Revised fertilizer recommendation for rubber seedling nursery

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Introduction

Rubber seedling nurseries are established and maintained for generating healthy root stocks to produce various planting materials by budgrafting. Significant progress has been made over the years in developing improved planting materials with good growth potential, through the use of appropriate rootstocks and improved budgrafting techniques. Budgrafted plants can be introduced to the main field as budded stumps, brown budded polybag/root trainer plants, green budded polybag/ root trainer plants and young budded plants.

Adequate and timely application of fertilizers enhance growth and early attainment of buddable girth of rubber seedlings. Current recommendation of chemical fertilizers for rubber seedling nursery is $N:P_2O_5:K_2O$ @500:250:100 kg/ha where N, P and K are applied as urea, rock phosphate and potash (Punnoose *et al.*, 1975). MgO@37.5 kg/ha is recommended from Thiruvananthapuram to Ernakulam region of the traditional rubber growing tract where the soil is inherently low in available Mg status.


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Studies conducted at RRII indicated changes in soil fertility status of permanent nursery sites of traditional rubber growing areas over the years due to continuous application of high quantities of N, P and K fertilizers. Acidification of the soil, reduced availability of secondary and micronutrients and a build-up of available P have been reported (Karthikakuttyamma *et al*, 2000; Joseph *et al.*, 2007; George and Nair, 2011). Excessive nitrogen fertilization not only increases cost of production, but also results in pollution of ground and surface water owing to nitrate leaching. Increasing soil acidification due to

excess N fertilization may adversely affect the growth of seedlings. Efficiency of N use by most crops ranges from 20-60 per cent (Prasad Babu and Sarkar, 2002; Kundu *et al.*, 2000) and nitrogen recovery in crops rarely exceeds 50 per cent (Roberts, 2008).

The change in nutrient status of rubber growing soils over decades under different agro climatic conditions warrants assessment of the optimum nutrient requirement for generating uniform and vigorous rubber seedlings. Therefore, experiments were conducted at different locations to revise the current fertilizer recommendation for seedling nursery.

Materials and methods

Seedling nursery experiments were conducted at different locations viz., Central Experiment Station (CES), Chethackal, Central Nursery (CN), Karikkattoor and Regional Nursery (RN), Kanhikulam, with varying levels of nutrients, during 2007-2012 period. To evaluate the N utilization from urea applied to rubber seedlings, an experiment was conducted at CES, Chethackal during 2007-08 using 15N tracer methodology. With the objective to assess the possibility of reducing the dosage of N in seedling nurseries by supplying small doses of N as foliar urea spray, two nursery experiments were conducted during 2008-09, one at CES, Chethackal and the other at CN, Karikkattoor. Experiments were also conducted at CN, Karikkattoor and RN, Perumpulickal to study the response of rubber seedlings to phosphorus application.

Results and discussion

Nursery experiments were conducted to study the effect of different levels of fertilizers on the growth of rubber seedlings in ground nursery at the CES, Chethackal of the Rubber Research Institute of India. In the first experiment, among the treatments, significantly higher number of buddable plants were obtained by the application of soluble form of N and P @ 250 kg/ha alone or in combination with phytonol, the plant growth hormone and N and P @ 150 kg/ha with

Table 1. Effect of different levels of inorganic fertilizers on diameter and buddability of rubber seedlings - 3.5 months after planting

Treatment	Diameter (mm)	Buddability (%)
T1- Standard practice (NPKMg @500-250-100-37.5 kg/ha)	5.69	47
T2- N&P@150 kg/ha as urea and RP + K@ 30 kg/ha + Mg@11.25 kg/ha	5.91	57
T3- N&P@250 kg/ha as urea and RP + K@ 50 kg/ha + Mg@18.75 kg/ha	6.12	52
T4- N&P@ 150 kg/ha as Ammophos + K@ 30 kg/ha + Mg@11.25 kg/ha	5.94	50
T5- N&P@ 250 kg/ha as Ammophos + K@ 50 kg/ha + Mg@18.75 kg/ha	6.24	70
T6- N&P@ 250 kg/ha as Ammophos + K@ 50 kg/ha +Mg@18.75 kg/ha + Phytonol	6.18	71
T7- N&P@ 150 kg/ha as Ammophos + K@ 30 kg/ha + Mg@11.25 kg/ha + PGPR	6.34	68
SE	0.08	4.2
CD (P≤0.05)	0.24	12.9

PGPR over standard practice 3.5 months after planting (Table 1). Seven months after planting, significant superiority in diameter was noticed by the application of N and P @ 250 kg/ha as ammophos (20-20) which was on par with N and P@ 150 kg/ha in soluble form along with PGPR (Table 2). In the second experiment at CES, Chethackal, plants attained highest diameter

Table 2. Effect of different levels of inorganic fertilizers on diameter of rubber seedlings - seven months after planting

Treatment	Diameter (mm)
T1- Standard practice - (NPKMg @500-250-100-37.5 kg/ha)	11.50
T2- N&P@150 kg/ha as urea and RP + K@ 30 kg/ha+ Mg@11.25 kg/ha	11.47
T3- N&P@250 kg/ha as urea and RP + K@ 50 kg/ha+ Mg@18.75 kg/ha	11.89
T4- N&P@ 150 kg/ha as Ammophos + K@ 30 kg/ha+ Mg@11.25 kg/ha	10.97
T5- N&P@ 250 kg/ha as Ammophos + K@ 50 kg/ha+ Mg@18.75 kg/ha	12.57
T6- N&P@ 250 kg/ha as Ammophos + K@ 50 kg/ha+ Mg@18.75 kg/ha + Phytono	12.07
T7- N&P@ 150 kg/ha as Ammophos + K@ 30 kg + Mg@11.25 kg/ha +PGPR	12.33
SE	0.11
CD (P≤0.05)	0.34

Table 3. Effect of different levels of inorganic fertilizers on diameter and buddability of rubber seedlings - CES, Chethackal

Treatment	4 months after planting		10 months after planting
	Diameter(mm)	Buddability(%)	Buddability(%)
T1-Control	6.30	63.62	47.66
T2- NPKMg@ 500- 250- 100- 37.5kg/ ha (Standard practice)	6.83	71.83	53.57
T3- N&P@ 150 kg/ha (ammophos) + K @ 30 kg/ha+Mg@11.25kg/ha	6.47	72.29	49.77
T4- N&P@ 250 kg/ha (ammophos) + K @ 50 kg/ha + Mg@18.75 kg/ha	6.89	67.03	53.81
T5- N&P@ 150 kg/ha (ammophos) + K @ 30 kg/ha + Mg@11.25kg/ha + PGPR	6.65	73.33	52.94
SE	0.12	1.83	1.08
CD (P≤0.05)	0.40	5.65	3.23

by the application of N and P @ 250 kg/ha as ammophos (20-20) and it was on par with standard practice and N and P@ 150 kg/ha as ammophos (20-20) in combination with PGPR four months after planting (Table 3). Among the treatments, the highest green buddability was noticed by the integration of N and P@ 150 kg/ha in soluble form with PGPR and it was on par with standard practice and N and P @150 kg/ha as ammophos (20-20). Ten months after planting, the highest brown buddability was noticed in the treatment, N and P@ 250 kg/ha was applied as ammophos (20-20) and it was on par with standard practice and N and P@ 150 kg/ha as ammophos (20-20) in combination with PGPR.

Results of the experiment at Central Nursery, Karikkattoor showed that the treatments viz; standard practice (NPKMg@ 500, 250, 100: 37.5kg/ha) and NPKMg @ 250:250:50:18.75 kg/ ha were comparable in diameter and buddability

Table 4. Effect of different levels of fertilizers on diameter and buddability- Central Nursery, Karikkattoor

Treatment	4 months after planting		10 months after planting	
	Diameter(mm)	Buddability(%)	Diameter(mm)	Buddability(%)
T1- NPKMg@ 500- 250- 100- 37.5 kg/ha (Standard practice)	7.25	61.73	12.95	67.04
T2- NPKMg@ 250-250- 50-18.75 kg/ha	7.21	59.31	11.98	65.22
T3- NPKMg @ 250-250- 50-18.75 kg/ha (N&P as ammophos (20-20)	7.44	65.12	12.89	65.09
SE	0.14	3.15	0.26	2.13
CD (P≤0.05)	NS	NS	NS	NS

Table 5. Effect of different levels of fertilizers on diameter and buddability-Regional Nursery, Kanhikulam

Treatment	4 months after planting		10 months after planting	
	Diameter(mm)	Buddability(%)	Diameter(mm)	Buddability(%)
T1- NPK@500- 250-100 kg/ha (Standard practice)	7.17	56.45	12.93	74.74
T2- NPKMg@ 500- 250-100- 37.5 kg/ha	7.35	56.19	13.25	74.99
T3- NPK@ 250-250- 50 kg/ha	7.72	59.88	13.70	67.99
T4- NPKMg@ 250-250-50-18.75 kg/ha	7.72	65.28	14.30	77.15
T5- NPK@250-250-50 kg/ha (N&P as Ammophos)	7.76	61.87	13.96	69.19
T6- NPKMg @ 250-250-50- 18.75 kg/ha (N&P as Ammophos	7.63	59.36	13.37	68.73
SE	0.33	4.52	0.41	3.81
CD(P≤0.05)	NS	NS	NS	NS

of plants (Table 4).

Similar result was observed in the experiment at Regional Nursery, Kanhikulam (Table 5). No significant effect was observed by the addition of Mg on growth performance of plants. This may be due to high Mg status of the soil. It was reported that beneficial effects due to application of K and Mg were observed only in soils which were low in these nutrients(Punnoose *et al.*, 1975).

The experiment conducted at CES, Chethackal to evaluate the N utilization from urea applied to rubber seedlings, using 15N tracer methodology showed that influence of higher rate of N application was observed only up to three months (Table 6). After six months, growth of plants was comparable for all the four N levels, viz, 125, 250, 375 and 500 kg N/ha. The study also showed that per cent N utilization from applied urea ranged from 13.6 per cent at 125 kg N/ha to 5.8 per cent at 500 kg N/ha, indicating that more than 80 per cent of the applied N was lost from the soil-plant system . Factors responsible for N loss that could explain the low N use efficiency include leaching, denitrification and ammonia volatilization (Kundu *et al*, 2000, Sarkar *et al.*, 1994).

In the experiments on foliar urea spray, conducted at CES, Chethackal and CN, Karikkattoor, the treatments included soil application of 250 and 500 kg N/ha alone and in combination with foliar urea spray (1 and 2 per cent at 15 days interval). In both the locations, with respect to growth of seedlings, there was no response to second dose of N, either as soil application or foliar spray indicating that the

Table 6. Diameter, height and number of whorls of plants three and six months after planting

	3 months			6 months		
N rate (kg/ha)	Diameter at 5 cm (mm)	Height (cm)	No. of whorls	Diameter at 10 cm (mm)	Height (cm)	No. of whorls
Control	5.18	55.22	2.96	5.57	81.89	3.93
125	5.15	56.38	3.23	6.29	83.16	4.11
250	5.18	53.70	3.22	6.39	82.43	4.14
375	5.44	60.28	3.23	6.68	90.20	4.44
500	5.60	60.08	3.40	6.65	87.23	4.49
SE	0.084	1.40	0.07	0.15	2.11	0.08
CD	0.25	4.21	0.25	0.46	NS	0.24

initial application of nitrogen @ 250 kg N/ha was sufficient for the growth of seedlings. Both the studies showed the possibility of reducing the recommended dose of N from 500 kg/ha to 250kg/ha .

The nutrient removal through biomass (@ 55000 plants per hectare) from one ha, showed that removal of N ranged from 124 to 138, phosphorus from 32 to 37, K from 43 to 58 and Mg from 30 to 38 kg/ha (Table 7) in the experiment at Central Nursery, Karikkattoor. The removal of P through biomass is substantially less compared

Table 7. Nutrient removal through biomass of brown budded plants - CN, Karikkattoor

Treatment	Nutrient removal (kg/ha)			
	N	P_2O_5	K_2O	MgO
T1- NPKMg@500-250-100- 37.5 kg/ ha (Standard practice)	138	37	58	38
T2- NPKMg@ 250-250- 50-18.75 kg/ha	124	32	43	30
T3- NPKMg @ 250-250- 50- 18.75 kg/ha {(N&P as ammophos (20-20)}	132	34	50	30

to P addition. Rock phosphates have residual effect also as indicated in several earlier studies (Kalam and Punnoose, 1975; George and Nair, 2011). In the nursery trials conducted at RN, Perumpulickal and CN, Karikkattoor there was no response to P application in the nurseries (Jessy *et al.*, 2010).

Results of all these experiments showed the possibility of 50 per cent reduction in N, P and K application in seedling nurseries. Therefore, the fertilizer recommendation for rubber seedling nurseriesis revised as N: P_2O_5 : K_2O at the rate of 250:125: 50 kg/ha respectively, with N applied in two equal split doses. This can be applied as urea, rock phosphate and muriate of potash, or as factamphos and potash. As in the earlier recommendation, MgO@37.5 kg/ha is recommended from Thiruvananthapuram to Eranakulam region, where the soil available Mg status is low.

For more effective and economic fertilizer application, farmers are advised to get the fertilizer recommendation after analysing the soil samples from the proposed nursery site at a soil testing laboratory of the Rubber Board.

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