RESPONSE OF MATURE RUBBER TO FERTILIZERS IN THE ULTISOLS OF KERALA, SOUTH INDIA

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Received: 07 April 2016 Accepted: 15 November 2016

Ulaganathan, A., Eappen, T., Syriac, J., Ambily, K. K., Karthikakuttyamma, M., and Jessy, M.D. (2016). Response of mature rubber to fertilizers in the Ultisols of Kerala, South India, *Rubber Science*, **29**(3): 298-303.

Field experiments with graded levels of N, P and K fertilizers were conducted in mature rubber, clone RRII 105, in farmers field in six locations of Kerala representing the major soil series, *viz.* Kanjirappally, Thiruvanchoor, Kadamband and Kunnathur. The treatments were N, P_2O_5 and K_2O @ 18:18:18, 36:36:36 and 54:54:54, standard general fertilizer recommendation (GFR) of 30:30:30 $kgha^{-1}$, soil test based fertilizer recommendation (DFR) and "a no" fertilizer control. The yield data showed no statistical difference among the treatments in the four locations where the soil was either Kanjirappally or Thiruvanchoor series. However, significant response to higher levels of fertilizer was observed in Kadambanad and Kunnathur series having high gravel content, indicating that fertilizer response in rubber is related to the soil properties and the capacity of the soil to supply the nutrients.

Key words: Dry rubber yield, Fertilizer response, Small holdings, Ultisols

Commercial cultivation of rubber in India commenced 11 decades ago in Kerala and major share of the rubber growing regions in India is in South India extending from Kanyakumari district in Tamil Nadu to southern districts of Karnataka in the North (Vijayakumar *et al*., 2000). At present the rubber cultivation is in the third or fourth planting cycle and continuous cultivation of rubber has depleted the soil properties (Karthikakuttyamma, 1997; Karthikakuttyamma *et al*., 1998; Ulaganathan *et al*., 2010). Soils of the traditional rubber growing regions are mainly Ultisols (NBSS & LUP, 1999). In general, Ultisols are poor in available nutrients with low soil pH, base saturation, CEC and high content of iron and aluminum oxides.

Though use of fertilizers to rubber is an established practice for better growth and yield, indiscriminate fertilizer application has often found to depress both growth and yield (Pushparajah, 1969; Guha *et al*., 1971; Punnoose *et al*., 1976). Good management in the immature phase of rubber plantation improves the soil fertility status and reduces the fertilizer requirement in the mature phase especially in the initial years of tapping (Punnoose *et al*., 1976). However, the response to the applied fertilizers in mature rubber through yield increase, is little or difficult to establish and differ widely with the nature of the soil and agro-management practices (Pushpadas *et al*., 1978) and inconsistent positive response or absence of response was reported (Punnoose

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et al., 1994; Jessy *et al*., 2004). Nutritional self sufficiency of the well maintained mature NR ecosystem in relation to latex yield and soil properties was reported (Sivanadyan *et al*., 1995 and George and Joseph, 2011). However, Choudhury *et al*. (2001) reported positive response to fertilizer application in north-eastern India, where the soil is poor in nutrient status due to the practice of jhumming/shifting cultivation followed over the years. In India, 90 per cent of the area under rubber cultivation is in the small holdings and the most popular clone is RRII 105. Hence, the present study was taken up to find out the responses of clone RRII 105 to graded levels of fertilizers in the small farmers field in the four major soil series.

Field experiment with graded levels of N,P_2O_5 and K_2O was conducted in farmers field in three distinct regions viz. southern (Adoor), central (Pala) and northern (Kozhikkod) in the traditional belt of rubber cultivation representing four major soil series *viz*. Kanjirappally, Thiruvanchoor, Kadamband and Kunnathur. In each region, experiment was conducted in two locations each *viz.* Kozhikode I and II, Pala I and II and Adoor I and II. Kozhikode-1 and Pala 1 represented Kanjirapally series and Kozhikode II and Pala II represented Thiruvanchoor series. Adoor I and II represented Kadambanad and Kunnathur soil series, respectively. Detailed description of the series is available in NBSS and LUP (1999). The experiment was conducted in the most popular clone RRII 105 which was planted in 1991. The treatments were imposed during 2001 at the age of 11 years and tapping on BO-1 panel on the fourth year of tapping. The gross plot size was 28 trees and observations were recorded from ten trees. The treatments were N, P_2O_5 and K_2O @ 18:18:18 (T_1), 36:36:36 (T_2), 54:54:54 (T_3), general fertilizer recommendation of 30:30:30 (T_4) kg ha^{-1}, soil test based discriminatory fertilizer recommendation (T_5) and no fertilizer control (T_6). Fertilizers were applied twice in a year during pre monsoon and post monsoon season. Soil and leaf samples were collected during the sampling period in the third year of experimentation. The soil pH was determined in distilled water using pH meter in 1:2.5 soil water suspension. Organic carbon was estimated by Walkley and Black wet oxidation method (Walkley and Black, 1934) and available P by Bray–II extractant (Bray and Kurtz, 1945). Available K was extracted with neutral normal ammonium acetate and the extracted K was estimated using flame photometer (Hanway and Heidal, 1952). Leaf samples were analyzed for total N, P and K (Piper, 1966). Girth of the trees was recorded annually for three years. Volume of latex and dry rubber content (DRC) was recorded every month and the dry rubber (g t^{-1} t^{-1}) was estimated. All the data were statistically analyzed by analysis of variance (Gomez *et al*., 1984).

Analysis of the soil samples from the experimental field prior to treatment incorporation indicated that soil pH ranged from extremely acidic to moderately acidic in all the locations. Organic carbon ranged from medium for all the locations except Kozhikode II where it was high as per the rating followed at RRII (Karthikakuttyamma *et al*., 2000). Similarly, the available P was low at Pala I and II, Adoor I and II and it was medium at Kozhikode I and II. Available K was low in all the locations except Adoor I where it was medium. Soil analysis data from the experimental plots after three years of treatment incorporation indicated that application of graded levels of N, P and K over three years did not affect soil pH, organic carbon and availability of P and K. Similarly, the concentrations of N, P and K in the leaf were also not affected by

Table 1. **Effect of fertilizer on girth (cm) of plants**

Treatments NPK ($kgha^{-1}$)	Locations					
	Kozhikode		Pala		Adoor	
	I	II	I	II	I	II
18:18:18 (T1)	64.6	75.0	78.2	72.9	57.4	67.1
36:36:36 (T2)	62.6	70.7	77.8	72.9	55.3	66.9
54:54:54 (T3)	65.9	74.8	76.3	71.1	53.7	67.9
GFR (T4)	66.5	71.2	74.0	76.9	52.3	67.4
DFR (T5)	63.9	73.2	74.8	73.0	53.0	68.2
Control (T6)	62.8	72.1	75.2	74.6	53.0	66.2
CD(P=0.05)	2.7	NS	NS	NS	NS	NS

different levels of N, P and K fertilization for three years.

Effect of graded levels of N, P and K treatments on girth was given in Table 1. Girth of the plants was not affected by application of fertilizer in all the locations except Kozhikode I. At Kozhikode I the highest girth was recorded for T4 and was on par with T1 and T5. Among the locations higher girth was recorded at Pala compared to Kozhikode and Adoor. Punnoose *et al*. (1975) reported that application of fertilizer

Table 2.**Effect of fertilizer on yield ($g\ t^{-1}\ t^{-1}$) at Kozhikode**

Treatments NPK($kgha^{-1}$)	Location 1				Location II			
	2001	2002	2003	Mean	2001	2002	2003	Mean
18:18:18 (T1)	49	50	58	52	49	58	60	56
36:36:36 (T2)	46	53	60	53	46	55	60	54
54:54:54 (T3)	48	54	55	52	49	60	59	56
GFR (T4)	46	58	58	54	51	57	64	57
DFR (T5)	50	50	56	52	50	57	61	56
Control	46	51	57	51	50	61	65	59
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 3. **Effect of fertilizer on yield ($g\ t^{-1}\ t^{-1}$) at Pala**

Treatments NPK($kgha^{-1}$)	Location I				Location II			
	2001	2002	2003	Mean	2001	2002	2003	Mean
18:18:18 (T1)	54	51	79	61	66	64	71	67
36:36:36 (T2)	81	56	69	69	68	62	64	65
54:54:54 (T3)	74	55	77	69	74	68	76	73
GFR (T4)	58	54	86	66	71	75	75	74
DFR (T5)	72	60	76	69	67	61	66	64
Control (T6)	70	49	68	62	62	61	75	66
CD(P= 0.05)	14.67	NS	NS	NS	NS	NS	NS	NS

Table 4. **Effect of fertilizer on yield (g t^{-1} t^{-1}) at Adoor**

Treatment	Location I				Location II			
NPK (kgha^{-1})	2001	2002	2003	Mean	2001	2002	2003	Mean
18:18:18 (T1)	57	32	49	46	41	41	42	41
36:36:36 (T2)	58	32	49	46	43	35	44	41
54:54:54 (T3)	68	42	49	53	48	43	50	47
GFR (T4)	62	36	47	48	44	39	44	42
DFR (T5)	59	34	48	47	44	42	45	43
Control (T6)	51	33	43	43	34	41	42	39
CD (P=0.05)	7.45	4.80	5.37	3.36	4.79	NS	4.40	3.10

improved the growth of plants during early immaturity period. Jessy *et al.* (2006) observed that after tenth year of planting growth was not significantly different among treatments with graded levels of fertilizer application.

The yield data for the different locations are presented in Tables 2, 3 and 4. The mean yield at Kozhikode (Table 2) was not influenced by application of graded levels of N, P and K fertilizer. The yield data from Pala (Table 3) indicated that yield was influenced by fertilizer treatments during the first year of treatment incorporation. During the subsequent years no response was recorded for graded levels of fertilizer treatments. Relatively higher yield was observed at Pala compared to Kozhikode.

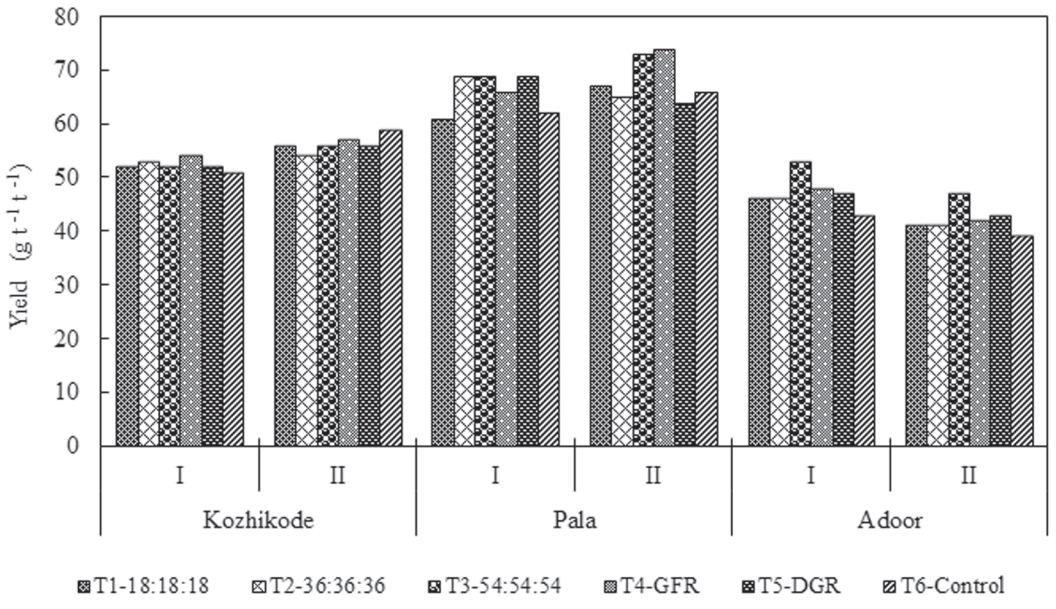

Fig. 1. Effect of fertilizer treatments on the mean yield at different locations

However, yield response was recorded at Adoor (Table 4) where the soil is gravelly. The highest mean yield over three years was recorded by the treatment T3 with 54:54:54 kg ha^{-1} of N, P and K which was significantly superior to all other treatments. Effect of treatments on the mean yield at three different locations are given in Figure 1. This clearly indicates that the fertilizer response is directly related to soil properties and the capacity of the soil to supply the nutrients which vary from location to location. Similar results were reported by Potty *et al*. (1980) stating that growth and yield of rubber trees under fertilizer application was higher than unfertilized treatments. Ou Onuwaje (1983) reported that application of N, K and Mg increased yield and combined application of N, K and Mg recorded higher yield than when it is applied individually.

The present study revealed that the response of mature rubber to fertilizer varied with locations. In two out of three locations, no yield response was observed with fertilizer application. However, yield response was recorded in one location where the soil was highly gravelly, indicating that fertilizer response is directly related to the soil condition.

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