MOVEMENT OF APPLIED POTASSIUM IN A SANDY CLAY LOAM SOIL UNDER RUBBER (*HEVEA BRASILIENSIS*) PLANTATION

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Field and laboratory experiments were conducted in a sandy clay loam soil under rubber (*Hevea brasiliensis*) cultivation to study the movement of surface-applied K. The field experiment indicated that the influence of K fertilizer on K availability is reflected only in the 0-10 cm layer of the soil. Higher levels of K application did not influence the available K status. In the laboratory experiment using soil columns, movement of K up to 30 cm depth was observed.

Key words: *Hevea brasiliensis*, Potassium, Soil.

INTRODUCTION

Potassium is one of the essential elements required for growth and productivity of rubber (*Hevea brasiliensis*) besides nitrogen (N) and phosphorus (P). It is more readily lost by leaching than P. The leaching losses of potassium (K) fertilizers vary with the texture of the soil, forms and rates of application and the intensity of rainfall (Soong, 1973; Sivanadyan, 1974). K tended to leach quickly in soils with clay contents less than 41 per cent (Boswell and Anderson, 1968). Pushparajah (1979) reported that in sandy soils, leaching losses were as high as 50 per cent of the added K fertilizer. Best and Drover (1979) observed that majority of the K^+ ions were held in the top one centimeter layer when K fertilizers were applied to the surface of soil columns containing 60 per cent clay. The present study was undertaken to quantify the availability of K at different depths of the soil in a mature rubber plantation, at fixed time intervals after K fertilizer application.

MATERIALS AND METHODS

Column study

Sixteen PVC columns (60 cm long and 8 cm in diameter) were filled with the sandy clay loam soil from a mature rubber plantation (Koney Estate) in Pathanamthitta District, Kerala, under the traditional rubber growing region of India. The soil was sampled depth-wise and filled as per the order of depth into the columns. Muriate of Potash at the rate of 30 kg K_2O per ha (75 mg K_2O per kg soil, equivalent to 125 mg MOP per kg soil, considering 20% of the area as the effective area of fertilizer application) was applied on the surface of the soil column and deionised water was added from the top to maintain the soil moisture at field capacity. Four columns were withdrawn at 5, 10, 15 and 30 days after the fertilizer application. The columns were segmented at every 10 cm and soil samples were collected and processed. The soil samples were extracted with 1N ammonium acetate and

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available K in the extract was estimated by flame emission spectrometry (Jackson, 1958).

Field study

The field experiment was also conducted in a mature rubber area at Koney Estate, from where soil for the column experiment was collected. This area was under a fertilizer trial for 14 years for which the treatments included four levels of K_2O, *viz.*, 0, 15, 30 and 45 kg/ha with five replications laid out in a randomised block design. The red ferruginous soils (laterite soils) in this area belong to clayey-skeletal, kaolinitic, isohyperthermic, ustic haplohumult. The soil samples for the field study were collected before and after (15, 30 and 60) days a fresh application of K fertilizer from four depths *viz.*, 0-10, 10-30, 30-45 and 45-60 cm. A total of 320 soil samples were collected and analysed for available K. Particle size distribution of the soil was determined by the international pipette method (Piper, 1942). Available P (Bray and Kurtz, 1945) and organic carbon (Walkley and Black, 1934) were also estimated.

RESULTS AND DISCUSSION

The experimental soil was acidic, sandy clay loam and contained organic carbon, available P and K in the medium range (Table 1).

Table 1. **Fertility status and texture of the soil**

Parameter	Quantity
Organic carbon (%)	1.25
pH	4.94
Available P (mg/100g)	1.51
Available K (mg/100g)	12.35
Sand (%)	48.64
Silt (%)	22.50
Clay (%)	27.62
Texture	Sandy clay loam

Column study

The quantity of available K in mg/100g, recovered from soil samples at different depths of the column at definite intervals of time, is shown in Table 2. K fertilizer application resulted in significant increase in K availability even after 30 days. K availability was observed to increase up to 30 cm depth of the column. Compared to 5 and 10 days, significant decrease in available K was observed after the 15 and 30 days of fertilizer application, which may be due to leaching loss.

Table 2. **Available K (mg/100g) in the column**

Depth (cm)	Days after fertilizer application					Mean
	0*	5	10	15	30	
0-10	13.55	22.59	20.94	18.58	14.29	17.99
10-20	8.56	13.39	13.11	14.30	13.96	12.67
20-30	8.21	10.46	8.99	7.82	10.83	9.26
30-40	8.79	8.52	8.22	7.15	8.76	8.29
40-50	7.99	8.16	8.46	6.55	8.50	7.93
50-60	7.66	8.45	8.45	6.04	8.76	7.87
Mean	9.13	11.93	11.36	10.07	10.85	

Source	Depth	Days	Depth x Days
SE	0.24	0.25	0.60
CD (P≤ 0.01	0.52	0.50	1.23

* The column 0 days represent the status before K fertilizer application

Field study

In the field experiment, Muriate of Potash was applied broadcast to the soil surface at four levels, *viz.*, 0, 15, 30 and 45 kg K_2O/ha. Available K recovered from different depths of the soil at definite intervals at varying levels of K application is shown in Table 3. At 0 - 10 cm depth, no significant difference was observed in the available K content of the soil for different levels of applied fertilizer. Significant decrease in available K content was observed at 30 and 60 days after fertilizer application, compared to that after 15 days indicating that the influence of K application on surface soil is only for a short duration.

Considerable decrease in K availability was observed at 10-30 cm depth of the soil, compared to 0-10 cm. In the control plot, the mean value of available K was only 8.54 mg/100g in the 10-30 cm layer as against 14.32 mg/100g in the 0-10 cm layer. Similar trend was observed in the fertilizer applied plots also. However, no significant difference in available K was observed among different fertilizer treatments at this depth also. Significant decrease in available K was observed at 30 and 60 days after fertilizer application.

In the 30-45 cm layer of the soil, available K was observed to be lower compared to the 10-30 cm layer. Significantly higher available K was observed in plots, which received 30 kg K_2O/ha, whereas the other two levels of fertilizer were comparable to the control. No significant change in available K was observed at different time intervals. At 45-60 cm depth of the soil, fertilizer application did not cause any significant change in available K content.

The results of both column study and

Table 3. Available K (mg/100g) at different depths of the soil

Soil depth	0-10 cm					10-30 cm					30-45 cm					45-60 cm				
Levels ($kg/K_2O/ha$)	0	15	30	45	Mean	0	15	30	45	Mean	0	15	30	45	Mean	0	15	30	45	Mean
Initial	14.7	13.4	16.5	14.4	14.7	7.87	9.33	11.50	8.47	9.29	8.41	8.87	7.65	7.01	7.99	7.72	8.46	7.60	8.17	7.96
15 days	15.6	15.2	17.0	15.8	15.9	10.3	8.14	10.60	7.85	9.22	7.88	6.63	10.50	5.43	7.62	8.18	7.77	7.02	5.58	7.14
30 days	13.1	11.2	12.8	12.3	12.3	8.88	7.42	8.95	7.90	8.29	7.80	5.70	7.81	7.68	7.25	7.08	6.77	7.15	6.52	6.91
60 days	14.0	11.8	13.5	11.0	12.6	7.14	7.06	8.35	7.30	7.46	5.28	8.12	10.49	5.84	7.43	7.26	7.80	8.36	6.61	7.51
Mean	14.3	12.9	14.9	13.4		8.54	7.99	9.86	7.88		7.34	7.33	9.12	6.49		7.59	7.70	7.53	6.69	
	SE	CD				SE	CD				SE	CD				SE	CD			
Levels	0.46	NS				0.35	NS				0.39	1.4**				0.41	NS			
Days	0.46	1.32**				0.35	0.99**				0.39	NS**				0.41	NS			
Level x Days	0.93	NS				0.70	NS				0.59	2.17**				0.78	NS			

field study indicated that the influence of K application on K availability is reflected only in the surface layers. In the column experiment, K availability improved with fertilizer application only up to 30 cm indicating slow downward movement of applied K. In the field situation, the influence of K fertilizer application was reflected only in the 0-10 cm for 15 days. Thereafter the K availability decreased.

As the K status of the soil was in the medium range before commencement of the experiment, further K application even up to 45 kg/ha did not influence the available K. The absence of downward movement of K may be, to a great extent, due to the uptake of K by the feeder roots of rubber trees, which are concentrated in the surface layer of the soil as is evident from the slight decrease in K status at 30 and 60 days after fertilizer application. The K requirement of rubber trees, especially the high yielding varieties was reported to be high. By the completion of one cycle of rubber plantation, a loss in K to the tune of 1500 kg/ha through timber and 180 kg/ha through latex was reported (Karthikakuttyamma *et al.*, 1997). Crop removal of K often exceeds annual addition from all sources, which may not reflect on the available K status immediately (Pasricha *et al.*, 2002). In the present study, even before fertilizer application the level of available K was being maintained indicating steady replenishment from K reserves. Karthikakuttyamma *et al.* (1997) reported a deficit of 883 kg/ha of potassium by the completion of one cycle of rubber plantation. Adequate K fertilizer application is highly essential to avoid depletion of soil K reserves, and also to ensure sustainable yield for farmers.

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