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Effect of inorganic and organic sources of fertilizers on growth of rubber (*Hevea brasiliensis*) seedlings

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The long period of immaturity before the plants can be exploited is a major problem faced by the rubber cultivators. One of the promising ways to reduce the immaturity period of rubber and number of runts is the use of good planting materials. Seedlings are essential for producing good quality budded plants. Hence, generation of uniform, vigorous and healthy seedlings is a basic requirement in the rubber plantation industry.

Among different planting materials, polybag plants got wide acceptance among farmers because of easy establishment, uniformity and better performance in the main field. Polybag plants must be adequately and frequently manured to maintain them at optimal nutritional level. The present fertilizer recommendation for polybag plants is N, P, K and Mg@6-6-2.4-1 g/plant as urea, rock phosphate (RP), muriate of potash (MOP) and magnesium sulphate. Soluble phosphate provides a starter effect on early establishment of the plants and nitrogen in NH_4^+ form was found to be more effective in seedling nursery (RRIM, 1973). Biofertilizers are reported to have significant influence in improving the availability of nutrients to crop plants.

Microbial inoculants are different types of microorganisms which have an ability to mobilize nutritionally important elements from non usable to usable form through biological process. In recent years, they are considered as an important component in the integrated nutrient management system to improve nutrient supplies and consequently the crop growth and yield. Integration of chemical and organic sources and their efficient management has profound influence in sustaining the productivity, soil health and in reducing the quantity of chemical fertilizer requirement of crops (Rabindra *et al.*, 1990; Hedge and Dwivedi, 1993).The present experiment was conducted to study the effectiveness of inorganic and organic sources of fertilizers on growth of rubber seedlings *(Hevea brasiliensis)* raised in polybags.

A polybag experiment was conducted at the Central Experiment Station of the Rubber Research Institute of India, Chethackal during 2007. Black polythene bags of size 55 x 25 cm were filled with 10 kg top soil collected from the farm. The initial nutrient status of the soil was estimated (Jackson, 1958). Rock phosphate @ 20 g/bag was mixed with the top 15 cm soil layer. Rubber seedlings were raised in polybags by planting germinated seeds. The experiment was laid out in completely randomized design (CRD) with eight treatments (Table1) and four replications with a plot size of 40 plants/plot. Six weeks after planting, treatments were incorporated and each treatment was applied in four splits at 20 days interval.

Fifty kg cowdung alone and in combination with 5 kg groundnut cake was mixed with 500 l water and kept for one week. The supernatant liquid @ 500 ml/ plant was applied in the case of the treatments T2, T5

Table 1. Treatment details

	Treatments
T1	- NPKMg@ 6-6-2.4-1 g/plant (standard practice, where N and P as urea and RP)
T2	- T1 + Cowdung slurry
T3	- T2 + Ground nut cake
T4	- NPKMg@ 6-6-2.4-1 g/plant [N and P as ammophos (20-20)]
T5	- T4 + Cowdung slurry
T6	- T5 + Ground nut cake
T7	- T4 + Phytonol (plant growth hormone)
T8	- 50% of T4 + PGPR (plant growth promoting rhizhobacteria)

and T3, T6. Phytonol, a plant growth hormone (Triacontanol enriched with micronutrients) was mixed in water @ 3 ml/l and sprayed on the mature leaves. Plant growth promoting rhizobacteria (PGPR), a mixture of phosphate solubilising bacteria, nitrogen fixing bacteria (*Azotobacter)* and plant growth promoting *Pseudomonas* was used with 50 % of the recommended level of fertilizer in soluble form. The inorganic fertilizers were applied 15 days after the application of PGPR.

The diameter of plants was recorded 3½ months after planting and percentage buddability was assessed. Plants were destructively sampled to estimate the dry matter production. The plant parts, viz; leaf, stem and roots were analysed for N, P and K by standard procedures (Piper, 1966) and the uptake of nutrients was calculated. The data were statistically analyzed in CRD (Snedecor and Cochran, 1967).

The top soil used for filling the polythene bag was acidic in reaction with pH 4.31. The organic carbon status (3.0 %) of the soil was high and medium in available K (6.10 mg/ 100 g soil). Available P (0.81 mg/ 100g soil) and available Mg (0.42 mg/ 100 g soil) status were low in the soil.

The chemical and organic sources of fertilizers significantly influenced the growth of rubber seedlings (Table 2). Among the treatments, plants supplied with N and P in soluble form (ammophos), along with PGPR (T8) recorded the highest diameter followed by cowdung slurry and groundnut cake and phytonol which were on par. Kochuthressiamma *et al.* (2003) reported the possibility of using PGPR for improving the growth of rubber seedlings in the nursery. When different sources of N and P alone were compared, plants supplied with ammophos recorded higher diameter than urea and rockphosphate indicating the beneficial effect of soluble form of N and P which are immediately available to the rubber seedlings. It was reported that soluble phosphate provides a starter effect for early establishment of plants (RRIM, 1973).

The dry matter production (DMP) significantly increased by the applications of chemical fertilizer in combination with cowdung slurry, groundnut cake or PGPR over the fertilizer alone treatments (Table 2). The highest DMP of 13.31 g was noticed in the treatment T6, a combination of soluble form of fertilizer with cowdung slurry and groundnut cake followed by T5, T8 and T3 which were on par.

Application of 50 % ammophos (20-20) along with PGPR (T8) recorded the highest percentage buddability (98.3 %) followed by cowdung slurry and groundnut cake (Table 2). Significantly higher buddable plants were obtained in the treatments with ammophos and its combinations over urea and rock phosphate combinations.

Significant difference was noticed between the treatments for leaf nutrient status and uptake of nutrients (Table 3). Among the treatments, significant superiority in leaf nutrient status and uptake of nutrients was recorded in T5, which received ammophos in combination with cowdung slurry. It was reported that application of farmyard manure along with chemical fertilizer significantly increased growth and yield of sugarcane (Vijaya Sankar Babu *et al.*, 2007). Similarly application of ammophos alone or its combination with cowdung slurry and groundnut cake significantly increased the uptake of N, P and K by the rubber seedlings.

Table 2. Effect of inorganic and organic fertilizers on diameter, DMP and buddability

Treatment	Diameter (mm)	DMP (g)	Buddability (%)
T1 - Standard practice (N and P as urea and RP)	6.68	10.21	63.3
T2 - T1 + Cowdung slurry	6.73	11.58	68.3
T3 - T2 +Ground nut cake	6.79	12.94	60.0
T4 - Standard practice (N and P as ammophos)	6.88	10.27	80.0
T5 - T4 + Cowdung slurry	6.94	13.16	78.3
T6 - T5 + Groundnut cake	7.04	13.31	83.3
T7 - T4+ Phytonol	6.91	10.14	73.3
T8 - 50 % of T4+ PGPR	7.38	13.12	98.3
SE	0.07	0.42	4.67
CD(P = 0.05)	0.22	1.27	14.0

Table 3. Effect of inorganic and organic fertilizers on leaf nutrient status and nutrient uptake

Treatment	Nutrient status (%)			Nutrient uptake (mg/plant)		
	N	P	K	N	P	K
T1 - standard practice (N and P as urea and RP)	3.42	0.14	0.98	152.4	7.29	58.0
T2 - T1 + Cowdung slurry	3.60	0.12	1.02	210.0	8.24	93.8
T3 - T2 + Groundnut cake	3.34	0.12	1.10	220.2	8.06	85.3
T4 - Standard practice (N&P as ammophos)	3.72	0.12	1.05	185.8	8.20	79.0
T5 - T4 + Cowdung slurry	4.11	0.16	1.20	329.8	12.25	132.0
T6 - T5 + Ground nut cake	3.00	0.10	1.07	257.4	10.81	114.8
T7 - T4+ Phytonol	3.17	0.10	1.06	228.2	8.40	72.5
T8 - 50 % of T4+ PGPR	3.50	0.14	1.08	212.2	10.63	103.5
SE	0.11	0.007	0.02	10.32	0.63	5.6
CD(P = 0.05)	0.33	0.02	0.07	30.97	1.90	16.8

The results of the study indicated the significance of the application of organic fertilizers along with chemical fertilizers in the growth of rubber seedlings. Plants supplied with 50 % of N and P in soluble form as ammophos (20-20) along with PGPR recorded the highest diameter and percentage of buddable rubber seedlings, 3½ months after planting. The treatments having N and P in soluble form along with organic sources viz; cowdung slurry and groundnut cake significantly increased the growth, nutrient uptake and percentage buddability of seedlings when compared to urea and rock phosphate alone or its combinations.

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