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Forms of Potassium and its Relationship with different Soil Properties from Selected Land use Systems in Southern Transect of Bengaluru

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Abstract

The research work was conducted in an order to get an insight about the status, availability and supplying behaviour of potassium (K) for a meaningful K-fertilizer management strategy for sustainable crop production in southern transect of Bengaluru during 2020-22. Eighty surface (0-15 cm) soil samples representing the southern transect of Bengaluru were collected for assessing the important physico-chemical properties and distribution of different forms of potassium *viz.,* total K, lattice K, non-exchangeable K, exchangeable K, hot water soluble K and water soluble K. The average water soluble K, hot water soluble K, exchangeable K, non exchangeable K, lattice K and total K were 4.12, 6.76, 36.65, 477.61, 5376 and 5894 mg kg^{-1}, respectively in southern transect of Bengaluru. The average shares of lattice potassium, non exchangeable, exchangeable and water soluble to the total potassium were 91.21, 8.10, 0.62 and 0.07 per cent, respectively. Results of the study revealed that the different forms of K content in the soils of selected land use systems were in the descending order: Agriculture > Mulberry > Vegetable > Plantation. Among the forms of K, correlation studies showed that water soluble K had significant positive correlation with sand (r^2=0.938, *pd”*0.05), while exchangeable K (r^2 = 0.922, $pd \leq 0.05$), lattice K (r^2 = 0.959, $pd \leq 0.01$) and total K (r^2 = 0.953, $pd \leq 0.01$) was found to be significant and had a positive correlation with organic carbon and the same forms of had negative correlation with sand. All the forms of soil potassium were interrelated, indicating the existence of a dynamic equilibrium among them.

Keywords : Potassium forms, Land use systems, Southern transect, Lattice K, Total K

The importance of potassium (K) nutrition to plants in Indian agriculture is increasing with passage of time as a result of modern explosive agriculture with less attention in K fertilizer administration. The soils which were once rated sufficient in available K are becoming deficient due to continuous depletion of K by harvested crops and inadequate addition of K to soils under intensive use of nitrogen and phosphorus and crops have now started responding to potassium fertilization (Yadav *et al.*, 2011 and Patil & Basavaraja, 2015). The equilibrium between solution K and exchangeable K occurs rapidly, but that of exchangeable K and non-exchangeable K is cropped up very slowly (Ghiri *et al.*, 2010). Thus the total quantity and the relative abundance of these various forms of K greatly influence the K supplying capacity of a soils and K nutrition to crops. Henceforth, an overall knowledge on the distribution of different K forms and their relationship among themselves and also with various physicochemical properties of the soils helps to predict the ability of the soils to supply K to plants. In the present system of increasing cropping intensity with high yielding varieties without adequate K fertilization to crops, the soils are getting depleted of the K reserves at a faster rate (Srinivasa and Chikkaramappa, 2019). As a result, K is becoming a limiting factor in crop production especially in the intensively cropped areas of Karnataka and posing a serious threat in creating nutrient imbalances with major implications for factor productivity and environmental concerns.

According to increasing order of plant availability, soil K exists in four forms *i.e.*, mineral K (5000 - 25000 mg kg^{-1}), non-exchangeable K (50-750 mg kg^{-1}), exchangeable K (40-600 mg kg^{-1}) and solution K (1-10 mg kg^{-1}). Potassium cycling or transformations among the K forms in soils are dynamic. Soils that are rich in vermiculite and micas can have large amounts of non-exchangeable K, whereas, soils containing kaolinite, quartz and other siliceous minerals contain less available and exchangeable K (Martin and Sparks, 1985). Knowledge of different forms of K in soil together with their distribution is of great relevance in assessing the long-term availability of K to crops and in formulating a sound basis of fertilizer recommendation. There are equilibrium and kinetic reactions between these forms that affect the level of soluble K at any particular time and thus, the amount of readily available K for plants. There is a paucity of information on the status of different forms of K in different cropping systems of southern transect of Bengaluru. With this view, an attempt was made to study the relationship of different forms of K with soil properties and relationship amongst different forms of K in selected land use systems.

Material and Methods

Study Area

In the context of a larger study that investigates social-ecological transition processes in the rural-urban interface of the South Indian Metropolis, Bengaluru, two transects (Northern and Southern transect) were defined as a common space for interdisciplinary research. The northern transect (N-transect) is a rectangular strip of 5 km width and 50 km length and the Southern transect (S-transect) is a polygon covering a total area of 300 km^2. The corner co-ordinates of southern transect of Bengaluru are presented in Table 1 and Fig.1 (Hoffmann *et al.,* 2017).

Soil Sampling and Analysis

Preliminary survey was carried out to know the dominant land use systems around the southern transect of Bengaluru. Finger millet, maize, minor millets, pulses were grouped under conventional agricultural crops. Vegetable crops like chilli, cabbage, cauliflower, tomato, brinjal, capsicum and wide spaced long duration plantation crops like coconut, banana, mango, sapota, were noticed, whereas mulberry is major commercial crop next to these groups in the southern transect of Bengaluru. Twenty geo-referenced surface soil samples (0-15 cm) were collected randomly during the month of November to December from each different land use systems *i.e.,* agricultural, vegetables, mulberry and plantation in southern transect of Bengaluru (Fig. 2). At each location soil was collected from four places, mixed thoroughly and reduced to get a representative sample by quartering. The collected soil samples were air dried and ground to pass through a 2 mm sieve. The soil samples were analysed for pH, electrical conductivity (EC), available potassium (K_2O) and particle size

TABLE 1

Corner coordinates of the southern transect of Bengaluru

S- Transect	
Latitude	Longitude
N 12° 54' 54"	E 77° 32' 25"
N 12° 53' 43"	E 77° 34' 54"
N 12° 44' 40"	E 77° 32' 19"
N 12° 40' 04"	E 77° 28' 39"
N 12° 40' 03"	E 77° 24' 21"
N 12° 45' 17"	E 77° 23' 41"

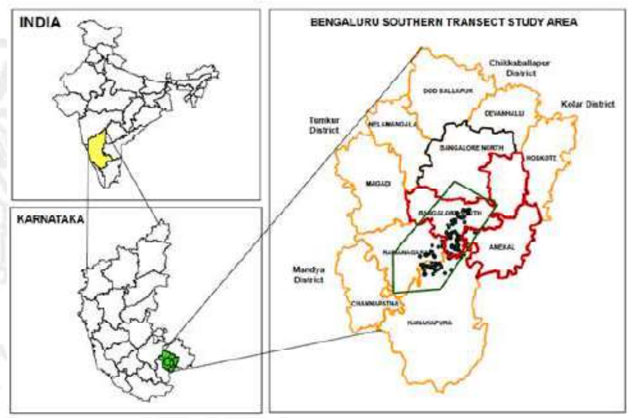

Fig. 1: Map showing location of study area (Southern transect of Bengaluru)

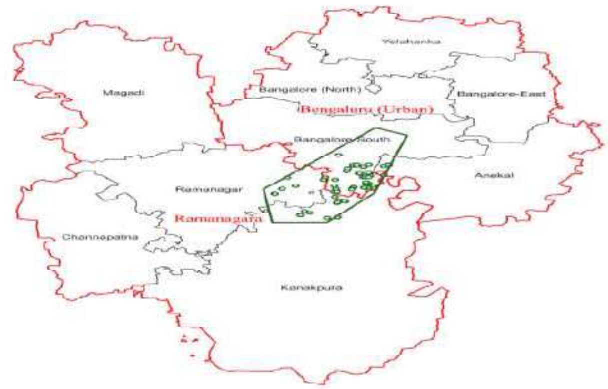

Fig. 2: Grid points of study area in southern transect of Bengaluru

distribution (international pipette method) using standard methods suggested by Jackson (1973), soil organic carbon (OC) by Walkley-Black (1934), available nitrogen (N) (Subbaiah and Asija, 1956), available phosphorus (P_2O_5) (Bray and Kurtz, 1945), total potassium of soil by standard method of Lim and Jackson(1973), water soluble potassium, exchangeable potassium and non-exchangeable K by Black (1965), hot water soluble potassium by Nash (1971) and mineral potassium was calculated by the formula suggested by Martin and Sparks (1985). Correlations between different forms of K and soil properties were worked out by the procedure described by Panse and Sukhatme (1978).

Results and Discussion

Physico-Chemical Soil Properties as Affected by Different Cropping Systems

Soil Physical Properties : The results of soil physical properties as influenced by different land use systems are presented in Table 2. The highest mean value of sand was recorded in agriculture land use system (57.60 %), while the lowest was recorded in plantation land use system (51.48 %). The mean clay content was found highest in plantation land use system (32.25%) and the lowest was found in agriculture land use system (26.62%). The lowest clay content under agriculture land use system is associated with the agriculture practices such as ploughing, harrowing, threshing and intercultural operations which leads to mechanical disturbance of the top soil there by recording more clay deposit in the lower layers. Similarly, Mulugeta *et al*. (2019) reported that the phenomenon of preferential removal of clay particles and its downward movement into the subsurface soil layer through the process of clay migration. Chemeda *et al*. (2017) reported that the clay content of cultivated land increased from the surface to subsurface soil layer due to the prolonged periods of cultivation. Gebrelibanos and Assen (2013) also reported that lower clay and higher sand content was found in the surface layer and higher clay content was found in the subsurface layer of cultivated land than the other adjacent natural forest, plantation forest and grazing lands.

Soil Chemical Properties

Soil pH, EC and OC : The soil pH, EC and OC contents were found to vary with the land use system. Higher mean value of soil pH was recorded in agriculture (7.12) and lowest was recorded in plantation (5.87) land use systems. Intensive agriculture practices such as heavy tillage, irrigation with poor quality water and excess application of nitrogenous fertilizer have led to soil acidity in horticulture and mulberry land use system. The EC content recorded was highest in agriculture land use system (0.89 dS m^{-1}) and lowest was recorded in vegetable land use system (0.41 dS m^{-1}). The high EC content in agriculture land use system was recorded is attributed to continuous application of chemical fertilisers and manure to crops which could have resulted in the salt accumulation in soils. Similar results were reported by Sumita *et al.* (2018). Among the different land use systems, agriculture land use system (0.77 %) showed higher OC content followed by mulberry (0.64 %) and vegetables (0.55 %), whereas lowest was recorded in plantation land use system (0.45 %). The highest OC content in agriculture land use system is manily due to regular application of manures before sowing of crops. On the other hand, intensive cultivation, tillage and several management practices in horticulture and mulberry hastens the loss of SOC through facilitating microbial activities and the process of oxidation. The results are in confirmation withVikas Sharma *et al*. (2014) (Table 2).

TABLE 2

Soil nutrient status of southern transect of Bengaluru in different land use systems

Soil parameters	Agriculture land use system ± SD (n=20)	Vegetable land use system ± SD (n=20)	Mulberry land use system ± SD (n=20)	Plantation land use system ± SD (n=20)	Between land use systems		
					Mean	S.Em.±	LSD* (p=0.05)
Sand (%)	57.60^{a} ± 4.31 (48.52 - 66.20)	54.83^{b} ± 6.34 (41.71 - 66.86)	51.96^{c} ± 5.79 (43.28 - 66.47)	51.48^{c} ± 6.45 (37.15 - 68.12)	53.97	0.29	0.81
Silt (%)	15.05 ± 3.83 (8.97 - 22.11)	15.71 ± 3.60 (9.45 – 22.23)	16.15 ± 5.06 (9.97 – 25.15)	15.88 ± 4.40 (8.97 – 23.65)	15.70	NS	NS
Clay (%)	26.62^{d} ± 4.21 (19.32 - 35.69)	28.93^{c} ± 5.91 (19.89 - 41.08)	31.45^{b} ± 5.68 (20.77 - 38.74)	32.25^{a} ± 6.46 (16.23 - 41.20)	29.81	0.28	0.79
pH (1:2.5)	7.12^{a} ± 1.19 (4.68 - 8.45)	6.33^{b} ± 1.16 (4.58 - 7.98)	6.18^{b} ± 1.15 (4.58 - 8.33)	5.87^{c} ± 0.95 (4.32 - 7.23)	6.38	0.06	0.16
EC (1:2.5)	0.89^{a} ± 0.23 (0.12 - 2.37)	0.41^{c} ± 0.14 (0.01 - 0.96)	0.58^{b} ± 0.14 (0.04 - 2.19)	0.52^{b} ± 0.19 (0.02 - 1.40)	0.60	0.03	0.08
OC (%)	0.77^{a} ± 0.29 (0.37 - 1.23)	0.55^{c} ± 0.23 (0.32 - 1.13)	0.64^{b} ± 0.29 (0.19 - 1.16)	0.45^{d} ± 0.19 (0.27 - 0.89)	0.60	0.01	0.04
Available N (kg ha^{-1})	338.15^{a} ± 86.33 (189.64 - 485.63)	274.37^{c} ± 66.88 (166.50 - 404.25)	304.20^{b} ± 74.30 (196.23 - 435.32)	242.49^{d} ± 68.52 (166.85 - 389.23)	289.80	3.72	10.48
Available P_2O_5 (kg ha^{-1})	29.27 ± 10.79 (14.69 - 48.62)	27.40 ± 8.87 (15.26 - 44.12)	26.40 ± 8.38 (10.56 - 41.23)	24.48 ± 9.27 (11.68 - 45.56)	26.89	NS	NS
Available K_2O (kg ha^{-1})	237.33^{a} ± 64.41 (112.56 - 349.44)	216.60^{b} ± 67.31 (121.23 - 356.69)	217.34^{b} ± 60.23 (124.56 - 335.60)	181.54^{c} ± 53.83 (114.52 - 304.62)	213.20	3.08	8.68

*> 0.05 p value is significant, NS: Non-Significant, Figures followed by same letters in the row do not differ significantly by DMRT (P=0.05), Range values are mentioned in parenthesis

TABLE 3

Potassium fractions in different land use systems of southern transect of Bengaluru

Potassium (mg kg-1)	Agriculture land use system ± SD (n=20)	Vegetable land use system ± SD (n=20)	Mulberry land use system ± SD (n=20)	Plantation land use system ± SD (n=20)	Between land use systems		
					Mean	S.Em.±	LSD* (p=0.05)
Water soluble-K	4.51 ^{a} ± 1.40	4.22 ^{b} ± 1.41	4.26 ^{b} ± 1.18	3.47 ^{c} ± 1.06	4.12	0.06	0.18
	(1.20 - 7.10)	(2.27 - 7.25)	(2.35 - 6.54)	(1.98 - 5.68)			
Hot water soluble-K	7.48 ^{a} ± 2.20	6.85 ^{b} ± 2.29	6.93 ^{b} ± 1.90	5.84 ^{c} ± 1.80	6.76	0.10	0.29
	(3.22 - 11.25)	(3.59 - 12.05)	(3.58 - 10.20)	(3.20 - 10.25)			
Exchangeable-K	39.81 ^{a} ± 11.54	38.15 ^{b} ±11.17	39.67 ^{a} ± 10.60	28.96 ^{c} ± 10.19	36.65	0.54	1.53
	(24.25 - 63.15)	(15.13 - 57.15)	(16.25 - 60.75)	(15.75 - 49.51)			
Non Exchangeable-K	535.40 ^{a} ± 153.76	498.75 ^{b} ±147.86	476.80 ^{c} ±139.36	399.49 ^{d} ± 108.66	477.61	6.93	19.50
	(222 - 789)	(230 - 800)	(220 - 690)	(550 - 640)			
Lattice-K	6119 ^{a} ± 1484	5402 ^{b} ± 1664	5445 ^{b} ± 1497	4538 ^{c} ± 1346	5376	75.10	211.50
	(2887 - 8802)	(2985 - 8856)	(3158 - 8425)	(2839 - 7625)			
Total-K	6699 ^{a} ± 1627	5942 ^{b} ± 1821	5966 ^{b} ±1644.45	4970 ^{c} ±1463	5894	82.18	231.45
	(3136 - 9662)	(3328 - 9718)	(3397 - 9182)	(3140 - 8316)			

*> 0.05 p value is significant, Figures followed by same letters in the row do not differ significantly by DMRT (P=0.05), Range values are mentioned in parenthesis.

Available N, P_2O_5 and K_2O

Among the different cropping systems, agriculture land use system (338.15, 29.27 and 237.33 kg ha^{-1}) exhibited significantly higher available N, P_2O_5 and K_2O, respectively followed by vegetables, mulberry and lowest was recorded in plantation land use systems (242.49, 24.48 and 181.54 kg ha^{-1}) (Table 2). Excess application of urea, DAP causes soil acidity which intern affects the availability of nutrients in vegetables and mulberry land use system. Indiscriminate use of inorganic fertilizers leads to nutrient imbalance in soil causing ill effect on soil health and micro flora (Choudhary *et al.,* 2015). Unfortunately, continuous application of higher amount of fertilizer pose deleterious effects which leads to decline in productivity and deteriorates the physical, chemical and biological properties of soil. The lower values of available N, P_2O_5 and K_2O in plantation soils is due to soil erosion, improper fertiliser application and due to higher biomass of plantation crops. More uptake of nutrients from soil tend to lower the nutrient status in plantation soils. The higher available P and K content in land use system could probably be due to addition of fertilizers which led to build-up (Rajwinder and Bhat, 2017). Similar results were reported by Sumita *et al.* (2018).

Potassium Forms in Different Land Use Systems

The data related to forms and distribution of potassium in southern transect of Bengaluru is presented in Table 3.

Water Soluble Potassium

The water soluble potassium in southern transect of Bengaluru ranged from 1.20 to 7.25 mg kg^{-1} with a mean of 4.12 mg kg^{-1} in soils. The highest water soluble K was recorded in agricultural land use system (4.51 mg kg^{-1}) soils. The lowest water soluble K in surface soils was recorded in plantation land use system (3.47 mg kg^{-1}) soils. The water soluble K contributed 0.07 per cent to total K (Table 6).

The water soluble potassium ranged from 1.20 to 7.10, 2.27 to 7.25, 2.35 to 6.54 and 1.98 to 5.68 mg kg^{-1} in agricultural, vegetable, mulberry and plantation land use systems respectively. The amount seemed to be quite inadequate to meet the major part of requirement of fast growing short duration crops. It is due to higher amount of sand and organic matter present in agricultural soil contributed for high water-soluble K than other cropping systems soil (Saini and Grewal, 2014; Chahal *et al.,* 1976).

Hot Water Soluble Potassium

The hot water soluble potassium in southern transect of Bengaluru varied from 3.20 to 12.05 mg kg^{-1} with a mean of 6.78 mg kg^{-1} in soils. Higher hot water soluble K was obtained in soils of agricultural land use system (7.48 mg kg^{-1}). The lowest water soluble K was recorded in surface soils of plantation land use system (5.84 mg kg^{-1}). The decrease trend of hot water soluble K was observed in agricultural land use systems followed by mulberry, vegetables and plantation land use systems. A statistical significance between the land use systems was observed for hot water soluble potassium.

Exchangeable Potassium

The exchangeable K represents the fraction which is adsorbed on the soil surface. The data obtained in the study showed that exchangeable K varied from 24.25 to 63.15 mg kg^{-1} with mean value of 39.81 mg kg^{-1} in agricultural land use system, 15.13 to 57.15 mg kg^{-1} with mean value of 38.15 mg kg^{-1} in vegetable land use system, 16.25 to 60.75 mg kg^{-1} with mean value of 39.67 mg kg^{-1} in mulberry land use system and 15.75 to 49.51 mg kg^{-1} with mean value of 28.96 mg kg^{-1} in plantation land use system. The exchangeable K contributed 0.62 per cent to total K (Table 6).

The mean exchangeable K was recorded higher in agricultural and mulberry land use system soils mainly due to K fertilization and application of manures enriched with the exchangeable sites of clay-humus complex there by increased the exchangeable K content and the results are in agreement with the organic carbon content of agricultural and mulberry land use system soils. The lower values of exchangeable K in plantation land use system is due to crop uptake and also less exchange sites available

TABLE 4

Correlation between different forms of potassium and selected soil properties in southern transect of Bengaluru

Parameters	Sand	Silt	Clay	pH	EC	OC
Water soluble-K	0.938 *	0.698	0.913 *	0.872	0.445	0.770
Hot water soluble-K	0.829	0.579	0.798	0.883	0.621	0.942
Exchangeable-K	-0.635	0.284	0.586	0.675	0.371	0.922 *
Non Exchangeable-K	-0.897	0.642	0.868	0.891	0.536	0.873
Lattice-K	-0.87	0.662	0.846	0.930 *	0.691	0.959 **
Total-K	0.872	0.657	0.847	0.926 *	0.676	0.953 **

*Correlation is significant at the 0.05 level (2-tailed) ; **Correlation is significant at the 0.01 level (2-tailed).

for potassium in the soil. The results are in confirmation with Divya *et al*. (2016).

Non-Exchangeable Potassium

The perusal of the data revealed that non-exchangeable potassium in southern transect ranged from 220 to 789.50 mg kg^{-1} with mean value of 477.61 mg kg^{-1} in all the soils under investigation. In different land use systems, the mean non-exchangeable potassium was recorded highest in agricultural land use systems (535.40 mg kg^{-1}) and lowest in plantation land use systems (399.49 mg kg^{-1}). Conversion of exchangeable and water soluble potassium into non-exchangeable potassium is a slow process but this equilibrium plays an important role in potassium nutrition of plants (Dhillon *et al*., 1985). The non exchangeable K contributed 8.10 per cent to total K (Table 6).

The highest content of non-exchangeable K in agricultural land use systems was related to clay type which could fix the K in soils, due to presence of illitic and other 2:1 type of clay minerals. The low reserve of this form in the plantation soil is due to its release in the exchangeable form as a result of its depletion by crop uptake and leaching loss. Similar findings were obtained by Kundu *et al*. (2014) and Divya *et al*. (2016).

Lattice Potassium

The lattice potassium in different land use systems of sothern transect varied from 2887-8802 mg kg^{-1} (agriculture), 2985-8856 mg kg^{-1} (vegetables), 3158-8425 mg kg^{-1} (mulberry) and 2839-7625 mg kg^{-1} (plantation). The lattice K contributed 91.21 per cent of total K (Table 6).

TABLE 5

Correlation among different forms of potassium in southern transect of Bengaluru

Parameters	Water soluble-K	Hot water soluble-K	Exchange able-K	Non Exchange able-K	Lattice-K	Total-K
Water soluble-K	1	0.914	0.830	0.977 *	0.917	0.924
Hot water soluble-K		1	0.942	0.979 *	0.994 **	0.995 **
Exchangeable-K			1	0.911	0.898	0.903
Non Exchangeable-K				1	0.976 *	0.980 *
Lattice-K					1	0.996 **
Total-K						1

*Correlation is significant at the 0.05 level (2-tailed). ; **Correlation is significant at the 0.01 level (2-tailed)

The average lattice potassium in agricultural land use systems indicate that these soils have been derived from potassium bearing minerals such as 2:1 type of clay minerals which favoured the lattice potassium content in soils. Based on degree of weathering, lattice K content have been varied among the samples. The present results are corroborated with the findings of Divya *et al*. (2016) and Harsha and Jagadeesh (2017).

Total Potassium

The average total potassium were 6699.16 mg kg^{-1}, 5942.82 mg kg^{-1}, 5965.98 mg kg^{-1} and 4969.57 mg kg^{-1} in agricultural, vegetable, mulberry and plantation land use systems, respectively. Among different land use systems, the highest total potassium content was recorded in agricultural land use system and the lowest in plantation land use system. Depending on clay mineralogy, lattice K content and organic matter content, the total K content have been varied in different land use system soils. The results are in comparison with those of research findings of Hebsur and Gali (2011), Jagmohan & Grewal (2014) and Divya *et al*. (2016).

Relationship Between Potassium Forms and Soil Properties

The data presented in the Table 4 indicates that in surface soil, clay content showed positive correlation with all forms of potassium except the coefficient of correlation of water soluble-K (r^2 = 0.913) was significant at 5 per cent level of significance. Soil pH showed positive correlation with all the forms of potassium except lattice-K (r^2 = 0.930) and total-K (r^2 = 0.926) was significant at 5 per cent level of significance. Sand showed significant correlation with water soluble-K at 5 per cent level of significance. In general, electrical conductivity (EC) of surface soil showed positive relationship with all the forms of potassium. However, non significant was observed among the different forms of potassium. The organic carbon (OC) content of surface soil samples showed positive relationship with exchangeable K (r^2 = 0.922) at 5 per cent level of significance, lattice K (r^2= 0.959) and total K (r^2 = 0.953) at 1 per cent level of significance.

The results on the relationship among different forms of K are presented in Table 5. water soluble K was positively related in surface soil with hot water soluble K (r^2=0.914), exchangeable K (r^2=0.830), lattice K (r^2=0.917) and total K (r^2=0.924) except non exchangeable K (r^2=0.977), showed positive correlation relation at 5 per cent level of significance. Hot water soluble-K showed positive correlation with non exchangeable K (r^2=0.979) at 5 per cent level of significance, whereas lattice K (r^2=0.994) and total K (r^2=0.995) showed positive relation at 1 per cent level of significance. Exchangeable-K showed positive relation with all forms of potassium but found non-significant relationship. This indicates that the replenishment of exchangeable K upon depletion from non-exchangeable K was easy in these types of soils. Non exchangeable-K showed positive and significant relationship with lattice K (r^2=0.976) and total K (r^2=0.980) at 5 per cent level of significance. Lattice-K showed significant positive correlation with

TABLE 6

Contribution (%) of potassium fractions to total potassium in soils of southern transect of Bengaluru

Parameters	% contributed potassium fractions to Total potassium				Average
	Agriculture land use system	Vegetable land use system	Mulberry land use system	Plantation land use system	
Water soluble-K	0.07	0.07	0.07	0.07	0.07
Exchangeable-K	0.59	0.64	0.66	0.58	0.62
Non Exchangeable-K	7.99	8.39	7.99	8.04	8.10
Lattice-K	91.35	90.89	91.27	91.31	91.21

total K (r^2=0.996) at 1 per cent level of significance. This indicated the rapid equilibrium between these two forms of soil potassium.

The results of the present investigation on potassium dynamics in soils under different land use system in southern transect of Bengaluru showed that the contribution of different K fractions was in order of lattice K > non-exchangeable K > exchangeable K > water-soluble K. In general, water-soluble K, exchangeable K, non-exchangeable K, lattice K and total K content was recorded higher in agricultural land use systems than other land use systems. Higher availability of K is due to occurrence of potash rich minerals like mica and feldspar in these soils. From the present study it is very clear that mineral K (lattice K) is the main source for total K, which accounted more than 90 per cent in all the land use systems. Whereas, water soluble K, exchangeable K and non exchangeable K contributed less than 10 per cent to total K in all the land use systems. Knowledge of different forms of potassium in soil together with their distribution has greater relevance in assessing the long-term K supplying power of soil to crops and is important in formulating a sound fertilizer program for a given set of soil series and crops. This helps the planners to formulate an effective potassium fertilizer program in general for a zone, particularly for a soil type. A highly significant and positive relationship was observed between different forms of K, These relationships indicate that there existed equilibrium between these forms of K and depletion of one is instantly replenished by one or more of the other forms of K.

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