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Journal of Plantation Crops, 2003, 31 (1) : 23-27

High density multi species cropping system for root (wilt) affected coconut gardens – Its impact on productivity and economic viability

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(Manuscript Received : 10-7-2002; Revised : 12-8-2002; Accepted : 12-8-2002)

Abstract

A field experiment was conducted at Central Plantation Crops Research Institute (Regional Station), Kayangulam to study the impact of high density multi species cropping system in root (wilt) affected garden on productivity and economic viability. It is evident from the result that, the system productivity was higher and there was increase in the nut yield of coconut from 30 nuts per palm per year (pre-experimental) to 75.8 nuts per palm per year during 2000-2001. The intercrops/mixed crops like banana, pineapple, pepper, nutmeg and tuber crops performed very well and provided additional yield and income. The higher benefit : cost (B:C) ratio of 2.28 indicated higher additional return for the investment and higher positive Net Present Worth (Rs.180106 ha^{-1}) indicated that high density multi species cropping system is economically viable in root (wilt) affected area. By adopting the system, there was stabilized income for coconut farmers even during lower price prevailing for the coconut.

Key words: Coconut, cash flow analysis, economics, HDMSCS, productivity, root (wilt)

Introduction

Coconut (*Cocos nucifera* L.) is a high value plantation crop grown in an area of 1.91 million hectares with the production of 15,000 million nuts in India (Ninam, 2001). In recent years, many coconut farmers have suffered economic difficulties due to unstable copra prices in the world and local markets. Being a small farmers' crop in India, it does not provide adequate income and gainful employment to the dependent families. The productivity of coconut in Kerala is as low as 6188 nuts per hectare mainly because of the prevalence of root (wilt) disease, scientific agro-techniques not being practised in majority with crop being rainfed. Coconut root (wilt) disease is a non-lethal, debilitating malady that affects the production potential of the palm. The disease is caused by phytoplasma, a vascular limited pathogen. The disease is prevalent in all districts of Kerala in varying severity, in parts of Tamil Nadu bordering Kerala and in Goa. There is no therapeutic control measures for the disease. However, research efforts have resulted in evolving viable technologies to increase the productivity of the diseased palms.

Studies have revealed that, sole crop of coconut spaced at 7.5 x 7.5 m apart effectively uses only 22.3 per cent of land area occupied by the crop while the average air space utilization by the canopy is about 30 per cent and solar radiation interception is 45-50 per cent. Adoption of coconut based intercropping/ mixed cropping systems is one of the ways to utilize the natural resources effectively. The potential for increasing the productivity per unit area of land, time and inputs through high density multi species cropping system (HDMSCS) is considerably higher in perennial crops (Bavappa and Jacob, 1982). Bavappa *et al.* (1986) reported the advantages of HDMSCS involving compatible crops in coconut with the increase in yield of coconut by 176 % and additional income.

With the above background, the work on

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HDMSCS under root (wilt) affected garden is meager and hence a study was initiated to evolve a suitable HDMSCS model, and to analyse its impact on productivity of the system and its economic viability.

Materials and Methods

The experiment was carried out at Central Plantation Crops Research Institute, Regional Station, Kayangulam, which is situated at 9° 8' N latitude and 76°31' E longitude at an elevation of 3.05 m above mean sea level. The experimental area receives an annual rainfall of 2580 mm, with the mean maximum temperature ranging between 29°C to 32.9°C and mean minimum temperature of 20.6 °C to 24.9 °C.

The soil of the experimental field is red sandy loam with low fertility and is acidic in nature (pH 5.5). The Mechanical composition of the soil is with 69% fine sand, 18.9% coarse sand, 8.9% clay and 3.2% silt.

HDMSCS Model

High density multi species cropping system model with different crops was initiated in an area of 1.0 ha of coconut root (wilt) affected garden during 1993-94. The coconut palms were of different age group: 10-15 years: 10 palms, 16-20 years: 36 palms, 21- 30 years: 19 palms, >31 years: 60 palms.

Coconut palms were indexed for root (wilt) disease as per the procedure given by George and Radha (1973). Of the total palms 15% were apparently healthy, 23% were Disease Early, 52% were Disease Middle and 10% were Disease Advanced palms. The disease advanced palms yielding less than 10 nuts per palm per year were removed and under planted with seedlings. The crops with their population is given in the Table 1 and the plan and layout of different crops is given in Fig.1.

Table 1. Crops with their population in HDMSCS in coconut root (wilt) affected garden (1.0 ha area).

Crops	Population
Coconut : Adult (West Coast Tall)	**125 Nos.** (1995-1998) 112 Nos.(1998-2001)
Seedling/Juvenile	152 No.
Nutmeg (local)	45 Nos.
Pepper (Karimunda)	30 Nos.
Banana: (Poovan, Njalipoovan, Robusta, Nendran, Palayankodan, Karpooravalli)	500 Nos.
Pineapple (Kew)	3600 Nos.
Tuber crops: *Amorphophallus* (Local)	100 Nos
Colocasia (Local)	100 Nos.
Dioscorea (Local)	100 Nos.

For coconut, the packages of integrated root (wilt) management practices recommended by CPCRI (RS)

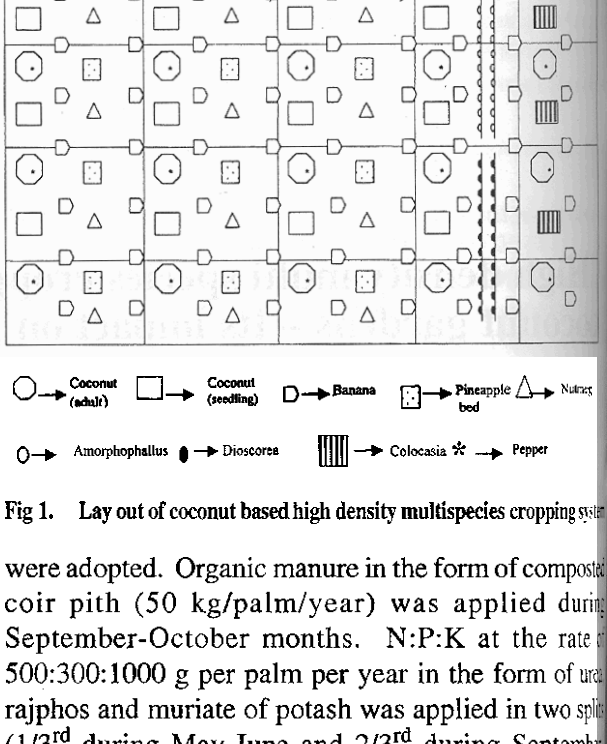

Fig 1. Lay out of coconut based high density multispecies cropping syst

were adopted. Organic manure in the form of composte coir pith (50 kg/palm/year) was applied durin September-October months. N:P:K at the rate 500:300:1000 g per palm per year in the form of ure rajphos and muriate of potash was applied in two spli (1/3rd during May-June and 2/3rd during Septembe October). $MgSO_4$ at the rate of 1 kg per palm w applied. Green manure crop-Cowpea was grown in th coconut basins during monsoon period and incorpora during September-October months. Recommended pe and disease control practices were adopted as per t schedule. For component crops, the package of practic recommended as per the Kerala Agricultural Univers were adopted (KAU,1996). Hose irrigation was provid during initial years and later perfo irrigation was adopt and water to a depth of 20 mm was provided at the I CPE ratio of 1.0.

Inputs and output

A record of the quantities of the inputs such manures, fertilizers, plant protection chemicals, labo used for establishing and sustaining the model w maintained. Harvesting of the economic produce w done at appropriate stages and the yield recorded fr 1.0 ha area. The market rates for both inputs and outp for the corresponding years, were considered to estim the economics of the system for one-hectare area. Mar prices of different produces during the year 2000-20 was as follows: Coconut @ Rs. 3.75 per nut, Banana Rs. 11 per kg, Pineapple @ Rs. 11 per kg, Pepper @ R 120 per kg, Nutmeg:Mace @ 275 /kg and seed @ R 175/kg, Tuber crops @ Rs. 5 per kg. Tabular analys was performed to identify the individual share of fact of production in the total cost including the annuity val Based on the total returns and total cost, gross mar

worked out. Cash flow analysis (Das, 1982) was ertaken, using a discount rate of 12 per cent which the bank interest rate for the opportunity cost for stment.

Results and Discussion

ld of different crops

The yield of coconut and other component crops e system over the years is given in the Table 2. Over years, there was increase in the yield of different crops e system.

Performance of component crops

Average yield per plant of different crops grown in the system is given in Table 3. Among banana varieties studied, palayankodan and karpooravalli varieties produced highest yield per plant. Pineapple crop also produced on an average 1.2 to 2.0 kg fruit yield. Tuber crops such as *Amorphophallus, Dioscorea* and *Colocasia* also performed very well in the system and provided additional yield. Sadanandan *et al.* (1979) also reported increase in yield and income by growing tuber crops in root (wilt) affected garden. Pepper and nutmeg also started yielding and the yield was very good in the system. Under arecanut based HDMSCS also good performance of pepper, banana, pineapple has been described by Bhat *et al.* (1999) and Ray *et al.* (2000).

2. Yield of coconut and component crops in HDMSCS from 1.0 hectare area over the years

	Coconut (nuts/year)	Banana (kg)	Pepper (kg)	Pineapple (kg)	Nutmeg (kg) Mace	Nutmeg	Amorpho. (kg)	Dioscorea (kg)	Colocasia (kg)
94	6149	975	-	-	-	-	280	310	205
95	6225	823	-	280	-	-	310	285	235
96	6115	912	25	385	-	-	230	260	
97	6364	876	26	288	-	-	390	237	230
98	6053	660	28	320	5	8	350	260	
99	4848	1339	32	298	8	13	360	289	187
00	6042	1102	28	315	12	20	355	305	
01	8486	1030	26	268	14	23	302	387	

onut

There was an increase in the nut yield of coconut the years. During 2000-2001, increase in yield was e extent of 100%, 110%, 105% and 18% under rently healthy, disease early, disease middle and se advanced palms respectively compared to pre-rimental yield. The average yield obtained during 0-2001 in the garden was 75.8 nuts per palm per year pared to pre-experimental yield of 30 nuts per palm ear. Probable reasons for increase in nut yield was o the overall influence of integrated management ices for coconut and changes in microclimate due ixed cropping (Bavappa *et al.*, 1986, Nair and krishanan, 1977). Addition of organic manure, ing green manure crops in the coconut basins might improved the soil characteristics, which have ive influence on growth and yield of nut. Such a icial influence has been reported by many workers conut and high density multispecies cropping system n., 2000; Thomas and George, 1990; Khader *et al.*, Liyanage and Dassanayake, 1993). Overall, the (wilt) index of different palms did not change, but was reduction in flaccidity and yellowing of the s, which was mainly due to the application of tion and $MgSO_4$. Effective control measure for leaf isease also resulted in increase in photosynthetic nd in turn benefited growth and nut yield.

Table 3. Average yield of different crops in coconut based HDMSCS.

Crops/Variety		Yield/plant
Banana:	Poovan	15-20 kg/bunch
	Njalipoovan	14-19 kg/bunch
	Robusta	12-17kg/bunch
	Nendran	13-18 kg/bunch
	Palayankodan	20-24 kg/bunch
	Karpooravalli	22-25 kg/bunch
Pineapple (Kew)		1.2-2.0 kg/fruit
Amorphophallus (Local)		7.5-10.0 kg/plant
Dioscorea (Local)		5.5-7.0 kg/plant
Colocasia (Local)		3.0-4.0 kg/plant

Economics

The details of input cost for one ha of the system are furnished in Table 4. Over the years, total cost of production has increased due to increase in labour cost which is the major constituent of cost of inputs. The total cost during the initial year was Rs. 28,950/- (1993-94) and it went up to Rs.37,250/- per hectare during 2000-2001. In the input cost, the labour cost alone constituted 56 per cent of the total cost, which indicates that the labour requirement was more in high density multi-

Table 4. Details of input cost for coconut based HDMSCS (Rs./ha)

Year	Planting material	Org./chem. fert.	Plant protection	Labour	Irrigation/ Misc.	Annuity	Total Cost
1993-'94	10500	2600	1100	12500	750	1500	28950
1994-'95	1000	3000	1500	12200	800	1500	20000
1995-'96	1100	3500	1600	13100	800	1500	21600
1996-'97	1200	7700	1800	14200	900	1500	27300
1997-'98	6200	8200	1950	16000	950	1500	34800
1998-'99	1200	9100	1975	17600	1000	1500	32375
1999-'00	1200	9800	2100	18200	1000	1500	33800
2000-'01	1400	10100	2200	21000	1050	1500	37250

species cropping system wherein planting and replanting operations need to be taken up in addition to normal operations. Hence adoption of coconut based HDMSCS provides additional employment for the farming family. In the system, crops like pineapple requires more labour for weeding and fertilizer application.

The total returns from the system are furnished in Table 5. From the data it can be clearly seen that, the total return from the system was Rs.54,920/- during 1993-94 which increased to Rs.84,430/- during 2000-2001 per hectare. During the period of 1999-2000 and 2000-2001, the price of coconut was very low and resulted in lower returns from coconut, whereas returns realized from intercrops was Rs. 31,180/- and Rs. 30,180/- per hectar respectively. This indicates that, the system was able provide more stabilized income to coconut farmers. Tr net return obtained from the system was Rs.25,97(during 1993-94 and it was Rs.47,180/- during 20(2001/-.

Cash flow analysis was performed using a discou rate of 12 per cent to assess the economic viability of th system (Table 6). The analysis indicated that the syste realized highly positive values of discounted increment benefit. The benefit: cost ratio (BCR) and net prese worth (NPW) of 2.28 and Rs. 1,80,106, respectivel indicated the additional return and economic worthine

Table 5. Details of returns of various component crops and economic analysis of coconut-based HDMSCS (Rs/ha)

Year	Coconut*	Banana	Pepper	Pineapple	Nutmeg	Tuber crops	Miscellaneous	Total returns"	Net returns
1993-'94	36587	9750	-	-	-	5080	3500	54920	25970
1994-'95	37038	8230	-	2867	-	4922	3500	56560	36560
1995-'96	38509	10032	3750	3850	-	3810	3800	63750	42150
1996-'97	40163	9636	3900	3168	-	5325	3800	65990	38690
1997-'98	42350	7260	3500	3520	2450	4726	3950	67760	32960
1998-'99	31609	14729	4000	3278	4475	5112	4000	67200	34830
1999-'00	37730	12122	3500	3465	7280	4810	4200	73110	39310
2000-'01	49744	11330	3120	2948	7875	4908	4500	84430	47180

*Coconut return was worked out for 175 adult palms/ha.
"Rounded figures

Table 6. Cash-flow analysis of coconut based HDMSCS in a root (wilt) affected garden (Rs/ha)

Year	Total Cost	Total Return	Cost	Discounted Return	Margin
1993-'94	28950	54920	25848	49036	23188
1994-'95	20000	56560	15944	45089	29145
1995-'96	21600	63750	15374	45376	30002
1996-'97	27300	65990	17350	41938	24588
1997-'98	34800	67760	19746	38449	18702
1998-'99	32375	67200	16402	34046	17643
1999-'00	33800	73110	15289	33071	17782
2000-'01	37250	84430	15045	34100	19055
Total	140999	321104	180106		
Benefit:Cost Ratio					2.28
Net Present Worth					180106

le system under root (wilt) affected area. Sairam *et* 1999) also reported stabilized income from coconut d HDMSCS under Kasaragod region of Kerala.

From this study it can be concluded that adoption coconut based HDMSCS helps to realize better ility for the gross farm income and additional loyment to the farming community.

Acknowledgements

The authors are grateful to Head, CPCRI (RS), angulam, Director and Head (Division of Crop duction), CPCRI, Kasaragod for the support given ng the study and the work initiated by Mr. Chacko thew and Mrs. Sumathi Kutty Amma (Retd. ntists) is highly acknowledged. The technical stance of Mrs. Rema Bai and Mrs. K. Bhanumathy atfully acknowledged.

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