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EFFECT OF DIFFERENT LEVELS OF N, P AND K ON GROWTH OF IMMATURE RUBBER IN LOWER BRAHMAPUTRA VALLEY OF ASSAM

In India, cultivation of rubber (*Hevea brasiliensis*) has been extended to non-traditional areas in order to bridge the gap between production and consumption and the North-Eastern states are the most potential areas where rubber can be grown successfully. Rubber trees face different stress factors, like low temperature during cold season and high wind velocity together with hail-storm when cultivated in this belt (Sethuraj *et al.*, 1989). In addition, the shifting cultivation and removal of thatch grass lead to nutrient depletion of soils (Laskar *et al.*, 1983). Essential cations such as K, Mg and Ca also get leached out due to high rainfall (Talukdar, 1997).

Application of higher doses of NPK during juvenile period helps in reducing the gestation period of rubber trees (Dijkman, 1951). Bolton (1960) observed in a long-term fertilizer experiment on a sandy latosol in Malaysia that fertilizer application resulted in increased growth and yield. Akhrust and Owen (1950) and Owen *et al.* (1957) reported that the major nutrients, *viz.* N, P and K influenced favourably the growth during the immature phase and a marked response was reported for soluble phophatic fertilizers. The objective of the present experiment was to ascertain the optimum requirements of NPK for young *Hevea*, grown under the agro-climatic condition of lower Brahmaputra Valley of Assam, India.

A field experiment was conducted at Nayakgaon, Kokrajhar, Assam, 240 km away from Guwahati. The area is situated at an elevation of 75 m above msl and receives about 2100 mm rainfall annually. The terrain is plain with clay loam textured soil. Nine-month-old polybag plants of clone RRII 105 were planted in 1987. The trial was laid out in factorial randomised block design with thirty-six treatments and two replications, with a gross plot size thirty-six and a net plot of sixteen plants. The treatments consisted of four levels of nitrogen (0, 20, 40 and 60 kg N/ha), three levels of phosphorus (0, 20 and 40 kg P_2O_5/ha) and three levels of potassium (0, 20 and 40 kg K_2O/ha). Fertilizers were applied twice in an year, during April/May (pre-monsoon) and September (post-monsoon). Nitrogen was supplied as urea and P as water soluble P (super phosphate) during the first two years and as water insoluble P (Mussoorie rockphosphate) in the subsequent years and K as muriate of potsh. Routine cultural operations were carried out following the recommendations of the Rubber Research Institute of India. Soil samples were collected from the experimental area prior to the commencement of the experiment (Table 1) and also from each plot at the end of the fifth year and analysed for organic carbon, available P, K, Ca, Mg and pH following the standard analytical procedures (Karthikakuttyamma, 1989). Girth was recorded at a height of 150 cm from the bud union periodically.

The data on growth (girth) during the initial five years are presented in Table 2. There was increase in the growth of plants

Table 1. **Pre-treatment nutrient status of soil**

Depth (cm)	Organic carbon (%)	Available nutrients (mg/100 g soil)				pH
		P	K	Ca	Mg	
0-30	0.98	0.09	1.85	10.86	6.42	4.37
30-60	0.94	0.08	2.15	10.80	5.80	4.38

with application of N. The results indicate that higher doses of N up to 40 kg per ha is beneficial for early growth and are in conformity with earlier reports (Lim, 1977; Krishnakumar and Potty, 1989; Punnoose *et al.*, 1994 and Owen *et al.*, 1957). A significant increase of 6.25, 8.57 and 9.37 cm in girth over control was noticed for treatments receiving 20, 40 and 60 kg N per ha respectively. The plants registered an average girth increment of 25.4 cm over five years, the corresponding values for plants receiving 20, 40 and 60 kg per ha and no N being 25.35, 27.36, 28.09 and 20.67 cm, respectively.

Table 2. **Effect of N, P and K application on girth and girth increment**

Treatment (kg/ha)	Mean girth (cm)					Girth increment over years (cm)
	1st year	2nd year	3rd year	4th year	5th year	
Nitrogen (N)						
0	9.22	12.79	18.28	23.61	29.89	20.67
20	10.79	15.56	22.95	29.76	36.14	25.35
40	11.10	16.99	25.17	32.22	38.46	27.36
60	11.17	17.60	25.92	33.08	39.26	28.09
Sem±	0.21	0.37	0.51	0.58	0.69	0.54
CD (5%)	0.56	1.01	1.38	1.61	1.91	1.49
Phosphorus (P_2O_5)						
0	10.39	15.04	23.13	29.68	35.99	25.60
20	10.61	15.35	22.29	28.46	34.76	24.15
40	10.71	15.96	23.71	30.85	37.26	26.55
Sem±	0.13	0.24	0.39	0.46	0.57	0.30
CD (5%)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Potassium (KO)						
0	10.14	14.79	21.85	28.27	34.59	24.45
20	10.61	15.45	22.96	29.57	36.04	25.43
40	10.97	16.96	24.42	31.15	37.38	26.41
Sem±	0.13	0.24	0.39	0.46	0.57	0.30
CD (5%)	0.37	0.65	1.05	1.27	1.59	0.82
NP or NK,	0.26	0.48	0.78	0.92	1.14	0.61
PK	0.21	0.42	0.71	0.85	1.04	0.48
NPK	0.42	0.84	1.42	1.70	2.08	0.96
C.D. at 5% for NP, NK, PK, NPK	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

N.S. = Non-significant

Table 3. **Effect of N, P and K on available nutrient status and pH of the soil**

Treatment (kg/ha)	Organic carbon (%)		Available nutrients (mg/100 g soil) P		K		Ca		Mg		pH	
	A	B	A	B	A	B	A	B	A	B	A	B
Nitrogen (N)												
0	1.51	0.91	0.73	0.12	12.50	13.04	12.70	11.14	3.24	3.51	4.79	4.71
20	1.68	0.95	0.78	0.15	11.90	10.96	11.67	9.29	3.50	3.72	4.80	4.81
40	1.71	1.02	0.98	0.17	10.64	8.93	10.44	9.12	3.83	3.59	4.74	4.70
60	1.76	1.03	1.45	0.31	10.09	8.65	13.95	9.71	3.94	3.68	4.81	4.56
Sem±	0.013	0.007	0.191	0.013	6.68	0.186	0.179	0.387	0.066	0.067	0.089	0.011
CD (5%)	0.036	0.021	0.529	0.036	NS	0.516	0.498	1.070	0.182	0.183	NS	0.029
Phosphorus (P_2O_5)												
0	1.60	0.93	0.17	0.11	12.96	11.26	7.20	8.54	3.35	3.74	4.81	4.74
20	1.68	0.79	0.82	0.15	10.54	10.46	14.59	14.19	4.88	3.98	4.73	4.72
40	1.73	1.04	1.20	0.33	10.35	8.51	16.79	16.71	5.01	4.14	4.82	4.63
Sem±	0.011	0.006	0.165	0.011	5.79	0.161	0.155	0.335	0.057	0.058	0.077	0.009
CD(5%)	0.030	0.018	0.457	0.030	NS	0.446	0.431	0.929	0.158	0.159	NS	0.025
Potassium (K_2O)												
0	1.57	0.92	1.09	0.23	7.55	8.30	13.40	10.77	3.86	3.37	4.91	4.79
20	1.69	0.98	1.22	0.20	11.20	9.40	10.39	10.47	4.15	3.69	4.67	4.69
40	1.74	1.04	1.41	0.15	14.56	12.51	9.79	8.21	4.52	3.88	4.78	4.61
Sem±	0.011	0.006	0.165	0.011	5.79	0.161	0.155	0.335	0.057	0.058	0.077	0.009
CD (5%)	0.030	0.018	0.457	0.030	NS	0.446	0.431	0.929	0.158	0.159	NS	0.025

A=0-30 cm depth; B=30-60 cm depth

No significant response due to application of phosphatic fertilizers were noticed during the study period, though P at the highest level, *i.e.* 40 kg P_2O_5 per ha, was found numerically superior over the other treatments. A balanced dose of N and P is warranted for proper establishment of *Hevea*. This observation is in accordance with the results of Punnoose *et al.* (1994). Significant increase was observed with added K during immature phase. However, response was more pronounced for the application of 20 kg K_2O per ha though progressive response in girth with increasing levels of K (40 kg K_2O/ha) was also noticed. None of the interaction effects was significant.

In pre-treatment soil samples, both available P and K were extremely low (Table 1). Organic carbon, a measure of available N, registered a medium status. Representative soil samples from each plot were collected after five years and the nutrient status is presented in Table 3. The results showed that available P and K contents increased significantly with higher levels of application. Similarly, soil organic carbon content also increased significantly. Marginal increase in available Ca was noticed which could be attributed to the input of Ca through rock phosphate / super phosphate. However, a decrease in available Mg was noticed as compared to the pre-treatment values. Improved available nutrient status of soil can be attributed to the application of fertilizers and decomposition of litter, as reported by Krishnakumar and Potty (1989).

It can be concluded that the optimum levels of N and K are 40 and 20 kg per ha respectively for proper establishment of *Hevea* in this region. An insurance dose of 20 kg per ha of P is advisable considering the very low inherent P status of the soil under the agro-climatic conditions of lower Brahmaputra Valley zone of Assam. This, along with proper establishment of cover crops, could help in reducing immaturity period of rubber in this area.

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