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POTASSIUM: ITS STATUS IN RUBBER GROWING SOILS OF SRI LANKA

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ABSTRACT

The water soluble, exchangeable and total potassium (K) contents are considered as indicators of K status of rubber growing soils. Water-soluble K is very low in all rubber growing soil series in Sri Lanka. Total K is highest (1743 mg/kg) in the *Parambe* series and *Matale, Ratnapura* and *Agalawatta* series soils have medium K contents (718mg/kg to 456mg/kg). *Boralu* and *Homagama* series soils have the lowest K contents of 121 and 113 mg/kg, respectively. The soil series, therefore, fall into three broad categories *i.e.* comparatively high, moderate and low.

Between different soils, total K and exchangeable K correlates positively, indicating that a soil, which has a high total K content, will generally have a high exchangeable K content. In relating the exchangeable K status of the soils to the sufficiency ranges of K content in rubber growing soils, it is evident that *Parambe* series soil has medium level of K while all the other soil series fall into low and very low categories. Accordingly, to supplement the K requirement through fertilizer, low and high K fertilizer mixtures are recommended for medium and low to very low level soils, respectively.

INTRODUCTION

Potassium is one of the major nutrient elements required and taken up in large amount by the rubber tree besides nitrogen and phosphorus. Soils normally play a major role in determining the availability of K to rubber trees and the influence on this availability is primarily through the mineral reserves in the soil. Rubber is mainly confined to the wet and intermediate zone and is grown on a wide range of soils with variable availability of potassium.

Classification of rubber growing soils

Planting of rubber (*Hevea brasiliensis*) in Sri Lanka is mostly confined to two Great Soil Groups; Red Yellow Podzol (RYP) and Reddish Brown Latosol (RBL). The Red Yellow Podzolic soils are predominant in the rubber growing districts of Kalutara, Galle, Matara, Ratnapura, Avissawella and Moneragala. The Reddish Brown Latosolic soils occur mainly in the Kegalle, Mawanella, Kurunegala and Matale regions. In these rubber growing areas seven important soils units have been identified *viz. Parambe, Matale, Homagama, Agalawatta, Ratnapura, Boralu and*

Deniya (Table 1), taking into consideration only the parent material from which the soils were derived (Table 2).

Table 1. *Different soil series of rubber growing areas*

Soils series	Location	Great Soil Group	Soil taxonomy
Parambe	Kegalle/Kurunegala	Reddish Brown Latosol	Ultisol
Matale	Matale	Reddish Brown Latosol	Ultisol
Agalawatta	Around Sinharaja forest	Red Yellow Podzol	Ultisol
Ratnapura	Ratnapura/Meegahatenna	Red Yellow Podzol	Ultisol
Boralu	Southern coastal area	Red Yellow Podzol	Ultisol
Homagama	Yatiyantota/Deraniyagala	Red Yellow Podzol	Ultisol
Deniya		Low humic gley	Alfisol

Table 2. *Parent materials of different soil series*

Soils series	Parent material
Parambe	Micaceous biotite gneiss
Matale	Crystalline limestone
Agalawatta	Granitic rocks
Ratnapura	Garnetiferous rocks
Boralu	Vijayan and Khondalite rocks
Homagama	Quartzitic rocks

K distribution in rubber growing soils

The water soluble, exchangeable and total K contents are considered as indicators of K status of rubber growing soils. Water soluble K is very low in all soils, due perhaps to the heavy leaching that takes place in soils of the rubber growing areas, confined mainly to the low country wet zone with high average rainfall. Total K and exchangeable K contents indicated significant differences between different rubber growing soils (Table 3). Total K is highest (1743 mg/kg) in the *Parambe* series and these soils are derived from micaceous parent materials, biotite gneiss. These soils are deep, sandy clay loam in texture and brown in colour. There are glistening specks of mica throughout the soil mass. The main areas where *Parambe* series soils occur are the Kegalle and Kandy districts. *Homagama* series soil has the lowest K content (113mg/kg), which may be attributed to the very sandy nature of the soil, derived mainly from highly quartzitic rocks (Table 4). Further, high porosity and low bulk density of *Homagama* series soil, which contribute towards higher leaching rate, can also reduce the soil K content (Table 5). These soils are moderately deep and sandy loam in texture. *Boralu* series soil also has very low K content of 121 mg/kg. These soils are shallow and the presence of laterite at different depths is a diagnostic character of this soil series. Generally other soil series have medium K contents varying from 718 to 456 mg/kg. The soils, therefore, fall into three broad categories *i.e.* comparatively high, medium and low (Table 6). However, it is evident that for *Parambe* and *Matale* series soils the range is large, while for the other soil series it is very narrow. This shows to a certain extent the homogeneity with regard to this property in the *Ratnapura, Agalawatta, Homagama* and *Boralu* series soils.

Table 3. *Soil K content in different soil series*

Soils series	Total K (mg/kg)	Ex. K (meq/100g)
Parambe	1743	0.27
Matale	718	0.17
Agalawatta	456	0.12
Ratnapura	597	0.13
Boralu	121	0.04
Homagama	113	0.07

Table 4. *The particle size distribution and textural class of different soil series*

Soil series	Particle distribution (%)				Texture
	Coarse sand	Fine sand	Silt	Clay	
Parambe	40-52	15-18	10-15	28-34	sandy clay loam
Matale	42-54	18-20	7-10	20-30	sandy clay loam
Homagama	57-65	17-28	4-5	10-20	sandy loam
Agalawatta	42-55	13-18	9-12	20-30	sandy clay loam
Ratnapura	42-54	16-19	7-12	20-30	sandy clay loam
Boralu	49-55	19-22	5-8	20-30	sandy clay loam

Table 5. *Bulk density and porosity of different soil series*

Soils series	Bulk density (g/cm^2)	Porosity (%)
Parambe	1.49	53.1
Matale	1.33	54.7
Agalawatta	1.51	52.0
Ratnapura	1.36	54.6
Boralu	1.38	53.2
Homagama	1.12	56.2

Table 6. *Categorization of different soil series according to soil K status*

Soil K status	Soil series
High	*Parambe*
Moderate	*Matale, Ratnapura, Agalawatta*
Low	*Homagama, Boralu*

Moreover, both total K and exchangeable K contents indicate a marked gradient with depth of soil, total K content having an increasing gradient with depth and exchangeable K content having a decreasing gradient (Table 7).

Table 7. *Soil K content vs. soil depth in different soil series*

Soils depth	Total K (mg/kg)	Ex. K (meq/100g)
0-15cm	625	0.19
15-30cm	743	0.13
30-60cm	902	0.08

K requirement through fertilizer application

Between different soils, total K and exchangeable K correlates positively, indicating that a soil, which has a high total K content, will generally have a high exchangeable K content. In relating the exchangeable K status of the soils to the sufficiency ranges of K content in rubber growing soils (Table 8), it is evident that *Parambe* series soil has medium level of K while all the other soil series fall into low and very low ategories. Accordingly, to supplement the K requirement through fertilizer, low and high K fertilizer mixtures are recommended for medium and low to very low level soils, respectively. The general fertilizer application to rubber with high K mixtures commences with 17 kg of K per hectare during the 1[st] year of planting and rates increase by 16 kg of K every year until tapping and low K mixtures in the medium K soil, fertilizer application commences with 9 kg of K per hectare during the 1[st] year of planting and rates increase by 8 kg of K every year until tapping. Application of higher rates of K in the region of 12-25 kg per hectare is recommended for correction of the K deficiency. The K fertilizer recommendation for mature rubber is based basically on its nutrient status (site specific fertilizer recommendation based on soil and foliar analysis).

Table 8. *Sufficiency ranges of K content in rubber growing soils*

Forms of K	Very low	Low	Medium	High	Very high
Total K (mg/kg)	<100	101-200	201-780	781-1560	>1560
Ex. K (meq/100g)	<0.15	0.151-0.250	0.251-0.400	>0.4	

K nutrient cycle

In rubber plantations K is lost from the soil mainly by removal of latex and by removal of timber during replanting operations. Apart from this K may be lost by leaching through the soil and by surface erosion. It is estimated that 216 kg and 990 kg of K is removed from the system through latex and timber, respectively.

K is added to the soil mainly by fertilizer application, annual leaf fall, contribution from cover crops and addition by mulching with paddy straw.

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REASONS FOR ABANDONING RUBBER CULTIVATION: A CASE STUDY USING BAYESIAN NETWORK (BN) APPROACH

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INTRODUCTION

Low rubber prices prevailed for a fairly long time have caused smallholder rubber farmers to move away from rubber cultivation towards more profitable crops such as tea or other forms of land use. The attitude of the farmers on this issue depends on many factors. These factors may directly or indirectly affect the farmer's attitude and are of importance in different magnitudes on the ultimate decision. Studying this kind of situation cannot be effectively done through conventional survey approach based on questionnaires. Participatory Rural Appraisal (PRA) is a family of approaches and methods, which are suitable to analyze such situations where the local people are given a chance to analyze their own living conditions, share outcomes and plan activities.

The ideal PRA tool for analysis of problems of this nature is termed as a 'problem tree' or a 'causal map', which is a directed graph that represents the cause-effect relations. A simple causal map is given in Fig. 1, which identifies reduced income and insufficient subsidies as the main causes affecting the decision of giving up rubber where as rubber prices and heavy rainfall are indirect causes.

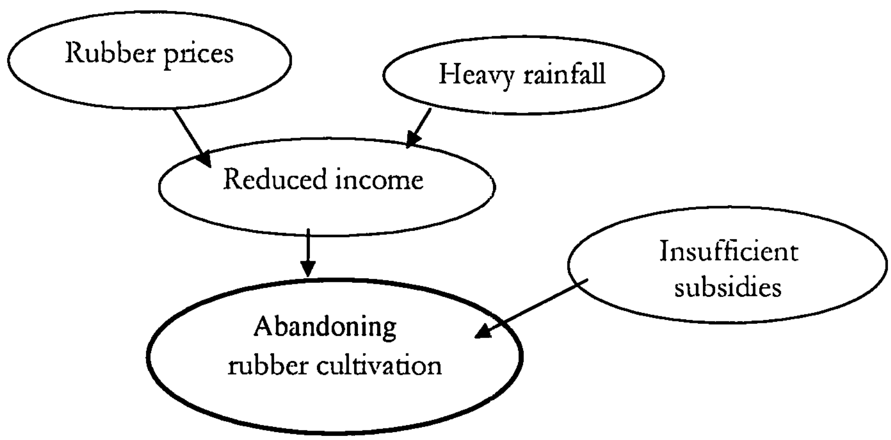

Fig. 1. A causal map representing reasons for evading from rubber cultivation