Comparison of dissolution pattern of rock phosphates and their evaluation in seedling nurseries of rubber

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Abstract

Phosphorus is one of the essential nutrients needed for rubber and rockphosphates are the popularly applied source of P fertilizer. A number of indigenously mined and imported rockphosphates are now available in the market. In order to study the dissolution pattern of P from three rockphosphates viz., Mussoorie rockphosphate, Rajasthan rockphosphate and Tunisia rockphosphate an incubation experiment was carried out using soils from a typical rubber growing tract. Three levels of P equivalent to 50, 100 and 150 kg P_2O_5 per ha were mixed with 1 kg of soil and incubated. Available P status at different time intervals were done using Bray II extractant. The pattern of dissolution with respect to different time intervals showed similarity among the sources, Tunisia having the highest availability upto 60 days of incubation. The differences between the sources were more pronounced at higher levels. After 60 days of incubation, the available P content decreased which was attributed to the fixation of the released P into Fe and Al phosphates. The experiment conducted in seedling nurseries of rubber did not register significant differences among the three sources.

Introduction

India is a major producer of natural rubber in the world and *Hevea brasiliensis* is the principal source. Our production fall short of demand and scientific cultivation of rubber plants with judicious application of fertilizers is viewed as one of the strategies in increasing production. The crop is mainly confined to the traditional areas in Kerala which comprises mainly of laterite soils poor in nutrient phosphorus. But these soils respond well to good management (Aiyer and Nair 1995). These soils being lateritic with high percentage of sesquioxides pose special problems with respect to management of phosphatic fertilizers.

Powdered phosphate rocks find great suitability as an alternate source of soluble forms of P fertilizer in acidic soils and for rubber, Mussoorie rock phosphate is the popularly recommended P fertilizer. The success of the directly applied rock phosphates depends on many factors. The inherent reactivity of the phosphate rock and its dissolution in a particular soil to a great extent decide its effectiveness. Though Mussoorie rock is the popularly used source of P, a number of indigenous and imported materials are now available in the market. In order to assess the suitability of two such sources viz., Rajastan phos and Gafsa phos/Tunisia phos along with a standard source (MRP), used for incubation experiment.

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Materials and Methods

Soil samples collected from a typical rubber growing tract at RRII, Kottayam, was used for the study. The physico-chemical properties of the soil was studied. The incubation experiment was carried out using 2 mm sieved soil after incorporating the 3 rock phosphate with 1 kg of soil at rates equivalent to 50, 100 and 150 kg P_2O_5 ha^{-1}. The experiment was replicated thrice and kept at moisture level equivalent to 50% field capacity. Samples were drawn at intervals of 15, 30, 45, 60, 75 and 90 days of incubation and the available P status estimated using Bray II (Bray and Kurtz 1945). The data were statistically interpreted

Results and Discussion

The physico-chemical properties of the soil are presented Table 1. The soil was clayey in texture with an acidic pH. The available P and bases were low. Tunisia recorded the highest P content followed by Rajphos and MRP (Table 2).

The dissolution pattern of the three different sources at three levels viz., 50, 100 and 150 kg P_2O_5 ha^{-1} are shown in Tables 3, 4 and 5 respectively. For the lowest level, highest availability was noted for MRP 15 days after incubation. Tunisia phos and Rajphos maintained almost steady levels of available P, the former having higher values generally at the 50 kg P_2O_5 ha^{-1} level. At this level the differences between the sources were not very prominent. But at the second and third levels, the differences were noticeable. Among the three sources, Tunisia registered the highest availability up to 60 days of incubation. In levels 2 and 3, after the 60th day of incubation, the availability was decreasing. Fixation of the released P into freshly formed Al and Fe sesquioxides could be the reason for the decrease in available P content as the period of incubation progresses. (Anjos and Rowell 1987).

Table 1. Physico-chemical properties of the soil

pH	4.2
CEC (meq/100 gm soil)	6.5
Organic Carbon (%)	1.09
Available P	Traces
Available K (mg/100 gm)	18.7
Available Mg	Traces
Mechanical composition:	
Coarse sand (%)	22.8
Fine sand (%)	6.1
Silt (%)	21.0
Clay (%)	50.0

Table 2. Phosphorus content of the different fertilizers

Mussoorie rock phos	18.6 %
Rajphos	20.0 %
Tunisia phos (Gafsa Phos)	28.63 %

The three sources of rock phosphates at three different levels were compared with respect to the available P contents at different time intervals. Among the different sources, Tunisia phos recorded the highest available P. MRP was on par with Rajphos having the lowest value (Table 3). Comparison of the differences among the different sources at each of the levels revealed that at L1, MRP was superior to the other two while at L2 and L3, both MRP and Tunisia phos were superior to Rajphos.

Table 3. Available P (mg P/100 g soil) estimated after 15 days of incubation

	Levels			
Sources	L1	L2	L3	Mean
MRP	1.07	1.53	2.1	1.57
Rajphos	0.60	1.13	1.87	1.20
Tunisia phos (Gafsa Phos)	0.77	1.53	2.57	1.62
Control	-	-	-	0.03

C.D. (0.05) for comparison of sources = 0.11.
C.D. (0.05) for source x levels = 0.18.

Tunisia phos had the highest value closely followed by MRP. In all the three levels tried, RajPhos gave significantly lower values compared to the other sources. Again the differences between levels for each of the sources were significant after 45 days of incubation (Table 4).

Table 4. Available P (mg P/100 g soil) estimated after 45 days of incubation

	Levels			
Sources	L1	L2	L3	Mean
MRP	0.77	1.60	2.23	1.52
Rajphos	0.55	1.18	1.85	1.19
Tunisia phos (Gafsa Phos)	0.73	1.61	2.62	1.66
Control	-	-	-	0.010

C.D. (0.05) for comparison of sources = 0.10.
C.D. (0.05) for source x levels = 0.17.

When the sources were compared after a period of 75 days (Table 5) it was noticed that Rajphos and Tunisia phos recorded significantly higher values as compared to MRP. A comparison of different levels of each source also recorded significant differences among the levels. Here, level 2 of the Rajphos and Tunisia phos were on par with level 3 of MRP.

Table 5. Available P (mg P/100 g soil) estimated after 75 days of incubation

	Levels			
Sources	L1	L2	L3	Mean
MRP	0.01	0.17	1.07	0.41
Rajphos	0.67	1.17	1.67	1.17
Tunisia phos (Gafsa Phos)	0.70	1.17	1.53	1.13
Control	-	-	-	0.030

C.D. (0.05) for comparison of sources = 0.10.
C.D. (0.05) for source x levels = 0.18.

The uniqueness of MRP among the available Indian rock phosphates has been demonstrated by Narayanasamy *et al.* (1981) based on X-ray analysis. The mineralogical studies conducted by them revealed that the deposits in Rajstan contain fluorapatite and that in Mussoorie, carbonate apatitie. But at the 75th day of incubation, the P availability of the MRP applied soils were less compared to the other two sources. The reason for this could be due to the precipitation of the already released P and the possibility of such fixation loss is to be further examined. Patnaik (1988) has also elaborated the reactivity of the Indian rock phosphates based on their X-ray diffraction data and indicated very low substitution of $CO_3 + F$ for PO_4, which made them less effective. However the dissolution of P from rock phosphate was hastened under acid soil conditions and the ability of the crop to absorb P from a soil system involving rocks may be different.

In a trial conducted in the seedling nursery, Karikattoor, various sources of rock phosphates were tried to evaluate their performance on the seedling growth. Girth recorded 10 months after planting showed comparable girth for all the sources of rock phosphates tried. However there was no statistical significance for the various sources of rock phosphates.

The study indicates that the three sources of rock phosphate tried performs in a similar pattern and Tunisia has slight superiority over the other two. However conclusive inferences can be drawn only after elaborate field experiment since plant root system has a definite role in the dissolution of rock phosphates.

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