1240

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EFFECT OF WATER SOLUBLE AND WATER INSOLUBLE FORMS OF PHOSPHATIC FERTILIZERS ON THE GROWTH OF *HEVEA BRASILIENSIS* DURING THE IMMATURE PERIOD

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A field experiment was conducted for seven years from 1989 to 1995 to study the relative performance of water soluble and water insoluble forms of phosphatic fertilizers and their effect on the growth of *Hevea brasiliensis*. Ammonium phosphate sulphate (20:20:0), single super phosphate and Mussoorie rock phosphate were tried at the rate of 40 kg P_2O_5/ha during 1989-92 and 30 kg P_2O_5/ha during 1993-95. The growth of *Hevea* was recorded and soil and leaf samples analysed for various nutrients. No significant growth difference was noticed among the three sources of P fertilizers tried. The leaf P level was also not influenced by the various P sources. However, available soil P buildup was noticed due to P fertilizer application irrespective of the source.

INTRODUCTION

The red and lateritic soils, where rubber (*Hevea brasiliensis*) is generally grown, are acidic in reaction and inherently deficient in phosphorus (P). From a study on fertility status of the rubber growing soils of Kerala based on more than twenty thousand soil tests for available P, it was found that the soils of 11 districts are low in P level (Karthikakuttyamma *et al.*, 1991). In acid soils P fixation can be minimized for economical crop production by using insoluble form of P fertilizers like rock phosphate (RP). RP serves as an effective P source in soils of high P fixing capacity and those where acidity is due to the preponderence of active phases of Fe and Al. Such soils can release P slowly and steadily and also prevent P fixation mechanism due to its inherent constituents like carbon, calcium and carbonate ions. Chemically processed water soluble P fertilizers are being used by many growers for manuring rubber, ignoring the high unit cost of these materials. This would be a desirable practice only if adequate return on investment is obtained. The present study was undertaken to find out the effect of different P fertilizers on the growth of rubber during its immature phase using three forms of P fertilizers *viz*., ammonium phosphate sulphate (APS), single super phosphate (SSP) and Mussoorie rock phosphate (MRP).

MATERIALS AND METHODS

Field experiments were conducted at Vaniampara Estate in Thrissur and Kinalur Estate in Kozhikode districts during 1989- 95. The soil of Vaniampara was acidic in reaction (pH 5.2) and low in Bray II reagent extractable P (7.8 kg/ha). The soil of Kinalur also was acidic pH (4.9) and low in Bray II-P (15.5 kg/ha). The treatments comprised three sources of P fertilizers (APS, SSP and MRP) each at the rate of 40 kg P_2O_5/ha/yr during 1989 to 1992 and 30 kg P_2O_5/ha/yr from 1993 to 1995. The ammoniacal nitrogen (NH_4-N) contribution from APS was duly compensated in the other treatments with ammonium sulphate (AS). Besides, urea was also tried with SSP and MRP being a low-cost nitrogen fertilizer. The experiment was laid out in a randomized block design with four replications using polybag plants of GT1. A uniform

application of muriate of potash (MOP) at the rate of 20 kg K_2O/ha/yr during 1989 to 1992 and 30 kg K_2O/ha/yr from 1993 to 1995 was given in all plots. Fertilizers were applied in two equal split doses during April-May and September-October periods every year. During 1989 to 1992 fertilizers were broadcasted around the plant basin followed by light forking and during 1993-95 fertilizer application was done in the inter row areas. In all the experimental plots ground cover of *Pueraria phaseoloides* was established along with the planting of rubber.

The first measurement of girth of plants was recorded before the fertilizer application in 1989 and the subsequent girth recordings were done at annual intervals. Soil samples were collected in 1989 (pretreatment) and in 1992 and composite leaf samples were collected in 1993 and 1995. Soil samples were analyzed for pH and Bray II-P and leaf samples for N, P and K using standard analytical procedures (Jackson, 1958).

RESULTS AND DISCUSSION

Girth increment of rubber plants from 1989 to 1993 and 1989 to 1995 are given in Table 1. A perusal of the data showed that no significant difference in girth increment was noticed for the three forms of P fertilizers tried at both the locations. Superiority of soluble P fertilizers was not noticed in terms of growth. Results from a previous experiment revealed that soluble P sources had a better effect in the early stages of growth (30 months after planting), but the difference narrowed down later and towards the end of the immaturity period (78 months after planting) no difference in girth was noticed (Karthikakuttyamma *et al.*, 1980). In the present study polybag plants of GT1 were used for field planting which had developed root system at the time of planting and the plants might have absorbed nutrients more efficiently. In the previous trial the planting material used was budded stumps which had only very few roots at the time of field planting and the soluble P fertilizers would have augmented the development of a fairly good root system which in turn resulted in more efficient absorption of nutrients,especially during the early period of immaturity (28 months after planting). At both the locations, growth of rubber plants continued to be not influenced by the type of P fertilizer applied as is evident from the data for 1989 to 1995. The higher girthing noticed in Kinalur may be due to the better climatic conditions prevailing in that region.

Table 1. Effect of different P sources on girth increment (cm)

Treatment	1989-93		1989-95	
	Vaniampara	Kinalur	Vaniampara	Kinalur
APS	26.3	30.2	39.1	45.6
SSP + AS	26.0	30.1	38.8	44.9
SSP + U	25.5	31.6	38.1	45.7
MRP + AS	26.1	31.0	39.0	45.8
MRP + U	25.5	30.5	38.5	45.6
	NS	NS	NS	NS
Mean	25.8	30.7	38.6	45.5
SE	0.77	1.10	0.84	0.92

APS - Ammonium phosphate sulphate (20:20:0)
AS - Ammonium sulphate (20.6 % N)
MRP - Mussoorie rock phosphate (20 % P_2O_5)
SSP - Single super phosphate (16 % P_2O_5)
U - Urea (46 % N)

Effect of P sources on soil P content is given in Table 2. Application of P increased the available P content in both locations, irrespective of P sources. At the time of commencement of the trial (1989) mean soil P content at Vaniampara was 8.2 kg/ha which increased to 36.7 kg/ha by 1992 and in Kinalur the increase was from 15.9 to 40.6 kg/ha. Table 3 shows the effect of P sources on soil pH. Data indicated

Table 2. Effect of P sources on soil P

Treatment	Bray II P (kg/ha)			
	Vaniampara		Kinalur	
	1989	1992	1989	1992
APS	9.2	35.8	18.1	39.5
SSP + U	6.5	37.5	12.3	41.2
MRP + AS	6.7	38.7	18.6	41.8
MRP + U	9.2	35.2	17.3	40.3
Mean	8.2	36.7	15.9	40.6

Table 3. Effect of P sources on pH

Treatment	Vaniampara		Kinalur	
	1989	1992	1989	1992
APS	5.2	5.1	4.9	5.0
SSP + U	5.2	5.1	4.7	4.9
MRP + AS	5.2	5.0	4.8	4.9
MRP + U	5.3	5.2	4.9	5.0
Mean	5.2	5.1	4.8	4.9

that pH was not influenced by the P sources tried at both the locations. Effect of P sources on leaf nutrient content is given in Tables 4 and 5. Data showed no significant differences with regard to P sources tried. However, leaf P content registered an increase between 1993 and 1995 in both locations. This may be due to the increased P build-up due to continuous P application.

Table 4. Effect of P sources on percentage leaf nutrient contents (1993)

Treatment	Vaniampara			Kinalur		
	N	P	K	N	P	K
APS	3.5	0.23	1.2	3.5	0.24	1.2
SSP + U	3.6	0.24	1.3	3.5	0.25	1.2
MRP + AS	3.5	0.23	1.2	3.4	0.25	1.1
MRP + U	3.6	0.24	1.2	3.5	0.24	1.1
	NS	NS	NS	NS	NS	NS
Mean	3.6	0.24	1.2	3.5	0.24	1.2
SE	0.14	0.01	0.07	0.07	0.01	0.08

Table 5. Effect of P sources on percentage leaf nutrient contents (1995)

Treatment	Vaniampara			Kinalur		
	N	P	K	N	P	K
APS	3.6	0.26	1.3	3.5	0.27	1.2
SSP + AS	3.8	0.27	1.2	1.2	0.29	1.2
MRP + AS	3.8	0.26	1.3	1.3	0.29	1.3
MRP + U	3.7	0.25	1.2	1.2	0.29	1.2
Mean	3.7	0.26	1.3	3.5	0.28	1.2
SE	0.11	0.01	0.05	0.10	0.02	0.09

The total fertilizer inputs from 1989 to 1995 were 230 kg N, 230 kg P_2O_5 and 160 kg K_2O. It was found that the combination of Urea + MRP + MOP is cheaper and leads to a saving of 70 per cent on fertilizer cost against the APS + MOP combination.

CONCLUSIONS

Results from the present study revealed that no significant difference in growth of rubber was obtained among three sources of P fertilizer *viz.*, APS, SSP and MRP. The use of Mussoorie rock phosphate is desirable as P fertilizer for rubber grown in acid soils of Kerala due to many advantages. Continuous application of P fertilizers increased the P content in soil.

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