https://doi.org/10.29321/MAJ.10.A02837

Madras agric. J. 67 (5): 308–312 May 1980

Evaluation of Different Methods of Measuring Available Potassium in Laterite Soils of Nilgiris District.*

N. S. BOLAN[1] and U. S. SREE RAMULU[2]

Seven extractants, viz., neutral normal ammonium acetate, Morgan's universal solution, 0.01 *M* $CaCl_2$, 6*N* H_2SO_4, 1*N* HNO_3, 0.5*N* HCl and distilled water were tested to assess the available K status in 27 samples of high level laterite soils of Nilgiris District. Uptake of K in all these soils was determined by Neubauer seedling technique using rice as test crop. Correlations were worked out between the quantities extracted by these seven extractants and uptake of K by rice seedlings. Morgan's reagent was found to be the best extractant in assessing the available K status in laterite soils.

The total K content varies from 0.2% to 3.3% in normal agricultural soils. The total quantity of K in a soil constitutes an inventory only and does not indicate the amount available to plants growing on that soil (Scheffer and Schachtschabel, 1967). A number of extractants, including electrolytes, acids and buffering agents have been employed by different workers for the estimation of available K in the soils (Swami and Lal, 1970; and, Lakshminarasimhan *et al.*, 1973). However, there is no unanimity about the suitability of these extractants for all types of soils. Swami and Lal (1970) recommended neutral normal ammonium acetate for estimating available K. Good correlations were obtained between K uptake by *ragi* seedlings and K extracted by different extractants like 0.1*N* HNO_3, 0.1 *N* HCl and Morgan's reagent. This study was taken up to find out the utility of different extractants in assessing the availability of K in high level laterite soils of Nilgiris District.

MATERIALS AND METHODS

Twenty seven surface samples covering wide area of Nilgiris District and representing high level laterite soils were used in the present study. The soils were analysed for available K using different extractants, viz., (a) neutral normal ammonium acetate (Hanway and Heidal, 1952), (b) Morgan's reagent (Morgan, 1941), (c) 0.01*M* calcium chloride (d) 6*N* sulphuric acid (Hunter and Pratt, 1957), (e) IN Nitric acid, (f) 0.5*N* hydrochloric acid and (g) distilled water. Uptake of K by rice (IR 20) seedlings was assessed by Neubauer technique. Correlations were worked out between the quantities extracted by these seven extractants and uptake by rice seedlings.

RESULTS AND DISCUSSION

K extracted by different chemical extractants and by Neubauer's seedlings are presented in the (Table I). The amount of K extracted by the extractants was in the following order:

* Part of M. Sc. (Ag.) thesis submitted by the first author to Tamil Nadu Agricultural University, Coimbatore.

1 and 2. Dept. of Soil Science, Tamil Nadu Agricultural University, Coimbatore.

1*N* HNO_3 > 1*N* NH_4OAC > 0.5*N* HCL > Morgan's reagent > 6 *N* H_2SO_4 > 0.01 *M* $CaCl_2$ > distilled water. A similar result was obtained by Ramamoorthy and Paliwal (1965) and Swami and Lal (1970). The acid extractant (HNO_3) extracted the highest amount of K because it included not only exchangeable K but also some non-exchangeable K which was brought into solution by the breakdown of primary and secondary minerals during boiling. Ammonium ions of ammonium acetate did not decrease fixable/non-fixable ion ratio on the exchange sites and consequently blocked the removal of non-exchangeab'e K. In 0.5 *N* HCl and 6*N* H_2SO_4 extractants, very little non-exchangeable K could be solubilised by the simple contact with the soil in a short period at room temperature. Sodium ion in the Morgan's reagent and calcium ion in the calcium chloride solution have less blocking effect in the removal of non-exchangeable K than ammonium ion but the reduced extraction was due to low replacibility of Solution sodium ion in single extraction and shorter period of contact. The low value with water is due to its low ionisation.

When correlations were worked our between quantity of K extracted by different chemical extractants and Neubauer's K, that extracted by Morgan's reagent was found to be closely correlated with K uptake (r=0.804). Least but still highly significant correlation (r=0.503) was obtained with 0.01 *M* $CaCl_2$ extractable K. (Table II).

The ultimate worth of the various extractants for available K extraction was decided by the faithfulness with which they reflect actual plant uptake, Judging the various extractants based upon this criterion and employing Neubauer's technique as a measure of plant uptake, it was found that all the methods measure upto the requirements for ideal extractants for determining plant available soil K. This was evidenced by the close relationships obtained between different chemical extractants and Neubauer's technique. Since the highest correlation was obtained between K uptake in Neubauer's technique and K extracted by Morgan's solution, this solution can be considered more suitable for estimating plant availabie K in laterite soils.

Permission accorded by the Tamil Nadu Agricultural Univers ty for pub ishing the M.Sc. (Ag.) thesis is gratefully acknowledged. The first author wishes to thank the Indian Council of Agricultural Research for having awarded the junior research fel owship during the course of this study.

REFERENCES

HANWAY, J. and H. HEIDAL. 1952. Soil analysis methods as used in Iowa State College Soil Testing Laboratory. *Iowa State College Agric. Bull.* 57: 1-13.

HUNTER, A. H. and P. F. PRATT. 1957. Extraction of potassium from soils by sulphuric acid. *Soil Sci. Soc. Amer. Proc.* 21: 595-98.

LAKSHMINARA SIMHAN, C. R., C. S. BALASUNDARAM, K. RAJAKKANNU and P.RANGASWAMY. 1973. Evaluation of available potassium ni soils-Ex-changeable potassium method and thermodynamic approach. *Madras agric. J.* 60 : 750-54.

MORGAN, M.F. 1941. Chemical soil diagnosis by the universal soil testing system. *Bull. Conn. Agric. Exp. Sta.* 450 : 1-10.

NEUBAUER, H. 1927. The utilization of seedlings in the estimation of soil nutrients. *Internal Rev. Sci. Prot. Agric.* (*Rome*) 2 (n.s) : 788-794. quoted by Ames, J.W. and R. Gerdal, in *Soil Sci.* 23 : 455-56.

RAMAMOORTHY, B. and K. V. PALIWAL. 1965. Potassium adsorption ratio of some soils in relation to their K availability to paddy. *Soil Sci.* 93 : 236-42.

SCHEFFER, F. and P. SCHACHTSCHABEL. 1967. Plant nutrients in Soil-potassium. *Pot. Rev. Subject* 4 : Suite 37.

SWAMI, B. N. and P. B. LAL. 1970. Correlation studies on plant uptake of potassium and Soil test values. *J. Indian. Soc. Soil Sci.* 18 : 27-31.

TABLE-I. Available potassium assessed by different methods (ppm)

Soil No.	Extractants							Neubauer technique (K. uptake)
	1 *N* NH_4 OAC	Morgan's Solution	0.01 M Cacl 2	6 *N* H_2SO_4	1 *N*HNO_3	0.5 *N* HCl	Distilled water	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	45	56	14	56	230	40	10	70
2	325	276	161	144	1725	500	55	241
3	45	72	21	60	250	60	10	72
4	55	76	21	72	260	60	20	88
5	70	110	42	114	520	100	20	221
6	115	132	49	98	295	120	25	129
7	35	72	14	28	170	40	10	63
8	250	170	105	192	590	240	60	178
9	90	120	49	76	215	100	15	111
10	380	164	151	180	500	200	37	221
11	385	216	224	300	640	360	75	231
12	250	180	113	176	400	260	20	114
13	40	94	21	44	170	60	10	43
14	115	120	49	154	630	140	30	189
15	35	94	14	50	120	60	5	73
16	45	72	21	94	250	60	10	66
17	90	154	42	72	210	100	10	93
18	180	132	56	154	400	220	25	197
19	60	52	21	98	480	80	10	101
20	125	98	50	108	390	140	20	118
21	70	84	35	68	350	80	20	89
22	265	240	154	192	690	280	70	201
23	820	516	449	792	675	640	210	248
24	110	136	63	100	260	120	30	98
25	110	94	42	124	390	160	15	94
26	850	492	371	600	625	680	175	245
27	60	72	21	90	325	80	10	89

TABLE-II Correlation coefficients (r) between K extraeted by different extractants and K uptake

Sl. No.	Extractants	r
1	1 *N* HNo3	0.745**
2	1 *N* NH_4 OAC	0.731**
3	0.5 *N* H Cl	0.794**
4	Morgan's reagent	0.801**
5	6 *N* H_2 SO_4	0.714**
6	0.01 *M* Ca Cl_2	0.503**
7	Distilled water	0.650**

** – Significant at 1% level.