SUSTAINABILITY OF RUBBER ECOSYSTEM - A CASE STUDY AT RRII FARM

Elsie S. George*, M.D. Jessy and N. Usha Nair*
Rubber Research Institute of India, Kottayam - 686 009, Kerala, India

Abstract

A study was conducted to assess the effect of continuous rubber cultivation on soil chemical properties. RRII farm was selected for the study and the soil fertility status of the farm during 1977 and 2009 was compared. The area is well maintained with fertilizer application and other cultural practices. The results indicated that during 32 years under rubber cultivation there was no decline in organic carbon status. An increase in available phosphorus (P), potassium (K) and calcium (Ca) while a decline in magnesium(Mg) and pH was noted in both top (0-30 cm) and bottom (30-60 cm) soil. Results of the study indicated that by following proper agro management practices, soil fertility status can be sustained in rubber plantations.

Introduction

Since the introduction of rubber (*Hevea brasiliensis*) in 1873 there has been rapid increase in the spread of this crop in Kerala, Tamilnadu, Karnataka and also to North Eastern region. Now most of the plantations in traditional areas are in the third or fourth cycle. Currently, rubber is grown in an area of 6.62 lakh hectare in India, of which the traditional belt accounts for nearly 84%. Swarup(2002), reported that continuous cultivation of a single crop and its management practices were likely to bring

* Retd.

Table.1 Fertility change in different fields of RRII farm at 0-30 cm depth

Field No.	C %		pH		Available nutrients(mg/100g soil)							
					P		K		Ca		Mg	
	1977	2009	1977	2009	1977	2009	1977	2009	1977	2009	1977	2009
3	2.82	2.58	4.30	4.36	1.77	2.23	3.75	6.02	1.57	8.23	5.47	1.60
4	2.30	1.80	4.65	4.60	0.34	1.48	3.75	3.83	3.20	6.99	3.53	1.44
5	2.58	2.25	4.55	4.33	0.21	0.57	2.75	3.91	4.40	11.22	3.11	1.89
6	2.68	1.94	4.75	4.31	0.35	2.97	2.13	5.62	5.40	12.92	3.00	2.17
10	1.29	2.08	4.75	4.41	0.30	2.38	2.35	6.13	3.20	8.93	4.38	2.48
11	1.40	1.56	4.70	4.36	0.32	1.45	2.12	7.93	4.60	23.04	5.11	4.78
12	1.16	1.47	4.60	4.45	0.50	2.82	2.50	5.15	5.40	16.33	3.40	3.74
Mean	2.03	1.95	4.61	4.40	0.54	3.41	2.76	5.51	3.97	12.52	4.00	2.58

Table.2 Fertility change in different fields of RRII farm at 30-60 cm depth

Field No.	C %		pH		Available nutrients(mg/100g soil)							
					P		K		Ca		Mg	
	1977	2009	1977	2009	1977	2009	1977	2009	1977	2009	1977	2009
3	1.69	1.42	4.15	4.63	0.50	0.76	3.00	5.23	2.60	7.25	4.00	1.07
4	1.60	0.64	4.65	4.54	0.30	0.74	2.63	2.53	2.60	5.31	3.28	1.02
5	1.66	1.50	4.45	4.40	0.30	0.07	2.75	2.90	3.20	7.35	3.53	1.46
6	1.84	1.21	4.50	4.34	0.15	0.25	2.38	4.13	2.80	7.10	5.71	1.98
10	1.08	1.85	4.75	4.51	0.25	0.22	4.40	5.50	4.40	8.64	3.40	1.80
11	1.23	1.09	4.70	4.31	0.18	Trace	2.04	6.51	2.20	9.82	4.74	2.21
12	1.16	1.27	4.85	4.50	0.32	Trace	2.60	3.82	2.60	9.54	5.11	1.21
Mean	1.46	1.28	4.55	4.45	0.27	0.29	2.18	4.374	2.91	7.858	4.25	1.54

about changes in the chemical and physical properties of the soil, which may influence the crop production in the long run. But the information on the effect of continuous rubber cultivation on the soil properties in a well maintained rubber plantation is meager and the present study was taken up with this objective.

Materials and methods

During 1977, there were 12 fields in RRII farm and surface (0-30 cm) and sub surface (30-60 cm)soil samples were collected from all fields and analysed for pH, organic carbon(OC), available phosphorus(P), potassium(K), calcium(Ca)

Table 3 Change in fertility status of soil (0-30 cm)

Nutrient	Year		Significance
	1977	2009	
Organic carbon (%)	2.03	1.95	NS
Av.Phosphorus(mg/100g soil)	0.54	3.41	*
Av.Potassium(mg/100g soil)	2.76	5.55	**
Av.Calcium(mg/100g soil)	3.97	12.52	**
Av. Magnesium(mg/100g soil)	4.00	2.59	NS

Table 4 Change in fertility status of soil (30-60 cm)

Nutrient	Year		Significance
	1977	2009	
Organic carbon (%)	1.46	1.28	NS
Av.Phosphorus(mg/100g soil)	0.27	0.30	NS
Av.Potassium (mg/100g soil)	2.18	4.38	**
Av.Calcium (mg/100g soil)	2.91	7.86	**
Av. Magnesium (mg/100g soil)	4.25	1.50	**
pH	4.55	4.45	NS

and magnesium(Mg) following standard procedure (Jackson,1958). While during 2009 there were only 7 fields and surface and subsurface samples were collected from those fields . Soil samples were analysed for pH, organic carbon, available P, K, Ca and Mg following the same procedure . Analytical results of 7 fields during 1977 and 2009 were compared to study the effect of continuous cultivation of rubber.

Results and discussion

Fertility change in different fields of RRII farm during 1977 and 2009 is given in table 1& 2

Mean organic carbon content of top and bottom soils were 2.03 and 1.46 per cent during 1977 while during 2009 it was 1.95 and 1.28 per cent respectively. Available P and K content were in the low level during 1977 while an improvement was noted after 32 years. Eventhough there was decline in Mg level of both top and bottom soils the values are within the sufficiency range. pH of both top and bottom soils vary from 4.61 to 4.40 and 4.55 to 4.45 respectively

No decline in organic carbon content was noted in RRII farm at both depths (Tables 3 & 4). Significant improvement in available K and Ca status were noted in both depths. Sustainability of the system by maintaining organic carbon level and improvement in K and Ca noted may be because of regular fertilizer application, adoption of proper cultivation practices, recycling of nutrients by establishing cover crop during initial years and also from annual leaf litter addition.

The data revealed a build up of soil P and the difference is significant at 0-30 cm depth. The high P fixing capacity of the soil, less leaching losses, low removal by way of plant uptake and addition of P application as rock phosphate have caused significant increase in soil P content in top soil. It is well known that the P added to acidic soil is precipitated as polymorphic complexes of Al and/or Fe, and are not leached out in any substantial quantities (White,1976) and hence the improvement in P status observed in the top layer of 30 cm was not observed in the bottom layer. These results are in agreement with the findings of Ransmussen and Douglas (1992).

A reduction in availble Mg was noted and the difference is significant at lower depth which may be ascribed to the higher uptake by the plants and also due to leaching of Mg as a result of laterisation.

Decline in pH was noted after 32 years and the difference is significant at 0-30 cm depth. The lowering of pH may be due to the application of acid forming fertilizers, production of organic acids in the process

of decomposition of organic matter and removal of cations by leaching and crop uptake. Many workers have reported significant drop in pH on continuous use of chemical fertilizers (Gattani et al, 1976; Seeliger,1976).Leaching of bases can be an important cause of acidification in heavy rainfall and well drained regions.

Conclusions

Comparing the present fertility status with the fertility status before decades has indicated no change in organic carbon status and an improvement in P, K and Ca status. A decline in pH of top soil was also noted. The study indicate that by following proper agromanagement practices, soil organic carbon and nutrient status can be sustained in rubber plantations. However, the soil acidification over years is a case of concern, and management practices need to be evolved to prevent further acidification.

Reference

Gattani, P.O., Jain, S.V. and Seth,S.P. (1976). Effect of continuous use of chemical fertilizers and manures on soil physical and chemical properties. *Journal of Indian Society of Soil Science*.24 : 284- 289

Jackson,M.L.(1958).Soil chemical analysis. PrenticeHall of Inc;NewYork p.498

Ransmussen, P.E. and Douglas, C.L.(1992). The influence of tillage and cropping intensity on cereal response to P. *Fertiliser Research*.31: 15-19

Seeliger, M.T.(1976). An observation of the residual effect of sulphate of ammonia on soil pH. pp.52-53. In *Agricultural Record*, Dep. Agr. And Fish .3 (5)

Swarup, A (2002) Lessons from long term fertilizer experiments in improving fertilizer use efficiency and crop yield. Fertilizer News 37(12), 71-73.

White, R.E., Tiffin,L.O and Taylor, A.W (1976). The existence of polymeric complexes in dilute solutions of aluminium and ortho phosphate. Plant and soil 45: 521-529