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EFFECT OF HIGHER DOSES OF FERTILIZERS ON GROWTH AND YIELD OF RUBBER IN TRIPURA

The cultivation of rubber (*Hevea brasiliensis*) was initiated in Tripura in the early sixties and the area has been increasing over the years. Most of the area available for rubber cultivation in the state are degraded forests, a good portion of which was once subjected to shifting cultivation and thus not adequate in nutrient content to support successful crop production (Krishnakumar and Potty, 1989a). Though the rubber tree is known to thrive in marginal soils, it responds positively to fertilizer application in such soils. The major nutrients *viz.* nitrogen (N), phosphorus (P) and potassium (K) were found to influence the growth favourably during the immature phase (Akhurst and Owen, 1950; Owen *et al.*, 1957). Higher doses of N, P and K during immaturity period helps in reducing the gestation period (Dijkman, 1951). Significant effect of fertilizer application during the immature phase of rubber was reported on sandy latosol in Malaysia (Bolton, 1960).

Fertilizer recommendations for *Hevea* at various stages of growth have been formulated by the Rubber Research Institute of India (Pushpadas and Ahmed, 1980) based on field experiments conducted in the traditional rubber growing tracts of India as well as on information available from other rubber growing countries. Nutrient requirement of rubber is likely to be higher in the north eastern region of India where the soil is highly depleted due to shifting cultivation. The situation is aggravated by the routine practice of cutting and removing the thatch grass (Laskar *et al.*, 1983). Soluble sources of phosphatic fertilizers have been found to give quick response during the early stages of growth (Karthikakuttyamma *et al.*, 1980) in the traditional rubber growing areas. However, such information is lacking for the non-traditional areas. The present investigation was therefore taken up to study the influence of higher levels of NPK on growth and yield of rubber and to monitor the soil nutrient status over the years. A comparison of water soluble and insoluble sources of P was also attempted in this study.

The experiment was laid out in the demonstration farm of the Rubber Board at Tulakona, Agartala, by adopting a randomized block design with six treatments and three replications. The clone used was RRIM 600 planted during 1986. The treatments (Table 1) were imposed during 1990. Fertilizers were applied in two equal splits, during April/May and September/October. Nitrogen was supplied as urea (46% N), water soluble P as single superphosphate (16% P_2O_5), water insoluble P as Mussoorie rock phosphate (20% P_2O_5) and K as muriate of potash (60% K_2O). Cover crop (*Pueraria phaseoloides*) was grown and maintained during the early phase of the plantation. Other cultural operations were carried out following standard recommendations (Rubber Board, 1990). The trees were tapped following 1/2S d/3 tapping system since May, 1994. On an average there were only 65 tapping days in a year since the trees were given tapping rest during post-winter months. Girth was recorded at half yearly intervals and yield from individual trees at fortnightly intervals, by cup coagulation. Standard procedures were followed for collection and analysis of soil and leaf samples (Pushpadas and Ahmed, 1980).

Table 1. **Influence of nutrients on yield and girth**

Treatment (kg/ha) ($N:P_2O_5:K_2O$)	Mean yield over 3 years (g/tree/tap)	Projected yield (kg/ha)	Cumulative girth (cm)
T1 30:30:30	37.18	997	55.30
T2 30:15(15):30	34.42	895	55.21
T3 60:60:60	46.87	1219	60.05
T4 (60:30(30):60	42.25	1099	58.79
T5 90:90:90	47.41	1233	60.72
T6 90:45(45):90	44.23	1150	58.11
Mean	42.06		58.03
CD (P≤0.05)	6.80		4.00

Figures in parentheses indicate quantity of P in water soluble form.

The mean yield per tree per tap over the three year period from 1995 to 1998 and the girth at the close of the experiment are presented in Table 1. Significantly higher yield was obtained with the higher doses of fertilizers (60:60:60 and 90:90:90) compared to the lowest dose of 30:30:30, but the difference between the two higher doses (T3 and T5) was not significant. The increases in yield with 60:60:60 and 90:90:90 kg/ha compared to 30:30:30 kg/ha were 26.1 and 27.5 per cent respectively. The effect of different sources of P on yield was not significant though the performance with water insoluble P was comparatively better. The mean yield obtained from treatments with water insoluble P (T1, T3 and T5) was 8.7 per cent higher than that from the treatments with both water soluble and water insoluble phosphorus (T2, T4 and T6). Similar trend was also obtained for girth of the tree during 1998. Increases to the tune of 8.6 per cent and 9.8 per cent in girth were obtained with 60:60:60 and 90:90:90 kg/ha respectively compared to that with 30:30:30 kg/ha. The difference in mean girth obtained by treatment with rock phosphate alone and treatment with combination of rock phosphate and single super phosphate was only marginal.

Analytical results of the soil samples collected in 1986 before planting of rubber and imposition of treatments showed that the organic C, available P and available K contents were 0.73 per cent, 0.23 mg/100 g and 7.08 mg/100 g respectively in the surface layer (0-30 cm) (Krishnakumar and Potty, 1989b). An increase in organic carbon content (31.5%) of the surface soil (0-30 cm) has been observed (Table 2) compared to that before planting of rubber. The organic matter distribution down the profile showed enrichment in the surface horizon and a decline in the sub-surface horizons (Krishnakumar and Potty, 1989b). The high accumulation of organic matter in the top soil is due to the maintenance of luxuriant leguminous ground cover, which adds about six tonnes of organic matter per hectare during the pre-tapping phase of rubber.

Table 2. **Soil nutrient status eight years after planting**

Treatment	Depth (cm)	Organic carbon (%)	Available nutrients (mg/100g)				pH (H_2O)
			P	K	Ca	Mg	
T1	0-30	0.96	0.62	4.53	11.20	1.19	4.39
	30-60	0.37	0.31	4.03	5.63	0.63	4.58
T2	0-30	0.91	0.61	5.87	12.03	2.18	4.32
	30-60	0.71	0.31	4.93	5.36	0.65	4.27
T3	0-30	0.90	0.73	7.26	16.16	2.19	4.33
	30-60	0.50	0.56	7.93	5.73	0.53	4.06
T4	0-30	0.97	0.62	7.70	16.25	1.27	4.38
	30-60	0.74	0.33	4.80	8.53	0.90	4.36
T5	0-30	0.98	0.85	7.90	17.66	1.96	4.29
	30-60	0.56	0.42	7.83	5.13	1.12	4.57
T6	0-30	1.06	0.72	7.57	16.14	2.29	4.28
	30-60	0.81	0.68	7.00	7.00	1.00	4.14
CD (P≤0.05)	0-30	0.15	0.08	0.17	1.80	NS	0.05
	30-60	0.20	NS	2.17	NS	NS	0.33

Addition of litter through annual leaf fall after canopy closure also helps in the build up of organic matter. On an average, about six tonnes of organic mater have been added every year through annual leaf fall. Krishnakumar *et al.* (1991) reported 0.6 per cent increase in the organic matter content of soils in a 10year old rubber plantation compared to a 'jhum' cultivated field in the same location.

It is noticed that the available P content has increased with higher doses of fertilizers in the experiment. Philip *et al.* (1993) also reported similar changes in available P content in soils under rubber due to the application of fertilizers in Tripura. It is observed that higher doses of fertilizers maintained the available K content of soil in the medium range while it depleted with the lowest dose. Changes in pH with different treatments over the period of experiment were only marginal.

Leaf analysis (Table 3) revealed that N content was in the medium range with all the treatments. However, increases in the N content has been observed with increasing levels of N fertilizer. Significant increase in leaf P was observed with higher doses of fertilizers. Further, P content in leaf was higher when rock phosphate was applied alone as compared to combined application of rock phosphate and SSP. K content of leaf was significantly higher in higher doses of fertilizer application. However, the difference in K content of leaf between the higher doses of fertilizer treatments was not significant.

Table 3. **Leaf nutrient content* (%)**

Treatment	N	P	K
T1	3.14	0.21	1.00
T2	3.17	0.21	1.02
T3	3.31	0.26	1.20
T4	3.36	0.23	1.20
T5	3.42	0.27	1.21
T6	3.50	0.24	1.19
CD (P≤0.05)	0.15	0.03	0.14

* Recorded in 1997

It is observed from the experiment that significantly higher yield was obtained from 60:60:60 kg/ha compared to 30:30:30 kg/ha and further increase in the amount of fertilizers did not result in significant increase in yield or girth. Water insoluble rock phosphates when used alone favoured growth and yield. There is appreciable accumulation of P in soil with addition of P fertilizers. At least 60 kg/ha of K is required to maintain its status in the soil.

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