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Cropping / Farming System Research in Coconut Root (wilt) Affected Gardens

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In recent years many coconut farmers have suffered economic difficulties due to the unstable copra price. Being a small holders' crop in India, coconut under monocropping does not provide adequate income and gainful employment to the dependent families. In a situation where the coconut industry is threatened with recurring uncertainties, the need for a farm practice that augments the coconut farm income becomes essential and urgent.

Root (wilt) disease of coconut caused by phytoplasma has no definite control measures. Productivity of coconut in Kerala is as low as 6188 nuts per hectare due to the fact that in eight southern districts root (wilt) disease is prevalent with varied degree of intensity and due to improper management practices. The bearing palms, which are in the initial to middle stage of disease intensity, respond well to the management practices. Suitable management practices have been evolved to sustain the productivity of root (wilt) affected coconut palms.

In coconut holdings with palms spaced at 7.5x7.5 m apart, nearly 75% of the land goes unused by the palm. In coconut garden with palms which are more than 25 years of age, 45-50% of the sunlight is infiltrated on to the ground without interception by the coconut. In order to utilize this natural resource along with soil nutrients and water efficiently, the practice of inter/ mixed cropping is followed in one or the other way by coconut farmers, but the management is not scientific always. To increase the productivity as well as the returns per unit area, growing of different suitable crops in the interspaces in coconut garden is recommended. Unfortunately, only a few farmers practice intercropping/ mixed cropping in coconut gardens. Cropping systems involving different crops, ensure additional employment and income in addition to improvement in the soil properties in general and improvement in microbial population and biological activities in the root region in particular resulting in the modification of soil environment to the benefit of plant growth.

Studies conducted on cropping system research in root (wilt) affected garden at Central Plantation Crops Research Institute RS, Kayangulam revealed the successful productivity of following crops.

Cocoa (*Theobroma cacao*) : Single or double hedge system resulted in increase in yield of coconut by 27 to 35 per cent.

Fodder crops : Hybrid Napier - NB21 & Pusa giant Napier, Guinea grass (*Panicum maximum*) (var. Mackuenii), *Centrosema pubescens, Stylosanthes gracilis.* Cultivation of fodder crops and integrating with dairy followed by recycling of farm wastes in the root (wilt) affected garden resulted in overall increase in nut yield by 28 per cent.

Tuber crops : Tapioca (*Manihot esculenta*), Amorphophallus (*Amorphophallus companulatus*), Yam (*Diascorea alata*).

Fig1. A view of HDMSCS model under root (wilt) affected garden

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Currently, research work is being undertaken on High Density Multi Species Cropping System (HDMSCS) involving perennial, biennial and annual crops in coconut root (wilt) affected garden. Soil of the experimental area is sandy loam, and the annual rainfall of this area is 2500 mm. One such model involving the following crops is under study at this station in 1.5 ha area. Disease advanced palms have been removed and planted with new seedlings.

Coconut :	
Adult	- 114 numbers
Seedlings (underplanted)	- 152 numbers
Clove	- 38 plants
Nutmeg	- 56 plants
Pepper trailed on coconut	- 38 plants
Banana :	
Poovan, Njalippoovan, Palayankodan, Robusta, Nendran, Karpooravally varieties	- 500 plants
Pineapple - (Kew variety)	- 3600 plants
Yam (Diascorea alata)	- 75 numbers
Amorphophallus	- 75 numbers
Colocasia	- 75 numbers

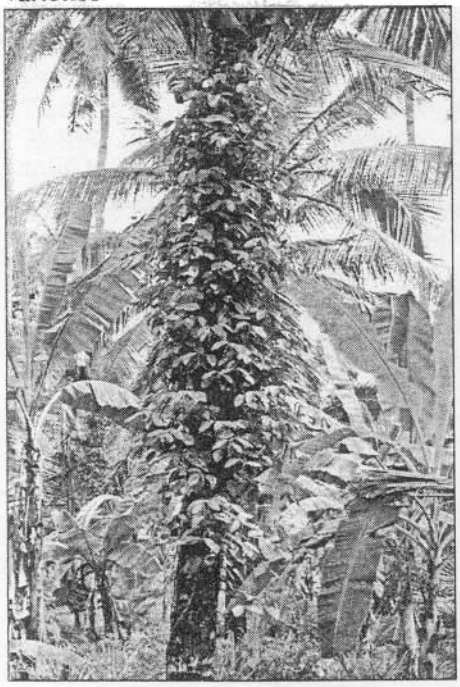

Fig. 2. Good growth of pepper on coconut

Management Aspects of Crops

In any cropping system model, careful attention should be given for managing different crops in order to achieve their maximum potential. In coconut based system, care should be taken to plant the intercrops (except for pepper) away from 2 m radius from coconut bole. Nutrients and water should be applied for each crop separately as per the schedule. Need based plant protection for each crop needs to be undertaken as and when required.

Following is the management practice schedule for each crop being grown as inter/mixed crop in HDMSCS:

Coconut

- Grow green manure crop (Cowpea) in the coconut basin and incorporate when it attains maximum growth.

  Apply 50 kg Farm Yard Manure / green leaves/compost per annum during Sept.-Oct. The chemical fertilizer dose of N:P:K - 500:300:100 g/palm/ annum should be applied in 2 splits (1/3rd during May-June and 2/3rd during Sept. - Oct. i.e., 1.0 kg urea, 1.75 kg rajphos and 2.0 kg muriate of potash) along with $MgSO_4$ - 3 kg/palm/annum (MgO - 500 g/palm/year). Application of Borax-500 g/palm/ annum is needed, if adult palms show boron disorder symptoms.

- Following is the schedule for Integrated leaf rot control :

1. Cut and remove rotten portions of the spindle and the adjacent two innermost fully opened leaves.
2. Pouring of 300 ml of fungicidal solution containing 2 ml of Contaf 5% EC or 3 g Dithane-M-45 in the spindle well after removing the rotten portions.
3. Apply of 20 g phorate 10 G mixed with 200 g fine sand around the base of the spindle. The above treatment has to be imposed twice a year in April-May and October-November.

Pineapple (*Ananas camosus*)

Select healthy suckers of uniform size weighing 500-1000 g. Plant the suckers at a spacing of 70cm between rows and 30 cm between plants in a trench of 2.5 to 3.0 m length. Apply compost/FYM - @ 25 tonnes/ha as basal dressing. Following is the chemical fertilizer (NPK) schedule:

Dose	N	P	K
Per plant/year (g)	8	4	8
Per/ha/year (kg)	320	160	320

Fig. 3. Bumper crop of pineapple when grown as intercrop in a root (wilt) affected coconut garden

Apply the full dose of P at the time of planting. N and K may be applied in 4 splits as given below :

1st dose = May - June (at planting)

2nd dose = August - September

3rd dose = November

4th dose - May - June (2nd year)

Clove (*Eugenia caryophyllus*)

Select 18 months old seedlings for planting and should be planted at the centre of four coconut palms. Apply compost / FYM - 15 kg / tree / annum. Apply the recommended fertilizer dose of N:P:K ie 20:18:50 g/plant during the first year and N:P:K @ 40:36:100 g/ plant during the second year. Apply NPK @ 300:250:750 g/tree/annum for a well grown tree in equal two splits (50% during May-June and 50% during Sept. - October). The trees begin to yield from 7-8 years after planting.

Nutmeg (*Myristica fragrans*)

Select 12 months old grafts for planting and should be planted at the centre of four coconut palms. Apply compost / FYM - 10 kg/tree/annum and the recommended fertilizer dose of N:P:K ie 20:18:50 g/plant during the first year and N:P:K: @ 40:36:100 g/ plant during the second year. From third year onwards N:P:K: @ 500:250:1000 g/tree/annum should be applied in equal two splits (50% during May-June and 50% during Sept. - October).

Pepper (*Piper nigrum*)

Pepper cuttings are to be planted 1-1.5 m away from the trunk of the palm. Trail the pepper vines on a temporary stake for 1-2 years and when they attain sufficient length to reach the trunk, remove the stake without causing damage to the vines and tie the pepper plants on to the tree trunk and trail them on it.

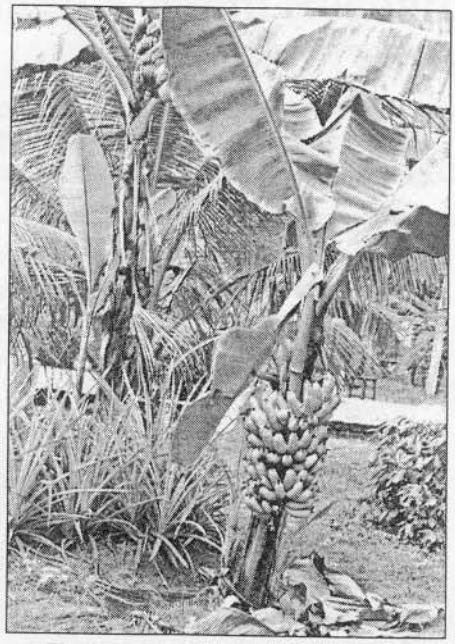

Fig. 4. Bumper crop of banana (robusta) as intercrop in a root (wilt) affected coconut garden

Manuring for pepper vines is to be done in basins, 10-15 cm deep and 50-75 cm radius, taken around the plants depending upon the growth of the plants. Apply compost/FYM/green leaves-10 kg/plant/annum. The general recommendation of N:P:K is 50:50:150 g/plant/annum in equal two splits (50% during May-June and 50% during Sept. - October).

Banana (*Musa* sp.)

Select 3-4 months old disease free sword suckers from healthy clumps. In the case of Nendran variety, cut back pseudostem to a length of 15-25 cm from corm and remove the old roots. The rhizomes are to be smeared with cowdung solution and ash dried in the sun for about 3-4 days and stored in shade upto 15 days before planting. Planting should be done in a pit having the size of 50x50x50 cm with the spacing of 2.5 mx2.5m. Apply compost/ FYM-10 kg/plant in the pit and plant the suckers upright in the centre of pits with 5 cm of pseudostem remaining above the soil level. The recommended dose of N:P:K for Nendran variety is 190:115:300 and for other varieties is 200:200:400 g/plant/annum, to be applied in equal two splits (50% during May-June and 50% during Sept. - October).

Remove side suckers produced till the emergence of flowers. Retain 1-2 suckers produced after the emergence of bunch. Banana psudostem weevil is a serious pest in recent days. Adult female weevil punctures and inserts egg into the pseudostem. Grubs emerging out, feed extensively on the pseudostem and thereby the entire plant droops. For effective control of this pest, field sanitation has to be carried out by removing affected plant and destroying them by burning or burying in deep pits in the soil. Remove dry outer sheaths of the pseudostem of all infected and uninfected plants in the endemic areas and spray with Chlorpyrifos @ 0.03% (1.2 ml in 1 lit of water). Spraying has to be repeated after 3 weeks if the infestation persists.

Diascorea (*Diascorea alata*)

Use cut pieces of 250-300 g size as planting material and dip the cut pieces in cowdung slurry and allow to dry under the shade before planting. Planting can be done at a spacing of 1m x 1m in the pits of 60x60x45 cm size. Apply compost / FYM - 2 to 2.5 kg / pit as basal dress. Apply the full dose of P (60 kg/ ha or 4 g/plant) and half the dose of N and K @ 40 and 40 kg / ha or 3.5 g/ plant) 45 days after planting and apply the remaining part of N and K @ 40 and 40 kg / ha, one month after the first application. Trailing has to be done within 15 days after sprouting by coir rope to expose the leaves to sunglight.

Amorphophallus (*Amorphophallus companulatus*)

Cut pieces of one kg each is ideal for

planting and dip the cut pieces in cowdung and allow to dry under shade before planting. Pits of 60x60x45 cm size at a spacing of 1mx1m should be dug and plant the seed material and cover with dried leaf. Apply compost / FYM - 2 to 2.5 kg/pit as a basal dress. Apply the full dose of P (60 kg/ha) and half the dose of N and K @ 40 or 3.5 g/ plant and 50 kg / ha or 4.0 g/ plant) 45 days after planting and apply the remaining part of N and K @ 40 and 50 kg / ha one month after the first application.

Colocasia (Taro) (*Colocasis esculenta*)

Use side tubers each of 25-35 g size as seed material and can be planted at a spacing of 60 x 45 cm. Apply compost/ FYM-2 to 2.5 kg/pit as a basal dress. Apply the full dose of P (50 kg/ha) and half the dose of N and K @40 or 1.0 g/ plant and 50 kg/ha or 1.5 g/plant) within a week after sprouting and apply the remaining part of N and K @40 and 50 kg/ha one month later.

Irrigation

Irrigation for the above crops is a prerequisite during the non-rainy season. For the HDMSCS model, the best method of irrigation to be adopted is perfo/sprinkler system. Irrigate the field based on IW/CPE ratio of 1.0 i.e. irrigate once in 4 days to a depth of 20 mm.

At CPCRI, RS, Kayangulam, the HDMSCS model is under study and the output obtained during the year 1999-2000 is as follows :

Coconut	-	6042 nuts (from 114 adult palms)
Banana	-	892 kg
Pineapple	-	75 kg
Pepper	-	16 kg
Amorphophallus	-	155 kg (from 25 plants)
Diascorea alata	-	305 kg (from 60 plants)

The average yield from each crop grown as intercrop in HDMSCS is as follows :

Banana : Varieties

Poovan	-	10-12 kg/bunch
Njalipoovan	-	10-12 kg/bunch
Palayankodan	-	16-18 kg/bunch
Robusta	-	12-14 kg/bunch
Nendran	-	16-18 kg/bunch
Karpooravally (Culinary type)	-	20-22 kg/bunch

Pineapple : Average 1.0 to 1.5 kg/fruit

Amorphophallus	:	6.5 to 7.5 kg/plant
Diascorea	:	5.0 to 6.0 kg/plant
Colocasia	:	3 to 3.5 kg/plant

Coconut : There was an increase in the nut yield of coconut due to the following HDMSCS model involving different crops. Three years' average nut yield (1997-2000) was 49.2 nuts per palm per annum, whereas the pre-experimental yield was 28 nuts per palm per year. Probable increase in nut yield may be attributed to synergistic effect of each crop component leading to overall efficiency of the system.

Clove and nutmeg have started yielding and takes some more years for achieving stabilized yield.

By following such a cropping system model, a coconut farmer can get additional income and sustained productivity from root (wilt) affected palm. The additional income depends upon the management level adopted for component crops and the price of the commodity. However, in coconut based HDMSCS model the yield obtained from component crops is an additional benefit without affecting coconut yield. To work out the economics of the system, such a system has to be maintained for 5 years or more.

There is a need to study the performance of flowering plants, medicinal and aromatic plants and fruit crops as intercrops/mixed crops in different soil and agro climatic zones under root (wilt) affected area.