

ARECANUT (*ARECA CATECHU* L.) BASED HIGH DENSITY MULTISPECIES CROPPING SYSTEM IN WEST BENGAL *

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ABSTRACT

A study on the high density multispecies cropping models was taken up in an arecanut garden at Mohitnagar Research Centre during 1983. Nine different crops including annuals, biennials and perennials were tested for their suitability to grow in arecanut gardens, both under irrigated and rainfed conditions. Results of seven years study showed that all the crops can be grown satisfactorily in the interspaces of arecanut. Black pepper was found to be one of the most productive crops, while pineapple and turmeric were least productive. Arecanut, banana, black pepper and cocoa or acid lime can be a most profitable combination for the region. Due to high water table existing in the Research Centre all the crops including arecanut were found to perform well under rainfed condition except shallow rooted crops like betelvine and black pepper.

INTRODUCTION

Arecanut farmers grow different crops in areca garden to get some returns during the long prebearing period, to add to the meagre income from initial harvest of arecanut, as an insurance against pests and diseases and to meet the varied needs of the farming family (Sannamarappa and Muralidharan, 1982). Khader *et al.* (1990) reported that crops like black pepper, cocoa and banana can be grown to improve productivity and returns of areca gardens under Dakshina Kannada conditions. To introduce scientific cultivation and management of inter and mixed crops in arecanut gardens and to study the response of areca palms to such practices in West Bengal, high density multispecies cropping models were formulated and experimented upon.

MATERIALS AND METHODS

The experiment was started in 1983 in

a 16 year old arecanut garden at the Research Centre of Central Plantation Crops Research Institute, Mohitnagar, Jalpaiguri, West Bengal. Jalpaiguri is situated between 26° 16' to 27° N latitude and 88° 25' to 89° 53' E longitude with an elevation of 91.3m above MSL. The soil type is sandy loam with 1.5 per cent organic carbon in 0-50 cm depth, 30-45 kg/ha available phosphorus and 200-300 kg/ha available potassium.

Initially the experiment consisted of 3 models, each comprising of 2 blocks having 304 areca palms planted at a spacing of 2.7 x 2.7 m. In each model, one block of 304 palms was irrigated and the other was maintained as rainfed. Subsequently in 1986, two more models were included. Each model had an irrigated and a rainfed block with 152 palms in each. The crops planted in each model are given in Table 1 (Layout in Fig. 1).

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Black pepper and betelvine were trained on to areca palms wherever they were included as mixed crops. Banana and other intercrops in different models were planted in alternate rows at a distance of 2.7 metres. Turmeric was planted in one square metre beds in both areca and intercrop rows with a spacing of 25 x 25 cm. Turmeric growing season extended between April and December of each year.

Arecanut palms received 10 kg of FYM each during September-October along with half

the quantity of 100 g N, 40 g P_2O_5 , and 140g K_2O in the form of urea, super phosphate and muriate of potash respectively. The remaining half of chemical fertilizer was applied during March-April. All the intercrops were fertilized separately with the recommended doses of fertilizer every year. During December to March, irrigation was given at fortnightly intervals as per treatment.

Plant protection measures adopted consisted of regular sprays of endosulfan (0.05%) for cocoa defoliators, quinalphos (0.05%) for acid

Fig. 1 Layout of high density multispecies cropping models at Mohitnagar (the diagram does not represent actual no. of palms)

- Arecanut with pepper
- Banana
- Cocoa, acid lime, coffee or cinnamon as per the model. In model III pineapple beds in alternate rows.

Turmeric in Model IV and V in the interspaces of arecanut, banana and coffee or cinnamon.

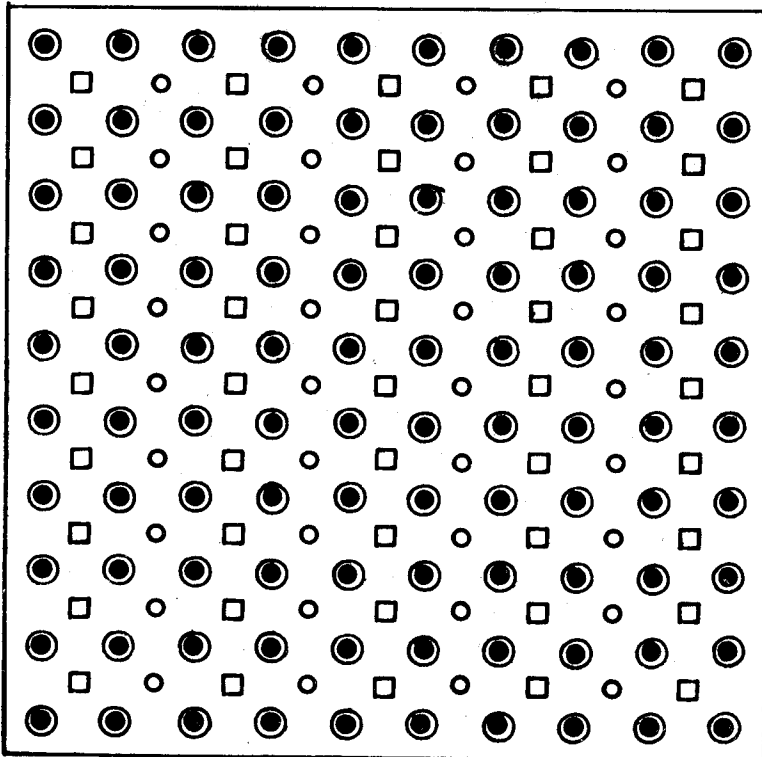


Table I. Crop species, spacing, plant population and fertilizer schedule of crops grown with arecanut at Mohitnagar

Crop	Spacing m	Models					Fertilizer			FYM ² kg/palm
		I	II	III	IV	V	N	P ₂ O ₅ g/palm or tree	K ₂ O	
		population/ha					g/palm or tree			
Arecanut	2.7x2.7	1300	1300	1300	1300	1300	100	40	140	10
Black Pepper	2.7x2.7	1300	1300	—	—	—	100	40	140	—
Banana ¹	2.7x5.4	685	685	685	685	685	160	160	320	20
Cocoa	2.7x5.4	685	—	—	—	—	100	40	140	—
Acid Lime	2.7x5.4	—	685	—	—	—	300	250	500	20
Betelvine	2.7x2.7	—	—	1300	—	1300	100	40	140	20
Pineapple	35x35x90cm	—	—	17256	—	—	8	4	8	1.5
Coffee	2.7x5.4	—	—	—	685	—	50	40	50	—
Cinnamon	2.7x5.4	—	—	—	—	685	100	90	300	—
Turmeric	25x25 cm	—	—	—	50700	50700	30	30	60	1.0

¹In model-I variety Chinichemba, in Model-II variety Malbhog and in model-III variety Kachchakola. Black Pepper - variety Panniyur - 1, Betelvine - variety Gaach Paan, and Pineapple - variety Kew

²Farm yard manure

lime leaf miner and cinnamon flea beetles and monocrotophos (0.05%) for coffee scales. Pineapple was removed during 1989 as the yields were low and the quality was poor. Yield data of all the crops were collected.

Depth of water table observation

Wells were dug in the month of December, 1989 at three different spots to represent the whole garden to monitor the water table and to measure capillary fringe. Initially wells were dug until water level was reached. Then the water table was measured after 24 hours after digging. Digging was continued once every month as the water table receded. Water table was monitored during 1990-91 also.

RESULTS AND DISCUSSION

Climate

The average rainfall at Mohitnagar Centre is above 300 mm per annum which occurs from April to the end of September (Fig. 2). Maximum amount of rainfall is received during the month

of July. The maximum and minimum temperatures vary between 25 to 35°C and 5 to 22°C respectively.

Although the total rainfall is very high, the potential evapotranspiration curve indicates that from November to middle of April there is moisture deficit which suggests that crops may suffer from lack of moisture during these months.

Depth of Water Table and Capillary Fringe

During 1989-90, the water table was at a depth of 1.8 metres during the month of December (Fig. 1). Subsequently, it went down to 2.9 metres in April, which was the maximum depth that the water table has reached. During the 1990-91 season the water table was monitored from October. Water table was at a depth of 1.38 m during October, and reached a maximum depth of 3.0 m. The capillary fringe extended upto 60-70 cm above the water level.

Performance of various intercrops

All the crops studied established well in

Fig. 2. Weather data and climatic water balance for Mohitnagar (West Bengal)

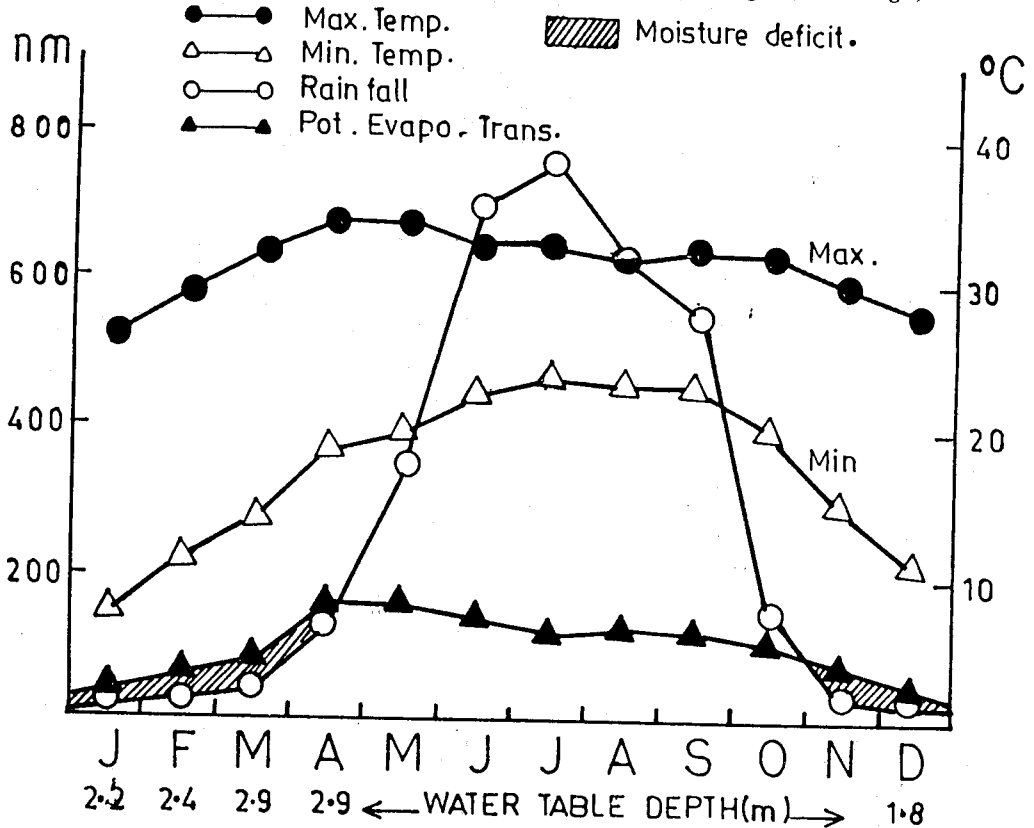


Table II. Yield* pattern of intercrops in the High Density Cropping System at Mohitnagar

Crop	Plant population per ha.	Year						
		1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	1989-90
1. Banana (kg/ha)								
i) Chenichempa	580	148	4144	2508	2425	109	2300	1042
ii) Malbhog	580	35	3247	2530	2268	—	2020	1198
iii) Kachchakola	580	—	2355	2194	1715	—	2080	2493
2. Black pepper (dry-kg/ha)	1300	—	—	19	73	287	598	1350
3. Cocoa pods (kg/ha)	580	—	—	—	1358	1659	3193	1917
4. Acid lime (nos/ha)	580	—	—	16170	20417	18044	25209	29997
5. Betelvine (nos/ha)	1300	—	—	—	32775	273026	152874	245081
6. Turmeric (kg/ha)	—	—	—	—	843	813	1525	1917
7. Coffee (kg/ha)	580	—	—	—	—	—	—	8.0
8. Cinnamon bark (kg/ha)	580	—	—	—	—	—	—	1.6

* to show the yield potential of the crop, Maximum yields recorded are presented. Mean yields are presented in Table IV.

the areca garden as indicated by their visual growth and yield pattern (Table II). The banana varieties studied produced maximum yields of 2000-4000 kg/ha depending on the variety in second year itself, and the yields decreased after third year. In model-I, where banana was grown along with black pepper and cocoa, during sixth year it was found to be growing tall and its productivity reduced. This is probably because as black pepper and cocoa canopy developed there was competition for light at lower levels. Abdul Khader et al. (1990) also recorded similar observation on the performance of banana in areca garden.

Black pepper started yielding from third year and a maximum yield of 1350 kg/ha dry pepper was obtained by seventh year, which is more than a kilogram per vine. Black pepper did not show any pest and disease problem until 1990; therefore, no plant protection was undertaken. However, during 1990 slow wilt symptoms appeared and about 30 per cent of vines died. It will be imperative to take appropriate sanitary and plant protection measures to prevent the disease, and for successful growth of black pepper in arecanut gardens.

Cocoa commenced yielding from fourth year and produced a maximum yield of 3193 kg pods/ha during third year of bearing. Acid lime started yielding from third year and a maximum yield of 29,997 fruits per ha were harvested during fifth year of bearing. Betelvine leaves were harvested starting from fourth year. A maximum of 2,73,026 leaves were harvested during the fifth year after planting. Although vegetative growth of turmeric was good, the yields were poor as only a maximum of 2 tons of turmeric was harvested. Cinnamon and coffee started yielding from 1989-90 only and produced 1.6 kg bark and 8.0 kg beans respectively.

Effect of irrigation

Arecanut yield data indicated that irrespective of the treatment imposed i.e., both irrigation and intercrop, there is year to year variation in arecanut yield (Table III). The mean yield of six years indicated that the response to irrigation varied considerably among different models. Irrigation increased the yield of arecanut in model-I and III by 18.4 and 7.3 per cent respectively, while it decreased the arecanut yield

Table III. Effect of intercropping on arecanut yields in kg/ha at Mohitnagar

Model	Year						Mean
	1983-84	1984-85	1985-86	1986-87	1987-88	1988-89	
I Irrigated	1470	1780	1860	2300	1510	1880	1830
Rainfed	1480	1480	1520	1890	1240	1530	1590
II Irrigated	1520	1610	1950	2780	1320	2370	1990
Rainfed	1850	1550	1970	2610	1440	2310	2010
III Irrigated	1390	1600	2280	2960	1700	3320	2210
Rainfed	1360	1370	1950	2730	2040	2830	2110
IV Irrigated	—	—	1590	2050	1790	2980	2060
Rainfed	—	—	2250	2570	1860	2980	2350
V Irrigated	—	—	1390	2650	1220	3030	2040
Rainfed	—	—	1460	2810	1540	3030	2200
Control	1320	970	1150	1730	1080	2140	1390

in models II, IV and V by 1.5, 12.9 and 6.4 per cent respectively. Although these differences could not be checked statistically, it is likely that the positive response to irrigation in model I was due to relatively low water table, and also due to competition from cocoa. The decrease in yield could not be attributed to poor drainage as both irrigated and rainfed plots had similar water table and the amount of irrigation water applied is unlikely to cause water stagnation. Therefore, these responses could not be explained with the available data.

The yield data of intercrops in different models as influenced by irrigation is presented in Table IV. From the data it can be seen that irrigation increased the yield of black pepper by 43.9 per cent, cocoa by 11 per cent, betelvine by 43 per cent, banana by 20 per cent while the yield of acid lime and turmeric was decreased by 6.9 and 9.6 per cent respectively. However, as mentioned earlier, turmeric growing season extends between April and December; therefore, the crop is not irrigated. Although the irrigation responses could not be verified statistically due to lack of replicated data, it does suggest that

shallow rooted crops responded to irrigation more consistently than the deep rooted crops due to high water table.

The climatic water balance chart (Fig. 1) indicated that the water deficit occurs during November to April, however, the magnitude of deficit is small probably due to the low radiation load as indicated by the low mean maximum and minimum temperatures during that period. Secondly, the ground water table was within the reach of arecanut and other deep rooted crops (arecanut 2.0 metres, cocoa 1.9 metres, acid lime 1.2 metres root depth) that supplied adequate moisture through capillary fringe of about 0.5 m in these soils. Therefore, it is likely that deeprooted crops do not experience drought while shallow rooted crops may experience drought due to drying of surface layers of soil.

Effect of intercropping on arecanut yield

A comparison of the arecanut yields of different models with monocrop of arecanut (Table III) revealed that the yield of arecanut in all the models was higher than the monocrop of

Table IV. *Effect of irrigation on yield¹ of different intercrops in HDMSC system at Mohitnagar*

Crops	Irrigated	Rainfed
1. a. Arecanut (Chali kg/ha)	2025	2056
b. Black pepper (kg/ha)	827	513
2. Cocoa pods (kg/ha)	2256	2078
3. Betelvine (nos. of leaves)	190495	132854
4. Acid lime (nos.)	19187	20604
5. Banana (kg/ha)		
i) 'Chini champa'	2300	1940
ii) Malbhog	1680	1540
iii) Vegetables	2080	1570
6. Turmeric (kg/ha)	1634	1808

¹Yield of all crops except arecanut and black pepper represents is mean yield for three years; Arecanut 6 years average and Black pepper two years.

Table V. *Effect of intercropping on arecanut yield at Mohitnagar*

Model	Irrigated		Rainfed	
	r	b	r	b
I	0.52	0.0188	-0.31	-0.008
II	0.19	0.0058	+0.27	0.006
III	0.69	0.0342	0.82*	0.051
IV	0.96**	0.0785	0.79	0.056
V	0.92**	0.0593	0.81*	0.057
Control	—	—	0.21	0.006

*, ** indicates significance at 0.05 and 0.01 level respectively

arecanut. The effect of growing of intercrops on arecanut yield in each model was studied by regression analysis (Table V). In this, the number of years after introducing intercrop was taken as independent variable which will represent the age of the intercrop, while the arecanut yields were taken as dependent variable. It is interesting to note that in all models under both irrigated and rainfed conditions, except in Model-I under rainfed condition, arecanut yields were increased as indicated by positive 'r' and 'b' values. However, in Model-I and II these values have not reached significant level. Similarly, under rainfed conditions in Model I, growing intercrops seemed to have lowered arecanut yield, but the negative effect has not reached significance level.

The better performance of arecanut in intercrop situation can be attributed to the fact that all the intercrops are receiving optimum doses of fertilizers as though they are growing as

monocrops. Secondly, a large amount of biomass is being recycled in intercrop situations which will be considerably low in a monocrop situation. This biomass recycling also adds to the nutrient balance of the system. Abdul Khader et al. (1990) reported nutrient build up in terms of P_2O_5 and K_2O due to intercropping in arecanut gardens.

In summary, all the crops studied can be successfully grown as intercrops without any detrimental effect on arecanut. However, considering the economic value of black pepper, its inclusion as an intercrop would make the system more remunerative. High labour input and poor yields of turmeric and poor quality of pineapple would make these crops unremunerative. Therefore, a model consisting of arecanut, banana, black pepper, and cocoa or acid lime can be a most profitable combination for the region. However, depending upon individual needs and marketing facility, other combinations can be grown successfully. Irrigation is necessary when shallow rooted crops are included in the system.

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