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A Review on Fertilization of Soils Using Potassium in India

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INTRODUCTION

In India, until the eighties, potassium did not gain much consideration on the grounds that of the general conviction that Indian soils were overall supplied with potassium. In actuality, trim evacuation of potassium frequently equivalents or surpasses that of nitrogen.

In the wake of recognizing all the natural and inorganic increments, a net shortage of 7.049 million tones K2O for every year has been assessed which implies a consumption of Indian soils at the rate of 37.5 kg K2O/ha/year. In light of the above actualities, one may get some information about the advancing potassium insufficiency in soils resulting upon the serious editing with moderately higher rates of N and P requisition with for all intents and purpose next to no K provision. Indeed, this is much more apparent from the supplement utilize degrees as a part of the nation what's more in distinctive districts too. At present the N : P2O5 : K2O utilization degree in the nation is 1.0 : 0.38 : 0.14 while in the northern India, it is highly lopsided at 1.0 : 0.29 : 0.034 as the K use in the seriously growed states of Punjab, Haryana and Uttar Pradesh is practically unimportant. Because of this imparity in supplement utilize, various samples of soil K exhaustion from seriously developed ranges of Punjab, U.p. what's more different states and so on have risen. In future, these cases are certain to further duplicate and the circumstance will irritate.

As we realize that escalated editing with high yielding mixtures makes extensive request on the soil supplement assets, it is subsequently, likely that even those soils which are recognized sufficient in accessible potassium will be unable to support this condition for long. Nonetheless, work as of late, consideration was being paid to the potassium provision to field crops aside from some industrially imperative ones.

There were some purposes behind this absence of investment in potassium fertilization. Firstly, examinations directed till the fifties did not carry out obvious edit reactions to potassium. Truth be told, Stewart (1947) who submitted his report on soil fruitfulness examine in the nation obviously expressed that all Indian soils are sufficient in K aside from the lateritic ones. This brought about setting up of various straightforward fertilizer trials on cultivators' fields under the Technical Co-operation Mission of the Usa. The outcomes got from these field investigates distinctive oat, oilseed and money harvests throughout the last four decades have definitively indicated that requisition of potassic fertilizers is advantageous and noteworthy crop reactions are very normal in Indian soils.

POTASSIUM FERTILITY MAPS

Potassium fertility of Indian soils has been researched and mapped first by Ramamoorthy and Bajaj in 1969 and therefore by Ghosh and Hassan in 1976. In like manner, potassium inadequacy was truly far reaching in the eastern what's more northeastern states and decently regular in the states of J & K, Kerala and Uttar Pradesh. A terrible examination of these two maps prescribe that the K supply position of the soils enhanced throughout the course of 7 years, on the grounds that in 1976, 11% a bigger number of locale were high as opposed to medium in soil K. Nonetheless, a closer examination of the information demonstrated that the locale grouped as medium in accessible soil K diminished from 53% in 1969 to 42% in 1976, however with a attending build in high classification, from 27% to 38%. This disparity could be traced to the poor delegate character of examining, noncognizance of pedological grouping of soils. Likewise, as far as possible for soil grouping of soils into low, medium and high K classifications have been taken to be indistinguishable for all soils, independent of their mineralogy and measures of non-replaceable K. As needs be, K-fertility maps drawn on the premise have just constrained utility in advancing significant suggestions or checking soil fertility changes. In its report, the National Commission on Agricultural (1976) called attention to that a sounder groundwork for soil fertility examinations might be to efficiently dissect specimens of recognized soil arrangement. Soil arrangement are recognized on the support of profile qualities and on concoction and mineralogical lands of soils. Proposals formulated on the groundwork of soil arrangement could be amplified to comparable zones with a bigger level of trust. In addition, the seat mark destinations give a superb chance to screen the progressions in soil K fertility under genuine agriculturists' conditions of editing and fertilization.

POTASSIUM FERTILITY STATUS

A restricted information on potassium fertility in 109 out of the 180-benchmark soil series is accessible on the foundation of N Nh4oac-extractable K and a guide has been ready at Prii. In spite of the fact that this information is not sufficient to portray the status of K accessibility in soils varying in sum and nature of dirt introduce because of the absence of between relationship around the soil series and likewise information on the degree of their appropriation, yet the guide can give a reasonable thought of the topographical appropriation of K deficiency/sufficiency. As needs be, out of the 109 soils series, 17.5% were low, 40% were medium and 42.5% were high in accessible K. Low fertility soils series were accounted for to happen primarily in states of Punjab, West Bengal, Karnataka, Rajasthan, Maharashtra and Madhya Pradesh. Information on store K was not accessible which constrained the utility of this information.

Soil series	*NH_4OAc-K (mg/kg ± SD)*	*HNO_3-K (mg/kg ± SD)*	*Fertility rating*	
			Available-K	*Reserve-K*
a) Alluvial				
Lidder (J&K)	49± 22	430 ± 77	Low	Low
Bagru (H.P.)	94± 37	346±64	Medium	Low
Nabha (Punjab)	104± 54	965 ± 255	Medium	High
Lukhi (Haryana)	78± 45	618 ± 159	Low	Low
Masitawali (Rajasthan)	251± 84	1310±313	High	High
Akbarpur (U.P.)	125± 41	1448±203	Medium	High
Rarha (U.P.)	95±33	1531±353	Medium	High
Khatki (U.P.)	99± 22	1494±212	Medium	High
Balisahi (Orissa)	30± 14	92±34	Low	Low
Jagdishpur Bagha (Bihar)	79± 58	1753±220	Medium	High
Raghopur (Bihar)	89± 29	2115±408	Medium	High
Hanrgram (W.B.)	132± 53	425±160	High	Low
Kharbona (W.B.)	42± 17	119±34	Low	Low
Chandole (A.P.)	424± 233	1030±565	High	High
b) Red				
Kodad (A.P.)	70± 32	266 ± 70	Low	Low
Vijayapura (Karnataka)	68± 43	127 ± 57	Low	Low
Tyamagondalu (Karnataka)	76± 27	365 ± 12	Low	Low
Doddabhavi (Tamil Nadu)	92± 31	1049 ± 239	Medium	High
c) Laterites				
Kumbhave-5 (Maharashtra)	70± 35	189± 72	Low	Low
Nedumangad (Kerala)	69± 33	120± 38	Low	Low
d) Arid soil				
Mazodar (Gujarat)	109± 55	606± 167	Medium	Low
e) Vertisols & Veric type soils				
Sarol (M.P.)	348 ± 88	769±252	High	Low
Kamaliakheri (M.P.)	279± 75	603± 182	High	Low
Pithvajal (Gujarat)	407 ± 89	776±173	High	Low
Shendvada (Maharashtra)	482± 81	1024± 187	High	High
Pemberty (A.P.)	216± 50	711± 133	High	Low
Noyyal (T.N.)	688 ± 132	2339±276	High	High
Kalathur (T.N.)	193± 38	893 ± 102	High	Low
f) Acid sulphate soil				
Purakkad (Kerala)	245± 77	386± 60	High	Low

Table : Potassium Fertility of 29 Bench mark soil series of India.

Out of 29 bench-mark soil series examined in portion by Prii (Sekhon et al., 1992), in the ballpark of 30% were minimal, 30% were medium and the remaining 40% were sufficient in the local supply of potassium . In like manner, the inadequate soils were in the states of West Bengal (Birbhum distt.), Orissa (Puri distt.) and Andhra Pradesh (Nalgonda distt.) and Kerala (Trivendrum distt.) furthermore Maharashtra (Ratnagiri distt on the West Coast) additionally a soil each in Southern Karnataka (Bangalore distt.) and Kashmir (Anantnag distt.).

Besides available K, reserve K status of these soils was also studied by extracting these soils with 1N boiling HNO3. Accordingly, when the information on both available as well as reserve K was studied together for making fertilizer K recommendations, the following picture emerged (Sekhon *et al.*, 1992):

Similarly, soil series of West Bengal have been classified on the basis of their exchangeable and non-exchangeable K status and their need for K application (Sarkar *et al.,* 2001). Hanrgram soil series which was found to be moderate in available K earlier changed to low category in the later study under intensive cropping.

SUBSOIL K FERTILITY

Although a major portion of K is absorbed by crop plants from the surface soil, subsoil contribution to K nutrition is often substantial. The amount of K taken up from lower soil horizons depends on K concentration in soil and rooting characteristics of plant. Part of the plant nutrients applied on surface soil may leach down and accumulate in subsoil horizons that are often exploited by deep-rooted crops in a crop rotation. Different forms of K in subsoil (15-30 cm) were evaluated in relation to those in surface soil (0-15 cm) in 22 benchmark soil series of India (Srinivasarao *et al.*, 2001). The overall proportion of subsoil K to the surface soil K varied from 71 to 96, 62 to 90, and 60 to 82% in kaolinitic, illitic and smectitic soils, repectively.

NON-EXCHANGEABLE K (NEK) CONTRIBUTION

Potassium availability to crop plants is regulated by the dynamic harmony around diverse forms of soil K which expedites the arrival of K from nonexchangeable form to accessible forms under K nature's domain. A survey of Mengel (1985) on uptake of K from non-replaceable form demonstrated that numerous plants especially the monocots feast upon this wellspring of K. Potassium fertility is described for the most part dependent upon promptly accessible K forms.

Notwithstanding, numerous reports demonstrate the occasions where accessible K dependent upon Nh4oac extraction is not delicate to the progressions in soil K that happen throughout cropping. Thusly, as of late a trend is rising on characterization of soil K dependent upon non-interchangeable K part in soil (Srinivasarao et al.

2001b). Twenty-nine benchmark soil series gathered by Potash Research Organization of India have prior been sorted dependent upon non-exchageable K saves as demonstrated in Table (Sekhon et al., 1992).

EFFECT OF SOIL TEXTURE ON CHANGES IN SOIL K

Changes in gauges of K by water dissolvable, Nh4oac and Hno3 extractable K according to textural classes in the 10 soil series introduced in Table . Around the diverse textural classes in the same soil series, it was watched that finer textured specimens, by and large held more measures of distinctive forms of K. Impact of texture on diverse forms of K was seen conspicuously in accessible and hold K of Lukhi, accessible K in Nabha, accessible and save K in Akbarpur, Vijayapura, Kodad and Noyyal soil series. Both Nh4oac-K and Hno3 extractable K expanded with largeness of texture in these series.

Soil series	*Textural class*	*No. of samples*	*Mean K extracted (mg/kg) by*					
			Water		*NH_4OAc*		*HNO_3*	
			**I*	**II*	*I*	*II*	*I*	*II*
Alluvial								
Nabha	Sandy	7	29.5	27.6	80	48	690	668
	Loamy sand	14	41.2	27.6	142	61	1044	998
	Sandy loam	4	27.0	32.5	108	72	1335	975
Lukhi	Sandy	13	24.7	12.2	86	64	461	438
	Loamy sand	11	16.9	10.2	78	73	588	582
Khatki	Sandy loam	2	17.6	16.0	86	95	1425	1475
	Loam	14	15.5	12.0	95	79	1476	1393
	Silty loam	7	12.8	13.6	90	92	1450	1507
Akbarpur	Loamy sand	11	23.7	17.6	115	93	1505	1239
	Sandy loam	7	24.5	19.7	157	144	1324	1260
	Loam	5	26.8	25.4	165	158	1688	1474
Rarha	Loamy sand	9	15.0	18.8	79	83	1590	1433
	Loam	9	13.4	16.5	85	79	1559	1517
	Silty loam	6	19.5	13.5	115	72	1629	1438
Red								
Kodad	Sandy loam	8	9.3	12.0	46	71	245	231
	Sandy clay loam	8	12.6	12.9	82	93	291	268
Vijayapura	Sandy loam	11	15.9	11.2	49	38	120	124
	Sandy clay loam	11	16.5	13.4	65	62	146	147
Tyamagondalu	Loamy sand	7	19.6	18.7	55	47	320	309
	Sandy loam	14	20.5	20.2	83	86	359	367
Noyyal	Clay loam	3	77.5	85.5	658	683	2285	2233
	Silty clay loam	3	88.3	110	939	954	2475	2450
	Clay	5	91.3	81.2	702	750	2559	2590
Kalathur	Clay	3	13.2	26.5	212	168	833	810
	Clay loam	19	10.7	20.6	190	172	905	891

*I – Initial
*II – After 10 years cropping

Table . Changes in mean K extracted by water, NH4OAc and HNO3 according to textural classes in selected samples from 10 soil series over a period of time Changes in K release rates under long term cropping.

By and large, there was an increment in water dissolvable K with time altogether textural classes of Rarha, Kodad, Noyyal and Kalathur soil series perhaps because of the slight moving of harmony towards the left as cropping upgraded the discharge of K. By and large, hold K diminished with time in all the textural classes of all the soil series with a few exemptions and the greatness of lessening fluctuated with texture to some degree just. It could maybe be surmised that exhaustion of K with cropping in the same soil series is less with increment in weight of the soil texture. This is in light of the fact that more measures of residue and earth mean the vicinity of additional measure of K in the soil and more dynamic is the K trade harmony in the soil.

The release of non-replaceable K (Nek) hinges on various variables for example nature and amount of earth minerals, level of interchangeable pool of K furthermore the K reserves, expansion of K fertilizers, cropping power, crop species furthermore its root enlargement, root C.e.c., crop pivots, and so on. Memonet al. (1988) suggested that at first K uptake by plants is singularly from the interchangeable sources, however once the discriminating consumption arrange has been arrived at, K up take was predominantly from non-exchangeable portion, with just a little further commitment from replaceable sources. A portion of Nek, which is held around the edges and wedge zones of micaceous minerals, is termed as "intermediate K" (Beckett, 1971). The recent may not customarily be concentrated with unbiased typical Nh4oac, and is subsequently barred while rating the K-fertility status of soils, yet gets released when K fixation in soil result upon exhaustion (by crop uptake, draining, and so forth.) achieves a certain basic low quality. The last is known as the "edge" K level (Scott and Smith, 1966). The uptake of Nek by crop under exhaustive cropping in pot experiments (Richards and Bates, 1988; Pati Ram and Prasad, 1991) secured the long haul K-supplying power of soil.

This "edge" K level, for release of transitional K, was free of the amount of K store however depends rather on the nature of K-bearing minerals in soils (Song and Huang, 1983), and the dirt structure and additionally its degree of development (Datta and Sastry, 1988). The edge level might not have settled values for soils, subjected to long haul development with force, without superfluous provision of K fertilizers. A higher edge worth shows less relentlessness with which K is held in wedge zones of micaceous minerals (Datta what's more Sastry, 1988).

CONCLUSION

- Based on K fertility evaluation of 109 benchmark soils of India, 17.5 per cent were low, 40 per cent were medium and rest were high.

- Out of 29 benchmark soil series studied critically for K fertility at PRII, Guragon, about 30 per cent soil series were marginal.

- Light textured red, lateritic and alluvial soils, acidic alluvial and shallow black soils are prone to K deficiency under intensive cropping.

- Dominant as well as associated minerals in clay and silt fraction of soils mostly contribute to variations in K fertility of Indian soils.

- Though soils of alluvial belt of northern India are rich in nonexchangeable K, the release of K is very slow and K additions are essential at sensitive growth stages in particularly K loving crops.

- The magnitude of crop response has been on upward trend in many areas as a consequence of K fertility decline in these regions.

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