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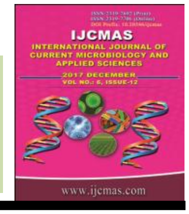

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Potassium Status of Indian soils: Need for Rethinking in Research, Recommendation and Policy

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A B S T R A C T

Growing population and its need pressurize Indian agriculture to produce more from shrinking arable land. Balanced nutrition plays a key role in enhancing the productivity of crops and sustainability of production systems. Potassium is third most important plant nutrient. Recent studies showed declining status of K in majority of the soils in India. High crop K removal than K addition by farmers and imbalanced use of NPK fertilizers contributed to large-scale K mining and K deficiency in soils and crops. K fertility depletion observed in all soil types. Widespread K deficiency was identified in rice-wheat system of Indo-Gangetic plains, horticultural, plantation, ornamental, aromatic and avenue plants. The current fertilizer recommendations are obsolete, very much generalized without considering the soil types, hence need revision and revalidation. Site-specific fertilizer recommendations, if followed can minimize the fertility K depletion and maintain productivity and sustainability and also economize the fertilizer cost. Awareness on K use by farmers needs immediate action.

Introduction

Potassium (K) is third most important plant nutrient, vital to many plant processes owing to its requirement for activation of at least 60 different enzymes involved in plant growth, important for osmoregulation, cation-anion balance, protein synthesis, water balance, reducing lodging, imparting disease resistance and improving quality and shelf life of crop produce. Nutrient K is less mobile in soils because of the strong affinity with exchange sites of clays. Large rates of K uptake can be attributed to its high mobility due to the large permeability of cell membranes to K-ions, which arise from the occurrence of a range of highly K selective, low and high affinity ion channels and transporters. The large K uptake rate achieved by roots result in a steep depletion of solution K in the rhizosphere. It has been well established that a significant proportion of plant needs of K are met from non-exchangeable fraction of soil K (Sreenivasa Rao *et al.*, 2010; 2014).

Exchangeable K and non-exchangeable K can thereby significantly be depleted and contribute to a substantial proportion of plant uptake. Agronomically, the demand for K largely varies with plant species and cultivars and productivity. The large portion of K uptake essentially occurs during the vegetative stage and can reach values of10 kg/ha/day and above. In India, until 1980's, potassium application did not receive much attention because of general belief that Indian soils were rich in potassium and a profitable response to applied K had not always been observed so as to warrant blanket application (Ghosh and Hasan, 1976). The fertilizer K use and fertilizer K consumption reached maximum peak in 2010-11 from 29000 t and 0.19 kg per in 1960-61 to 3514000 t in 2010-11and 18.0 kg per ha, respectively (Table 1). However, total fertilizer nutrient consumption is increased especially N and P but the consumption of K fertilizers declined (Table 1), which lead to wide gap in NPK ratio leading to mining of soil K and imbalance nutrition. In this article an attempt has been made to review the past and recent information on K status of Indian soils.

K status - scenario at country level

Available K map prepared in 1969 showed that K availability was low in 20 per cent districts, medium in 52 per cent and high in 28 per cent (Ramamurthy and Bajaj, 1969). Seven years later, Ghosh and Hasan (1976) summarized the soil test results of 4.5 million samples and observed that soils in 20 per cent districts (63 districts) were low, 42 per cent (130) were medium and 38 per cent (117) were high in available K. States like Gujarat, Haryana, Madhya Pradesh and Rajasthan were rated high in K status. Andhra Pradesh, Arunachal Pradesh, Bihar, Karnataka, Kerala, Maharashtra, Orissa, Punjab, Tamil Nadu and West Bengal states showed maximum area under medium K status (Table 2). Assam, Himachal Pradesh, Jammu and Kashmir, Meghalaya, Mizoram, Tripura, Pondicherry and Uttar Pradesh (U.P.) states recorded more area under low K status. A comparison of the past two evaluations indicated that K status of soils in more than 40 districts of 10 states had made an upward shift (high K status), even though actual potassium use during this period was negligible. Based on 3.65 million soil samples analyzed between 1997 to 1999 (Motsari, 2002) (Table 2) and based on 11 million soil samples (Hasan and Tiwari, 2002), the considerable area under low potassium status was observed in the states of Tripura and Jammu & Kashmir, medium in Assam, Arunachal Pradesh, Haryana, Himachal Pradesh, Kerala, Meghalaya, Mizoram, Odisha, Puducherry, Punjab, Uttar Pradesh (U.P.) and West Bengal while high in Andhra Pradesh, Gujarat, Madhya Pradesh, Maharashtra, Karnataka and Tamil Nadu (Naidu *et al.*, 2010 and Naidu *et al.*, , 2011). The general trend indicated that K status in Indian soils had been sliding from medium to high (in year 1976) to medium to low (in year 2002). Similar trend of change in available K was reported in some of the bench mark soils spread in different states (Bansal *et al.*, 2002; Sekhon, 1999).

Recent K status - at regional and micro level

Soil nutrient mapping had been gaining more importance in different states and among the farming community too. In this direction, central and state R&D departments had taken up soil analysis in extensive areas and the recent K status is presented below.

Northern region

The recent K status of 2003 in 126 districts in Indo-Gangetic Plains (IGP) indicated that Meerut, Shajanpur, Rampur, Bijnor, Aligarh and Mainpuri districts of Uttar Pradesh showed low to medium in K status, Faizabad, Gazipur, Siddarthnagar of Uttar Pradesh, Hoshiarpur, Kaprthula, Moga, Ludhiana, Mukatsar of Punjab, Ambala, Sonepat, Faridabad, Hisar, Sirsa, Kurukshetra of Haryana and Gorakhpur, Padrona, Mirzapur of Uttar Pradesh (Sharma, 2003). At district level, in Haryana, the K status in Panchkula district was rated as low to medium, Ambala, Gurgaon, Faridabad, Rewari and Mahendragarh districts were medium to low, Yamuna Nagar, Kurukshetra, Bhiwani and Jhajjar districts were medium to high while Kaithal, Fatehabad, Sirsa, Hisar, Jind, Panipat and Karnal were high.

Eastern region

About 70 percent of the Jharkhand state was rated medium to high in K status (Sarkar *et al.*, 2007). Sitamadi, Madhuban, Gopalgunj of Bihar and Birbhum in West Bengal showed medium to low, Aurangabad in Bihar and West Dinjapur and Malda in West Bengal showed medium to high and Mursidabad, Midanapur and 24 Parganas-north of West Bengal showed high K status (Sharma, 2003). Sarkar *et al.*, (2010) observed low to medium and medium to low in various districts in West Bengal.

North-East region

In Assam, Chirang, Goalpara, Kokrajhar districts were rated as medium to low (Baruah *et al.*, 2009). In Tripura, three out of four districts showed medium to low K status (Sarkar *et al.*, 2010).

Southern region

During 1970s, in Karnataka, about 17, 50 and 33 per cent of the total cropped area recorded low, medium and high K status, respectively. The subsequent soil test information indicated only 61 per cent of total soil samples analyzed were rated as high in K status (Motsari, 2002). Available K status map of Karnataka (Shivaprasad *et al.*, 1995) at 10-km grid interval showed that small pockets in Dakshina Kannada, Uttara Kannada, Kodagu, Chikmagalur, Shimoga and Bijapur districts were low in available K while major parts of Kolar, Bangalore, Tumkur, Mandya, Mysore, Kodagu, Dakshina Kannada, Chikmagalur, Shimoga, Uttar Kannada, Belgaum and northwestern parts of Bijapur, southern parts of Dharwad and Gulbarga districts were medium in K status. At sub-district level (taluka) in Karnataka the K status declined either from high to medium or medium to low (Table 3). Recent studies indicated that K status improved from low to medium in Sringeri, Bijapur, Athani and Khanapur taluks might be due to regular K application to cash crops like sugarcane and plantation crops. The dominant soils that showed major decline in K status were red, lateritic and shallow black soils (Shivaprasad *et al.*, 1995). During 2010-11, the analysis of surface soil samples of major land use types in Mysore, Shimoga, Hassan, Bijapur, Raichur, Haveri, Belagaum, Bagalkote, Chikkaballapur and Kolar districts indicated that K status was medium (Table 3) when compared to that of the year 2002 (Hasan and Tiwari, 2002). Similar exercise in H.D.Kote, Hunsur, Periyapatna and Mysore taluks of Mysore district during 2011 indicated that the available K status as compared to the year 2004, (Shetty *et al.*, 2008), the K status of all the taluks (sub-district level) showed decline in K status.

In Andhra Pradesh, the trends in K status during the period 1975 to 1996 indicated that Guntur, Krishna, Prakasham, Srikakulam, Visakhapatnam, Anantapur, Chittoor, Kurnool, Mahabubnagar and Medak districts were rated medium, East Godavari, Nellore and Nalgonda medium to high and Adilabad, Kadapa, Khammam and Rangareddy districts rated high while in 1996, high K status was observed in most of the districts except Adilabad (medium) (Naidu *et al.,* 2002). The recent fertility assessment of Medak district indicated that overall available K status was rated as medium (54%) to low (43%) (Reddy *et al.,* 2005). At cadastral level, in watersheds and research farms of Anantapur and Kadapa districts of Andhra Pradesh, even in medium deep and deep black soils, low to medium status of K was observed (Naidu *et al.,* 2009; Nair *et al.,* 2003). This indicated that decline in K availability more pronounced in recent days than earlier.

In 1976, in Kerala, the K status was medium in 56 percent area and low in 44 per cent area while in 1999, the trend indicated 62 percent area was low and 31 percent under medium (NBBSS and LUP, 1999). Soil fertility assessment of Kerala carried out in 2012 indicated 33 percent area was low, 37 percent medium and 31 percent high (Rajasekharan *et al.,* 2013). At sub-taluk level, 42 panchyaths of Palakkad district showed low K status in eastern and central region while medium in western region (Kutty *et al.,* 2008). The K status over a period shifted from medium to low, even though K fertilizer use was popular in Kerala. In Puducherry region, the K status was medium to low while in Karikal region it was medium to high (Vadivelu *et al.,* 2008).

Western region

At sub- taluka level (Panchayat Samithi), the soil test information of 0.58 million surface samples from 14 districts in Rajasthan during 1990 to 2000 revealed that 97 per cent of the Panchayath Samities showed high available K (Kanthaliya *et al.,* 2003).

K balance sheet in diverse soil regions

The nutrient addition, removal, balance and nutrient mining index for India and for different states covering alluvial, black, red, lateritic and desertic soil regions indicated that K removal by crops far exceeded than the K addition through fertilizers. At national level, the K depletion was about 10.2 m t/year and mining index for K was 8.0. In all the soil regions, K balance was negative. The K mining index was highest in Rajasthan (152.7) followed by Haryana (105.7) Punjab (40.7), Madhya Pradesh (35.2) and least in Kerala (2.01) and Karnataka (2.79) which indicated K depletion in all soil types (Table 4).

Fertilizer misapplication leads to K depletion

Misapplication of nutrients had been defined as excess or under application of nutrients required to soil and crops. The amount of N, P and K fertilizers applied over period in Indian agriculture indicated that K fertilizers were applied in much lower dose with wide ratios of NPK. The fertilizer consumption of N increased from 1.4 to 85 kg/ha from 1960 to 2010 whereas K consumption increased from 0.2 to 18 kg/ha during the same period (Table 1). The K application was still below i.e. 10 kg in major food grain producing states (Punjab, Haryana, Uttar Pradesh. etc.). The imbalanced use of NPK fertilizers was due to dual pricing policy of national government. The price of N and P fertilizers was almost maintained steadily for a long period where as the cost of K fertilizers had increased considerably. Besides this, easy access and availability of N and P fertilizers in the local markets and unawareness of importance and benefits of K application in crops by farmers since the effect of applied K would be visible at or after maturity stage. Further, the inadequate application of K fertilizers might be due to lack of crop response to applied K fertilizers in some situations even on low K status soils but in contrast significant responses to applied K were also recorded in soils with high K status.

Table.1 Fertilizer consumption in India

	Fertilizer consumption (000 t)			Fertilizer consumption (kg/ha)			Ratio of N: P: K
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	
1960-61	210	53	29	1.39	0.35	0.19	7.3:1.8:1.0
1970-71	1487	462	228	8.92	3.26	1.43	6.3:2.2:1.0
1980-81	3678	1214	624	21.3	7.00	3.60	5.9:1.9:1.0
1990-91	7997	3222	1360	43.1	17.3	7.20	6.0:2.4:1.0
2000-01	10920	4215	1567	58.9	22.8	8.50	7.0:2.7:1.0
2010-11	16558	8050	3514	84.9	41.3	18.00	4.7:2.3:1.0
2015-16	17372	6979	2401	89.1	35.8	12.3	7.5:3.0:1.0

[Source: Department of Agriculture and Cooperation (DAC)]

Table.2 K status in different states over period

State	**Percentage distribution of samples in different fertility classes**					
	1976			**2002**		
	Low	**Medium**	**High**	**Low**	**Medium**	**High**
Andhra Pradesh	9.5	62.0	28.5	9	30	61
Arunachal Pradesh	-	100	-	9	46	45
Assam	66	34	-	30	46	34
Bihar	-	71.5	28.5	-	-	-
Gujarat	-	-	100	5	30	65
Haryana	-	18	82	27	41	32
Himachal Pradesh	86	36	28	45	47	8
J & K	57	43	-	62	32	6
Karnataka	17	50	33	7	32	61
Kerala	44	56	-	29	44	27
Madhya Pradesh	7	21	72	10	32	58
Maharashtra	-	52	48	8	18	74
Meghalaya	100	-	-	34	63	3
Mizoram	100	-	-	10	73	17
Orissa	15	85	-	33	41	26
Pondicherry	100	-	-	2	97	1
Punjab	-	58	42	6	48	46
Rajasthan	-	26	74	-	-	-
Tamil Nadu	-	54	46	12	36	52
Tripura	100	-	-	54	22	24
Uttar Pradesh	58	34	8	12	55	33
West Bengal	13	80	7	30	36	34

(Source: Ghosh and Hassan, 1976; Naidu *et al.*, 2002)

Table.3 Long term fertility changes in available K status in Karnataka soils

District	Taluks	Soil type	Potassium Fertility Status				
			1971	**1980**	**1985**	**1995**	**2010**
Bangalore	Hoskote	Lateritic Soils	M	M	M	L	L
Belgaum	Khanapur	Shallow red soils	M	M	M	L	M
	Athani	Shallow red soils	H	H	M	L	M
	Belgaum	Lateritic soils	M	H	M	L	L
Bellary	Kudligi	Shallow red soils	H	M	M	M	L
Bijapur	Bijapur	Shallow black soils	M	M	-	L	M
	Indi	Shallow black soils	M	H	-	L	L
Chickmangalur	Sringeri	Lateritic soils	M	M	M	L	M
Dharwar	Shirhatti	Shallow red soils	M	M	M	L	L
Gulbarga	Shapur	Shallow red soils	H	H	-	M	-
Kodagu	Mercara	Lateritic soils	M	M	M	L	-
	Virajpet	Lateritic soils	M	M	M	L	-
Dakshina Kannada	Bantwal	Lateritic soils	M	M	L	L	-
	Mangalore	Lateritic soils	M	M	L	L	-
	Puttur	Lateritic soils	M	M	L	L	-
	Udupi	Lateritic soils	M	M	L	L	L
Uttara Kannada	Honnavar	Lateritic soils	M	M	L	L	-
	Siddapur	Lateritic soils	M	L	L	L	-

(Source: Rao, 1971; Karnataka State Department of Agriculture (KSDA), *Booklet*, 1980; Singh *et al.*, 2007)

Table.4 K balance sheet in different states

Alluvial Soils					
State	Nutrients (000 t) Addition (A)	Removal (R)	Balance	Mining index (R/A)	Source
Punjab	18.7	763.5	-744.8	40.7	Aulakh and Behl, 2001
UP	113.6	1777.2	-1663.6	15.6	Yadav *et al.*, 2001
Haryana	4.6	490.1	-485.5	105.7	Kumar *et al.*, 2001
Black soils					
Maharashtra	196.9	2095.9	-1899.1	10.6	Patil *et al.*, 2001
Madhya Pradesh	24.1	848.8	-824.7	35.2	Swarup *et al.*, 2001
Red soils					
Karnataka	216.1	603.6	-387.5	2.8	Hegde and Sudhakar Babu, 2001
Lateritic Soils					
Kerala	87.3	175.6	-88.3	2.0	John *et al.*, 2001
Desertic Soils					
Rajasthan	7.0	1068.0	1061.1	152.7	Gupta, 2001
All India	**1454.2**	**11656.5**	**-10202.3**	**8.0**	

Table.5 Potash use pattern by farmers in different crops and states

State	District	Crop	K dose (kg/ha)	
			Recommended	**Farmer applied K**
A.P.	Nellore	Paddy	40	60
Punjab	IGP region	Paddy	30	0
Haryana	IGP region	Paddy	60	0
U.P.	IGP region	Paddy	60	2.2
Bihar	IGP region	Paddy	40	9.8
West Bengal	IGP region	Paddy	40	32.7
Punjab	IGP region	Wheat	30	0
Haryana	IGP region	Wheat	60	0
U.P	IGP region	Wheat	40	2.1
Bihar	IGP region	Wheat	40	11.6
West Bengal	IGP region	Wheat	70	27.6
Rajasthan	Bhasatpur	Rape seed	20	0
M.P.	Morena	Rape seed	20	0
Orissa	Sambalpur	Rape seed	20	15
Assam	Nagoan	Rape seed	15	0.4
Tamil Nadu	Thiruvannamalai	Groundnut	45	23.3
Karnataka	Kolar	Groundnut	25	10.5
Karnataka	Tumkur	Groundnut	25	11.4
A.P.	Ananthapur Kurnool Vizianagaram	Groundnut Groundnut Groundnut	20 20 20	5.3 4.5 0
Gujarat	Junagadh Rajkot	Groundnut Groundnut	0 0	0 0
Karnataka	Belgaum	Sugarcane	187.5	20.3
Maharashtra	Nagpur Nagpur Nanded Amravati Yavarmal Jalgaon	Cotton Soybean Cotton Cotton Cotton Cotton	50 0 50 50 50 50	10 0 19.3 8.8 8.9 20.9
Karnataka	Dharwad	Cotton	25	0.9

Rec – Recommended dose, F.P- Farmers practice
(Source: Kumar *et al.*, 2001; Challa, 2002).

Table.6 Potash misapplication in various crops

District (State)	Crop	Soils	Recommended practice				Farmers practice			
			Av. Yield (q/ha)	K (Kg/ha)	STCR (Kg/ha)	Misapplication (kg/ha)	Av. Yield (q/ha)	K (Kg/ha)	STCR (Kg/ha)	Misapplication (kg/ha)
Nellore (AP)	Paddy	Red coastal clay	40.0	40	34	+6	35.0	60	25	+35
		Shrink swell (cal) clay	45.0	40	36	+4	40.5	60	28	+32
Nagpur (Maharashtra)	Cotton	Shrink-swell clay (shallow)	3.7	50	49	+1	2.6	10	33	-23
		Shrink-swell clay (medium deep)	7.4	50	102	-52	5.0	10	68	-58
		Shrink-swell clay (deep)	15.2	50	207	-157	10.0	10	132	-122
Nagpur (Maharashtra)	Soybean	Shrink-swell clay (shallow)	8.7	0	8	-8	6.0	0	0	0
		Shrink-swell clay (medium deep)	13.0	0	25	-25	9.0	0	9	-9
		Shrink-swell clay (deep)	16.0	0	0	0	11.8	0	0	0
Belgaum (Karnataka)	Sugar cane	Shrink-swell clay	1080.0	187.5	229	-41.5	825.0	203	175	+28
		Red gravelly clay	1050.0	187.5	223	-35.5	920.0	203	195	+8
Ludhina (Punjab)	Wheat	Coarse loamy	56.2	30	75	-45	55.0	35	72	-37
		Fine loamy	59.2	30	55	-25	60.0	35	57	-22

Fertilizer use by farmers in various crops cultivated across states showed wide variations in amount of nutrient K use, crop to crop and region to region.

Farmers did not apply recommended K except sugarcane (Table 5). Farmers seldom apply K in oilseed and pulse crops under rainfed situation.

Over all, the minimal or no K application over years led to continuous K depletion in soils.

Suboptimal K recommendation *vis-a-vis* K depletion

The status and application scenario of K had been contrast to that of N and P. In general, the recommended K was lower than the required due to the general belief that Indian soils were rich in available K.

In cotton, soybean, sugarcane and wheat, the recommended K and application of K by farmers was sub optimal except in sugarcane where farmers had been applying K slightly more than the required (8 to 28 kg/ha) in Belgaum region of Karnataka (Table 6).

In soybean, even there was no K recommendation and further, the farmers were also ignorant about K application leading to continuous K mining in black soils (Table 6). Further, in case of many rainfed crops such as groundnut, finger millet, pearl millet, chickpea and maize, K recommendation was missing in regional recommendations which led to K depletion by imbalanced application. The twin problems of suboptimal fertilizer recommendations and K misapplication by farmers lead to continuous K depletion. The present K recommendations for various crops in different states were developed in late 1970s which need revision and revalidation to bridge the gap between K application and crop removal.

Factors affecting potash consumption in India

In India, potash consumption depends mainly on three factors *viz*., maximum retail prices fixed by government, availability of potash based on import and availability of potash carrying complexes in the region. With launching of complex fertilizers in 1970s, significant improvement in the use of complex fertilizers in southern India was observed but, in major areas of northern India, it is meager. During last one and half decade, urea availability was satisfactory, but the same was not the case with other fertilizer products. Lack of availability of potash and potash carrying complexes is one of the reasons for imbalanced NPK ratio in northern India. Further, during last decade, there is no addition to manufacturing capacities of complex fertilizers in the country and production of complexes is more or less stagnant.

Tendency of the Indian farmer is to buy the fertilizer, whichever is available in the market. Seriousness on potash application was lacking due to lack of farmers' education and awareness. Farmers tend to overlook the benefits of K application because; the effect of nutrient application on plants is visible only at maturity stage in the form of improvement in size, shape, colour and quality of the produce. In contrast, the effect of nitrogen and phosphorus is seen soon after the time of application.

Nutrient Based Subsidy (NBS) - a policy initiative for K application

In the context of Nation’s food security, the declining response of agricultural productivity to increased fertilizer usage in the country and to ensure the balanced application of fertilizers, the Government of India introduced the Nutrient Based Subsidy (NBS)

Policy with effect from 1st April 2010 for decontrolled P and K fertilizers which enabled to provide murate of potash, NPKS complexes along with other fertilizers to the farmers at subsidized rates based on the nutrients (N, P, K & S) contained in these fertilizers (http://pib.nic.in/newsite/erelease. aspx? relid=63723), further the policy also allowed import of complex fertilizers. It was observed that post implementation of NBS in P & K sector, in the first year the subsidy payout reduced but the increase in international prices resulted in increase in subsidy payout as well as increase in retail price. Subsidized fertilizers can also be used as inputs for customized fertilizers. The NBS policy has also allowed import of complex fertilizers which is a beneficial step. These major steps will help in promoting balanced use of fertilizers and in improving fertilizer availability in different parts of the country.

The other government programmes initiated to restore soil health are like *Bhoo Chetan,* is mainly focusing on micronutrient supplement. In such schemes, if K is also included along with micro and secondary nutrients based on site specific soil test, which help in maintenance of soil health and productivity. Issue of Soil Health Card (SHC) to each farmer is another programme initiated in Tamil Nadu and Kerala, where in SHC indicates the soil nutrient status, fertilizer application requirement for different crops to be grown by a farmer. It forms a part of land use planning at farm level. Farmer, soil and eco-friendly nutrient subsidy policies help in reducing the misapplication of nutrients and also cost of production.

The available K status in Indian soils over four decades, from national to cadastral level, showed a gradual decline in K status with more depletion in red, lateritic and shallow black soils. Recent isolated studies indicated that the K status declined to medium to low even in medium deep and deep black soils. These trends were due to low K application by the farmers, imbalanced use of NPK fertilizers, misapplication and blanket K recommendations leading to wide spread K deficiency in soils and crops. Also, the present fertilizer recommendations, which were of four decades old and still being followed in certain pockets, warrants revision and revalidation. Site-specific fertilizer recommendations, if followed can minimize the fertility K depletion and maintain productivity and sustainability and also economize the fertilizer cost. With more policy support like NBS which though encouraging, more farmer, soil and ecofriendly action plans can be drawn and implemented.

Future research needs

Need to harmonize data on K status and develop a new K fertility map for the country with revised rating limits.

Intensive research, both at national and state level, based on the benchmark soils and soil types on differential response of crops to applied K fertilizers, to make recommendations considering soil K pools. Fertilizer recommendations to be revised and revalidated based on soil-crop-climatic conditions.

Research efforts needed to increase K use efficiency in crops and its recycling to reduce the K loss from the soil-crop system

Large scale on-farm demonstrations to sensitize the farmers on the need for K application, particularly in K deficient regions, in convergence with the ongoing national programmes like Rashtriya Krishi Vikas Yojana, National Food Security Mission etc.

References

Aulakh, M.S. and Behl, G.S. 2001. Nutrient Mining in Agro-climatic Zones of Punjab, *Fert. News*, 46 (4): 47-48, 51-58 & 61.

Bansal, S.K., Srinivasa Rao, Ch., Pasricha, N.S. and Imas, Patricia. 2002. Potassium dynamics in major benchmark soil series of India under long-term cropping. Paper presented in 17th WCSS, Thailand from 14-21st August 2002.

Baruah, U., Sarkar Dipak, Das, K.H., Reza, S.K., Bandopadhyay, S., Chattopadhyaya, T. and Dutta Dipak. 2009. Assessment and mapping of some important soil parameters including macro & micronutrients for 13 districts of Assam state towards optimum land use planning, *Annual Report 2009-10*, NBSS & LUP.

Challa, O. 2002. Agro economic characterization and constraint analysis of rained cotton based production system in relation to soil, rainfall and socio economic factors. *Project report of NATP-RCPS-1*, NBSS & LUP, Nagpur.

Ghosh, A.B. and Hasan R. 1976. Available potassium status of Indian soils. In: *Potassium in soils, crops and fertilizers*. Bulletin No.10, 1976, Indian Soc. of Soil Science, New Delhi.

Gupta, A.K. 2001. Nutrient Mining in Agro climatic Zones of Rajasthan. *Fert. News*, Vol 46, No 9, pp 39-43, 45-46.

Hasan, R. and Tiwari, K.N. 2002. Available potassium status of soils of India. Fertilizer Knowledge. No.1.

Hegde, D.M. and Sudhakar Babu, S.N. 2001. Nutrient Mining in Agro climatic Zones of Karnataka. *Fert. News*, 46 (7): 55-58, 61-72.

http://pib.nic.in/newsite/erelease.aspx?relid=63723.

John, P.S., Mercy George and Romy Jacob. 2001. Nutrient Mining in Agro-climatic Zones of Kerala, *Fert. News*, 46 (8): 45-52, 55-57.

Kanthaliya, P.C., Totwat, K. L. and Arvind Verma. 2003. *Review and refinement of nutrient recommendations for major crops of Rajasthan*, 2003:10-16.

Karnataka State Department of Agriculture (KSDA). 1980. Seshadri Road, Bangalore, pp. 1-32.

Kumar, V., Antil, R.S., Narwal, R.P. and Kuhad, M.S. 2001. Nutrient Mining in agro climatic Zones of Haryana. *Fert. News*, 46 (4): 81-92.

Kutty, N.M.C., Suresh Kumar, P., Balchandran P.V., Nair, K.M., Beana, C. and Premchandran, P.N. 2008. *Nutrient management plan for Soils of Palakkad* KAU, Pattambi, pp 1-42.

Motsari, M.R. 2002. Available NPK Status of Indian Soils as depicted by soil fertility maps. *Fert. News*, 47 (8): 15-21.

Naidu, L.G.K., Niranjan, K.V., Ramamurthy, V., Ramesh Kumar, S.C., Anil Kumar, K.S. and Thayalan, S. 2009. Planning Optimum Land Use based on Biophysical and Economic Resources in Pulivendla Region, Kadapa District, A.P. *NBSS Publ. 1029*.

Naidu, L.G.K., Ramamurthy, V and S.C. Ramesh Kumar. 2010. Potassium deficiency in soil and crops. *Indian J. Fertilizers*, 6(5): 32-38.

Naidu, L.G.K., Ramamurthy, V., G.S. Sidhu and Dipak Sarkar, 2011. Emerging deficiency of potassium in soils and crops of India. *Karnataka J. Agric.Sci.*, 24 (1): 12-19.

Naidu, L.G.K., Reddy, R.S., Niranjan, K.V., Srinivas, S., Dhanorkar, B.A., Nasre, R.A., and Arti Koyal. 2002. Fertility status and trends in fertilizer use in major soils of A.P. *Fert. News*, 47 (10): 25-36.

Nair, K.M., Bhora Prasad, Gaddi, A.V., Arti Koyal, Srinivas, S. and Krishnan, P. 2003. Soils of Godehothur Watershed, Urvakonda, Anantapur District, A.P., *NBSS Publ. 587*.

National Bureau of Soil Survey and Land Use Planning (NBSS & LUP). 1999. *Soil Survey and Mapping of Rubber Growing Soils of Kerala and Tamil Nadu*, pp.289.

Patil, V. D., Pholene, L.P. and Adsul, P.B. 2001. Plant nutrient mining in different agro-climatic Zones of Maharastra. *Fert. News*, 46 (7): 43-48 & 51-54.

Rajasekharan, Nair, K.M., Rajasree, G., Sureshkumar, P., and Narayanan Kutty, M.C. 2013. *Soil fertility assessment and information management for enhancing crop productivity in Kerala*. Published by Kerala Planning Board.

Ramamurthy, B. and Bajaj, J.C. 1969. Soil

Fertility Map of India, Indian Agricultural Research Institute, New Delhi.

Rao, D.1971. Department of Agriculture, Bangalore, 1971.

Reddy, R.S., Naidu, L.G.K., Ramesh Kumar, S.C., Budhihal, S.N. and Krishnan, P. 2005. Land Resources of Medak district, A.P. for Land Use Planning, *NBSS Publ. No. 791*.

Sarkar Dipak, Sarkar, A.K., Sahoo, A.K., Nayak, D.C., Das, K., Gangopadhyay, S.K., Chattopadhyay, T., Sah, K.D., Mukhopadhyay, S., Singh, D.S., and Swaminathan. 2007. Assessment and mapping of some important soil parameters including soil acidity for state of Jharkand towards rational land use plan, NBSSLUP, *Annual report 2006-07*.

Sarkar Dipak, Singh, S. K., Nayak, D.C., Sahoo, A.K., Gangopadhyay, S.K., Das, K., Sah, K.D., Dipak Dutta, Chattopadhyay, T., Mukhopadhyay, S., and Banerjee, T. 2010. Assessment and Mapping of some important parameters including macro and micro nutrients for the state of West Bengal towards Optimum land use plan *NBSS Annual Report 2009-10*.

Sekhon, G.S. 1999. Potassium in Indian Soils and Crops, *PINSA*, B65 (3 & 4): 83-108.

Sharma, S.K. 2003. Characterization and Mapping of Rice-Wheat System, its changes and constraints to system sustainability, *NATP Report*, PDCSR, Modipuram.

Shetty, Y.V., Amaranatha Reddy, A.L., Dinesh Kumar, M., Vageesh, T.S. and Jaiprakash, S.M. 2008. Fertility status and nutrient index of maize growing areas of Southern transition zone of Karnataka. *Karnataka J. Agric. Sci.*, 21 (4): 580-582.

Shivaprasad, C.R., Niranjana, K.V. Dhanorkar, B.A. Swaminathan, Naidu L.G.K., Hanumantha Rao, P. S. and Sehgal, J. 1995. Available K status of Karnataka. J*ournal of Potassium Research*, 11 (3 and 4): 219-227.

Singh, R.S., Singh. A.K. and Shyampura, R.L. 2007. Soil Resource Survey and Mapping of Soils of Bundi district, *Annual Report 2007-08*, NBSS & LUP.

Sreenivasa Rao, Ch., Sharan Bhoopal Reddy and Sumanta Kundu. 2014. Potassium nutrition and management in Indian agriculture-Issues and strategies. Indian J. Fertilizers, 10 (5): 58-80.

Sreenivasa Rao, Ch., Subba Rao, A., Rao, K.V., Venkateswarlu, B. and Singh, A.K. 2010. Categorization of districts based on the non-exchangeable potassium: implications in efficient K fertility management in Indian agriculture. *Indian Journal of fertilizers*, 6 (7): 40-55.

Swarup A., Sammi Reddy, K. and Tripathi, A.K. 2001. Nutrient Mining in agro climatic Zones of Madhya Pradesh. *Fert. News*, 46 (4): 33-38, 41-45.

Vadivelu, S., Ramesh Kumar, S.C., Thayalan, S. and Sarkar Dipak. 2008. *Perspective Land Use Plan, Union Territory of Puducherry*, NBSS Publ. 142.

Yadav, R.L., Dwivedi, B.S., Singh, V.K. and Shukla, A.K. 2001. Nutrient mining and apparent balances in different agro climatic Zones of Uttar Pradesh. *Fert. News*, 46 (4): 13-18, 21-28 & 31.

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