INTERCROPPING IN COCONUT GARDEN

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INTERCROPPING IN COCONUT GARDENS

Coconut is primarily a crop of small and marginal farmers. In Kerala, the average size of a holding is as small as 0.2 ha and about 98% of the holdings are below 2 ha in size. Coconut is cultivated mostly under rainfed condition and the income derived from the holdings is insufficient to sustain even small families. In addition, coconut as a monocrop does not provide adequate on-farm employment for family labour. One of the feasible ways to step up production and enhance the family income is to grow compatible annual or perennial crops in association with coconut. This, besides giving immediate returns, will also meet the varied needs of the farmer and provide gainful employment to family labour.

Scope for intercropping in coconut gardens

There is vast scope for multiple cropping in coconut gardens. Some of the features which favour inter/mixed cropping are:-

1. *Soil space availability:* It has been found that active roots of adult palms under good management are concentrated within a radius of 1.8 m from the bole, and vertically from 30 to 120 cm soil depth. Thus, roots of coconut palms spaced at 7.5 m apart effectively forage only 23% of the soil surface. Hence, the remaining space could be utilized for intercropping.

2. *Sunlight availability:* Coconut being a widely spaced crop, considerable amount of solar radiation reaches the ground depending upon the age of the palms. It has been reported that a mature palm actually intercepts only 40% of the total solar radiation. The best use of the remaining solar radiation could be made possible only by raising subsidiary crops. Coconut gardens thus offer the best opportunity for growing a variety of crops in the interspaces.

Advantages of intercropping

1. Better utilization of natural resources and applied nutrients
2. Improvement of soil fertility
3. Reduces risk of soil erosion
4. Better control of weeds
5. Increases productivity of palms
6. Provides additional employment for the family
7. Increases the income of the farmer
8. Provides safeguards against market risks

Effect of intercropping on the productivity of coconut palms

Unlike in annual crops, intercropping in coconut does not affect the productivity of the main crop. The selection of crops should be such that they make best use of the natural resources without unduly competing with coconut. Although the intercrops may not compete with coconut for light, they are likely to compete for soil moisture and nutrients. If these two inputs are supplied as per the requirements of various intercrops, there may not be any adverse effect on coconut yield.

Based on the growth and canopy development, the life span of the palm could be divided into three distinct phases from the point of view of intercropping. The first phase (upto 8 years) starts from planting till the full development of canopy. During this period, when the canopy size increases gradually, the interspaces could be utilized for growing annuals or other short duration crops which would not compete with the developing coconut palms for their requirements. The period from 8 to 25 years is the second phase when the coverage of the ground by the coconut canopy is about 90% and the crown is low due to short trunk height. There is little or no scope for growing other crops in the interspaces during this period. After about 25 years of age, there is a gradual decrease in apparent ground coverage with increase in trunk height and reduction in crown size which facilitates greater penetration for sunlight to reach the ground. This period is ideal for intensive intercropping.

Soil type and climate for intercrops

In the humid tropics coconut is mostly grown in sandy loam and lateritic soils. In these soils various crops can be successfully grown without causing any deleterious effect on coconut. Some of the intercrops benefit the soil by enriching it with nutrients directly or indirectly.

The amount and distribution of rainfall plays a vital role in selection and successful production of intercrops. In areas where rainfall is well distributed, long duration crops like elephant foot yam, cassava, banana, turmeric, ginger, etc. are most successful. In northern parts of Kerala, although the average annual rainfall is around 3500 mm, about 75 percent of it is received during the south west monsoon i.e. June to August. From November onwards, practically there is no rain. Thus, under such situations, shade tolerant crops which are less susceptible to moisture stress should be preferred.

Crops suitable for intercropping

A compatible intercrop is one which produces fairly high yields without reducing coconut productivity. By growing suitable intercrops, farmers can get substantial income and also meet their food requirements.

Several crops have been tested for their suitability as intercrops in coconut plantations at the Central Plantation Crops Research Institute, Kasaragod (Appendix I). They include cereals - paddy and millets; pulses - green gram, cowpea, horse gram and soybean; oilseeds - groundnut, sesamum and castor; tubers - cassava, elephant foot yam, sweet potato, chinese potato, colocasia, greater yam and lesser yam; rhizomatous spices such as ginger and turmeric; and fruit crops like banana and pineapple.

Of the several crops mentioned above, tropical tubers like cassava, elephant foot yam, colocasia, yams and sweet potato and fruit crops like banana and pineapple are commonly grown in association with coconut. They tolerate shaded conditions to a considerable extent, giving substantial yield. These crops with low water requirement and less susceptibility to diseases and pests ensure sufficient additional income at low cost of production. Another important reason for their popularity is that while coconut gives cash income to the farmer, the tubers grown as intercrops partially meet his food requirements.

Management of intercrops

The details of management practices to be adopted for various intercrops are summarized in Table 1 and planting pattern is depicted in Fig.1. The sowing time and growing period of intercrops is shown in Fig.2. The other cultivation details are summarized below.

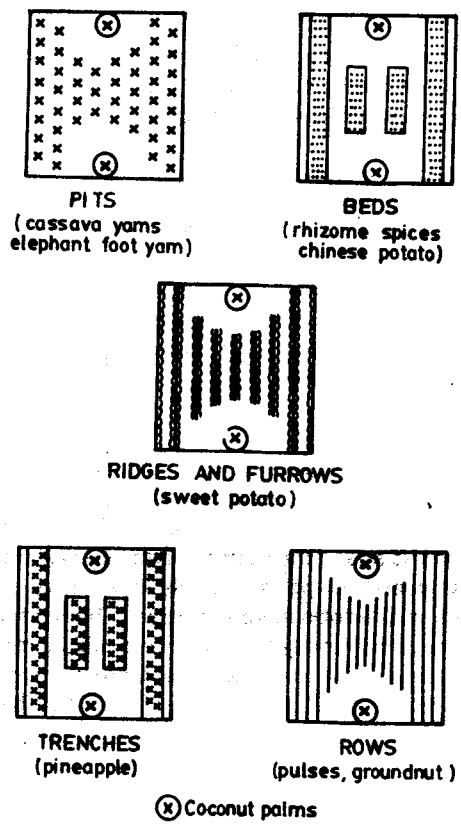

Fig.1. Planting patterns for different intercrops

Table 1: Cultivation details of the intercrops

Sl. No.	Intercrops	Method of planting	Spacing	Gross area utilized by the intercrop (%)	Fertilizer dose (kg/ha) (for gross area of coconut) (N	P_2O_5	K_2O)
1.	Cassava	Mounds	1.0 m × 1.0 m	80	80	80	80
2.	Elephant foot yam	Pits	1.0 m × 1.0 m	80	65	50	80
3.	Greater Yam	Pits	1.0 m × 1.0 m	80	65	50	65
4.	Lesser yam	Pits	0.75 m × 0.75 m	80	50	50	65
5.	Chinese potato	Beds	20 cm between plants	70	45	45	70
6.	Sweet potato	Ridges and furrows	50 cm × 15-20 cm	70	55	30	55
7.	Ginger	Beds	25 cm × 25 cm	65	50	45	45
8.	Turmeric	Beds	25 cm × 30 cm	65	20	20	40
9.	Upland rice	Rows	20 cm between rows	80	65	50	65
10.	Banana	Pits	2.7 m × 2.7 m	80	160	160	320*
11.	Pineapple	Trenches	70 cm between rows and 30 cm between plants	80	8	4	8*

*g per plant

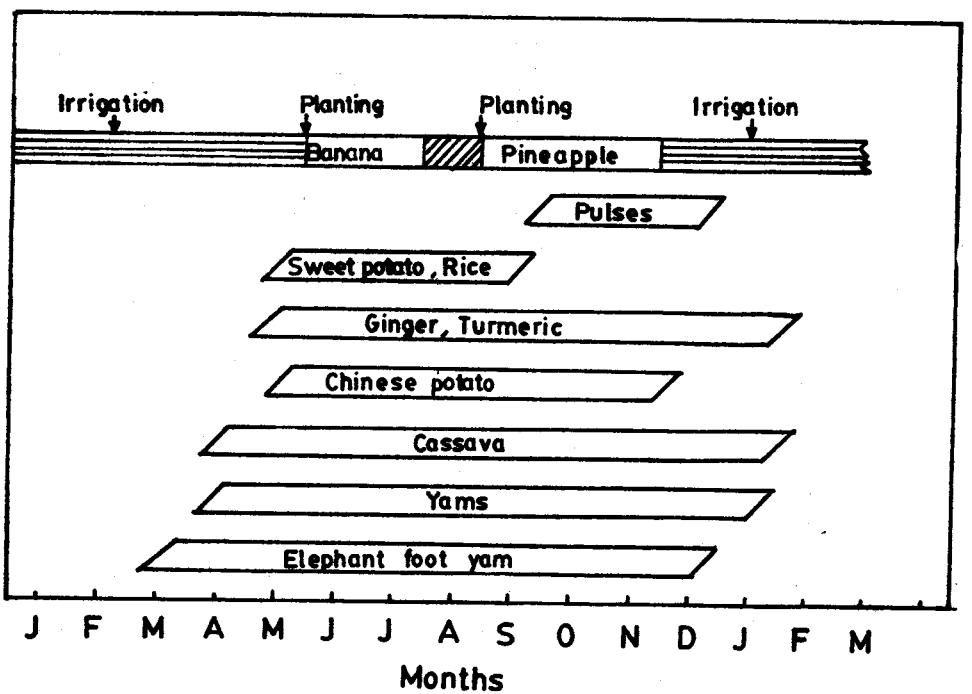

Fig.2. Schedule of growing intercrops

Cereals

1. Rice: Rice being the staple food of humid tropics, considerable efforts were made at Nileshwar (Kerala State) as early as 1934 to grow it as an intercrop in coconut. Studies at Kasaragod revealed that upland rice varieties performed fairly well and the variety 'Rohini' which gave the highest mean yield of 1650 kg per ha was found to be the most suitable one. The upland rice can be sown immediately after the onset of monsoon at a row spacing of 20 cm. A fertilizer dose of 80 kg N, 60 kg P_2O_5 and 80 kg K_2O per ha is optimum.

2. Millets: Attempts were made during the '1930s and '40s to grow millet crops like tenai, samai, ragi, cholam, kudiravali, panivaragu, cumbu and varagu. Among these, cumbu (*Pennisetum typhoides*), ragi (*Eleusine coracana*) and varagu (*Paspalum scrobiculatum*) gave satisfactory yields. In some cases, the straw yield was very high indicating excessive vegetative growth. Sowing of these crops is preferably done before the commencement of rains taking best advantage of pre-monsoon showers. Thus, the plants will be well established by the time heavy rain sets in; otherwise the tender seedlings will be destroyed by incessant rains and continuous dripping of water from coconut leaflets. These crops are not very popular at present.

Pulses: As leguminous crops, pulses help in enriching the soil with nitrogen when grown in association with coconut. Among the pulse crops, cowpea, black gram, green gram, bengal gram, short duration red gram and soybean give satisfactory yields in the *maidan* areas of Karnataka. Under Kerala conditions, horse gram, cowpea, green gram and black gram gave yields ranging from 250-500 kg per ha when grown in the interspaces of cocenut. It is advisible to grow these crops after the cessation of heavy monsoon rains i.e. after August. It is recommended to adopt 30 cm × 15 cm spacing for horse gram, cowpea and green gram and 90 cm × 60 cm spacing for red gram. Application of 25 kg N, 50 kg P_2O_5 and 25 kg K_2O per ha for horse gram, cowpea and green gram is desirable. For redgram application of 40 kg N, 80 kg P_2O_5 and 40 kg K_2O per ha is recommended. In non-traditional areas, the seeds should be treated with rhizobium culture before sowing. During the rainless periods, it is necessary to provide irrigation atleast during critical stages to maintain favourable soil moisture conditions.

Oilseeds: Among the various oilseed crops tried, groundnut has been found to be successful as an intercrop. In the trials conducted at various locations, groundnut yielded 600-1300 kg pods per ha. Kernel at the rate of 100 kg per ha is either dibbled or dropped behind the plough in rows 30cm apart at a distance of 15cm within the row. Recommen-ded dose of fertilizer for groundnut is 25 kg N, 50 kg P_2O_5 and 25 kg K_2O per ha. Application of gypsum @ 250 kg per ha at the time of flowering is recommended for groundnut and it should be incorporated into soil by raking or light hoeing.

Fruit crops: Banana and pineapple are the two fruit crops which come up successfully in association with coconut. Both the crops are shade tolerant. Banana is grown as popular intercrop in Andhra Pradesh, Tamil Nadu and Kerala. In Kerala varieties like Poovan, Chenkadali and Palayankodan, and in Tamil Nadu, Kanchi and Karpooravalli have been found to perform better. Under Kerala conditions the yields range from 5000 to 9000 kg per ha. Three to four month old disease-free sword suckers are planted in pits of 50 cm × 50 cm × 50 cm size at a distance of 2.7 m. Recommended dose of fertilizer is 160 g N, 160 g P_2O_5 and 320 g K_2O per plant per annum. Fertilizer is applied in two equal splits i.e. half of the dose two months after planting and the remaining half four months after planting.

Pineapple has low water requirement. Further, the crop can generate additional employment opportunities in the post-harvest processing like canning. For a successful crop, healthy suckers weighing 500 to 1000 g are to be planted in trenches of 1.0 m width, 0.3 m depth and of convenient length. Two rows of

suckers are planted at a spacing of 70 cm × 30 cm. Recommended fertilizer dose is 8 g N, 4g P_2O_5 and 8g K_2O per plant per annum. The full dose of P_2O_5 is applied as basal dose and N and K_2O are applied in 3 equal splits i.e. basal, three months and six months after planting. Although wide variation in yield is observed, on an average 8000-12000 kg of fruits per ha are obtained.

Rhizomatous spice crops: Ginger and turmeric are the important rhizomatous spice crops commonly intercropped in coconut gardens. Better performance under partially shaded conditions, assured market demand, easy processing and long storage life are some of the factors that favour growing of these intercrops. Ginger and turmeric are planted in raised beds of 4-7m length, 1 to 1.2 m width and 30 cm height. Farmyard manure is to be mixed with soil or the seed material is to be covered with FYM in pits after planting. In case of ginger, rhizome bits of 15 g weight are planted at a spacing of 25 cm × 25 cm at a depth of 4.5 cm with buds facing upwards. Turmeric finger rhizomes are planted on raised beds with buds facing upwards at a spacing of 15 cm × 30 cm and covered with dry powdered cattle-manure. Before planting, the selected rhizomes are soaked for 30 minutes in a solution of mancozeb 0.2% and malathion 0.1%. The treated rhizomes are dried in shade by spreading on the floor. Mulching is done with green leaves immediately after planting, at the rate of 15 t per hectare. Mulching is repeated after 50 and 100 days of planting. Although under favourable situations ginger gives high returns, it is highly susceptible to soft-rot disease which could become devastating. By adopting proper precautions against this disease, a successful crop of ginger can be raised. The yield of ginger and turmeric as intercrops under average management conditions ranges from 7000 to 8000 kg per ha.

Tuber crops: Various tropical tuber crops can be successfully grown as intercrops in coconut gardens (Table 2). They include cassava, colocasia, elephant foot yam, sweet potato, chinese potato, greater yam, lesser yam, etc. Among these, cassava and sweet potato are propagated by stem and vine cuttings respectively. Yams are propagated by cut pieces of tubers. Cassava and sweet potato can be planted immediately after the onset of the monsoon. Elephant foot yam is to be planted in March-April. Cassava is planted in pits at a spacing of 1 m. Elephant foot yam is planted in pits of 60 cm × 60 × 45 cm size at a spacing of 1 m. For cassava and elephant foot yam, the recommended fertilizer dose is 80 kg/ha each of N, P_2O_5 and K_2O. Fertilizer is applied in three splits i.e. 1/3rd dose as basal, 1/3rd at three months after planting for cassava. In case of elephant foot yam, a dose of 65 kg N, 50 kg P_2O_5 and 80 kg K_2O per ha is to be applied; out of which, half the dose of N and K and full dose of P_2O_5 is applied 45 days after planting, and the remaining half N and K, after 75 days of planting.

Table 2. Yield of rainfed intercrops (Average of five seasons - 1973-74 to 1977-78).

Sl. No.	Intercrop	Yield (t/ha)
1.	Elephant foot yam (local)	13.46
2.	Cassava (H-165)	14.82
3.	Sweet potato (H-42)	8.38
4.	Greater yam (local)	13.61
5.	Lesser yam (local)	9.26
6.	Chinese potato (local)	7.32
7.	Ginger (Rio-de-Janeiro)	8.61
8.	Turmeric (Armoor)	10.94

Economics: The choice of intercrop primarily depends on its acceptability to the grower. A crop that is a staple food for a family would always get preference. A rational cropping pattern should include a few crops rather than a single intercrop selected in such a way that the cultivation expenses and labour employment are distributed throughout the year. The cost of cultivation, net returns and additional labour employment of some of the profitable intercrops in coconut garden are furnished in Table 3. The most remunerative intercrop under rainfed condition is ginger with a total net return of Rs. 36,590/- per hectare

Table 3. Economics of intercropping in coconut garden (Rs/ha)

Sl.No.	Crop combinations	Gross cost	Gross return	Net return
1.	Coconut	16,750	27,150	10,400
2.	Coconut + elephant foot yam	26,400	47,340	20,940
3.	Coconut + cassava	23,300	41,970	18,670
4.	Coconut + sweet potato	23,300	39,720	16,420
5.	Coconut + greater yam	24,700	43,262	18,562
6.	Coconut + lesser yam	24,700	37,825	13,125
7.	Coconut + chinese potato	22,700	35,400	12,700
8.	Coconut + ginger	42,200	78,810	36,590
9.	Coconut + turmeric	25,450	48,525	23,075
10.	Coconut + groundnut	20,450	33,750	13,300
11.	Coconut + upland paddy	20,050	30,650	13,300
12.	Coconut + banana	25,200	50,875	25,675
13.	Coconut + pineapple	21,700	39,150	17,450

Market rates (Rs.)

Coconut	: 2.50 per nut	Ginger	: 6.00 per kg
Elephant foot yam	: 1.50 per kg	Turmeric	: 2.00 per kg
Cassava	: 1.00 per kg	Groundnut	: 5.00 per kg pods
Sweet potato	: 1.50 per kg	Upland paddy	: 2.50 per kg
Greater yam	: 1.25 per kg	Banana	: 3.50 per kg
Lesser yam	: 1.25 per kg	Pineapple	: 1.50 per kg
Chinese potato	: 1.25 per kg		

inclusive of coconut. However, ginger is highly susceptible to the 'soft-rot' disease caused by the fungus *Pythium aphanidermatum* which can devastate the entire crop, particularly if planted continuously in the same field or when the field is subjected to waterlogging even for a short period, and hence it is a high risk crop.

Next best crop for realising higher returns is banana (Rs. 25,675/-) followed by turmeric (Rs. 23,075/-). All the crops mentioned above are successful and remunerative only when when appropriate management practices are adopted.

Appendix-I

Scientific and local names of intercrops

Intercrop	Scientific name	Tamil	Malayalam	Kannada
Roots & tubers				
Cassava (Tapioca)	*Manihot esculenta* Crantz	Maravalli, or Kuchikizhangu	Kappa, or Marachini	Maragenasu
Elephant foot yam	*Amorphophallus campanulatus* Bl.	Senaikizhangu	Chena	Suvarna gadde
Greater yam	*Dioscorea alata* L.	Kizhangu	Kachil	Kunti genasu
Lesser yam	*Dioscorea esculenta* Burk.	Kizhangu	Kizhangu	Kunti genasu
Sweet potato	*Ipomoea batatas* Lamk.	Sarkaravalli Kizhangu	Madhura kizhangu	Genasu
Taro	*Colocasia esculenta* Schoot.	Cheppankizhangu	Chembu	Kesavine gadde
Rhizome spices				
Ginger	*Zingiber officinale* Rosc.	Inji	Inchi	Shunti
Turmeric	*Curcuma domestica* Val.	Manjal	Manjal	Arisina
Grain legumes				
Green gram	*Vigna radiata* Wilzek.	Pasipayaru	Cherupayar	Hesaru
Black gram	*Vigna mungo* Hepper	Uzhundu	Uzhunnu	Uddu
Red gram	*Cajanus cajan* Millsp.	Thuvarai	Thuvaranpayar	Thogari
Horse gram	*Dolichos uniflorus* Lam.	Kollu	Muthira	Hurali
Cowpea	*Vigna unguiculata* Walp.	Thatapayaru	Vanpayar	Alasande
Soybean	*Glycine max* Merr.	Soya payaru	Soyabean	Soyabean
Oilseed crops				
Groundnut	*Arachis hypogaea* L.	Nilakkadalai	Nilakkadala	Kadale kayi
Others				
Upland rice	*Oryza sativa* L.	Nel	Nellu	Bhatta
Banana	*Musa paradisiaca* L.	Vazhai	Vazha	Bale
Pineapple	*Ananas comosus* Merr.	Annasipazham	Kaitha chakka	Ananus