Short scientific report *Journal of Plantation Crops, 2009, 37 (2): 157-159*

Effect of organic manures and biofertilisers on nutrient uptake, yield and quality of *Plumbago rosea* grown as intercrop with coconut

(Manuscript Received: 20-01-08, Revised: 15-04-09, Accepted: 08-06-09)

Keywords: biofertilisers, organic manures, plumbagin content, *Plumbago rosea*, root yield

Chethikoduveli or Chitrak (*Plumbago rosea* Linn.) an important medicinal plant, is pungent, astringent, diuretic, germicidal and abortifacient. The freshly harvested plumpy roots after curing and drying are used for many ayurvedic preparations and it overcomes flatulence, piles, coughs and anal inflammation. Plumbagin is the major active compound and a potential biomarker in different Plumbaginales (Kapadia *et al.,* 2007). The cultivation of *Plumbago rosea* under organics is the best possible way for maximization of plumbagin production and hence development of quality *(*Kumari *et al., 2002).* In Kerala chethikoduveli is recommended as an intercrop in coconut and rubber plantations for commercial cultivation. The present study was undertaken to find out the influence of organic manures and biofertilisers on nutrient uptake, yield and quality of *Plumbago rosea* as intercrop in coconut garden.

The experiment was carried out in a D x T hybrid coconut garden aged over 30 years at Instructional Farm, College of Horticulture, Vellanikkara during August 2004 to December, 2005. The light availability in the interspaces of coconut garden ranged from 60-70 %. The soil is having a pH of 5.78 with EC of 0.41 dsm^{-1}, organic carbon content of 1.24 %, available P_2O_5 of 25.9 kg ha^{-1} and available K_2O of 440.5 kg ha^{-1}. The experiment was laid out in randomized block design (RBD) with three replications. There were 15 treatment combinations of organic manures [farmyard manure (FYM) and vermicompost] and biofertilizers (*Azospirillum* and phosphate solubilising bacteria, PSB).

Two months old cuttings of *P. rosea* were planted at a spacing of 50 x 20 cm in raised beads of 5 x 2 cm size and 25 cm height prepared in the interspaces of coconut plants. Doses of organic manures viz. FYM (mean nutrient content of 0.55 %N, 0.42%P and 0.32 % K) and vermicompost (mean nutrient content of 0.92 %N, 0.62 %P and 0.49 % K) were fixed on equivalent nitrogen basis and applied in beds prior to planting. Commercial inoculum of *Azospirillum* and PSB @ 2.5 kg/ha was applied along with organic manures. All the other management practices were carried out following the recommended package of practices recommendations (KAU, 2007). The crop was harvested at 18 months after planting.

The data on growth parameters viz., height, number of leaves, root length and dry matter production and yield were recorded. The content of N, P and K of leaf and soil were analyzed using standard procedures (Jackson, 1973). The plumbagin content was estimated by extracting the roots with acetone and the colour developed was read using spectrophotometer. The statistical analysis of data was done by adopting the standard procedures of Sukhatme and Amble (1985).

The variation in growth characters due to the application of FYM was significant compared to vermicompost (Table 1). *Azospirillum* showed a positive effect on root girth when applied with FYM. FYM was found to be more efficient in dry matter production compared to vermicompost. The microbial inoculants, *Azospirillum* and PSB together promoted higher dry matter accumulation compared to their individual performance. Similar results were reported due to biofertiliser inoculation in ginger (Sreekala and Jayachandran, 2006). The superior performance of growth parameters under FYM + *Azospirillum* + PSB treatments could be attributed to higher availability of

Table 1. Effect of organic manures and biofertilisers on growth and yield of *P. rosea*

Treatments	Height (cm)	No. of leaves	Root length (cm)	Root girth (cm)	Dry matter production (g/plant)	Root yield (t/ha)
FYM 15 t/ha	29.33	42.26	52.73	2.26	43.20	2.550
FYM 15 t/ha + Azo	32.73	60.60	52.13	2.53	40.53	2.400
FYM 15 t/ha + Azo + PSB	28.76	50.33	50.00	2.43	46.67	3.216
FYM 10 t/ha	21.03	24.93	47.26	2.30	33.20	2.200
FYM 10 t/ha + Azo	25.10	39.33	52.13	2.73	46.53	2.933
FYM 10 t/ha + Azo + PSB	32.40	52.26	53.93	2.83	77.20	3.700
FYM 5 t/ha	23.50	30.83	46.40	1.93	30.13	2.016
FYM 5 t/ha + Azo	24.46	38.66	47.66	2.40	31.60	2.066
FYM 5 t/ha + Azo + PSB	21.66	25.50	43.26	2.04	33.46	2.383
Vermicompost eq.10 t/ha FYM	12.50	14.96	35.80	1.76	19.73	1.263
Vermicompost eq.10 t/ha FYM + Azo	16.23	22.96	50.00	2.16	21.20	1.550
Vermicompost eq.10 t/ha FYM + Azo + PSB	17.56	23.00	50.06	2.50	34.00	2.003
Vermicompost eq.5 t/ha FYM	14.03	20.00	36.06	1.86	25.06	1.616
Vermicompost eq.5 t/ha FYM + Azo	13.63	15.86	46.93	2.16	24.13	1.750
Vermicompost eq.5 t/ha FYM + Azo + PSB	17.80	19.56	49.00	2.26	29.73	2.100
CD (P = 0.05)	8.67	11.04	NS	0.466	19.30	0.806

Azo - *Azospirillum* PSB-Phosphate Solubilising Bacteria
NS = Not Significant

N, P and K nutrients in the soil and their higher uptake through efficient root system in the plants. Significantly higher uptake of N, P and K were noticed due to FYM application compared to vermicompost (Table 2). The nutrient uptake is generally considered as a function of dry matter production. The combined application of *Azospirillum* and PSB resulted in higher N, P and K uptake than their individual application. *Azospirillum* helped in building up of nitrogen through biological nitrogen fixation (Singh *et al*., 2004)**.** PSB have the ability to solubilise native as well as applied phosphorus (Smith and Read, 1997). The highest uptake of nutrients was observed in the treatment combination of FYM @ 10 t/ ha along with *Azospirillum* and PSB @ 2.5 kg/ha. The higher uptake of P may be attributed to increased release from unavailable form in the soil. The synergistic effect as a result of two microbial fertilizers contributed to higher availability and uptake of nutrients resulting in higher yield.

Table 2. Effect of organic manures and biofertilisers on nutrient uptake, plumbagin content and plumbagin yield of *P. rosea*

Treatments	Nutrient uptake (g/plant)			Quality	
	N	P	K	Plumbagin content (%)	Plumbagin yield (kg/ha)
FYM 15 t/ha	30.86	4.23	22.46	5.278	134.50
FYM 15 t/ha + Azo	29.78	4.49	17.14	6.378	153.07
FYM 15 t/ha + Azo + PSB	42.14	5.83	23.94	6.082	195.59
FYM 10 t/ha	25.86	2.61	15.27	5.850	128.70
FYM 10 t/ha + Azo	54..42	4.69	28.98	5.689	166.85
FYM 10 t/ha + Azo + PSB	54.96	7.25	31.65	6.787	251.11
FYM 5 t/ha	33.29	2.44	15.15	5.610	113.09
FYM 5 t/ha + Azo	24.33	2.84	14.22	5.431	231.81
FYM 5 t/ha + Azo + PSB	24.66	2.17	15.39	5.124	122.01
Vermicompost eq.10 t/ha FYM	14.91	1.49	9.66	5.977	75.48
Vermicompost eq.10 t/ha FYM + Azo	16.62	2.07	9.60	6.021	93.32
Vermicompost eq.10 t/ha FYM + Azo + PSB	29.44	3.28	16.32	5.689	113.95
Vermicompost eq.5 t/ha FYM	23.98	2.45	15.03	5.558	89.78
Vermicompost eq.5 t/ha FYM + Azo	23.64	2.05	12.54	5.920	103.60
Vermicompost eq.5 t/ha FYM + Azo + PSB	29.55	2.91	14.18	4.82	101.22
CD (P = 0.05)	9.21	1.65	5.21	0.495	26.12

Azo - Azospirillum PSB - Phosphate Solubilising Bacteria

The soil analysis data revealed that the application of organic manures and biofertilisres did not influence the available nutrient status of soil. However, combined application of organic manures with biofertilisers had a positive influence on the nutrient status of soil. Inoculations of *Azospirillum* and PSB along with FYM have resulted in enhanced assimilation of mineral nutrients N, P and K due to the synergetic relationship between them. The increased release of nutrients in soil enhanced the uptake and there by yield of *P. rosea*. The results are in agreement with the findings reported by Pramanik and Singh (2003).

The different organic manures behaved differently in promoting root yield (Table 1). FYM was more effective for higher root yield than vermicompost. The biofertiliser application also produced significant variation in root yield. The root yield response due to *Azospirillum* and PSB was more pronounced in combination with FYM than with vermicompost. Similar results are available from studies of Kavitha and Vadivel (2006). Increased availability and absorption of nutrients have enabled the plants to absorb more nutrients and resulted in enhanced carbohydrate synthesis and effective translocation of photosynthates to the sink i.e. root. The root yield was the lowest when vermicompost alone was applied at a rate equivalent to 10 t/ha of FYM.

FYM was found to be a better source of organic manure for increased plumbagin content as well as yield compared to vermicompost (Table 2). The combined application of biofertilisers was found to be more effective for quality improvement. The treatment combination of FYM @ 10 t/ha with *Azospirillum* and PSB gave the highest plumbagin content as well as yield. Similar findings were reported in *Ocimum basilicum* (Kumar *et al*., 2006). The quality is a function of secondary metabolite and the secondary metabolite production is associated with the steady supply of balanced nutrients which was achieved from the combination of FYM with biofertilisers leading to enhanced quality. Thus, in the present experiment, a higher root yield, plumbagin content and nutrient uptake were observed when organic manures were applied along with biofertilisers. The treatment combination of FYM @ 10 t/ha with *Azospirillum* and PSB each @ 2.5 kg/ha was found out to be better in terms of maximum root yield and plumbagin content and yield in *P. rosea.*

References

Jackson, M.L. 1973. *Soil Chemical Analysis*. Prentice Hall of India Private Ltd., New Delhi.

Kapadia, S.N., Isarani, S.A. and Shah, M.B. 2007. A simple method for isolation of Plumbagin from roots of *Plumbago rosea*. *Pharmaceutical Biol*. **43**: 551-553.

KAU, 2007. *Package of Practice Recommendations*- 2007. Directorate of Extension, Kerala Agricultural University, Thrissur.

Kavitha, C. and Vadivel, E. 2006. Effect of organic manures and inorganic fertilizers on yield and yield attributing characters of *Mucuna pruriens*. *J. Med. Arom. Pl. Sci*. **28**: 18-22.

Kumar, T.S., Swaminathan, V., Sadasakti, A. and Balasubramanian, R. 2006. Influence of nitrogen and phosphorus along with biofertilisers on yield, constituents of essential oil and soil available nutrients of davana (*Artemisia pallens*). *J. Med. Arom. Pl. Sci*. **28**: 182-186.

Kumari, K.T.P., Suma, V.A., Minimol, J.S. and Potty, N.N. 2002. Effect of organic soil conditioners on yield of rhizomatous and tuber forming medicnal plants. pp. 137. In: *Conservation and utilization of medicinal and aromatic plants*. (Eds) S. Sahoo, D.B. Ramesh, Y.R. Rao, B.K. Debate and V.N. Misra. Allied Publishers.

Pranamik, K. and Singh, R.K. 2003. Effect of levels and mode of phosphorus application with and without biofertiliser on yield and nutrient uptake by chickpea. (*Cicer arietinum*). *Ann. Agric. Res. New Sciences* **24**(4): 768.

Singh, K., Singh, P.P., Beg S.U., Kumar, D. and Patra, D.D. 2004. Effect of harvesting time and nitrogen application on essential oil yield and quality of methyl rich cultivar of Indian basil (*Ocimum basilium*) *J. Med. Arom. Pl. Sci*. **26**: 293-296.

Smith, S.E. and Read, D.J. 1997. *Mycorrhizal symbiosis* 2nd Edn. Academic Press, San Diego. 126p.

Sreekala, G.S. and Jayachandran, B.K. 2006. Effect of organic manures and microbial inoculants on nutrient uptake, yield and nutrient status of soil in ginger intercropped coconut garden. *J. Plantn. Crops* **34**(1): 25-31.

Sukhatme, P.V. and Amble, V.N. 1985. *Statistical Methods for Agricultural Workers* (Rev. Edn.) ICAR, New Delhi.

All India Network Project on Medicinal and Aromatic Plants,
College of Horticulture, Vellanikkara,
Thrissur - 680656

*A. Latha,
V.V. Radhakrishnan,
S. Mini

**Assistant Professor (Senior Scale) (Agronomy), All India Network Project on Medicinal & Aromatic Plants, College of Horticulture, Vellanikkara, Thrissur-680654, Kerala*