

EVALUATION OF AVAILABLE PHOSPHORUS AND POTASSIUM IN SOIL USING A COMMON EXTRACTANT

K. M. Durga Devi and A. I. Jose

College of Horticulture, Vellanikkara 680 654, Kerala, India

At present, the soil testing laboratories of Kerala employ Bray No.1 (0.03 M $\text{NH}_4\text{F} + 0.025 \text{ N HCl}$) for extracting available P and neutral normal ammonium acetate for extracting available K. The extraction process can be made simpler and rapid especially in soil testing oriented to advisory works, if a common extractant can be employed both for P and K. The use of sophisticated laboratory instruments that are capable of analysing a solution for more than one element simultaneously is becoming widespread. The advantages of such modern equipment can be fully realised only if a single extracting solution can provide information on several soil nutrients.

A few extractants have been suggested by various scientists as common extractants for available P and available K. One per cent citric acid (Dyer, 1894), sodium acetate - acetic acid mixture (Morgan, 1937; Peech and English, 1944; Wolf and Ichisaka, 1947) and HCl (Spurway, 1935) were used in the early years of the present century. Among these extractants, Morgan's extractant viz., sodium acetate - acetic acid of pH 4.8 was established as an 'universal extractant' and was given much more importance. But despite its acidity, this solution was found to bring sufficient organic matter into solution to interfere seriously with P tests. Bray No.1 has been reported to be suitable both for P and K (Ram and Prasad, 1983). According to Subrahmanyam (1968) Bray No.2 and Olsen's methods could also be used for the determination of available P and K. But these extractants are not universally accepted since they were not tried under varying soil and climatic conditions. Recently some extractants have been reported for the determination of P, K, secondary nutrients and micronutrients. They include NH_4HCO_3 -DTPA (Soltanpour and Schwab, 1977), Mehlich II (Mehlich, 1978), 0.5 M $\text{NH}_4\text{F} + 0.005 \text{ M DTPA}$ (Rao and Ghosh, 1981), Morgan's extractant + 0.0001 M DTPA (Wolf, 1982), and Mehlich III (Mehlich, 1984). The extractants viz., NH_4HCO_3 -DTPA and Mehlich III remove organic matter into the soil solution due to their alkaline nature and the interference with organic matter has to be eliminated (Hanlon and Johnson, 1984). The use of activated carbon for the removal of organic matter from the soil extract is likely to introduce some error due to the adsorption of ions.

The present study was therefore planned to evolve a common extractant most suited for the extraction of both available P and K simultaneously in the soils of Kerala.

Materials and Methods

Eighty seven surface soil samples were collected from all over the state, covering all the districts, assuring wide variation in the content of available P, K and physico-chemical characteristics of the soil. The soils were analysed for moisture, pH, EC, organic carbon, CEC, total P, total K, available P, available K and P fixing capacity.

The selection of a common extractant was carried out through the following three stages of screening.

i) *An initial study:* This was conducted mainly to fix up an approximate range in concentration of the reagents. In this study 18 extractants were tried of which nine were NH_4F —DTPA combinations. The extractants were:

1. 0.1 M NH_4F +0.001 M DTPA
2. 0.1 M NH_4F +0.005 M DTPA
3. 0.1 M NH_4F +0.05 M DTPA
4. 0.5 M NH_4F +0.001 M DTPA
5. 0.5 M NH_4F +0.005 M DTPA
6. 0.5 M NH_4F +0.05 M DTPA
7. 1.0 M NH_4F +0.001 M DTPA
8. 1.0 M NH_4F +0.005 M DTPA
9. 1.0 M NH_4F +0.05 M DTPA
10. 0.06 N H_2SO_4 +0.06 N HCl +0.05 N oxalic acid (Mathew's triacid)
11. 0.03 M NH_4F +0.025 N HCl (Bray No.1)
12. 0.03 M NH_4F +0.05 M NH_4OAc +0.025 N HCl
13. 0.05 M NH_4F +0.05 M NH_4OAc +0.025 N HCl
14. 0.05 M NH_4F +0.05 M acetic acid
15. 0.03 M NH_4F +0.05 M acetic acid
16. 0.03 M NH_4F +0.025 N HCl+0.001 M DTPA
17. 0.03 M NH_4F +0.025 N HCl+0.005 M DTPA
18. 1.0 N neutral NH_4OAc

The available P extracted by Bray No. 1 and available K extracted by neutral normal NH_4OAc were found out and they were compared with that of the different extractants. A single soil solution ratio of 1:10 and two equilibration periods of 30 min and 60 min were employed using a single soil. The promising extractants were carried forward for preliminary screening.

ii) *A preliminary screening:* This consisted of nine soils, 15 extractants and five equilibration periods viz., 5, 10, 15, 30 and 60 min with a single soil solution ratio of 1:10.

The extractants used were:

1. 0.1 M NH_4F +0.001 M DTPA
2. 0.1 M NH_4F +0.003 M DTPA

3. 0.1 M NH_4F + 0.005 M DTPA
4. 0.3 M NH_4F + 0.001 M DTPA
5. 0.3 M NH_4F + 0.003 M DTPA
6. 0.3 M NH_4F + 0.005 M DTPA
7. 0.5 M NH_4F + 0.001 M DTPA
8. 0.5 M NH_4F + 0.003 M DTPA
9. 0.5 M NH_4F + 0.005 M DTPA
10. 0.06 N H_2SO_4 + 0.06 N HCl + 0.05 N oxalic acid
11. 0.03 M NH_4F + 0.025 N HCl (Bray No. 1)
12. 0.03 M NH_4F + 0.025 N HCl + 0.005 M DTPA
13. 0.05 M NH_4F + 0.05 M acetic acid
14. 0.5 M NaHCO_3 , pH 8.5 (Olsen)
15. Neutral normal NH_4OAc (Std)

Graphs were plotted taking period of equilibration on the X axis and the P and K values on the Y axis for each extractant solution. From the nature of the curves obtained a few extractants with suitable equilibration periods were selected for studying their performance in all the 87 soils for the final selection.

Neubauer seedling technique was used to find out the uptake of P and K by rice (variety—Annapoorna) from the soils. Correlation coefficients between the amount of P and K extracted by these extractants and the uptake of P and K by rice were worked out.

Hi) Final selection of the common extractant: This was based on the correlation between the amount of P and K extracted by the extractants and the amount of P and K extracted by the presently followed standard procedures viz., Bray No. 1 for P and neutral normal NH_4OAc for K. Eighty seven soils, 10 extractants with suitable equilibration periods and a 1:10 soil solution ratio were used in the final selection. The 10 extractants used for the final selection and their equilibration periods are given in Table 1.

Results and Discussion

The general properties of soils relating to the availability of P and K in soil are presented in Table 2. The soils varied in their texture from sand to clay. The soils were mostly acidic to neutral in character. The EC of the soils was in the range of 0.03 to 0.93 mmho/cm indicating that all the soils were non-saline. Organic carbon content of the soils under study was extremely varying, the range being 0.001% to 2.340%. The CEC of the soils ranged from 0.26 to 21.06 me/100 g of soil. The phosphorus fixing capacity varied from 5.12 to 147.5 mg P per 100 g soil. Maximum variation was obtained in the case of total P (the range being 55 ppm to 2831.2 ppm) and total K (the range being 100 ppm to 7000 ppm) content of the soils. Similarly soils varied very much in their status of available P estimated by Bray No. 1 and available K estimated by neutral normal ammonium acetate, the variation being 233 ppm to 338.74 ppm for P and 5 ppm to 1300 ppm for K.

Table 1

Details of the extractants used for the final selection of a common extractant for the estimation of available P and K.

Sl. No.	Extractant	Equilibration period, min
1	0.1 M NH ₄ F+0.001 M DTPA	5
2	0.1 M NH ₄ F+0.003 M DTPA	5
3	0.3 M NH ₄ F+0.001 M DTPA	10
4	0.5 M NH ₄ F+0.005 M DTPA	5
5	0.06 N H ₂ SO ₄ +0.06 N HCl+0.05 N oxalic acid	30
6	0.03 M NH ₄ F+0.025 N HCl	5
7	0.03 M NH ₄ F+0.025 N HCl+0.005 M DTPA	10
8	0.05 M NH ₄ F+0.05 M acetic acid	5
9	0.5 M NaHCO ₃ , pH 8.5 (Olsen)	30
10	Neutral normal NH ₄ OAc (std)	30

Table 2

General characteristics of the 87 soils selected for the study

Sl. No.	Characteristics	Mean	Range
1	Moisture, %	3.28	0.10 — 16.55
2	Organic carbon, %	0.69	0.001 — 2.340
3	pH in water	5.84	4.1 — 9.2
4	E. C. mmho/cm	0.16	0.03 — 0.93
5	CEC, me/100g soil	289	0.26 — 21.06
6	Total P, ppm	315.9	55.00 -2831.2
7	Available P (Bray No. 1), ppm	30.65	2.33 — 338.74
8	Total K, ppm	1618.6	100.00 —7000.00
9	Available K, (1 N neutral NH ₄ OAc), ppm	109.2	5.00 —1300.00
10	P fixing capacity, mg P/100g soil	83.18	5.12 — 147.50

Initial Study

Results of the initial study are given in Table 3. In NH₄F—DTPA combinations, increasing concentration of NH₄F retarded the extraction of P as well as K and they extracted much smaller quantities of P and K as compared to that of Bray No. 1 and neutral normal NH₄OAc. P and K released by 0.001 M DTPA along with NH₄F was the maximum. At an equilibration period of 60 min a higher amount of P was extracted when the concentration of DTPA was increased to 0.005 M. DTPA was not soluble in water at concentration higher than 0.005 M and hence those three combinations were eliminated from the estimation of P and K.

Increasing equilibration period had considerable effects on the extraction of P by Bray No. 1. The efficiency of extraction was decreased when the period of equilibration was increased from 30 to 60 min, possibly due to the absence of a chelating agent in order to prevent resorption. The amount of K extracted by Bray No. 1 was higher than that of neutral normal NH_4OAc (Std).

Use of ammonium acetate along with Bray No.1 inhibited the release of P drastically though no such interaction was noticed on K extraction.

Mathew's triacid extractant viz., $0.06\text{ N H}_2\text{SO}_4 + 0.06\text{ N HCl} + 0.05\text{ N}$ oxalic acid released large amounts of P and K. The efficiency of this extractant to extract P can be attributed to the chelating action of oxalic acid along with the combination of mineral acids. This result agrees with the findings already reported (Mathew, 1979). It was evident from the result that hydrogen ions could release K into the solution effectively.

Table 3
Phosphorus and potassium extracted by the various extractants used
at different periods of equilibration (min) in the initial study

Sl. No.	Name of extractant	P, ppm		K, ppm	
		30	60	30	60
1	0.1 M NH_4F 4 0.001 M DTPA	1.51	1.27	280.0	290.0
2	0.1 M NH_4F + 0.005 M DTPA	1.51	2.56	210.0	290.0
3	0.5 M NH_4F + 0.001 M DTPA	0.56	0.44	240.0	260.0
4	0.5 M NH_4F + 0.005 M DTPA	0.79	0.44	160.0	230.0
5	1.0 M NH_4F + 0.801 M DTPA	0.11	0.22	170.0	160.0
6	1.0 M NH_4F 4 0.005 M DTPA	0.17	0.33	100.0	60.0
7	0.06 N H_2SO_4 + 0.06 N HCl + 0.05 N oxalic acid	4.19	2.29	230.0	310.0
8	0.03 M NH_4F + 0.025 N HCl (Bray No.1)	3.27	2.02	270.0	240.0
9	0.03 M NH_4F + 4 0.05 M NH_4OAc 0.025 N HCl	0.44	0.11	230.0	260.0
10	0.05 M NH_4F + 0.05 M NH_4OAc 4 0.025 N HCl	0.11	0.44	220.0	230.0
11	0.05 M NH_4F 4 0.05 M acetic acid	1.45	3.12	250.0	260.0
12	0.03 M NH_4F 4 0.05 acetic acid	1.27	0.67	220.0	230.0
13	0.03 M NH_4F + 0.025 N HCl 4 0.001 M DTPA	0.67	0.98	150.0	180.0
14	0.03 M NH_4F + 0.25 N HCl + 0.005 M DTPA	0.67	0.67	170.0	180.0
15	Bray No. 1 (std) P—1.30 ppm				
16	Neutral normal NH_4OAc (std) K = 230.0 ppm				

Table 4

Mean values of P (ppm) extracted by various extractant at different periods of equilibration (min) in the preliminary screening

Sl. No.	extractant	Period of equilibration				
		5	10	15	30	60
1	0.1 M NH ₄ F + 0.001 M DTPA	49.6	57.3	67.2	55.8	48.7
2	0.1 M NH ₄ F + 0.003 M DTPA	65.0	57.2	66.9	61.5	62.0
3	0.1 M NH ₄ F + 0.005 M DTPA	73.2	79.2	82.8	90.7	106.6
4	0.3 M NH ₄ F + 0.001 M DTPA	84.7	92.3	94.3	96.4	115.6
5	0.3 M NH ₄ F + 0.003 M DTPA	72.3	75.6	70.8	95.8	115.7
6	0.3 M NH ₄ F + 0.005 M DTPA	114.7	124.9	113.8	121.8	106.4
7	0.5 M NH ₄ F + 0.001 M DTPA	81.9	96.8	93.5	95.5	98.2
8	0.5 M NH ₄ F + 0.003 M DTPA	89.3	91.3	91.9	90.5	96.5
9	0.5 M NH ₄ F + 0.005 M DTPA	96.4	85.8	81.5	72.3	103.8
10	0.06 N H ₂ SO ₄ + 0.06 N HCl + + 0.05 N oxalic acid (Mathew's triacid)	130.8	139.9	140.0	133.9	174.0
11	0.03 M NH ₄ F + 0.025 N HCl (Bray No. 1)	72.2	69.3	73.6	72.3	73.2
12	0.03 M NH ₄ F + 0.025 N HCl + 0.005 M DTPA	55.8	47.9	55.3	51.6	53.3
13	0.05 M NH ₄ F + 0.05 M acetic acid	65.4	68.1	65.9	64.7	64.4
14	0.5 M NaHCO ₃ (Olsen), pH 8.5)	52.9	57.4	57.0	59.8	61.3
15	N neutral NH ₄ OAc	17.1	32.2	42.3	46.7	55.0

The NH₄F + acetic acid was found to be a good combination in estimating available P and available K. NH₄F (0.05 M) + acetic acid (0.05 M) extracted more quantity of P even at 60 min than Bray No. 1 showing the chelating action of acetic acid. The amount of K extracted by neutral normal NH₄OAc was higher when the soil solution ratio was 1:10 as compared to 1:5 (Std).

Preliminary screening

Mean values of P and K extracted by various extractants at different periods of equilibration employed in the preliminary screening are presented in Tables 4 and 5. When graphs were plotted with period of equilibration on the X axis and the amount of P and K extracted by the various extractants on Y axis, it was found that the extractants viz., 0.1 M NH₄F + 0.005 M DTPA, 0.3 M NH₄F + 0.003 M DTPA, 0.3 M NH₄F + 0.005 M DTPA, 0.5 M NH₄F + 0.001 M DTPA and 0.5 M NH₄F + 0.003 M DTPA could not extract P and K simultaneously within the period of equilibration tried. All the other extractants had shown more or less similar patterns of P and K release from the soils.

From the graphs plotted, suitable equilibration periods for the 10 extractants were selected and the selected equilibration periods have been presented in Table 1.

The coefficients of correlation worked out between the amount of nutrients extracted by the extractants and the nutrient uptake by rice (Table 6 and Table 7), were highly significant at all the equilibration periods, most of them being on par. Thus it was very difficult to select an extractant based on the correlation between the nutrients extracted by the extractant and the nutrient uptake by rice. Since the initial and preliminary studies conducted have been established the suitability of Bray No. 1 for available P and the neutral normal ammonium acetate for available K, the final selection of a common extractant with 87 soils was oriented towards the highest correlation of P and K values of the selected extractants with that of Bray No. 1 P and neutral normal NH_4OAc extractable K, since these two extractants are already being used in soil testing laboratories of the State based on which soil fertility maps are being prepared.

Table 5

Mean values of K (ppm) extracted by various extractants at different periods of equilibration (min) in the preliminary screening

Sl. No.	Extractant	Period of equilibration				
		5	10	15	30	60
1	0.1 M NH_4F + 0.001 M DTPA	171.1	189.4	180.6	180.0	172.8
2	0.1 M NH_4F + 0.003 M DTPA	163.3	163.3	170.0	169.4	172.8
3	0.1 M NH_4F + 0.005 M DTPA	181.7	183.7	181.7	178.9	172.2
4	0.3 M NH_4F + 0.001 M DTPA	178.9	193.3	193.9	179.4	172.8
5	0.3 M NH_4F + 0.003 M DTPA	174.4	153.3	150.0	142.2	140.6
6	0.3 M NH_4F + 0.005 M DTPA	157.2	150.6	142.8	138.9	131.7
7	0.5 M NH_4F + 0.001 M DTPA	261.7	253.9	236.1	226.7	215.6
8	0.5 M NH_4F + 0.003 M DTPA	211.7	187.8	185.6	198.9	210.0
9	0.5 M NH_4F + 0.005 M DTPA	168.3	153.3	147.8	149.4	147.8
10	0.06 N H_2SO_4 + 0.06 N HCl + 0.05 N oxalic acid (Mathew's triacid)	194.4	195.0	202.8	208.9	223.3
11	0.03 M NH_4F + 0.025 N HCl (Bray No.1)	189.4	192.8	201.1	192.2	196.7
12	0.03 M NH_4F + 0.025 N HCl + 0.005 M DTPA	173.9	193.3	198.3	189.4	192.2
13	0.05 M NH_4F + 0.05 M acetic acid	173.3	174.4	179.4	169.4	170.0
14	0.5 M NaHCO_3 (Olsen, pH 8.5)	163.9	155.0	156.1	158.3	161.7
15	N neutral NH_4OAc	233.9	255.0	263.9	268.3	295.0

Table 6

Coefficients of correlation (r) between P extracted by the chemical extractants and P uptake by rice

Sl. No.	Extractant	Period of equilibration, min				
		5	10	15	30	60
1	0.1 M NH ₄ F + 0.001 M DTPA	0.8658	0.9572	0.9489	0.9341	0.9058
2	0.1 M NH ₄ F + 0.003 M DTPA	0.9180	0.8762	0.9248	0.8951	0.9005
3	0.1 M NH ₄ F + 0.005 M DTPA	0.9156	0.9253	0.8669	0.8760	0.8769
4	0.3 M NH ₄ F + 0.001 M DTPA	0.9085	0.8958	0.9073	0.9170	0.9048
5	0.3 M NH ₄ F + 0.003 M DTPA	0.8022	0.9155	0.9164	0.8703	0.9009
6	0.3 M NH ₄ F + 0.005 M DTPA	0.8998	0.8884	0.9034	0.9060	0.9252
7	0.5 M NH ₄ F + 0.001 M DTPA	0.8935	0.8778	0.8868	0.9030	0.9252
8	0.5 M NH ₄ F + 0.003 M DTPA	0.9053	0.9132	0.9140	0.9107	0.9155
9	0.5 M NH ₄ F + 0.005 M DTPA	0.8764	0.8860	0.8891	0.8964	0.8847
10	0.06 N H ₂ SO ₄ + 0.06 N HCl + 0.05 N oxalic acid	0.8577	0.8625	0.9016	0.8783	0.8764
11	Bray No.1	0.8758	0.8976	0.8894	0.8917	0.8968
12	Bray No.1 + 0.005 M DTPA	0.880	0.8880	0.8850	0.8700	0.8738
13	0.05 M NH ₄ F + 0.05 M acetic acid	0.8759	0.8896	0.8830	0.8879	0.8792
14	Olsen's extractant	0.8828	0.9009	0.8929	0.8924	0.8940
15	Normal neutral NH ₄ OAc	0.7230	0.8319	0.9060	0.8982	0.8835

* Significant at 5 per cent level

** Significant at 1 per cent level

Final selection

The mean values of P and K extracted by different extractants (ppm) at selected periods of equilibration are given in Table 8.

When the mean values of P extracted by the different extractants were compared, it was found that 0.1M+0.003M combination NH₄F and DTPA extracted the maximum quantity of P (88.21 ppm) while Bray No. 1 extracted much smaller amount of P (30.67 ppm). Neutral normal NH₄OAc was the least efficient in extracting P (7.16 ppm).

Table 7

Coefficients of correlation (r) between K extracted by the chemical extractants and K uptake by rice

Sl. No.	Extractants	Period of equilibration, min				
		5	10	15	30	60
		xx	xx	xx	xx	xx
1	0.1 M NH ₄ F + 0.001 M DTPA	0.9512	0.9543	0.9536	0.9572	0.9488
		xx	xx	xx	xx	xx
2	0.1 M NH ₄ F + 0.003 M DTPA	0.9522	0.9538	0.9513	0.9522	0.9500
		xx	xx	xx	xx	xx
3	0.1 M NH ₄ F + 0.005 M DTPA	0.9574	0.9584	0.9539	0.9534	0.9471
		xx	xx	xx	xx	xx
4	0.3 M NH ₄ F + 0.001 M DTPA	0.9560	0.9411	0.9369	0.9395	0.9364
		xx	xx	xx	xx	xx
5	0.3 M NH ₄ F + 0.003 M DTPA	0.9491	0.9399	0.9395	0.9208	0.9188
		xx	xx	xx	xx	xx
6	0.3 M NH ₄ F + 0.005 M DTPA	0.9394	0.9345	0.9172	0.9141	0.9122
		xx	xx	xx	xx	xx
7	0.5 M NH ₄ F + 0.001 M DTPA	0.9395	0.9361	0.9229	0.9209	0.9289
		xx	xx	xx	xx	xx
8	0.5 M NH ₄ F + 0.003 M DTPA	0.9160	0.9185	0.9150	0.9198	0.9197
		xx	xx	xx	xx	xx
9	0.5 M NH ₄ F + 0.005 M DTPA	0.9307	0.9247	0.9198	0.9198	0.9142
		xx	xx	xx	xx	xx
10	0.06 N H ₂ SO ₄ + 0.06 N HCl + 0.05 N oxalic acid	0.9500	0.9501	0.9527	0.9567	0.9562
		xx	xx	xx	xx	xx
11	Bray No. 1	0.9585	0.9531	0.9533	0.9448	0.9519
		xx	xx	xx	xx	xx
12	Bray No. 1 + 0.005 M DTPA	0.9513	0.9549	0.9489	0.9558	0.9608
		xx	xx	xx	xx	xx
13	0.05 M NH ₄ F + 0.05 M acetic acid	0.9499	0.9449	0.9489	0.9416	0.9455
		xx	xx	xx	xx	xx
14	Olsen's extractant	0.9573	0.9594	0.9593	0.9602	0.9607
		xx	xx	xx	xx	xx
15	Normal neutral NH ₄ OAc	0.9608	0.9445	0.9434	0.9464	0.9487
		xx	xx	xx	xx	xx
16	NH ₄ OAc (std)	0.9527				

xx Significant at 1 per cent level

Combinations of NH₄F and DTPA could not release large amount of K eventhough it could release large amount of P. The amount of K extracted by NH₄OAc (119.1 ppm) was the maximum and 0.5 M NH₄F + 0.005 M DTPA (62.0 ppm) extracted the minimum quantity.

Table 8

Mean value of P and K (ppm) extracted by various extractants in the final selection

Sl. No.	Extractant	P	K
1	0.1 M NH ₄ F + 0.001 M DTPA	31.56	88.1
2	0.1 M NH ₄ F + 0.003 M DTPA	88.21	88.4
3	0.3 M NH ₄ F + 0.001 M DTPA	43.43	83.6
4	0.5 M NH ₄ F + 0.005 M DTPA	31.45	62.0
5	0.06 N H ₂ SO ₄ + 0.06 N HCl + 0.05 N oxalic acid (Mathew's triacid)	27.31	110.7
6	Bray No. 1	30.67	101.4
7	Bray No. 1 + 0.005 M DTPA •	22.66	111.0
8	0.05 M NH ₄ F + 0.05 M acetic acid	28.56	94.1
9	Olsen's extractant	19.75	100.8
10	Neutral normal NH ₄ OAc (modified)	7.16	119.1
11	Neutral normal NH ₄ OAc (std)	—	107.4

Table 9

Coefficients of correlation (r) between the P and K extracted by the selected extractants and the P and K extracted by the standard P and K extractants

Sl. No.	Name of extractant	P (Bray No.1)	K N neutral NH ₄ OAc (Standard procedure)
1	0.1 M NH ₄ F + 0.001 M DTPA	0.8046	0.4009
2	0.1 M NH ₄ F + 0.003 M DTPA	0.4085	0.0817
3	0.3 M NH ₄ F + 0.001 M DTPA	0.8868	0.0788
4	0.5 M NH ₄ F + 0.005 M DTPA	0.9294	-0.0171
5	Mathew's triacid	0.8913	0.6436
6	Bray No. 1	1.000	0.1549
7	Bray No. 1 + 0.005 M DTPA	0.8897	0.0668
8	0.05 M NH ₄ + 0.05 M acetic acid	0.9168	-0.0080
9	0.5 M NaHCO ₃ , pH 8.5 (Olsen)	0.8977	0.2503
10	Neutral normal NH ₄ OAc (modified)	0.9014	-0.0153

x Significant at 5 per cent level

xx Significant at 1 per cent level

The correlation coefficients of P extracted by different extractants with Bray No. 1 P (Table 9) were in the following decreasing order. (i) 0.5 M NH₄F+0.005 M DTPA (ii) 0.05 M NH₄F + 0.05 M acetic acid (iii) NH₄OAc (iv) Olsen (v) Mathew's triacid (vi) Bray No. 1 + 0.005 M DTPA (vii) 0.3 M NH₄F + 0.001 M DTPA (viii) 0.1 M NH₄F + 0.001 M DTPA (ix) 0.1 M NH₄F + 0.003 M DTPA.

The correlation coefficients between NH₄OAc (std) K and K extracted by only three extractants viz., Mathew's triacid, 0.1 M NH₄F + 0.001 M DTPA and Olsen's extractant were statistically significant (Table 9). Highest correlation was established by Mathew's triacid.

The efficiencies of the extractants to extract both P and K simultaneously, when studied, found that Mathew's triacid extractant gave better correlation with Bray No. 1 P and NH₄OAc (std) K. As regards the speed of extraction 0.1 M NH₄F+ 0.001 M DTPA takes only 5 min to attain equilibrium P and K values. But considerable amount of organic matter brought into the solution by this extractant interferes with the calorimetric determination of P. Mathew's triacid is a combination of mineral acids and organic acid and it may be preferred to other extractants, since the acid conditions under which extraction takes place can be considered somewhat comparable to that of the field conditions under which P and K are taken up by plants from the acid laterite soils of Kerala.

Summary

A laboratory evaluation and an uptake study using Neubauer seedling technique was carried out for evolving a single common extractant suitable for extracting available P and available K so as to simplify the process of extracting these available plant nutrients in soil testing work. The study was conducted in three phases, viz., an initial study, preliminary screening and a final selection using different extractants. The triacid (0.06 N H₂SO₄ + 0.05 N HCl + 0.05 N oxalic acid) with a soil solution ratio of 1 :10 and equilibration period of 30 min was found to give very good correlation with Bray No. 1 P and NH₄OAc (std) K and this extractant can be recommended for different soils of the state.

സംഗ്രഹം

ഇന്ന് കേരളത്തിലുള്ള മണ്ണുപരിശോധനാ പരീക്ഷണശാലകളിൽ മണ്ണിലുള്ള ഭാവ ഹത്തിന്റേയും പൊട്ടാസ്യത്തിന്റേയും ലഭ്യത തിട്ടപ്പെടുത്തുന്നതിന് മാനദണ്ഡമായി ഉപയോഗിക്കുന്നത് യഥാക്രമം ബ്രേ നമ്പർ-1 നിർവീര്യമാക്കിയ rara<scB06TT>"lcs) അസരോററ എണ്ണി രാസലായിനികളാണ്. ഭാവകത്തിനും fl.-uogonro^OTrmHcTl^o കൂടി ചൊതുവായ raroi രാസലായനി ഉപയോഗിക്കുകയാണെങ്കിൽ fig^jjajfolGcFBoaum കൂടുതൽ എളുപ്പമാക്കുവാനും (airmen തിയിലാക്കുവാനും സാധിക്കും. അങ്ങനെ ഒരു ചൊതുവായ ലായനി രൂപപ്പെടുത്തുന്നതിനു പേണ്ടി പല rooaroeJoooffmTcft.^ ഉപയോഗിച്ച് വിവിധ ഘട്ടങ്ങളിലായി പഠനം നടത്തിയതിൽ നിന്നും മണ്ണിലെ സസ്യലഭ്യമായ ഭാവകവും CT-i-jogoaro^nj^o തിട്ടപ്പെടുത്തുന്നതിന് ഏറ്റവും അനുയോജ്യമായ ഒരു roocroejooiml ഉപയോഗിച്ചെടുക്കുവാൻ സാധിച്ചു. സരഫ്യൂരിക്, ഹൈഡ്രോക്ലോറിക്, ഓക്സാലിക് എന്നീ അമ്ലങ്ങളുടെ ഒരു മിശ്രിതമാണ് ഇതിന് ഏറ്റവും യോജിച്ചതായി കണ്ടത്.

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