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Forms of Potassium in Some Soils of Udaipur District

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Abstract : Different forms of potassium were estimated from Kumawanton-ka-guda, Dulawanton-ka-guda, Khamnor, Hunder and Negodia villages of Udaipur district of Rajasthan. Results revealed that water soluble potassium and exchangeable potassium were higher while nitric acid extractable potassium and reserve potassium were lower than the data for some other soils of Udaipur district of Rajasthan. The values of correlation coefficient among different available potassium indices were quite high, indicating the equilibrium between different forms of potassium.

Key words : Forms of potassium, soils of Udaipur.

The utilization of soil potassium varies from locality to locality. It is often found unpredictable for the soils under diverse terrain and soils subjected to different management practices. The knowledge on various forms of potassium in a soil and an understanding of the conditions controlling its availability to growing crops is important for the appraisal of the available K in soils. The fixed, slowly available and readily available potassium always maintain an equilibrium in a soil system. Any change in the system brings about a definite shift in the equilibrium. The present study was carried out to know about different forms of K in some surface soils of Kumawanton-ka-guda, Dulawanton-ka-guda, Khamnor, Negoiad and Hunder villages of Udaipur district (Rajasthan), which varied widely in their physico-chemical properties. The possible correlations between different forms of K and some soil properties have also been worked out.

Materials and Methods

Twenty-five surface soil samples (0-22 cm) were collected from five villages (five samples from each village). The physico-chemical properties (Table 1) were analysed by the methods of Jackson (1967). Nitric acid soluble K was determined using the method of Sutton and Seay (1958). Morgan's potassium and water soluble K were estimated as described by Morgan (1941) and McLean (1961), respectively. Exchangeable K was estimated as per method of Hanway and Heidal (1952).

Results and Discussion

The water soluble potassium varied from 0.40 to 1.00, 0.36 to 1.00, 0.60 to 1.04, 0.56 to 0.76 and 0.60 to 0.88 mg/100 g soil for Kumawanton-ka-guda, Dulwanton-ka-guda, Khamnor, Hunder and Negodia villages, respectively (Table 2). The mean values of exchangeable potassium were 6.30, 4.80, 6.70, 6.00 and 7.60 mg/100 g soil, for soils of Kumawanton-ka-guda, Khamnor, Hunder and Negodia villages, respectively. Sehgal *et al.* (1992) while studying different forms of K in six profiles developed on granite gneiss and basalt in south-eastern Rajasthan found that exchangeable K was significantly and positively correlated with water soluble K, HNO_3 soluble K and mineral K, indicating the existence of a dynamic equilibrium between the K forms.

The values of Morgan's extractable K varied from 2.05 to 3.20, 1.75 to 3.50, 2.40 to 5.00, 2.00 to 3.25 and 2.00 to 2.90 mg/100 g soil for Kumawanton-ka-guda, Dulawanton-ka-guda, Khamnor, Hunder and Negodia soils, respectively. The corresponding values for nitric acid soluble K varied from 32 to 175, 40 to 216, 80 to 184, 64 to 120 and 104 to 216 mg/100 g soil, respectively. The higher values of nitric acid soluble K may

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Table 1. Physico-chemical characteristics of soils from five villages of Udaipur district

Sample number	Village	Panchayat Samiti	pH (1:2)	EC (dSm^{-1})	OC (%)	CEC (C mol kg^{-1})	Texture
KG_1	Kumawanton-ka-guda	Bedgaon	7.7	0.36	0.75	18.15	Loam
KG_2	–do–	–do–	7.9	0.35	1.05	20.00	Clay loam
KG_3	–do–	–do–	7.8	0.37	0.98	18.20	Sandy clay loam
KG_6	–do–	–do–	7.2	0.60	0.83	17.20	Sandy loam
KG_{20}	–do–	–do–	7.1	0.56	0.38	20.00	Sandy clay loam
D_1	Dulawanton-ka-guda	–do–	7.9	0.28	1.29	21.00	Clay loam
D_8	–do–	–do–	7.3	0.34	0.60	18.00	Sandy loam
D_9	–do–	–do–	7.2	0.35	1.46	18.90	Silty clay loam
D_{23}	–do–	–do–	7.0	0.56	1.40	20.10	Sandy clay loam
D_{25}	–do–	–do–	7.5	0.39	0.71	14.52	Loamy sand
K_1	Khamnor	Khamnor	8.1	0.35	1.28	18.50	Clay loam
K_2	–do–	–do–	9.0	0.36	0.83	15.17	Sandy loam
K_3	–do–	–do–	8.1	0.36	1.28	18.00	Silty clay loam
K_4	–do–	–do–	8.1	0.36	1.50	17.90	Silty loam
K_5	–do–	–do–	8.4	0.56	0.30	20.00	Sandy clay loam
H_1	Hunder	Bedgaon	8.2	0.56	1.05	16.10	Sandy loam
H_2	–do–	–do–	8.2	0.40	1.17	17.10	Sandy clay loam
H_3	–do–	–do–	7.6	0.38	0.53	20.10	Clay loam
H_7	–do–	–do–	7.3	0.54	0.30	15.10	Silty loam
H_{13}	–do–	–do–	8.0	0.30	1.05	20.00	Loam
N_1	Negodia	Khamnor	8.2	0.56	1.47	23.10	Clay loam
N_2	–do–	–do–	8.3	0.39	0.78	19.10	Silty loam
N_4	–do–	–do–	8.0	0.35	1.44	15.10	Sandy loam
N_{19}	–do–	–do–	8.2	0.37	0.93	20.10	Sandy clay loam
N_{25}	–do–	–do–	7.7	0.38	0.48	15.10	Sandy loam

be due to the presence of illite type of clay mineral in the fine fractions of these soils, which can retain higher amount of potassium in their lattices.

The values of reserve potassium varied widely between the villages and within the village. This may be due to variation in texture, organic carbon and cation exchange capacity of the soil. Maximum reserve potassium ranged from 29 to 169.5, 34 to 208.5, 77 to 171.4, 59 to 116 and 100 to 213 mg/100 g soil for Kumawanton-ka-guda, Dulawanton-ka-guda, Khamnor, Hunder and Negodia villages, respectively. These values are lower than those observed by Swami (1975) for some other soils of Udaipur district.

The amount of reserve potassium depends on the degree of weathering and composition of clay minerals.

Table 2. Available potassium indices of soils from five villages of Udaipur district

Soil sample	Water soluble	Exchangeable	Morgan's	Reserve	Nitric acid soluble
	<		mg/100 g soil		>
KG_1	0.40	5.50	2.68	50.50	56.00
KG_2	0.76	8.50	2.68	71.50	80.00
KG_3	0.68	8.00	3.20	80.00	88.00
KG_6	0.60	6.50	2.35	169.50	175.00
KG_{20}	1.00	3.00	2.05	29.00	32.00
D_1	0.60	4.00	2.55	164.00	168.00
D_8	0.72	1.50	1.90	102.50	104.00
D_9	0.80	7.50	3.50	208.50	216.00
D_{23}	1.00	5.00	2.35	57.00	56.00
D_{25}	0.36	6.00	1.75	34.00	40.00
K_1	0.60	5.50	2.45	162.50	168.00
K_2	1.00	7.50	4.50	112.50	120.00
K_3	0.64	12.50	2.40	171.40	184.00
K_4	1.64	5.00	2.40	163.00	168.00
K_5	1.04	3.00	5.00	77.00	80.00
H_1	0.76	8.50	2.25	103.50	112.00
H_2	0.60	8.50	2.30	63.50	72.00
H_3	0.56	4.00	2.00	116.00	120.00
H_7	0.60	4.00	3.25	116.00	120.00
H_{13}	0.68	5.00	2.00	59.00	64.00
N_1	0.64	16.00	2.40	112.00	128.00
N_2	0.80	9.00	2.45	199.00	208.00
N_4	0.88	4.00	2.90	100.00	104.00
N_{19}	0.60	6.00	2.15	114.00	120.00
N_{25}	0.84	3.00	2.00	213.00	216.00
Mean	0.71	6.28	2.62	113.96	119.96
Cv (%)	25	51	30	48	46

Water soluble potassium, reserve K and nitric acid soluble K showed non-significant correlation with pH, OC and CEC of soils (Table 3). The exchangeable potassium was found to be significantly correlated with pH and organic carbon and Morgan's K with pH of the soil only (Table 3). Dixit *et al.* (1993) also found exchangeable potassium to be significantly correlated with pH and organic carbon content in some soil series of western Uttar Pradesh.

All the forms of potassium, except reserve K and nitric acid souble K, were not significantly correlated with each other (Table 4). The highly

Table 3. Coefficient of correlation between different forms of potassium and some soil properties

Potassium forms	pH	OC	CEC
Water soluble	0.108	0.094	0.069
Exchangeable	0.378*	0.491*	0.219
Morgan's K	0.397*	−0.120	−0.246
Reserve K	0.218	0.212	0.073
Nitric acid soluble K	0.134	0.238	0.066

* Significant at P = 0.05.

Table 4. Coefficient of correlation among different forms of potassium

Potassium forms	Water soluble	Exchangeable	Morgan's	Reserve	Nitric acid soluble
Water soluble	1	−0.172	0.483*	0.007	−0.012
Exchangeable		1	−0.002	0.134	0.192
Morgan's			1	0.32	0.033
Reserve				1	0.998**
Nitric acid soluble					1

* Significant at P = 0.5.
** Significant at P = 0.01.

significant positive correlation between reserve K and nitric acid soluble K indicates the dependence of nitric acid soluble K on reserve K.

To formulate sound fertilizer recommendations, a knowledge of potassium supplying capacity of the soil is essential for suggesting appropriate fertilizer application. This may depend on the content of different forms of K in the soil and their relationship with soil physico-chemical properties and also the relationship among different forms of K.

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