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RESEARCH PAPER

Potassium status and physico- chemical properties of the FCV tobacco growing soils of Southern Transition Zone of Karnataka

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***Abstract* :** The available potassium status of the soils of Southern Transition Zone of Karnataka varied from 27.5 to 448 kg ha^{-1}. Out of one hundred sixty surface soil samples only 3.13 per cent of samples were low in available potassium status, while, 32.5 per cent of soil samples were medium and 64.58 per cent of soil samples were high in available potassium status. Soil reaction of tobacco growing soils of Southern Transition Zone of Karnataka, in general was acidic to neutral in reaction and low amounts of soluble salts. Organic carbon content of the soil ranged from 2.70 to 14.10 g kg^{-1}. Available nitrogen content of the soils ranging from 92.28 to 485.04 kg ha^{-1}, most of the soils were medium to high in available phosphorus and potassium. Exchangeable calcium and magnesium was ranged from 2.30 to 7.10 and 1.0 to 30.6 cmol (p+) kg^{-1}, respectively. The chloride content ranged from 16 to 82 mg kg^{-1} and the CEC values ranged from 6.0 to 11.9 cmol (p+) kg^{-1}.

***Key Words* :** Available potassium, Soil reaction, Tobacco platform

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INTRODUCTION

Flue cured Virginia tobacco, a quality conscious commercial crop is grown on the light soils of Southern Transition Zone of Karnataka, India. The soils vary widely in physical and chemical characters and nutrient status and considerably influence the type, grade and quality of FCV tobacco produced. The essential soil requirements for growing good quality tobacco are light sandy soils will drained with clay sub- soil, low in organic matter, acidic to neutral pH and low reserve of essential nutrients (Krishnamurthy and Ramakrishnayya, 1986).

The soils of Southern Transition Zone of Karnataka, covering the tobacco platforms of Shimoga, Hassan and Mysore districts are mostly well drained light soils. The soils tend to produce a large thin leaf which is light in weight and colour, mild in strength, weak in aroma, soft in nature, low in nicotine and mature tobacco with high filling values.

In order to obtain information on potassium status and physico chemical properties of the tobacco growing soils and to characterize the soils to formulate a suitable fertilizer recommendation for producing good quality tobacco, the present investigation was carried out in different tobacco platforms area. The research of this investigation was carried out at College of Agriculture, Navile, Shimoga, and Karnataka, India during 2009.

MATERIALS AND METHODS

Soil samples were collected from different tobacco platforms of Karnataka *viz*., H.D.Kote-1, Hunsur-2, 3, Periyapatna-4, 5, 6, Ramanathapura-7 and Shimoga- 8. The soils selected for study are derived from peninsular granite and gneiss. In order to study the status of available potassium, one hundred sixty surface soil samples (0-20 cm) representing all the tobacco platforms of Southern Transition Zone of

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Karnataka (STZ) were collected. In addition to 160 surface samples, forty soil samples were selected to study the physical and chemical properties of the soils. The soil samples were processed and analyzed for particle size composition, pH, EC, OC, available-N, available –P, available–K, exchangeable calcium and magnesium, CEC by following the standard procedure as outlined by Jackson (1973). Chloride was analyzed by following the procedure as described by Chopra and Kanwar (1986). Nutrient index values for potassium were calculated using the concept of Parkar *et al*. (1951) and in interpretation of nutrients indices, the limits suggested by Ramamurthy and Bajaj (1969) was adopted.

RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Characterization of tobacco - growing soils:

Physical properties:

The data on particle size distribution of soils revealed that almost all soils contained higher percentage of coarse sand (Table 1). Bilagulli soils of Periyapatna-6 platform recorded highest (64.0%) coarse sand, where as the lowest (39.5%) was recorded in Reddy Koppal of Hunsur-2 platform. Fine sand content of the soils varied from 20.3 per cent in Sollapur farm of Hunsur -3 platforms to 39.8 per cent in Abbalagere soils of Shimoga-8 platform. Lowest silt content noticed was 2.0 per cent in H. halli in Hunsur plotform- 3, while highest was 12.0 per cent in Betlhur in Hunsur platform 2. Beemanahalli soils of H.D Kote-1 platform recorded lowest clay content (6.00%), while Belagutti of Shimoga platform- 8 were high (23.20%) in clay content. Out of 40 soil samples characterized, eighteen belonged to sandy loam, seventeen to loamy sand, four to sandy clay loam and one to coarse loamy sand.

The data on particle size (Table 1) analysis revealed that the texture of the soils varied from sandy loam to sandy clay loam. Even though the total sand content was high, soils contained appreciable amounts of silt and clay. The mean values of silt and clay contents ranged from 4.3 to 7.7 and 0.4 to 17.7 per cent, respectively under different tobacco platforms of Karnataka.

Soil pH, EC and organic carbon:

Soil reaction of tobacco growing soils of Southern Transition Zone of Karnataka in general was acidic to neural in reaction, the pH ranged from 5.2 (Kallahalli) to 7.5 (Azadnagar) of the Hunsur-2 platform. The soils were slightly acidic in reaction (Table 2). This may be attributed to acidic parent material like granitic gneiss (Anathanarayana and Perur, 1973).

Electrical conductivity of the tobacco growing soils of Karnataka varied from 0.01 to 0.09 dS m^{-1}. The results indicated that, all most all the soils were found to be low in electrical conductivity, indicating non saline nature of the tobacco growing soils of Karnataka. Low electrical conductivity of the soils studied indicated that the conditions prevailed were not favourable for accumulation of soluble salts in the soils.

Organic carbon content of the soils ranged from 2.7 to 14.1 g kg^{-1}. Highest organic carbon content (14.1 g kg^{-1}) was recorded in Gangenahalli soil of H.D Kote-1 platform and lowest content (2.7 g kg^{-1}) was recorded in soils of Malur in Hunsur-3 platform. The mean values of organic carbon content ranged from 4.3 to 8.4 g kg^{-1} in Ramanathapura-7 and Hunsur-2 platforms, respectively. In general, the organic carbon status was low to medium and this may be due to tillage operations by which the organic carbon build up would be low especially in soils under continuous cultivation of wide spaced crop like Tobacco (Hofuman, 1975 and Sharma and Agarwal1984). Rapid decomposition due to high temperature would also be the reason for low organic matter status in tropical situation. *In situ* incorporation of crop residues and addition of FYM and other organic manures to the surface soils would be the cause for higher organic matter in the surface layer than in the subsoil. Similar findings were also made by Srinivasa Rao *et al.* (1994).

Available NPK status:

Most of the surface soils were low to medium in available nitrogen status. The mean values of available nitrogen in soils ranged from 152 to 295 kg ha^{-1} in Ramanathapura-7 and HD Kote-1 platforms, respectively. Similar findings were also made by Krishnamurthy *et al.* (1988). In general, most of the surface soils were medium to high in available phosphorus status, where FCV tobacco is being cultivated continuously. This could be attributed to the spot placement of high dose of phosphorus (80 kg P_2O_5 ha^{-1}) and high residual effect of phosphorus (Gopalachari, 1984). Similar observations regarding high phosphorus build up in tobacco growing Karnataka light soils were reported by Vasuki *et al.* (1998). Most of the soils were medium to high in available phosphorus status. The lowest available phosphorus status(23.9 kg ha^{-1}) was recorded in Abbalagere in Shimoga platform and highest value of 85.2 kg ha^{-1} in Hannur of H. D. Kote platform. The mean values of available phosphorus were 41 and 65 kg ha^{-1} in Shimoga-8 and Hunsur-3 platforms, respectively.

The available potassium in the surface soils varied from 275 to 448 kg ha^{-1}. Jagadesh (2004) also observed this range of available potassium in soils of Southern Karnataka. The mean available potassium level was 294 and 381 kg ha^{-1} in Hunsur-2 and Ramanathapura-7 platforms, respectively. The reasons for relatively higher contents of available potassium as recorded in some soils could be attributed to higher amounts of potassium bearing minerals in the soils.

Table 1: Characterization of FCV tobacco growing soils of Southern Transition Zone: Particle size analysis

Plat forms/Location	Fine sand (%)	Coarse sand (%)	Silt (%)	Clay (%)	Textural classes
HD KOTE 1					
Ganganahalli	28.60	51.00	4.50	15.90	Sandy loam
Beemanahalli	36.00	52.00	6.00	6.00	Loamy sand
Adathore	25.99	55.00	4.40	15.00	Loamy sand
Kolauige	32.29	53.00	6.50	8.50	Loamy sand
Hannur	37.50	50.00	5.50	7.00	Sandy loam
Mean	32.07	52.20	5.30	10.40	
HUNSUR 2					
Kallahalli	24.50	51.00	6.50	18.00	Loamy sand
Kottemalawadi	20.50	50.00	9.50	20.00	Sandy clay loam
Reddy Koppal	27.00	39.50	11.50	22.00	Sandy clay loam
Kollugangur	21.00	59.00	3.50	16.50	Sandy loam
Agrahara	24.60	50.40	8.00	17.00	Sandy loam
Azada nagar	32.30	57.00	3.00	7.70	Coarse loamy sandy
Belthur	25.00	40.00	12.00	23.00	Sandy clay loam
Mean	24.98	49.55	7.71	17.74	
HUNSUR 3					
Chik hunsur	24.10	50.00	8.00	17.90	Sandy loam
Sollapur farm	20.30	49.50	10.00	20.20	Sandy loam
H. halli	30.99	60.00	2.00	7.50	Loamy sand
Marur	20.20	60.20	3.30	16.30	Sandy loamy
Mean	23.89	54.93	5.80	15.40	
PERIYAPATNA 4					
H.M patna	24.90	63.50	4.50	7.10	Sandy loam
Bellahalli	28.50	48.50	4.20	18.80	Loamy sand
Komalapura	26.59	58.00	4.30	11.90	Loamy sand
Belalpura	26.90	60.10	4.20	8.80	Sandy loam
Mean	26.40	57.53	4.30	11.65	
PERIYAPATNA 5					
Kothala halli	28.30	46.30	5.40	20.00	Sandy loam
Seeguru	26.20	61.00	4.30	8.50	Sandy loam
H.M. Bagilu	26.40	53.10	5.00	15.50	Sandy loam
Kagundi	26.90	60.00	4.30	8.80	Loamy sand
Mean	26.95	55.10	4.75	13.20	
PERIYAPATNA 6					
Surgi halli	28.00	48.40	4.80	18.80	Sandy loam
R.B.M. Koppal	28.30	45.00	5.70	20.00	Sandy loam
Bilagulli	24.30	64.00	4.70	7.00	Loamy sand
Kampalpura	28.60	46.00	5.40	20.00	Sandy loam
Surganahalli	26.40	60.50	4.30	8.80	Loamy sand
Mean	27.12	52.78	4.98	14.92	

Contd... Table 1

Table 1 contd….

RAMANATHAPURA 7					
Arkalgudu	26.40	53.10	5.00	15.50	Sandy loam
Mallarajapatna	31.50	45.50	4.00	19.00	Loamy sand
M.N.pura	36.29	48.50	6.00	10.00	Loamy sand
Kentena halli	30.28	52.10	7.50	10.00	Loamy sand
Mean	31.00	49.80	5.60	13.60	
SHIMOGA 8					
Jeenahalli	38.49	47.00	6.5	8.00	Loamy sand
Abbalagere	39.80	47.00	5.50	7.70	Loamy sand
Chattanahalli	39.00	47.00	6.00	8.00	Loamy sand
Palvanahalli	36.23	45.50	9.30	9.50	Sandy loam
Belagutti	21.80	46.00	9.00	23.20	Sandy clay loam
Kenchikoppa	38.00	48.00	6.00	8.00	Loamy sand
Kathige	37.79	49.00	5.20	8.40	Sandy loam
Mean	35.87	47.00	6.70	10.40	

Table 2 : Characterization of FCV tobacco growing soils of Southern Transition Zone: physical and chemical properties

Plat form/ Location	pH (1:2.5)	EC dS m^{-1} (1:2.5)	O.C (g kg^{-1})	Avail. N (kg ha^{-1})	Avail. P (kg ha^{-1})	Avail. K (kg ha^{-1})	Exch. cations (cmol (p+)Kg^{-1})		Chlorides (mg kg^{-1})	CEC (cmol (p+) kg^{-1})
							Ca	Mg		
HD KOTE 1										
Ganganahalli	6.6	0.02	14.10	485.0	65.0	448	3.4	2.2	65.9	10.80
Beemanahalli	6.9	0.07	11.10	381.8	23.9	336	5.1	2.3	32.9	11.00
Adathore	6.6	0.02	06.90	237.4	18.8	280	5.5	2.7	65.9	11.90
Kolauige	6.9	0.02	05.50	154.9	33.9	336	3.7	2.3	42.8	10.00
Hannur	7.2	0.13	06.00	220.0	85.2	291	4.4	3.6	45.5	8.00
Mean	6.8	0.05	07.34	295.8	45.4	338	4.4	2.6	50.6	10.34
HUNSUR 2										
Kallahalli	5.2	0.03	07.50	258.0	44.0	291	4.2	2.9	16.0	8.30
Kottemalawadi	6.8	0.04	09.90	340.0	40.6	224	6.8	1.0	20.0	9.10
Reddy Koppal	6.4	0.02	09.60	330.2	28.9	302	4.8	2.3	22.0	10.00
Kollugangur	6.0	0.02	06.30	216.7	38.9	257	7.0	1.7	20.0	11.00
Agrahara	6.9	0.02	09.60	330.2	75.9	392	7.5	2.2	20.0	10.20
Azada nagar	7.5	0.10	09.00	309.6	38.9	302	5.3	3.2	18.0	9.10
Belthur	6.6	0.02	06.60	227.0	34.39	290	6.2	2.1	32.9	11.00
Mean	6.5	0.04	08.40	287.4	43.0	294	6.0	2.2	24.3	9.80
HUNSUR 3										
Chik hunsur	6.9	0.09	03.60	123.8	78.4	380	3.4	2.8	32.9	7.90
Sollapur farm	6.7	0.07	05.40	185.8	72.0	257	3.9	1.3	65.9	7.70
H. halli	6.8	0.02	06.60	227.0	28.9	358	4.6	2.2	65.9	10.00
Marur	6.1	0.02	02.70	92.9	80.9	380	2.9	2.0	32.8	8.90
Mean	6.6	0.05	04.57	157.4	65.0	344	3.7	2.0	49.4	8.60

Contd… Table 2

Table 2 contd…

PERIYAPATNA 4										
H.M patna	5.8	0.08	09.00	309.60	33.9	347	2.8	1.2	25.0	6.50
Bellahalli	5.7	0.05	06.60	227.04	49.2	302	2.4	1.3	37.0	6.50
Komalapura	5.5	0.08	10.50	361.20	70.4	414	3.3	1.2	34.0	6.80
Belapura	6.0	0.01	03.90	134.16	75.9	347	3.8	2.1	38.0	7.70
Mean	5.8	0.06	07.50	258.00	57.4	353	3.1	1.5	34.0	6.90
PERIYAPATNA 5										
Kothala halli	7.3	0.02	7.20	247.7	42.03	347	7.1	2.0	61.54	11.9
Seeguru	6.6	0.01	7.20	247.7	70.4	426	4.7	3.1	61.54	10.1
H.M. Bagilu	6.9	0.09	5.40	185.8	59.7	246	2.3	1.5	37.50	6.5
Kagundi	7.3	0.01	6.60	227.0	81.4	436	4.9	2.6	61.54	9.1
Mean	7.0	0.03	6.6	227.0	63.4	363	4.8	2.3	55.53	9.4
PERIYAPATNA 6										
Surgi halli	5.6	0.09	5.10	175.4	23.9	313	2.9	1.7	40.00	6.8
R.B.M. Koppal	6.9	0.08	4.80	165.1	75.9	336	5.3	3.3	56.00	10.9
Bilagulli	6.5	0.01	11.4	392.2	78.3	437	2.4	1.4	44.00	6.3
Kamapura	6.4	0.02	10.2	350.8	70.0	291	6.7	1.8	36.00	11.0
Surganahalli	5.8	0.09	9.9	340.0	38.9	270	4.9	2.2	27.00	10.2
Mean	6.2	0.05	8.3	284.7	57.4	329	4.4	2.0	40.6	9.0
RAMANATH-PURA 7										
Arkalgudu	6.0	0.02	4.2	164.5	73.3	347	2.4	1.3	46.00	6.2
Mallarajapatna	5.0	0.05	4.8	165.1	28.9	439	2.8	1.8	61.54	6.3
M.N.pura	6.0	0.05	4.2	144.5	65.0	358	2.5	2.0	65.84	6.5
Kenche Koppal	5.5	0.06	3.9	134.2	70.4	380	4.4	2.2	32.00	9.3
Mean	5.6	0.05	4.3	152.0	59.4	381	3.0	1.8	51.34	7.1
SHIMOGA 8										
Jeenahalli	7.3	0.02	6.6	227.0	19.5	425	4.9	2.6	33.00	9.1
Abbalagere	5.7	0.02	5.4	185.8	23.9	275	5.7	2.8	61.00	11.0
Chattanahalli	6.4	0.09	2.8	92.8	40.6	380	2.3	1.5	30.00	6.0
Palvanahalli	5.5	0.01	5.4	185.8	74.6	291	4.9	2.6	82.00	10.2
Belagutti	6.7	0.02	3.6	123.8	29.2	403	4.9	2.9	42.00	10.2
Kenchikoppa	5.5	0.08	3.9	134.2	70.4	369	4.3	2.7	40.00	9.3
Kathige	5.7	0.02	6.6	227.0	28.9	436	3.5	2.5	61.00	6.8
Mean	6.1	0.04	4.9	168.0	41.0	368	4.4	2.5	49.86	8.9

Table 3 : Available potassium status of tobacco growing soils under various auction platforms of Southern Transition Zone

Tobacco plat forms name and number	No. of samples	Range of available potassium (kg ha^{-1})	Ratings		
			Low	Medium	High
HD Kote-1	22	130-790	0	7(31.8)	15(68.2)
Hunsur-2	13	290-840	0	4(30.70)	9(69.2)
Hunsur -3	19	210-790	0	5(26.3)	14(73.7)
Periyapatna-4	12	240-690	0	3(25.0)	9(75.0)
Periyapatna-5	14	240-760	0	2(14.3)	12(85.6)
Periyapatna-6	23	110-860	1 (4.34)	5(21.7)	17(73.9)
Ramanathpur-7	17	170-740	0	6(39.3)	11(64.7)
Shimoga-8	40	110-840	4 (10.00)	20(50.0)	16(40.0)

Figures in parenthesis represent per cent values

Table 4 : Available potassium status of FCV tobacco growing soils of Southern Transition Zone: District wise nutrient index and fertility ratings

District	Plat forms	No. of samples	Mean value K (kg ha^{-1})	Rating			Nutrient index	Fertility rating
				Low	Medium	High		
Mysore	H. D Kote-1, Periyapatna 4, 5 and 6 Hunsur 2 and 3	103	430 (110 - 860)	1 (0.97)	26 (25.24)	76 (73.78)	2.72	High
Hassan	Ramanathpura-7	17	364 (170 – 740)	0	6 (39.29)	11 (64.70)	2.64	High
Shimoga	Shimoga-8	40	446 (110 – 840)	4 (10)	20 (50)	16 (40)	2.30	Medium
All districts (over all)		160	413	5 (3.13)	52 (32.50)	103 (64.38)	2.61	High

Figures in parenthesis represent range values

Exchangeable cations and CEC:

Calcium and magnesium were also marginal in most of the soils. Calcium was the dominant cation on the soil exchange complex than magnesium. In the cultivation of FCV tobacco, calcium in general is high in all the tobacco growing soils in India (Prasad Rao and Murthy, 1993).The soils under the study showed low CEC varying from 6.0 to 11.9 cmol (p^+) kg^{-1}. Low CEC in the soil studied may be due to low clay content and dominance of Kaolinite type of clay (Walia and Chamuah, 1988).

Available potassium status of soils:

Among the platforms studied, large number of samples (85.6 %) was high with respect to available K status under Periyapatna-5, while Shimoga platform recorded high K status only in 40 per cent of the samples (Table 3).

Out of one hundred and sixty surface soil samples only 3.13 per cent were low in available potassium, while 32.5 per cent were medium and 64.4 per cent of soil samples were high in available potassium (Table 4) in different districts of FCV tobacco growing platforms in Karnataka light soil regions.

The data on nutrient index value for potassium presented in Table 4 revealed that soils of Mysore and Hassan districts were high in potassium fertility rating, where as Shimoga was medium in fertility rating. Thus the available potassium status of FCV Tobacco growing soils of Southern Transition Zone of Karnataka varied from medium to high range. These results are in conformity with the findings of Krishnamurthy and Ramakrishnayya (1986) and Krishnamurthy *et al.* (1988) in Northern light soils of Andhra Pradesh and flue cured tobacco growing soils of Mysore districts in Karnataka.

Most of the applied potassium remaining in labile pool or being released in to labile pool from non-exchangeable source may be the reason for medium to high range in available potassium status (Krishnamurthy *et al.,* 1988). The results also suggested that the soils, where tobacco is being cultivated might have encouraged potassium build up due to spot placement of higher dosage of potassium fertilizer application.

The above results revealed that the content of available nitrogen was low to medium and available P and K were medium in soils of FCV tobacco growing soils of Southern Transition Zone of Karnataka. It can be concluded that there is a strong probability for obtaining profitable response to nitrogen and phosphorus fertilization. The data on nutrient index for potassium revealed that soils of Mysore and Hassan districts soils were high in potassium fertility rating, where as Shimoga was medium in fertility rating. Although at present most of soils showed high available potassium status, maintenance dose of potassium will be sufficient. However, because of quick depletion of potassium from these soils, it is necessary to monitor these soils for available K content periodically.

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