



Culantro (*Eryngium foetidum* L.): A Profitable Intercrop in Arecanut Plantations for Diversification of Island Agriculture

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Abstract

Andaman and Nicobar Islands are a group of land masses in the Bay of Bengal, situated about 1200 km away from mainland India. Agriculture in these islands is dominated by plantation crops, arecanut being the popular one. However, mono-cropping is not desirable, especially in widely spaced crops within island ecosystems where land is limited. To optimally utilize land resources and improve profitability, experiment on arecanut based cropping system with culantro was initiated. Culantro is a popular aromatic herb used for imparting green coriander like aroma to the cuisines. Intercropping resulted in an additional yield of culantro (2.21 t/ha), increasing net returns to ₹ 13,03,065/- compared to ₹ 9,59,600/- from the sole arecanut crop. Quality of the culantro produced in terms of plant growth, photosynthetic pigments, ascorbic acid etc. was also determined. Hence, culantro could be recommended for cultivation as an intercrop in the arecanut plantations of humid tropical Andaman Islands.

Significance

Intercropping of culantro, an aromatic popular herb, was tested in the interspaces of arecanut to address the issue of limited land availability for crop cultivation in the Andaman Islands. Farmers' net income could be increased from ₹ 9,59,600/- in monocropping of arecanut to ₹ 13,03,065/- in intercropping with culantro.

Keywords *Areca catechu* · Bay Islands · Herbal Spice · Quality · Tropical

Andaman and Nicobar Islands in the Bay of Bengal is a fragile ecosystem characterized by the prevalence of plantation crops mainly coconut and arecanut. In recent years, the trend towards arecanut cultivation is increasing due to better price realization, limited input requirement, absence of major pests-diseases etc. and a large number of such plantations remained mono-cropped [1]. As the area available in these islands is a limiting factor, efficient use of land resource requires intensive cropping systems. Cost of cultivation in the islands is comparative higher due to several factors such as losses due to climatic irregularities [2], dependence on mainland supplies, fragmented cultivable area in different islands, higher labour charges, etc.

Culantro (*Eryngium foetidum* L.) is a low growing aromatic herb, which is grown in a number of tropical countries and utilized as a substitute to cilantro (leafy coriander- *Coriandrum sativum*) to impart refreshing aroma to the foods. The herb has been reported to contain 2.8–4.8% crude fat and 24.2–34.1% crude fibre besides being a source of vitamin A, C and minerals [3]. It is a popular crop in the Andaman Islands owing to its better shelf life, strong aroma, and hardy nature [4]. The herb fetches premium prices of about ₹ 300 to 500/- per kg in the island markets depending on the season. As such herbs are required in fresh form; continuous supply is desirable to meet the growing demands from the tourism sector as well as the local inhabitants. Appu [5] reported that culantro performs well in the shade of 75% intensity and hence, possibility of intercropping under plantation crops was advocated. Considering this, present study was carried out to know the performance of culantro under arecanut gardens of Andaman Islands.

The present investigation was carried out in a thirteen years old arecanut (var. Samrudhi) plantation located at Horticulture Research Farm, Sippighat, South Andaman Island, Andaman and Nicobar Islands, India. Mean monthly temperature (maximum 31.3 °C and minimum 25.2 °C), relative humidity (77.2%) and mean annual rainfall (3040 mm) were recorded during the study period. The soil in the

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experimental block showed following characteristics: pH (5.12), electrical conductivity (39.8 $\mu\text{S}/\text{cm}$), organic carbon (1.05%), total N (0.19%), available P (1.80 ppm) and available K (50.5 ppm). Arecanut was planted at $2.7 \text{ m} \times 2.7 \text{ m}$ on the hill slopes and terracing was done across the slope. Performance of sole crop of arecanut was compared with intercropping of culantro 'CIARI Broad Dhania-1'. Raised beds were prepared on the terraces in the interspaces of arecanut and culantro was planted on each terrace with a plot size of 29.2 m^2 (gross area) and 9.6 m^2 (net area) with five replications for each treatment.

Growth parameters of culantro such as no. of leaves per plant, mean leaf length (cm), mean leaf width (cm), mean plant weight (g) were determined using 20 plants when they attained maximum vegetative growth while still succulent. Moisture content (%) was estimated in triplicate using hot air oven at 105°C till constant weight was achieved. Ascorbic acid (mg/100 g) content was estimated using titrimetric method, while photosynthetic pigments viz. chlorophyll (Chl.) a (mg/g), Chl.b (mg/g), total Chl. content (mg/g) and total carotenoids (mg/g) were estimated using spectro-photometric method (125 mg leaf tissue in 6.25 ml of solvent) with dimethyl sulphoxide as the solvent and absorbance was recorded at 480 nm, 649 nm and 665 nm. The data was used for calculation using the formulae given in Wellburn [6]. Further, data on yield was recorded and cost economics for the treatments was calculated.

With the aim to optimally utilize the limited land resources and to improve profitability of farming in the

Andaman Islands, experiment on arecanut based cropping systems with culantro was conducted. In case of arecanut, yields of 4.23 t/ha was obtained in sole cropping, while it was 3.50 t/ha in case of intercropping treatment (Table 1a). Earlier study has reported yield range of 1.11 to 4.30 t/ha in the arecanut under island conditions depending on the intercrops studied viz. ginger, banana and elephant foot yam [1] and the values obtained in present study are in this range. Adoption of compatible intercrops could help in maintaining/ improving yield of main crop, which is a concern among some farmers who do not wish to take up intercropping assuming it would hamper the performance of the main crop. In the intercropping treatment, an additional yield of culantro was obtained (Fig. 1). Harvest data from two seasons indicated that green leaf yield in culantro of 0.11 t/ha was obtained during first season and it increased to 2.10 t/ha during second season. Cumulative yield of 2.21 t/ha was obtained from cultivation of culantro, when grown as intercrop. The crop is known to set seeds, which naturally fall on the ground and germinate thereby increasing the plant population after first harvest.

The crop is sold both with roots (uprooted plants) or without roots (leaves) in the markets of different regions, of which the former method is common in the island markets [4, 7]. In the present study, the percentage contribution of root weight in the total plant weight was $24.1 \pm 1.88\%$. This method of harvest, generally favours addition of biomass in the yield which is directly related to marketable produce available with the farmer as well as prolonging the shelf

Table 1 a Yields and economics of arecanut based cropping system under Andaman Island conditions

Treatment	Yield (t/ha)	Gross returns (₹)	Cost of cultivation (₹)	Net returns (₹)	Benefit: Cost ratio
T ₁ Arecanut sole crop	4.23	12,69,000/-	3,09,400/-	9,59,600/-	3.10
T ₂ Arecanut	3.50	10,50,000/-			
Culantro 'CIARI Broad Dhaniya 1'	2.21	6,62,040/-			
Total of T ₂	-	17,12,040/-	4,08,975/-	13,03,065/-	3.19

(Sale price of arecanut: ₹ 300/- per kg, culantro: ₹ 300/- per kg)

Table 1 b Growth and quality parameters of culantro grown as intercrop in arecanut based cropping system under Andaman Island conditions in comparison with previously reported systems

Parameters	System of cultivation		
	Present study	Open field	Pro-tray method
No. of leaves per plant	15.2 \pm 0.44	5.8 to 7.2	6.8 to 7.4
Mean leaf length (cm)	13.9 \pm 0.23	16.2 to 18.1	10.2 to 13.5
Mean leaf width (cm)	2.9 \pm 0.08	2.1 to 2.2	1.6 to 2.0
Mean plant weight (g)	22.0 \pm 1.27	8.3 to 10.0	2.8 to 5.7
Moisture content (%)	79.3 \pm 0.16	-	86 to 87
Chlorophyll a (mg/g)	1.33 \pm 0.078	-	1.5 to 2.5
Chlorophyll b (mg/g)	0.53 \pm 0.068	-	0.5 to 0.9
Total chlorophyll (mg/g)	1.86 \pm 0.134	-	2.0 to 3.4
Total carotenoids (mg/g)	0.24 \pm 0.015	-	-
Ascorbic acid (mg/100 g)	74.97 \pm 0.025	-	24 to 66
Reference	Present study	Mozumder et al. [9]	Horo et al. [7]



Fig. 1 General view of experimental block and harvested produce of culantro

life of produce due to intact roots. In such cases, the benefit of improved shelf life is also extended to the vendors and consumers.

The cost of cultivation in case of arecanut sole cropping was ₹ 3,09,400/- per hectare, which increased to ₹ 4,08,975/- per hectare in case of intercropping. However, incorporation of culantro in the interspaces could give higher net returns of ₹ 13,03,065/- as against ₹ 9,59,600/- in the arecanut sole crop. The benefit: cost ratio of this treatment was found to be 3.19 as against 3.10 in arecanut sole crop. Increase in seed rate is known to increase the yields in culantro [8]. As few plants in each bed are allowed to set seed and regenerate, the crop continues to increase in population and hence, higher yields in subsequent cycles could be expected. Earlier studies in Bangladesh have suggested that culantro has been identified as a profitable crop with high net benefits of \$34,348 per hectare and as a result of which it showed very high acceptability (86%) among the farmers there [8]. Considering the profitability of the crops in present study, it could be recommended for cultivation in the Andaman Islands, apart from opening avenues for its possible popularization in the arecanut growing belts of the country including coastal states and North-eastern India, wherein the herb has good potential.

The growth parameters of the culantro harvested from the intercropping was recorded and compared with other production systems reported earlier (Table 1b) i.e. open field condition [9] and novel pro-tray method [7]. The mean leaf production per plant was observed to be higher i.e. 15.2 ± 0.44 in present study, while it was 5.8 to 7.2 and 6.8 to 7.4 in open field and pro-tray method, respectively. Though leaf length in the present study (13.9 ± 0.23 cm) was lesser than the open field conditions reported earlier (16.2 to 18.1 cm), it was higher than the pro-tray system. Leaf width was comparatively higher in present study (2.9 ± 0.08) than both the reported systems. The mean plant weight, which is the prime component of yield, was found to be 22.0 ± 1.27 g and this value was much higher than the earlier reports i.e.

8.3 to 10.0 and 2.8 to 5.7. Moisture content of 79.3% was observed in the harvested produce in present study, which was lesser than the pro-tray method [7].

The photosynthetic pigments, which are important factors imparting greenness to the leafy produce [7], were determined in present study. Results suggested that 1.33 ± 0.078 mg/g of Chl. a, 0.53 ± 0.068 mg/g of Chl. b, 1.86 ± 0.134 mg/g of total Chl. and 0.24 ± 0.015 mg/g of total carotenoids were observed in the present study, indicating the superior quality of culantro produced in intercropping system. These values were lesser than the pro-tray method, which could be justified from the fact that pro-tray method was studied in protected condition. Ascorbic acid is an important component of the leafy greens including culantro and cilantro. In the present study, 74.97 ± 0.025 mg/100 g ascorbic acid was observed, which was much higher than that reported from Sikkim, India grown crop of culantro i.e. 18.33 to 32.33 mg/100g [3] as well as crop grown in pro-tray method [7].

It could be concluded that considering the better net profits of ₹13,03,065/- per hectare, culantro could be a profitable venture for the crop diversification of island agriculture. Further, the quality of culantro harvested from the intercropping system was found to be superior. Hence, the findings of present study emphasize upon adoption of intercropping over monocropping in arecanut in the land-constrained islands.

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Declarations

Conflict of interest The authors declare that they have no competing interests.

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