



Influence of organic nutrient management practices for noni (*Morinda citrifolia*) when grown as an intercrop in coconut garden

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ABSTRACT

The experiment was conducted to study the performance of noni (*Morinda citrifolia*) as an intercrop in coconut garden under organic nutrient management at ICAR-Central Plantation Crops Research Institute, Kasaragod, Kerala, during 2012-2015. Four organic source of nutrient management treatments, viz. T₁: Vermicompost (VC) alone, T₂: Vermicompost+vermiwash (VW)+ biofertilizers (BF), T₃: VC+VW+BF+coir pith application and T₄: VC+VW+BF+ *in situ* green manuring+ husk incorporation (At the time of planting and once in two years in between rows) + coconut leaf mulch were replicated five times in RBD design. Vermicompost, vermiwash (1:10 dilution) and biofertilizers (*Azospirillum* and *Phosphobacteria*) were applied at 6, 12, 18 months after planting (MAP) @ 2 kg, 2 l/plant, and 25 g/plant, respectively and at 24 MAP @ 5 kg 4 l/plant, and 50 g/plant, respectively. Among the treatments, VC+VW+BF+*In situ* green manuring + husk incorporation + coconut leaf mulch resulted in significantly greater noni fruit yield (6159 kg/ha/year) and the maximum net return (₹ 108 695/ha) and B:C ratio (1.31) compared to other treatments.

Key words: Coconut, Intercrop, *Morinda citrifolia*, Net return, Nutrient management

Growing intercrops in coconut gardens not only increase the utilization of unexploited natural resources, but will also have a beneficial effect on the farm economics and acts as a carbon stock as the greenery is maintained throughout the year. Studies revealed that a number of perennials like cocoa, clove, nutmeg, coffee, black pepper, mulberry and breadfruit are the most compatible crops with coconut and can be grown as intercrops in the west coast region (Maheswarappa *et al.* 2010). Noni (*Morinda citrifolia*) tree (syn: Indian mulberry, Cheese fruit, Hog apple) belonging to the family Rubiaceae, is an ever green small tree which flowers and fruits throughout the year and naturally spreads in the tropical regions of the world. In India, it is grown in Coastal Kerala, Karnataka, Tamil Nadu, Odisha and Andaman and Nicobar Islands. Noni is propagated through seeds and can be grown organically and comes up well in all types of soils with good drainage. The fruits of the plant have a history of use in the pharmacopoeias units in the Universe because it has more than 150 nutraceuticals, several vitamins, minerals, micro and macro nutrients that help the body in various ways from cellular level to organ level. Noni is one of the important traditional folk medicinal plants that have been used for over 2000 years in Polynesia.

More than 200 commercial entities across the globe sell these products and enjoy enormous market share. The fruit and its juice can be used to treat cancer, diabetes, heart disease, cholesterol, high blood pressure, HIV, rheumatism, allergies, infection, and inflammation. Performance of noni as an intercrop in coconut garden has been studied, whereas the impact of organic treatments on yield has not been attempted. Hence, a trial to study the performance of noni as an intercrop in coconut garden under organic treatments was conducted at ICAR-Central Plantation Crops Research Institute (CPCRI) with an objective of studying its impact on the yield of noni and coconut.

MATERIALS AND METHODS

Performance of noni as an intercrop in coconut under coastal agro-ecosystems was conducted at ICAR-Central Plantation Crops Research Institute (CPCRI), Kasaragod, Kerala, during 2012-2015. ICAR-CPCRI is situated at 12° 30" N latitude and 75° 00" E longitude at an elevation of 10.7 m above mean sea level. The mean annual rainfall during 2012 to 2015 was 3370 mm, the mean maximum temperature was 33.6°C, while minimum temperature was 25.3°C. The noni tissue cultured plants were planted in May 2012 as an intercrop in single hedge system at 3.75 m plant to plant distance at the centre of two rows of coconut (Total 356 noni plants will be accommodated in one ha coconut garden). The experiment was conducted in a 45 years old West Coast Tall (WCT) garden spaced at 7.5 m

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× 7.5 m. The details of organic source of treatments given to noni are as follows: T₁: Vermicompost (VC) alone, T₂: Vermicompost+Vermiwash (VW) +Biofertiliser (BF); T₃: VC+VW+BF+Coir pith application; T₄: VC+VW+BF+*In situ* green manuring (cowpea) +Husk incorporation (At the time of planting and once in two years in between rows) + Coconut leaf mulch. Noni crop was supplied with 2 kg/plant vermicompost, 2 l/plant vermiwash (1:10 dilution) and 25 g/plant biofertilizers at 6, 12 and 18 months after planting, whereas, supplied with 5 kg/plant vermicompost, 4 l/plant vermiwash and 50 g/plant biofertilizers at 24 months after planting.

Above treatments were replicated five times in a Randomized Block Design with six noni plants per treatment. For coconut, recommended package of practice of ICAR-CPCRI was followed. Irrigation was provided through sprinkler irrigation system during November to May months. The growth observations of noni, viz. plant height, number of branches/plant were taken yearly once during 2014 and 2015 and yield parameters, viz. number of fruits/plant, average weight of the fruit, weight of fruits/plant/year, yield of noni fruit were recorded during 2014-15. The yield of coconut, i.e. number of nuts/palm/year was recorded during each harvest and total nut yield/year was worked out. The economics of coconut + noni cropping system was calculated for 2014-15 including labour cost, input cost, irrigation, other miscellaneous charges for main crop and intercrop and converted into economics per ha.

RESULTS AND DISCUSSION

Growth, yield and quality of noni

The growth and yield performance of noni as an intercrop in coconut is presented in Table 1. Growth parameters recorded during 2014 indicated that there was no significant difference among the treatments with respect to plant height and number of branches. Uniformity in growth parameters among the treatments was attributed to initial slow release of nutrients from organic sources. During 2015, there was significant difference for growth parameters among the treatments. Significantly maximum

plant height and number of branches/plant (3.0 m and 25.8, respectively) were recorded in plants under the treatment VC+VW+BF+cowpea+coconut husk incorporation. This may be due an increase in availability of nutrients from different organic sources in the treatments over a period of time. Significantly lower plant height and number of branches were recorded in vermicompost alone treatment (2.0 m and 19.8, respectively) compared to all other treatments. The greater growth parameters in above treatments leads to higher yield parameters like number of fruits/plant/year, average weight of the fruit and weight of the fruits/plant/year. The significantly maximum yield parameters such as number of fruits/plant/year (18.4), average weight of the fruit (75.2 g) and weight of the fruits/plant/year (17.3 kg) were recorded in plants under the treatment VC+VW+BF+cowpea+coconut husk incorporation, which was followed by VC+VW+BF+coir pith treatment (18.2, 72.0 g and 14.4 kg, respectively). Because of improvement in yield parameters, significantly greater yield of noni was recorded in plants under the treatment VC+VW+BF+cowpea+coconut husk incorporation (6159 kg/ha/year) followed by VC+VW+BF+coir pith treatment (5126 kg/ha/year). Vermicompost treatment alone resulted in the lowest yield (3133 kg/ha/year) due to poor growth and lower yield parameters (Table 1). Total soluble solids (TSS) of noni juice varied among the treatments and the higher TSS content of noni juice found in plants under the treatment VC+VW+BF+cowpea+coconut husk incorporation (10.5°Brix), followed by VC+VW+BF+coir pith treatment (9.9° Brix). Organic nutrient sources will increase the availability of all essential nutrients to plants, thereby plant will perform better under such conditions. These results are in agreement with the findings of Shivakumar *et al.* (2012) in papaya and Maheswarappa *et al.* (2013) in coconut.

Yield of coconut

The yield performance of the coconut as influenced by intercrop of noni is presented in Table 2. Pre experimental period coconut yield was 95 nuts/palm/year. In intercropped garden, coconut yield was increased to 101, 110 and 131

Table 1 Growth and yield parameters of noni during 2014-15 as influenced by organic nutrient management practices when grown as an intercrop in a coconut garden

Treatment	Plant height (m)		No. of branches		No. of fruits/plant	Av. weight of the fruit (g)	Weight of the fruits (kg/plant/year)	Yield of noni fruit (kg/ha/year)	TSS (°Brix)
	2014	2015	2014	2015					
T ₁ - Vermicompost (VC) alone	1.53	2.0	14.0	19.8	11.9	56.1	8.8	3133	9.4
T ₂ - VC+ Vermiwash (VW)+ Biofertilizer (BF)	1.67	2.3	14.4	22.0	12.9	66.1	12.0	4272	9.5
T ₃ - VC+VW+BF+coir pith	1.83	2.6	13.6	24.0	18.2	72.0	14.4	5126	9.9
T ₄ - VC+VW+BF+ <i>In situ</i> green manuring + Husk incorporation + Coconut leaf mulch	1.78	3.0	12.6	25.8	18.4	75.2	17.3	6159	10.5
CD (P=0.05)	NS	0.35	NS	2.6	1.1	4.75	2.98	1044	NS

NS: Non significant

Table 2 Yield of coconut as influenced by intercropping of noni

Year	Coconut yield (nuts/palm/year)	
	Coconut monocrop system	Coconut+noni intercropping system
2010-12 (Pre-experimental)	95	96
2012-13	97	101
2013-14	92	110
2014-15	105	131

and soil suitability, coconut farmers can choose any of the herbal crops, grow them profitably as intercrop in coconut, and get additional revenue from their coconut garden.

Growing of noni as an intercrop with the application of vermicompost + vermiwash + biofertilizers + cowpea + coconut husk incorporation in coconut garden was found to be the best treatment to get maximum yield of noni and to get maximum profit from coconut garden. There was an increase in coconut yield by growing noni as an intercrop in coconut garden in coastal agro-ecosystem. The present study indicate that noni is a profitable intercrop in

Table 3 Economics of intercropping of noni in coconut and monocrop coconut garden during 2014-15

Treatment	Cost of cultivation (₹/ha)			Gross return (₹/ha)			Net return (₹/ha)	B: C ratio
	Coconut	Noni	Total	Coconut	Noni	Total		
T ₁ - Vermicompost (VC) alone	70258	8522	78780	130122	31330	161452	82672	1.05
T ₂ - VC+ Vermiwash (VW)+ Biofertilizer (BF)	70258	11245	81503	130122	42720	172842	91339	1.12
T ₃ - VC+VW+BF+coir pith	70258	14216	84474	130122	51260	181382	96908	1.15
T ₄ - VC+VW+BF+cowpea+coconut husk incorporation	70258	12759	83017	130122	61590	191712	108695	1.31
Monocrop of coconut	70258		70258	114475		114475	44217	0.63

nuts/palm/year during 2012-13, 2013-14 and 2014-15, respectively. Whereas, in monocrop coconut garden the coconut yield almost remained same over the years, i.e. 97, 92 and 105 nuts/palm/year during 2012-13, 2013-14 and 2014-15, respectively. Data indicates that nut yield increased during 2014-15 was to the tune of 36% under intercropping plot and it was 10.5% under coconut monocrop compared to pre experimental yield. Results analogous to these findings were also reported by Khandekar *et al.* (2014) in coconut intercrop with noni. The additional increase in coconut yield under intercropping of noni could be due to the synergistic effect of crop combination and organic nutrient management in the garden. Research conducted at ICAR-CPCRI and AICRP centers found that intercropping noni increases the coconut productivity due to addition of fertilisers and irrigation to the intercrop (CPCRI 2014, AICRP 2014). Thiruvarasan and Maheswarappa (2014) also stated that, intercropping herbal plants in coconut enhanced the annual nut yield than coconut without intercrop due to complementary effect of intercropping in the coconut garden.

Economics

Economics of the intercropping of noni was worked out based on the prevailing market price. The net returns and B:C ratio were maximum in coconut + noni intercropping system (₹ 82 667 to ₹ 108 695/ha, 1.05 to 1.31 respectively) compared to the monocropping of coconut (₹ 44 217/ha and 0.63, respectively) (Table 3). Among the integrated nutrient management practices, treatment VC+VW+BF+cowpea+coconut husk incorporation resulted in greater gross return (₹ 191 712/ha), net return (₹ 108 695/ha) and B:C ratio (1.31) compared to other treatments. Mohandas (2011), reported that based on the marketability

a coconut garden.

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