Rock phosphate: A potential source of 'P' in rubber plantations

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Abstract

Rubber tree (Hevea brasiliensis) is the principal source of natural rubber and the material is of immense strategic importance. Rubber cultivation in India is mainly confined to a narrow belt in the western slope of western ghats. The soils of the tract is predominantly of highly weathered laterite and lateritic type. Experiments conducted at Kerala in different locations using MRP has shown positive responses. Consequent to the association of legume ground cover, it is advantageous to use MRP on these acid soils.

Introduction

Natural rubber has multiple uses in the daily life of man and is natures one of the most versatile industrial raw materials.having immense strategic importance. Though rubber is found in the latex of over 895 species of plants, *Hevea brasiliensis*, the common rubber tree accounts for 99 percent of the worlds natural rubber (George *et al.*, 1980).

The total area under rubber in India during 1993-94 is 5,08,420 ha of which 85% are small holdings and the remaining estates. The productivity of rubber has increased from 284 kg ha^{-1} during to 1215 kg ha^{-1} during 1993-94 (Rubber Board, 1995).

Rubber growing soils: low P status

ubber cultivation in India is at present mainly confined to a narrow belt along the western slope of the Western Ghats, extending from the Kanyakumari district of Tamil Nadu in the south, to the Coorg district of the Karnataka state in the north running approximately 400 km in length. The soil in this rubber growing tract are highly weathered and consists mostly of laterite and lateritic types. The soils are found to be very porous, well drained, moderately to highly acidic, deficient in available phosphorus and variable with regard to available potassium and magnesium. The red soils found in some areas are characterized by their reddish to brown colours and fine loamy texture. These soils are also generally acidic and highly deficient in available phosphorus (Rubber Board, 1995). The available phosphorus status reported by some authors are presented in Table 1 Potty *et al.* (1976), Potty *et al.* (1978) and Mathew *et al.* (1986).

Table 1. Available P* status in different locations

Location	District	Av. P (mg) 100 g^{-1} soil
Arasu Rubber Corporation	Kanyakumari	0.23
Shaliacara Estate	Kollam	0.65
Boyce Estate	Kottayam	0.50
Perinadu Estate	Pathanamthitta	0.44
Malankara Estate	Idikki	0.27
Kundai Estate	Thrissur	4.00
Young India Estate	Mallapuram	0.48
Kinalur Estate	Kozhikode	0.44
N.S.S. Estate	Kasaragode	0.45
Regional Research Station (RRII) Nettana	South Kanara	0.40

* A P status of 1.00 to 2.50 is taken as medium.

Rock phosphates for rubber growing soils

Since rubber growing soils are generally acidic in reaction, the use of soluble phosphatic fertilizers will often lead to fixation problem. Therefore rock phosphates, which contain the phosphorus in the insoluble form are general preferred as the phosphatic fertilizer for rubber growing soils. When applied to acid soils, they become gradually soluble and available to plants without being fixed in large quantities. Guha and Pushparajah (1966), Guha and Yeow (1966), Punnoose *et al.* (1976) and Pushparaja *et al.* (1976) reported that rock phosphates are the desirable phosphatic fertilizers for rubber. Punnoose *et al.* (1976) also stressed that on economic considerations, rock phosphates are preferred for manuring rubber grown in acid soils.

In seven out of eight nursery experiments, using five different sources of phosphorus, it was indicated that rock phosphate is as good as the soluble sources of phosphorus (Punnoose *et al.*, 1976).

In another nursery experiments, conducted at Central Nursery, Karikatooor, using different sources of rock phosphates viz.; Mussoorie Rock Phosphate, GafsaPhos, RajPhos and MeghaPhos have revealed that the mean girth of rubber seedlings recorded 10 months after planting showed no significant difference among the different sources of rock phosphates, indicating that all are suitable sources (Philip, 1995).

In an experiment conducted at Mundakayam, Mussoorie Rock Phosphate was compared with water soluble Ammophos (Nair, 1995). The mean girth of the trees, (Table 2) has not shown significant difference among the treatments. This shows that Mussourie Rock Phosphate is as good as soluble Ammophos with two split applications.

Punnoose *et al.* (1976) observed that there was no significant difference between rock phosphate and soluble sources of P for rubber under tapping.

Table 2. Mean girth of trees (Mundakayam)

Treatment	Mean girth (cm)
Mussoorie Rock Phosphate	
40 kg P_2O_5 ha^{-1} –2 splits	35.80
40 kg P_2O_5 ha^{-1} –3 splits	35.63
Ammophos (N:P 16:20)	
40 kg P_2O_5 ha^{-1} –2 splits	36.30
40 kg P_2O_5 ha^{-1} –3 splits	36.60
Mussoorie Rock Phosphate	
50 kg P_2O_5 ha^{-1} –2 splits	35.47
50 kg P_2O_5 ha^{-1} –3 splits	35.97
Ammophos (N:P 16:20)	
50 kg P_2O_5 ha^{-1} –2 splits	36.43
50 kg P_2O_5 ha^{-1} –3 splits	35.93
SE	0.32

Rock phosphates and legume ground cover

It has been reported that application of rock phosphates to cover crops has markedly increased their content of nitrogen, phosphorus, calcium and magnesium held in the covers (RRII, 1963).

Application of rock phosphate to ground covers led to better tree growth than where the phosphate was directly applied to the rubber trees (Yogarathnam *et al.*, 1984)

It is thus seen that in a situation where rubber is generally grown in association with a legume ground cover, it is advantageous to use rock phosphates as the source of phosphorus.

Response of rubber to rock phosphates

sever field experiments were conducted by Rubber Research Institute of India on rubber at its various stages of growth. The results of a few of them are presented below.

Seedling Nursery

A set of four experiments was conducted in rubber seedling nursery using rock phosphate to supply 247 and 494 kg P_2O_5 ha^{-1} (Punnoose *et al.*, 1976). A no phosphorus control was also maintained. Tables 3 and 4 indicates that the effect of application of rock phosphate was significant in

Table 3. Effect of rock phosphate on mean height of rubber seedlings (cm)

Expt. No.	Level of P_2O_5 kg ha^{-1} 0	247	494	SE	CD
1	119.50	127.50	126.20	1.62	4.60
2	174.60	188.70	192.00	4.66	13.26
3	147.90	158.60	162.90	1.69	4.80
4	176.6	189.80	187.30	2.07	5.90

Table 4. Effect of rock phosphate on mean diameter of rubber seedlings (cm)

Expt. No.	Level of P_2O_5 kg ha^{-1}				
	0	247	494	SE	CD
1	14.23	15.15	14.94	0.19	0.54
2	18.62	20.43	20.72	0.52	1.48
3	16.57	17.52	17.78	0.12	0.34
4	19.17	20.61	20.34	0.20	0.57

increasing the height and diameter of seedlings. It is seen that application of rock phosphate equivalent to 247 kg P_2O_5 ha was sufficient for both height and diameter of seedlings, beyond which there was no further significant response.

Immature rubber in main field

Two experiments were started on immature rubber at Punalur and Kulashekharam where rubber was planted in 1986 and 1985 respectively (RRII, 1992). The levels of P_2O_5 used in the form of rock phosphate were 0,30 and 60 kg P_2O_5 ha^{-1} $year^{-1}$. Table 5 Indicates that at both Punalur and Kulashekharam the highest girth increment was obtained for the 30 kg level of P_2O_5 as rock phosphate.

Table 5. Mean girth increment (cm)

Level of nutrient P_2O_5 kg ha^{-1}	Punalur (1987–89)	Kulasekharam (1988–91)
0	33.12	26.93
30	35.84	28.28
60	34.38	26.43
SE	0.15	0.17
CD	0.44	0.50

Mature rubber

In an experiment conducted in mature rubber at Vadakkencherry, Palghat, (Rubber Research Institute of India, 1992) using 0,20 and 40 kg levels of P_2O_5 ha^{-1} $year^{-1}$, it is indicated that there was significant increase in yield with application of phosphorus as rock phosphate in both 20 and 40 kg levels of P_2O_5. (Table 6). However the 20 kg P_2O_5 level was found to be optimum.

Table 6. Mean yield, Palghat

Level of P_2O_5 kg ha^{-1}	Mean yield (g) $tree^{-1}$ tap^{-1}
0	74.08
20	82.90
40	84.01
SE	0.55
CD	1.61

4. *Mature rubber*
During the mature phase phosphorus is given at the rate of 30 kg P_2O_5 ha^{-1} $year^{-1}$. This is also applied as rock phosphate, usually as Mussoorie Rock Phosphate.

5. *Legume ground cover*
For legume ground cover, application of 150 kg Mussoorie Rock Phosphate/ha in 2 installments is recommended, the first one month after and the second two months after the first pplication.

Since the rubber growing soils of South India are acidic in reaction and rubber is grown in association with legume ground covers, it is advantageous to use rock phosphates as source of phosphorus.

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Another set of three field experiments was conducted on rubber under tapping at Kulashekharam, Thodupuzha and Balussery using three levels of rock phosphate at 0,30 and 60 kg P_2O_5 ha^{-1} (Punnoose *et al.*, 1993). There was significant response to application of phosphorus (Table 7), with 30 kg level of P_2O_5 was found to be sufficient.

Table 7. Mean yield (g) $tree^{-1}$ tap^{-1}

Level of P_2O_5 kg ha^{-1}	Locations		
	Kulashekharam	Thodupuzha	Balussery
0	45.55	38.81	37.77
30	50.41	41.49	40.78
60	50.35	41.45	41.04
SE	0.043	0.003	0.024
CD	0.124	0.010	0.071

Phosphatic fertilizers: Recommendation of the Rubber Board

The Rubber Board has the following recommendation for application of phosphatic fertilizers at different growth states of rubber.

1. *Seedling Nursery (Ground nursery)*
   Application of 350 kg Mussoorie Rock Phosphate analysing 20–24 percent P_2O_5 and of 100 mesh per hectare of nursery at the time of preparation of nursery beds.

2. *Polybag nursery*
   Incorporation of Mussoorie Rock Phosphate at the rate of 25 and 75 g per bag for small and large bags respectively at the time of filling bags with soil.

3. *Immature rubber*
   The yearwise recommendation is given in Table 8. This is being supplied as rock phosphate more commonly as Mussoorie Rock Phosphate

Table 8. General recommendation of phosphorus for immature phase

Years	*Quantity of P_2O_5 kg^{-1} ha^{-1}*
1	20
2	40
3	50
4	40
5	30
6	30
7	30
Total	240