100g^{-1}$) in soils of Ranga Reddy district

S. No	Village Name	1N HNO_3 step extraction							Constant rate K	Step K
		I	II	III	IV	V	VI	VII		
1	Chenvelli	2.83	1.34	0.83	0.78	0.77	0.77	0.77	0.77	2.06
2	Pothireddyguda	5.67	3.30	2.16	1.03	0.82	0.72	0.72	0.72	4.94
3	Wootpally	2.32	1.24	0.82	0.69	0.61	0.61	0.61	0.61	1.71
4	Parveda	5.92	2.78	1.13	0.90	0.83	0.83	0.83	0.83	5.09
5	Kathagadi	2.58	1.13	0.75	0.72	0.69	0.62	0.62	0.62	1.96
6	Kakkuluru	2.76	1.34	0.77	0.72	0.66	0.66	0.66	0.66	2.10
7	Masireddypalli	2.19	1.03	0.82	0.69	0.69	0.69	0.69	0.69	1.50
8	Muduchinthalapalli	6.03	2.27	1.13	0.77	0.65	0.60	0.60	0.60	5.43
9	Keesara	4.38	1.75	0.90	0.80	0.68	0.68	0.68	0.68	3.70
10	Bogaram	3.12	1.55	0.82	0.68	0.67	0.67	0.67	0.67	2.45
11	Manchal	2.94	1.44	0.98	0.70	0.70	0.70	0.70	0.70	2.24
12	Kongarakonal	3.35	1.65	0.93	0.70	0.67	0.67	0.67	0.67	2.68
13	Raviryala	5.67	3.19	1.34	0.76	0.66	0.66	0.66	0.66	5.01
14	Kocharam	4.35	2.27	1.13	0.73	0.70	0.70	0.70	0.70	3.65
15	Venkatapur	2.91	1.75	1.03	0.71	0.66	0.66	0.66	0.66	2.25
16	Rajendranagar	3.35	2.16	1.24	0.75	0.73	0.71	0.71	0.71	2.64
	Mean								0.68	3.09
	Range								0.60 – 0.83	1.50 – 5.43

Table 6: Assesment of K release by constant rate and step K values (me $100g^{-1}$) in soils of Mahaboobnagar district.

S. No	Village Name	1NHNO_3 step extraction							Constant rate K	Step K
		I	II	III	IV	V	VI	VII		
1	Penjerla	3.68	2.27	1.44	1.13	0.90	0.88	0.88	0.88	2.81
2	Papireddy Gudem	3.35	2.16	1.13	1.00	0.94	0.90	0.90	0.90	2.45
3	Mogiligidda	3.19	1.96	1.44	0.91	0.91	0.91	0.91	0.91	2.29
4	Chinna Revalli	2.86	1.55	1.13	0.90	0.90	0.90	0.90	0.90	1.96
5	Midjil	2.63	1.26	0.91	0.90	0.90	0.90	0.90	0.90	1.73
6	Kalwakurthy	2.50	1.24	1.03	0.93	0.89	0.88	0.88	0.88	1.62
7	Kotra	2.76	1.13	0.93	0.91	0.90	0.90	0.90	0.90	1.86
8	Kadthal	3.30	1.85	1.13	0.92	0.92	0.92	0.92	0.92	2.38
9	Indrakal	3.61	1.96	0.98	0.93	0.92	0.92	0.92	0.92	2.69
10	Nagarkurnool	5.07	2.58	1.10	0.98	0.93	0.93	0.93	0.93	4.15
11	Koneru	5.41	3.30	1.44	1.02	1.02	1.02	1.02	1.02	4.39
12	Duvasipalli	5.41	3.19	1.34	1.05	0.97	0.93	0.93	0.93	4.48
13	Jilledidinne	5.18	3.30	1.10	1.04	1.02	1.02	1.02	1.02	4.16
14	Uppunutala	5.25	3.09	1.00	0.97	0.92	0.92	0.92	0.92	4.34
15	Pulijala	3.22	1.75	1.34	0.93	0.91	0.91	0.91	0.91	2.31
16	Nacharam	2.70	1.34	0.91	0.91	0.91	0.91	0.91	0.91	1.80
	Mean							0.92	0.92	2.84
	Range								0.88 - 1.02	1.62 – 4.39

Conclusion

Higher step K values indicate that all the soils of Ranga Reddy and Mahaboobnagar districts are high in the K reserves, but the release of non-exchangeable K in general was very poor in these soils due to less clay and silt contents.

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