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Performance of Medicinal and Aromatic Crops as Intercrops in Coconut Garden under East Coast of Andhra Pradesh

E. Padma*, G. Ramanandam, A.V.D. Dorajee Rao, M. Kalpana and H. P. Maheswarappa

AICRP on Palms, Horticultural Research Station, Ambajipeta

Dr. Y.S.R. Horticultural University, Andhra Pradesh

Scientist (Hort), Horticultural Research Station, Ambajipeta, Andhra Pradesh, India

*Corresponding Author E-mail: padma.edee@gmail.com

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ABSTRACT

An experiment was conducted at Horticultural Research Station, Ambajipeta during 2006-2011 to identify the most suitable intercrop among medicinal and aromatics under coconut. The trial was laid out in June, 2006 with four aromatic crops and one medicinal crop in randomized block design with four replications. The results revealed that the yield of all the medicinal and aromatic plants grown as intercrop were found to be reduced compared to their sole crop yields. The reduction in yield was less in lemon grass (4.5%) followed by citronella (9.3%), palmarosa (10.3%), patchouli (14.7 %) and mango ginger (14.9%). The nut yield of coconut increased with intercropping of medicinal and aromatic plants. Coconut+patchouli intercropping system recorded 55.3% increase in nut yield/palm followed by coconut+palmarosa (43.5%) when compared to monocrop yield. The economic analysis of the cropping system revealed that the highest net returns were recorded in crop combination coconut + patchouli (Rs. 1,43,705/-) with benefit – cost ratio of 2.84 followed by coconut + citronella (Rs.1,08,870/-) with benefit – cost ratio of 2.12 compared to the net returns of Rs. 29,650/- with benefit - cost ratio of 1.60 in monocropping of coconut. Hence, cultivation of patchouli followed by citronella as intercrops in coconut can be recommended to the farmers of Coastal Andhra Pradesh in general and to the East Godavari area in particular.

Key words: *Intercropping in coconut, Medicinal crop, Aromatic crop*

INTRODUCTION

Medicinal and aromatic plants constitute a major segment of the flora, which provides raw material for use in the pharmaceuticals, cosmetics, and drug industries. The indigenous systems of medicines, developed in India for centuries, make use of many medicinal herbs. These systems include Ayurveda, Siddha, Unani, and many other indigenous practices. Medicinal and aromatic plants have a huge market potential with the world demand for herbal products growing at the rate of seven per cent per annum.

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Aromatic plants provide products that are extensively used as spices, flavouring agents and in perfumes and medicine. The demand for plant based medicines, health products, pharmaceuticals, food supplements and cosmetics is increasing day by day both in domestic and international market[17]. As a result, collection of medicinal and aromatic herbs from natural forest has increased and hence many of such plants have become rare or endangered. Problems arising out of rapid genetic loss of these plants forced the need for conservation and cultivation of medicinal and aromatic plants to ensure their availability in future.In India, Andhra Pradesh is one of the major coconut grown states after Kerala, Karnataka and Tamilnadu with 1.03 lakh hectares area and producing 1427 million nuts annually. Though, the state has the highest productivity of 13732 nuts per hectare[4], the net returns per unit area are quite low and uncertain. In coastal Andhra region, monocropping is predominant under irrigated conditions at spacing of 8.0 m x 8.0 m, which does not fully utilize the natural resources like soil, space and solar radiation. Therefore, the remaining interspaces could be profitably exploited for cultivation of intercrops suitable for the agro climatic condition and there is a good scope for increasing the net returns from existing coconut plantations. Coconut being widely spaced crop provides sufficient scope for intercropping different annual and perennial crops. Moreover, certain intercrops can successfully be grown because of their ability to tolerate coconut shade. The technique of growing intercrops in coconut garden had been standardized[9]. Earlier research efforts had revealed that tuber crops, fruit crops, rhizomes, pulses and vegetables can be grown under coconut garden[12]. Intercropping of citronella increased the land use efficiency from 21-46 per cent with additional yield of main crop[10]. The possible intercrops in coconut garden include perennials, biennials and seasonals including medicinal and aromatic crops. In the present scenario of fluctuating prices and high production cost, the pure crop of coconut is felt more uneconomical. Hence, the present investigation was carried out to evaluate the performance of medicinal and aromatic plants (MAPs) as intercrops in coconut gardens for augmenting the income of coconut farmer.

MATERIAL AND METHODS

A field experiment was conducted at Horticultural Research Station, Ambajipeta, East Godavari district of Andhra Pradesh during the years 2006-2011. The soils are coastal alluvial type with impeded drainage having a pH of 7.5-8.5, low in available nitrogen (170 kg/ha), low in available phosphorus (17.5 kg/ha) and medium in available potassium (260 kg/ha). The average annual rainfall during the experimental period was 1207 mm and mean temperature ranged from a minimum of 26.7^{o}C to maximum of 40 .7^{o}C. The average relative humidity varied between 65.7% and 87.2%. Prior to the experiment, the area was lying under monocrop coconut. A total of six treatments were laid out including four aromatic crops *viz*., (citronella (*Cymbopogon wintereanus*), lemongrass (*Cymbopogon flexuosus*), palmarosa (*Cymbopogon martinii*) and patchouli (*Pogostemon patchouli*)), and one medicinal crop (Mango Ginger, *Curcuma amada*) along with monocropped coconut plot. The experiment was laid out in randomized block design with four replications. The MAPs were grown in 84% of the area in the interspaces of coconut leaving 16% area in the coconut basins.The fertilizer dose consisting of 500 g nitrogen, 320 g phosphorus and 1500 g potassium was applied to each coconut tree as per DrYSRHU recommendations. Similarly, the recommended dose of fertilizer *viz*., nitrogen, phosphorus and potassium was applied to the intercrops also. (Citronella :46:40:60 kg NPK/ha;Lemon grass :45:40:60 kg NPK/ha; Palmarosa: 35:50:30 kg NPK/ha, Patchouli :23:24:60 kg NPK/ha and Mango ginger: 30:30:60 kg NPK/ha). No serious pest or disease was noticed in the experimental crops. For minor seasonal pests, neem oil was sprayed based on the need. The nut yields of coconut as well as intercrops were recorded.

Coconut equivalent yield was calculated as per formula given below:

$$\text{Coconut equivalent yield} = \frac{\text{(Yield of intercrop x Price of intercrop)}}{\text{Price of coconut}}$$

The gross income from the economic produce of medicinal and aromatic crops was worked out based on the prevailing market prices. The cost of production was calculated considering labour charges, manures, fertilizers, seeds and other inputs used for raising the crops. The net income was computed as the difference between gross income and cost of production. The benefit-cost ratio was calculated by dividing the gross income by the cost of production.

RESULTS AND DISCUSSION

Yield of medicinal and aromatic plants as intercrop in coconut garden and as sole crop

The yields of all medicinal and aromatic plants were reduced when grown as intercrop in coconut garden compared to their sole crop yields (Table 1). In lemon grass, minimum yield reduction was found with 4.5% followed by citronella (9.3%), palmarosa (10.3%), patchouli (14.7 %) and mango ginger (14.9%). The decrease in yield of MAPs can be attributed to the effect of coconut on intercrops coupled with loss in area due to coconut. The medicinal and aromatic plants were grown in 84 % of the area and the remaining 16% was the uncropped coconut basins. The poor availability of light to the understorey crop in intercropping system reduced the photosynthetic efficiency and resulted in lower yield of crops[3]. Similarly, the available reports indicated reduction in herb yield of lemon grass, Java citronella and Japanese mint under poplar[2]; palmarosa and lemon grass under coconut[14]; aloe, kalmegh, stevia, citronella, lemon grass, palmarosa and patchouli under teak[11]; kalmegh under artificial shade[13] and lemon grass, tulsi, arrow root, vetiver grass, kalmegh, makoi, citronella, garden rue under coconut[1].

Yield of coconut in intercropping system

From the data, it was evident that growing patchouli as intercrop in coconut recorded the highest nut yield of 99.6 nuts/palm/year followed by palmarosa with 92.0 nuts/palm/year (Table 2). This attributes to 55.3 per cent increase in nut yield/palm in intercropping system of coconut + patchouli followed by coconut + palmarosa (43.5 per cent) when compared to monocrop. Coconut intercropped with lemon grass and citronella recorded yield of 84.3 and 81.4 nuts/palm/year respectively. Coconut intercropped with mango ginger recorded yield of 73.2 nuts/palm/year. Monocrop coconut recorded the yield of 64.1 nuts/palm/year which attributes to 2.41 per cent increased yield compared to pre-experimental yields. The congenial microclimate due to intercropping might have favoured the growth and yield of coconut. Similar observations were made by Maheswarappa[5] in intercropping systems of coconut + kacholam and coconut+arrow root; and Ghosh *et al*.[4] in coconut + arrow root and coconut + sarpagandha. Increased nut yield of coconut when intercropped with herbal plants compared to pure coconut was also reported by Maheswari *et al*[7].

Coconut Equivalent yield

The coconut equivalent yield was significantly higher in intercropping systems of MAPs with coconut compared to yield of sole crops of MAPs and coconut (Table 3). Among the intercropping systems, coconut + patchouli recorded significantly higher coconut equivalent yield (38841 nuts ha^{-1}) followed by coconut + mango ginger (35859 nuts ha^{-1}), coconut + citronella (32034 nuts ha^{-1}), coconut + lemon grass(30109 nuts ha^{-1}) and coconut + palmarosa (27121 nuts ha^{-1}). This can be attributed to better performance of these MAPs in intercropping situation and also better market prices for their economic plant parts. Significantly highest coconut equivalent yield was also reported in coconut+ patchouli intercropping system by Nath *et al*[8].

Economics of intercropping of medicinal and aromatic crops in Coconut garden

The economic analysis of intercropping of medicinal and aromatic crops in coconut revealed that the highest net returns were recorded in crop combination coconut + patchouli (Rs. 1,43,705/-) with benefit – cost ratio of 2.84 followed by coconut + citronella (Rs.1,08,870/-) with benefit – cost ratio of 2.12 .The crop combinations including lemongrass, palmarosa and mango ginger recorded benefit – cost ratio of 1.83,1.81 and 1.92 respectively compared to net returns of Rs. 29,650/- with benefit - cost ratio of 1.60 in monocropping of coconut (Table 4). Maheswari *et al*. [6] have brought out that growing of ravolfia as intercrop gave extra income in coconut groves. Maheswari *et al.*[7] reported profitable cultivation of patchouli in irrigated coconut orchard of Kerala, wherein the shade intensity was between 25-50%. The economic advantages of intercropping systems of coconut with MAPs were also reported by Ghosh *et al*.[4], Basavaraju *et al*.[1], Thiruvarassan and Maheswarappa[15] and Nath *et al*[8]

Table 1: Influence of MAP intercropping on nut yield of coconut

Crop combination	Nut yield per palm						
	Pre-Experimental	During experimentation					
	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	Mean
Coconut + Citronella	72.5	58.8	70.5	94.5	92.7	90.4	81.4
Coconut + Lemon grass	64.6	70.6	88.5	88.6	89.7	84.1	84.3
Coconut + Palmarosa	69.7	81.0	98.5	90.4	93.5	96.4	92.0
Coconut + Patchouli	70.4	71.5	108.8	102.4	104.8	110.7	99.6
Coconut + Mango ginger	56.6	70.5	96.6	60.4	65.7	72.5	73.2
Monocrop Coconut	62.6	63.1	61.1	67.20	63.0	66.3	64.1
Mean	66.0	69.3	87.3	83.9	84.9	86.7	-
SEm	**6.36**	**3.15**	**4.08**	**3.98**	**3.59**	**3.74**	**-**
CD at 5%	**19.60**	**9.72**	**12.57**	**12.26**	**11.05**	**11.62**	**-**

Table 2: Yield of MAP intercrops in coconut garden as compared to sole crop

S.No	Name of crop	Yield as intercrop (t/ha)						Yield as sole crop (t/ha)						Mean reduction (-) or increase in yield of intercrop (+)
		2006-07	2007-08	2008-09	2009-10	2010-11	Mean	2006-07	2007-08	2008-09	2009-10	2010-11	Mean	
1.	Citronella	30.9	32.4	34.3	33.5	34.2	**33.1**	34.8	36.4	35.4	36.5	38.2	**36.2**	-9.3
2.	Lemon grass	39.1	38.4	47.2	47.1	46.2	**43.6**	40.1	41.1	49.2	49.3	48.3	**45.6**	-4.5
3.	Palmarosa	30.2	34.3	38.2	34.5	32.8	**34.0**	34.2	36.3	39.2	36.5	34.8	**36.2**	-10.3
4.	Patchouli	25.6	26.5	32.5	33.8	20.8	**27.8**	30.6	31.5	36.5	35.8	24.8	**31.9**	-14.7
5.	Mango ginger	18.8	20.2	22.0	20.9	21.8	**20.7**	21.8	26.2	24.0	23.9	23.1	**23.8**	-14.9

Table 3: Coconut equivalent yield of medicinal and aromatic plants grown as sole crop and intercrop in coconut garden (Mean of 5 years : 2006-07 to 2010-11)

S.No.	Crop	Coconut equivalent yield of sole crops of MAPs (Nuts/ha)	Coconut (Nuts/ha)	Coconut equivalent yield in intercropping system(Nuts/ha)	Total (Nuts/ha)
1.	Citronella	21756	12197	19836	32033
2.	Lemon grass	18240	12645	17464	30109
3.	Palmarosa	14480	13794	13600	27121
4.	Patchouli	31840	14946	27840	38841
5.	Mango ginger	28560	10971	24888	35859
6.	Monocrop coconut	-	9621	-	9621
	SEm	1036.84	661	1040.19	1089.54
	CD at 5 %	3135.22	1963	3145.35	3236.79

Table 4: Economics of intercropping of medicinal and aromatic crops in Coconut garden:

Crop combination	Gross returns (Rs. / ha)	Cost of cultivation (Rs. / ha)	Net returns (Rs. / ha)	B-C Ratio
Coconut + Citronella	1,60,170	51,300	1,08,870	2.12
Coconut + Lemon grass	1,50,545	53,200	97,345	1.83
Coconut + Palmarosa	1,35,605	48,200	87,405	1.81
Coconut + Patchouli	1,94,205	50,500	1,43,705	2.84
Coconut + Mango ginger	1,79,295	62,475	1,20,020	1.92
Monocrop Coconut	48075	18,425	29,650	1.60

Prevailing market prices of MAPs and coconut

S.No.	Name of the crop	Economic produce	Price (Rs/kg)
1.	Citronella	Green leaves	3.00
2.	Lemon grass	Green leaves	2.00
3.	Palmarosa	Green leaves with floral shoots	2.00
4.	Patchouli	Green leaves Dry leaves	5.00 25.00
5.	Mango zinger	Fresh rhizomes	6.00
6.	Coconut	Nuts	5.00/nut

CONCLUSION

It can be concluded from this experimentation that cultivation of patchouli followed by citronella as intercrops in coconut gardens were found more remunerative in terms of net returns and B: C ratio. Hence, these crops can be recommended as intercrops in coconut to the farmers of East Godavari areas in particular and Coastal districts of Andhra Pradesh in general for getting higher income.

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