Natural Rubber Research, **22** (1&2): 146-150, 2009 SHORT SCIENTIFIC COMMUNICATION

EVALUATION OF FOLIAR UREA SPRAY IN RUBBER SEEDLING NURSERIES

P. Prasannakumari, M.D. Jessy and Mercykutty Joseph
Rubber Research Institute of India, Kottayam - 686 009, Kerala, India

Prasannakumari, P., Jessy, M.D. and Joseph, M. (2009). Evaluation of foliar urea spray in rubber seedling nurseries. *Natural Rubber Research*, **22**(1&2): 146-150.

Experiments were conducted at two locations to assess the possibility of reducing the dosage of nitrogen applied as fertilizer in rubber seedling nurseries by supplying reduced doses of N as foliar urea spray, at the time of second round of N application. In both the locations, there was no response to the second dose of N, either as soil application or as foliar spray, may be because the initial soil application of 250 kg N/ha was sufficient for the growth of rubber seedlings. The study points to the possibility of reducing the dosage of nitrogen in rubber seedling nurseries.

Keywords: Foliar urea spray, Nitrogen, Rubber seedling nursery.

Nitrogen is indispensable for the growth of rubber seedlings and urea is the widely-used fertiliser. Nutrient management followed in rubber seedling nurseries involves incorporating large quantities of fertilisers into the soil to produce vigorous seedlings. The current recommendation of chemical fertiliser is soil application of 250:250:100:37.5 kg NPKMg/ha six to eight weeks after planting and application of 250 kg N/ha, six to eight weeks after the first application (Karthikakuttyamma *et al.*, 2000).

Use-efficiency of N fertilisers by most crops ranges from 20-60 per cent. Excessive nitrogen fertilisation not only increases cost of cultivation, but also results in pollution of ground and surface water due to nitrate leaching. High concentration of nitrate in drinking water causes severe health problems in mammals (Dinnes *et al.*, 2002; Giles, 2005). Soils of the traditional rubber growing area are acidic in nature and the excess acidification caused by nitrogen fertilisers can hinder the growth of seedlings.

Foliar application of urea is a widely-accepted practice in nitrogen management and is an efficient way to reduce nitrate leaching and increase N-use efficiency. Long-term experiments in citrus, apple and olive orchards have shown that foliar application of N is as effective as soil application (Embleton and Jose, 1974; Dong *et al.*, 2005). Dong *et al.* (2004) reported that in stock plants of poplar, a fast growing forest tree species, nitrogen applied as foliar urea spray was more easily mobilised for use in new growth than N taken up by the roots prior to foliar urea application. Studies conducted in apple with ^{15}N-labelled urea foliar spray showed that urea was converted to amino acids in leaves. Roots and bark were the main sinks

Correspondance: P. Prasannakumari (Email: prasannakumari@rubberboard.org.in)

Table 1. **Treatment details**

Treatment	Quantity and method of N application			Frequency of application	
	Soil	Foliar			
	Dose (kg/ha)	Dose (kg/ha)	Concentration of urea spray (%)	Soil	Foliar*
T1	250	-	-	1	-
T2	500	-	-	2#	-
T3	250	20	1	1	4
T4	250	30	1	1	6
T5	250	40	2	1	4
T6	250	60	2	1	6

* 15-day intervals; #equal splits

of N from urea applied to leaves (Dong *et al.*, 2002).

In rubber, an experiment conducted in seedlings raised in polybags showed that growth of plants in foliar spray treatments was on par with that of soil application and required only 1/10th N as compared to soil application (Philip and Punnoose, 1996).

The objective of the present study was to assess the possibility of reducing the dosage of nitrogen in rubber seedling nurseries by supplying N as foliar urea spray.

Field experiments on rubber seedlings were conducted at two locations, *viz.* Central Experiment Station (CES), Chethackal and Central Nursery (CN), Karikkattoor during 2008-09. The treatments included soil application of 250 and 500 kg N/ha alone and in combination with foliar N urea spray (1 and 2 %) as detailed in Table 1. The experiment was laid out in randomised block design with five replications. Initial soil samples at two depths *viz.* 0-30 and 30-60 cm were collected from both the locations and analysed for organic carbon, pH and available P, K, Ca and Mg as per the procedure outlined by Jackson (1958).

Germinated seeds were planted on nursery beds (8'x4'), at a distance of 30x30 cm. Planting was carried out at CES, Chethackal, during the third week of August, whereas at CN, Karikkattoor, during the third week of October.

Nitrogen @ 250 kg/ha was applied uniformly in all the plots, along with recommended doses of P, K and Mg, six weeks after planting.

Treatments of foliar urea spray were given at 15 day intervals, using a hand-

Table 2. **Soil nutrient status of the experimental sites**

Location	Depth (cm)	pH	OC (%)	Available nutrients (mg/100 g)			
				P	K	Ca	Mg
CES, Chethackal	00-30	5.27	1.51	3.90	4.40	8.59	3.90
	30-60	5.14	1.24	1.97	2.10	7.23	1.99
CN, Karikkattoor	00-30	4.28	1.12	6.20	3.10	4.93	0.77
	30-60	4.71	0.98	5.34	2.70	4.46	0.69

operated sprayer. After completing the spraying schedule, diameter of plants was recorded. Plants were uprooted and separated into different plant parts - root, stem and leaves and processed for analysis. Nitrogen status in different plant parts was estimated using the procedure outlined by Piper (1950) and total N uptake was estimated. On completion of the experiments, soil samples (0-30 cm) were collected and analysed for NH_4^+ - N and NO_3^- - N in an N analyser (Tecator) using 2M KCl extract.

Initial soil nutrient status of the two locations is presented in Table 2. Soil at both sites was acidic and organic carbon content was in the medium range. Available P was high due to the repeated application of rock phosphate. In both the locations, available K was in the low range, probably due to repeated nursery establishment in the same location. Available Mg was high at CES, Chethackal but low at CN, Karikkattoor.

The diameter and dry matter production of plants at CES, Chethackal and CN, Karikkattoor are presented in Table 3. The growth of seedlings at CN, Karikkattoor was comparatively poor because of the late planting and also due to the low soil nutrient status. At both the locations, diameter and dry matter production of plants did not vary significantly between treatments indicating that growth of seedlings was not influenced by the second dose of N application. Growth of plants in treatments where second dose of N was not applied was also comparable to other treatments of soil and foliar applied N, suggesting that initial dose of N @ 250 kg/ha was sufficient.

The N content of different plant parts, *viz.* leaf, stem and root at CES, Chethackal and CN, Karikkattoor did not show

Table 3. **Diameter and dry matter production (DMP) of plants**

Treatment	CES, Chethackal		CN, Karikkattoor	
	Diameter (mm)	DMP (g/plant)	Diameter (mm)	DMP (g/plant)
T1	13.06	147.40	8.38	38.13
T2	13.11	149.26	8.45	34.37
T3	12.95	123.18	8.55	36.58
T4	12.68	112.83	8.47	34.93
T5	12.83	141.41	8.60	37.20
T6	12.71	124.39	8.31	38.20
SE	0.28	12.50	0.26	3.37
CD (P = 0.05)	NS	NS	NS	NS

Table 4. **Nitrogen content (%) in different plant parts**

Treatment	CES, Chethackal			CN, Karikkattoor		
	Leaf	Stem	Root	Leaf	Stem	Root
T1	3.36	0.84	0.91	3.74	1.47	0.89
T2	3.62	0.81	0.83	3.73	1.49	0.98
T3	3.20	0.76	0.81	3.74	1.36	0.86
T4	3.40	0.87	0.74	3.70	1.37	0.82
T5	3.47	0.91	0.58	3.62	1.47	0.83
T6	3.37	0.83	0.70	3.68	1.50	0.86
SE	0.11	0.04	0.07	0.10	0.07	0.04
CD (P = 0.05)	NS	NS	NS	NS	NS	NS

Table 5. **Nitrogen uptake (g/plant) in different plant parts**

Treatment	CES, Chethackal				CN, Karikkattoor			
	Leaf	Stem	Root	Total	Leaf	Stem	Root	Total
T1	1.40	0.51	0.27	2.17	0.45	0.22	0.08	0.84
T2	1.46	0.46	0.24	2.16	0.48	0.21	0.08	0.76
T3	1.36	0.41	0.23	1.99	0.43	0.20	0.07	0.70
T4	1.05	0.44	0.17	1.65	0.47	0.19	0.06	0.71
T5	1.51	0.64	0.17	2.31	0.53	0.21	0.07	0.80
T6	1.63	0.44	0.19	2.04	0.53	0.23	0.08	0.83
SE	0.20	0.08	0.03	0.28	0.06	0.02	0.005	0.09
CD (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Table 6. **NH_4^+- N and NO_3^-- N in soil (0-30 cm) on completion of the study**

Treatment	CES, Chethackal		CN, Karikkattoor	
	NH_4^+- N (ppm)	NO_3^-- N (ppm)	NH_4^+- N (ppm)	NO_3^-- N (ppm)
T1	5.45	2.95(1.56)*	32.72	33.01(5.64) *
T2	11.76	4.80(2.14)	71.34	43.97(6.59)
T3	7.14	3.35(1.81)	66.74	35.74(5.94)
T4	8.06	2.53(1.50)	55.23	28.13(4.94)
T5	9.11	1.41(1.17)	59.37	22.48(4.74)
T6	8.76	1.25(1.11)	48.46	24.48(4.84)
SE	1.24	0.24	9.80	0.53
CD (P = 0.05)	3.74	NS	28.92	NS

*Figures in parentheses are the square root transformed values

significant variation among treatments (Table 4). Similarly, nitrogen uptake in different plant parts and total nitrogen uptake (Table 5) were also not influenced by the second dose of N application. Recent studies conducted at Rubber Research Institute of India also indicated that the current recommendation of 500 kg N/ha for seedling nursery is higher than the requirement (Syamala *et al.*, 2009).

NH_4^+- N and NO_3^--N contents in soil (0-30 cm) in the two locations are shown in Table 6. At both the locations, NH_4^+- N content in soil was significantly higher in plots where soil application of urea @ 500 kg/ha in two splits was given. NO_3^--N content in soil did not show significant variation among treatments.

In both 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 initial application of nitrogen @ 250 kg N/ha was sufficient for the growth of rubber seedlings. The study points to the possibility of reducing soil application of nitrogen in rubber seedling nurseries.

REFERENCES

Dinnes, D.L., Karlen, D.L., Jaynes, D.B., Kasper, T.C., Hatfield, J.L., Colvin, T.S. and Camberdella, C.A. (2002). Nitrogen management strategies to reduce nitrate leaching in tile-drained mid-western soils. *Agronomy Journal*, **94**: 153-171.

Dong, S., Cheng, L., Scagel, C.F. and Fuchigami, L.H. (2002). Nitrogen absorption, translocation and distribution from urea applied in autumn to leaves of young potted apple trees. *Tree Physiology*, **22**: 1305-1310.

Dong, S., Cheng, L., Scagel, C.F. and Fuchigami, L.H. (2004). Nitrogen mobilization, nitrogen uptake and growth of cuttings obtained from Poplar stock plants grown in different N regimes and sprayed with urea in autumn. *Tree Physiology*, **24**: 355-359.

Dong, S., Neilsen, D., Neilsen, G.H. and Fuchigami, L.H., (2005). Foliar N application reduces soil NO_3-N leaching loss in apple orchards. *Plant and Soil*, **268**: 357-366.

Embleton, T.W. and Jones, W.W. (1974). Foliar-applied nitrogen for citrus fertilization. *Journal of Environmental Quality*, **3**: 388-391.

Giles, J. (2005). Nitrogen study fertilizes fears of pollution. *Nature*, **433** (7028): 791.

Jackson, M.L. (1958). *Soil Chemical Analysis*. Prentice Hall Inc., New York, 498p.

Karthikakuttyamma, M., Joseph, M. and Nair, A.N. S. (2000). Soils and nutrition. In: *Natural Rubber: Agromanagement and Crop Processing* (Eds. P.J. George and C. Kuruvilla Jacob), Rubber Research Institute of India, pp.170-198.

Philip, V. and Punnoose, K.I. (1996). Foliar nutrition in rubber seedling nursery. *Proceedings of the Eighth Kerala Science Congress*, 1996, Kochi, pp.227-228.

Piper, C.S. (1950). *Soil and Plant Analysis*. University of Adelaide, Adelaide, 368p.

Syamala, V.K., George, S., Joseph, K., Idicula, S.P., Nair, A.N.S. and Nair, N.U. (2009). Effects of inorganic fertilizers and PGPR on growth of rubber seedlings (*Hevea brasiliensis*) in nursery. *1st Asian PGPR Congress for Sustainable Agriculture*, 21-24 June, 2009. Acharya N.G. Ranga Agricultural University, Hyderabad, p.54.