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Feasibility of intercropping medicinal plants in black pepper garden

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Abstract

The feasibility of cultivating medicinal plants in black pepper (*Piper nigram* L.) plantation was studied at Ambalavayal (Kerala). The plants tested were *Adhatoda beddomei*, *Desmodium gangeticum*, *Pseudarthria viscida*, *Ayapana triplinervis*, *Pogostemon cablin* and *Plumbago rosea* in a fifteen year old black pepper plantation. The results indicated that black pepper yield (2100 kg ha^{-1}) was higher under intercropping situation compared to sole crop (1675 kg ha^{-1}). Among the medicinal plants, maximum black pepper equivalent yield (PEY) (2100 kg ha^{-1}) was recorded in *P. rosea* followed by *P. cablin* (2000 kg ha^{-1}). Maximum net return was obtained from black pepper + *P. rosea* followed by *P. cablin*. The benefit: cost ratio was highest for inter cropping *P. rosea* (3.5) followed by *P. cablin* (3.3) and *A. triplinervis* (3.3).

Keywords: economics, intercropping, medicinal plants, *Piper nigrum* L.

Introduction

Black pepper (*Piper nigrum* L.) is usually planted at a spacing of 3 m x 3 m offering scope for inter cropping with suitable crops. Black pepper roots extend up to about 90 cm from the base and effective root zone of black pepper is reported to be 30 cm radius (Sankar *et al*. 1998) and therefore will not hinder the growth of intercrops. Although many crops have been tested as intercrops in black pepper, studies on intercropping medicinal plants is limited. The demand for medicinal plants is increasing in the national and international markets and in Kerala, medicinal plants are mainly used in ayurvedic preparations and are in short supply from traditional sources (Suneetha *et al.* 2003). Preliminary studies at the Rubber Research Institute of India (RRII) have identified *Plumbago rosea* L., *Adhatoda vasica* Nees., *Adahatoda beddomei* Clarke, *Alpinia galanga* (l.) Sw. and *Strobilanthes heyneanus* Nees. for cultivation under rubber canopy (RRII 1992). Hence, an experiment was conducted at Ambalavayal (Kerala) to study the profitability of medicinal crops as intercrops in black pepper garden.

Materials and methods

The field experiments were conducted for two years (2007–2009) in a bearing black pepper

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garden (> 15 years) at Regional Agricultural Research Station (RARS), Ambalavayal (Kerala). The station lies between 11° 26' and 11° 59' N latitude and 76° 26' and 75° 46' E longitude at an altitude of 974 m above MSL and enjoys a mild sub-tropical climate, with an annual rainfall of about 3000 mm. The soil of the experimental site is forest loam with a pH of 4.6, available N, 189 kg ha^{-1}, available P, 0.20 kg ha^{-1} and available K, 221 kg ha^{-1} respectively.

The medicinal plant species included in the trial were *Adhatoda beddomei* C.B. Clarke, *Desmodium gangeticum* (L.) DC., *Pseudarthria viscida* (L) Wight & Arn., *Ayapana triplinervis* (M. Vahl) R.King & H.Robinson, *Pogostemon cablin* (Blanco) Benth. and *Plumbago rosea* L. as intercrops along with sole crop of black pepper (var. Panniyur 1) as control laid out in RBD with three replications. Recommended package of practices (KAU 2004) was followed. The intercrops were planted during April–July in the interspaces of four black pepper plants trailed on silver oak spaced at 3 m × 3 m. A uniform dose of farm yard manure @10 kg $plant^{-1}$ along with NPK 140: 55: 270 g $plant^{-1}$ was applied in two splits to the black pepper plants. The spacing and planting material used for cultivation of different crops is given in Table 1.

Soil samples were collected after the experiment and soil nutrient status was estimated by standard procedures. Available N was determined by Kjeldahl method (Subbiah & Asija 1956), available P by Bray method (Bray & Kurtz 1945) and available K by atomic absorption spectro photometer (Hesse 1994). Availability of solar radiation received in the garden was measured using portable photosynthesis system (LCA 4). Solar radiation received in open condition varied between 1800–1900 μ moles. In medium shaded conditions, solar radiation varied between 500–700 μ moles.

The economic produce was harvested and the yields were recorded. Intercrop yield were converted to black pepper equivalent yield in order to test for statistical significance. The cost of cultivation, economics and benefit:cost ratio (BCR) were worked out based on prevailing market rates (Table 1). The data was statistically analyzed for variance by the procedure given by Panse & Sukhatme (1985).

Results and discussion

Yield of main crop

Intercropping medicinal plants significantly influenced black pepper yield. The mean yield of main crop (black pepper) for two years ranged between 1785 to 2100 kg ha^{-1} (Table 2). The highest black pepper yield (2100 kg ha^{-1}) was obtained when *P. rosea* was intercropped followed by *P. cablin* (2000 kg ha^{-1}). Better utilization of nutrients and congenial microclimate involving weed free condition and cultivation of intercrops far away from the effective root zone of black pepper might have resulted in increased growth and yield of black pepper. Earlier reports indicated that yield of black pepper was not adversely affected due to intercropping with elephant foot yam, ginger, turmeric, hybrid napier grass, guinea grass and Congo signal grass (Thankamani *et al.* 2011).

Table 1. Spacing adopted and planting material used in the experiment

Crops	Spacing (cm)	Planting material	Price of economic produce (Rs kg^{-1})
Black pepper + *Adhatoda beddomei*	45 × 30	Rooted cutting	28.0
Black pepper + *Desmodium gangeticum*	45 × 30	Seedling	55.0
Black pepper + *Pseudarthria viscida*	45 × 30	Seedling	55.0
Black pepper + *Ayyapana triplinervis*	25 × 25	Rooted cutting	8.0
Black pepper + *Plumbago rosea*	45 × 45	Rooted cutting	100.0
Black pepper + *Pogostemon cablin*	45 × 45	Rooted cutting	10.0
Black pepper (Sole crop)	3 × 3 m	Rooted cutting	102.0

Table 2. Economics of inter cropping medicinal plants in black pepper garden (pooled data of 2 years)

Crop combination	Black pepper yield (kg ha^{-1})	Intercrop yield (kg ha^{-1})	Black pepper equivalent yield	Gross income (Rs)	Cost of cultivation (Rs ha^{-1})	Net income (Rs ha^{-1})	BCR
BP[a] + *Adhatoda beddomei*	1857	650	1784	2,07,614	56,000	1,51,614	2.7
BP + *Desmodium gangeticum*	1935	55	30	2,00,395	55,000	1,45,395	2.6
BP + *Pseudarthria viscid*	1800	100	54	1,89,100	55,000	1,34,100	2.4
BP + *Ayapana triplinervis*	1785	5000	392	2,22,070	52,000	1,70,070	3.3
BP + *Plumbago rosea*	2100	400	392	2,54,200	56,000	1,98,200	3.5
BP + *Pogostemon cablin*	2000	4050	397	2,44,500	57,000	1,87,500	3.3
Black pepper alone	1675	-	-	1,70,850	40,000	1,30,850	3.2
CD(P=0.05)	14	-	5	-	-	-	-

[a]BP=Black pepper

Yield of intercrops

Among intercrops *A. triplinervis* (5000 kg ha^{-1}) and *P. cablin* (397 kg ha^{-1}) produced higher yields. The better performance of intercrops may be due to congenial microclimate in the black pepper garden and better utilization of natural resources like light (medium shade), space and nutrients than that of sole crop of black pepper. Hardy (1958) attributed the better performance of the crops under shade to the presence of threshhold illumination intensity beyond which the stomata of shade loving plant tend to close. *P. rosea* showed no significant yield difference under two cropping situations *viz.*, pure crop and as inter crop in coconut garden (Kurien 1999). *P. cablin* can be successfully grown under rubber/coffee/coconut /orchards plantations where humidity is high (Sharan & Kumar 1995; Thomas *et al*. 2000). Better performance of *P. cablin* under partially shaded condition due to better utilization of resources has been reported earlier (Puttanna *et al.* 2005; Sujatha *et al.* 2006).

Economic feasibility

Net income was highest in the crop combination of black pepper + *P. rosea* (Rs 1,99,200 ha^{-1}) followed by black pepper + *P. cablin* (Rs 1,87,500 ha^{1}) (Table 2) due to higher black pepper equivalent yield and better price for the produce. The variation in net return was due to the variation in the cost of cultivation of different crops and market value of inter crops. BCR was highest (3.5) in *P. rosea* followed by *P. cablin* (3.3) and *A. triplinervis* (3.3). Profitable cultivation of *P. cablin* in various cropping systems has been reported earlier (Puttanna *et al.* 2005; Sujatha *et al*. 2006). In all the treatment combinations, BCR was >1 due to higher market price of black pepper. Considering the net income per unit area, all the selected crops were suitable as intercrops in black pepper garden. However, *P. rosea, P. cablin* and *A. triplinervis* were more profitable. Performance of *P. viscida* and *D. gangeticum* were not satisfactory under medium shade conditions. But both the crops have been found to perform better in a juvenile black pepper garden (Thankamani 2009).

Soil nutrient status

Intercropping of medicinal plants markedly influenced the soil nutrient status (Table 3). Available N content was higher in intercropped plots compared to sole crop of black pepper. Maximum available N level was observed in black pepper + *P. viscida* (390 kg ha^{-1}) followed by black pepper + *A. beddomei* (360 kg ha^{-1}) which was on par with black pepper + *P. cablin* (354 kg ha^{-1}). Greater available N level under black pepper + *P. viscida* combination is possibly because the later is capable of fixing N (Mathewkutty 2002). Intercropped plots had

Table 3. Soil pH and major nutrient status in black pepper garden intercropped with medicinal plants

Crop combination	pH	N	P	K
		(kg ha^{-1})		
BP + *Adhatoda beddomei*	4.6	360	0.60	576
BP + *Desmodium gangeticum*	4.7	368	0.60	450
BP +*Pseudathria viscida*	4.8	390	0.60	510
BP +*Ayyapana tripli nervis*	4.7	356	0.44	470
BP + *Plumbago rosea*	4.8	346	0.40	465
BP +*Pogostemon cablin*	4.6	354	0.46	460
Black pepper alone	4.7	340	0.36	460
CD (P=0.05)	NS	7.6	NS	15.7

significantly higher available K content than sole crop of black pepper. Maximum available K content was observed in the crop combination, black pepper + *P. viscida* followed by black pepper + *A. beddomei.*

The present investigation showed that intercropping in black pepper garden enhanced black pepper yield and generated additional income than sole black pepper. All the medicinal plants selected were suitable for intercropping in black pepper garden. However, better returns were obtained when *P. rosea*, *P. cablin* and *A. triplinervis* were grown as intercrops.

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References

Bray R H & Kurtz L T 1945 Determination of total organic and available forms of phosphorus in soils. Soil Sci. 59: 39–45.

Hardy F 1958 The light interaction of cocoa. Cocoa Manual. International Institute of Agricultural Science. Turnialba. Costa Rica.

Hesse P R 1994 A Text Book of Soil Chemical Analysis, CBS Publishers and Distributors, Delhi.

KAU 2004 Package of Practice Recommendations (Crops), Kerala Agricultural University, Thrissur.

Kurien A 1999 ICAR *Ad hoc Project* on 'Evaluation and selection of medicinal plants suitable for a coconut based farming system'. Final Report, Kerala Agricultural University, Thrissur.

Mathewkutty T 2002 Medicinal plant as ground cover in rubber plantation. In: Global Competitiveness of Indian Rubber Planter's Industry. Rubber Planter's Conference, (pp 89–92), Rubber Research Institute of India, Kottayam.

Panse V G & Sukhatme P V 1985 Statistical Methods for Agricultural Workers 4th ed. Indian Council for Agricultural Research, New Delhi.

Puttanna K, Prakasha Rao E V S, Ganesh Rao R S, Gopinath C T & Ramesh S 2005 Effect of shade and nitrogen on herb yield and longevity of patchouli (*Pogostemon cabli*). J. Med. Arom. Plant Sci. 27: 297–300.

RRII 1992 Annual Report. Rubber Research Institute of India, Kottayam.

Sankar S, Wahid P A & Kamalam N V 1988 Absorption of soil applied radiophosphorus by black pepper vine and support tree in relation to their root activities. J. Plantn. Crops 16: 73–87.

Sharan P A & Vasantha Kumar T 1995 Patchouli. In: Chadha K L & Rajendra Gupta (Eds). Medicinal and Aromatic plants, Advances in Horticulture Vol. II pp. 751–771 Malhotra Publishing House, NewDelhi.

Subbiah B V & Asija G L 1956 A rapid procedure for the determination of available nitrogen in soils. Curr. Sci. 25: 259–60.

Sujatha S, Bhat Ravi, Balasimha D & Kannan C 2006 Crop diversification in arecanut plantation through inter cropping of medicinal and aromatic plants. J. Plantn. Crops 34: 318–322.

Suneetha M S & Chandrakanth M G 2003 Intercropping medicinal plants in coconut gardens: A feasible enterprise. Ind. Coconut J. 2: 12–14.

Thankamani C K 2009 Enhancing the productivity in black pepper by intercropping. Final Report, Indian Institute of Spices Research, Calicut, p.30.

Thankamani C K, Kandiannan K, Madan M S, Raju V K, Hamza S & Krishnamurthy K S 2011 Crop diversification in black pepper gardens with tuber and fodder crops. J. Plantn. Crops 39: 358–362.

Thomas J, Joy P P, Mathew S, Skaria P, Duethi P P & Joseph T S 2000 Agronomic Practices for Aromatic and Medicinal Plants. Directorate of Arecanut and Spices Development, Calicut, 124p.