# Agronomic strategies for sustainable production in root (wilt) affected coconut gardens

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***Coconut root (wilt) disease is a non-lethal, debilitating malady that affects the production potential of palm. There are no therapeutic control measures for the disease; however, research efforts have resulted in evolving viable technologies to increase the productivity of the diseased palms. Adoption of suitable agronomic techniques results in increased and sustained productivity of root (wilt) affected coconut palms over the years.***

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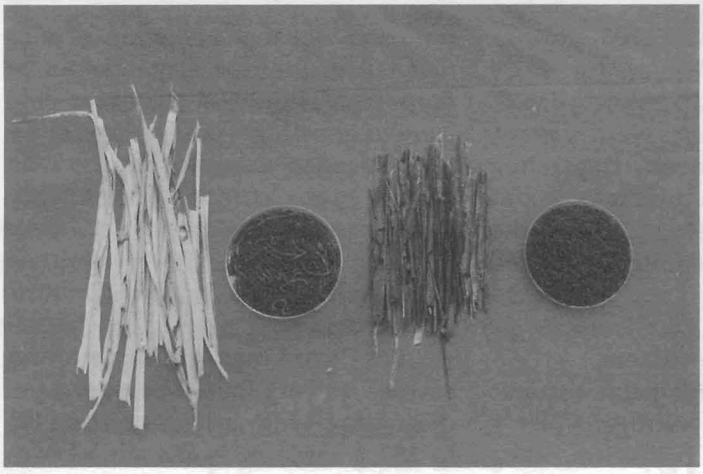

Fig. 1. Earthworm shows conversion of coconut leaves into vermicompost

Fig. 2. Cowpea as a green manure crop in coconut basins

COCONUT PALM, commonly called as 'Kalpavriksha', plays a significant role in the economic, cultural and social activities of the people. The coconut cultivation and processing industries provide income and employment to a sizeable section of the rural population in the major coconut growing states. Coconut root (wilt) disease is a non-lethal, debilitating malady that affects the production potential of coconut palm. The disease is prevalent in contiguous manner in 8 southern districts of Kerala and sporadic occurrence of the disease has been reported in the remaining districts of Kerala, districts of Tamil Nadu bordering Kerala and Goa.

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Phytoplasma, a vascular limited pathogen, has been found to be the causal organism of the disease by extensive light and electron microscopic and transmission studies. The disease is transmitted by insect vectors, viz. lace bug and plant hopper. The most consistent and diagnostic symptom of the disease is the characteristic bending of the leaflets termed flaccidity, foliar yellowing and marginal necrosis of the older leaves were observed in association with the disease symptoms. There are no therapeutic control measures for the disease, however, research efforts have resulted in evolving viable technologies to increase the productivity of the diseased palms. In a situation where the coconut sector is threatened with recurring uncertainties, the need for a farm practice that augments the coconut farm income becomes clear and urgent.

## AGRONOMY

Agronomic techniques help to increase the coconut productivity in root (wilt) affected areas.

### Integrated nutrient management system

Integrated application of balanced dose of chemical fertilizers, organic manures, biofertilizers and recycling of crop residues ensures availability of nutrients to crops and is necessary for maintenance of soil productivity and sustainable crop yields.

Fig. 3. Drip irrigation layout for coconut in sandy loam soil

Fig. 4. HDHSCS model in coconut garden.

**Organic manures**

Application of organic manures improves soil physico-chemical and biological properties, which ultimately enhances yield. Apply any of the following organic manures along with the second dose of application of chemical fertilizers (September/ October) by opening a basin to a depth of 30 cm in 1.8 m radius from the bole: 25 kg farmyard manure or green leaves or 25 kg composted coir pith or 25 kg vermicompost/palm/year.

**Ecofriendly vermicomposting technology**

The dried coconut leaves and other wastes in coconut plantations can be effectively converted into vermicompost using epigeic, pigmented *Eudrilus* sp. earthworm. Coconut leaves and other wastes can be vermicomposted by heap method or pit method or in coconut basin itself. The length and breadth of the vermicompost unit in tanks or pit can be as per convenience but the depth should be less than 1 m. For compost preparation, coconut leaves weathered for 2 to 3 months are to be used. The leaves are used as such or after chopping into pieces. As the earthworms prefer partially decomposed organic matter in the initial stages, the collected coconut leaves are to be treated with cowdung slurry @100 kg/ tonne of leaves and allowed to further decompose for 2 to 3 weeks. Sufficient moisture is to be ensured by sprinkling water. Earthworms @ 1000 worms/ tonne of coconut leaves are to be introduced. It should be mulched with available organic wastes viz. dry grass, straw or coconut leaves. Depending on the extent of weathering of leaves used for composting, 70%of the material will be composted within 60 to 75 days (Fig.1).

**Balanced dose of fertilizers**

An adult coconut palm requires nutrients @ 500 g nitrogen, 300 g phosphorus, 1000 g potassium, 500 g magnesium oxide/palm/year. To get the nutrients in the above level application of chemical fertilizers 1.1 kg of urea, 1.5 kg mussoorie rock phosphate, 1.7 kg muriate of potash and 1 kg of magnesium sulphate is necessary. The fertilizer should be applied in 2 splits, one-third during April/May and two-third during September/October under rainfed condition and in 4 splits during January, April, July and October under irrigated condition. The deficiency of boron nutrition could be corrected by applying 150 and 250 g of borax for seedlings and adult palms respectively in two split doses along with the recommended dose of fertilizers.

**Green manure/cover crops**

The cover crops to be grown in coconut gardens should be tolerant of shade. The latter requirement arises from the fact that gathering of nuts that fall in the ripe stage cannot be done satisfactorily, if the cover crop were to grow high. Following are the recommended cover crops for coconut basins viz. cowpea, sunnhemp (*Crotalaria juncea*), mimosa (*Mimosa invisa*), calapo (*Calopogonium mucunoides*), and kudzu (*Pueraria phaseoloides*).

For growing green manure cowpea, sowing should be carried out during April-May by broadcasting 125 to 150 g seeds in 2 m radius basins after application of one-third chemical fertilizers. When cowpea attains maximum flowering, it should be uprooted and incorporated in the basins during September-October along with two-third fertilizer application. Cowpea crop yields about 20 to 25 kg of green biomass. On dry weight basis, whole plant of cowpea (root, stem, leaves) contains 2.77% N:, 0.25% P, and 2.33% K. On incorporation of cowpea in the basin, it contributes 134.2 g of N, 12.3 g of P and 113.7 g of K / basin/season. By growing cowpea as green manure crop, the N P K can be scaled down to the tune of 27 % of N, 3.5% of P, and 12% of K as per the recommendations for coconut (Fig.2).

**Water management and drainage**

Water plays an important role in

Fig. 5. Hybrid napier as mixed crop in coconut garden.

growth and development of the palm and during summer, palm experiences mild to severe stress which affect the nut and copra yield. Depending upon the availability of water and cropping system practised in the garden, following irrigation methods are suitable for coconut gardens.

### Basin irrigation

This method can be adopted in a coconut monocrop garden. Open a basin of 30 cm depth with the radius of 0.75 m, 1.0 m and 1.8 m for 1-to 2-year-old seedlings, for 3- to 4-year old seedling and adult palms, respectively.

### Drip irrigation

This method is effective for coconut monocrop garden in water scarcity area. For seedlings of 1- to 2- year-old place two emitters 50 cm away from the base of the seedling, whereas for 3 to 4-year-old seedlings place 3 emitters, 75 cm away from the base of the seedling. For adult palms, 4 emitters should be placed 1 m away from the bole at equidistance by opening a small pit measuring 25 $cm^3$ in laterite and red sandy loam soil whereas, for littoral sandy soil use 6 emitters/palm placed at equidistance. This system of irrigation ensures water saving and higher water use efficiency in the field (Fig.3).

**Table 1.** Quantity of water to be applied.

| System of irrigation | Age of the palm | Quantity of water (litre/palm) |
|---|---|---|
| Drip irrigation | 1 to 2 years | 10 litre/day |
| | 3 to 4 years | 20 litre/day |
| | Adult | 32-35 litre/day |
| Basin irrigation | 1 to 2 years | 25-30 litre once in 2 days |
| | 3 to 4 years | 75-80 litre once in 4 days |
| | Adult | 250-300 litre once in 4 days |

### Perfo irrigation or sprinkler irrigation

This system is ideal for cropping systems to ensure uniform distribution of water to all the crops. Irrigate the field to a depth of 20 mm once in 4 days.

### Drainage

It should be provided in water-logged area for increasing aeration in the soil and more soil should be applied in basin to facilitate production of new roots.

### Mulching with coconut leaves

Mulching the manuring basin with coconut leaves provides beneficial effects during summer by reducing direct heating of soil surface and reducing evaporation of soil moisture. Mulching also benefit the coconut garden by suppressing the growth of weeds in the garden. Coconut basins can be mulched during October/November and retained till April/May.

### Adoption of appropriate cropping/farming system

In coconut holdings with palms spaced at 7.5 m × 7.5 m apart, only 25% of the land is being utilized by the palm and with palms of more than 25 years of age 45 to 50% of the sunlight is intercepted and remaining infiltrated on to ground. To utilize this natural resource efficiently along with soil nutrients and water, farmers are adopting inter-mixed-cropping, though not in a proper scientific way. Intercropping coconut garden with suitable crops increases the productivity as well as the net returns from a unit area.

Suitable inter-crops/mixed-crops may be selected depending on the soil type and agroclimatic condition.

**Table 2.** Following crops can be grown in coconut garden without affecting the yield of coconut.

| Category of Crops | Agricultural Crops |
|---|---|
| Tuber crops | Cassava, Elephant foot yam, Greater yam, Lesser yam, Colacasia. |
| Fruit crops | Banana, Pineapple. |
| Fodder crops | Pusa Giant, Hybrid napier NB-21 and BH18, Guinea grass, Stylosanthes, Fodder cowpea. |
| Beverages | Cocoa |
| Spices | Ginger, Turmeric, Black pepper, Nutmeg, Clove, Vanilla |

### Multistoreyed cropping/high density multi-species cropping system

Growing different stature crops in the same field, which ensures utilization of natural resources to the maximum extent and higher yield per unit area, eg Coconut, pepper, cocoa, nutmeg, clove, banana, pineapple,

tubercrops (Cassava, Amorphophallus, Dioscorea).

In cropping system, care should be taken to add recommended organic and inorganic fertilizers for component crops separately. In cropping system wastes of different crops can be converted into suitable organic manure and recycled into the garden.

Experiments on high density multi-species cropping system in root (wilt) affected coconut garden with banana varieties Poovan, Njalipoovan, Nendran, Karpooravalli, Robusta, Palayankodan, Kew pineapple, pepper trained on coconut, nutmeg, tuber crops (cassava, amorphophallus, colocasia, dioscorea) is under study since from 1993-94 at Central Plantation Crops Reaearch Institute, Regional Station, Kayamkulam (Fig. 4). Productivity and economic viability of the system indicated that, the productivity was higher and there was increase in the nut yield of coconut from 30 nuts/palm/ year (pre-experimental) to 61 nuts/palm/year during 2002-2003. The intercrops/ mixed crops viz. banana, pineapple, pepper, nutmeg, tuber crops performed very well and provided additional yield and income. The higher benefit:cost ratio of 2.28 indicated higher additional return for the investment and higher positive net present worth (Rs 1,80,106) indicated the high density multi-species cropping system is economically viable under root (wilt) affected area. By adopting the system, there was stabilized income for coconut farmers even during lower price for the coconut. During 1999-2000 and 2000-2001, the price of coconut was very low and the return from the coconut was lower whereas, the returns realized from intercrops/mixed crops was Rs 35,340 and Rs 30,180/ha, respectively in the system. The total variable cost involved in maintaining the system during 2001-2002 and 2002-2003 was Rs 38,214 and Rs 38,945/ha respectively. The net return obtained during 2001-02, was Rs 48,390/ (based on nuts sold), Rs 58,285/ (based on copra sold) and the net return obtained during 2002-03, was Rs 47,926/ (based on nuts sold), Rs 66,201/ (based on copra sold).

There was reduction in the root (wilt) symptoms viz. flaccidity, necrosis and yellowing due to the integrated management practices. There was improvement in the soil physico-chemical and biological properties in the garden.

**Mixed farming system**

In recent days the farming system research is gaining importance as it ensures sustainable productivity of crops. In India, there is no scope for horizontal expansion of land for cultivation, therefore alternative is on diversification in agriculture and adoption of integrated mixed farming system. Adoption of such system ensures increased food supply, recycling of crop/farm residues, restoration of soil fertility and conserving environment, increased employment etc.

Growing fodder crops as mixed crops in coconut garden coupled with integrating with dairy enterprise in root (wilt) coconut garden ensures additional employment, income for a coconut farmer along with restoring soil fertility without affecting coconut yield (Fig.5). There is possibility of self sustainability of the system by practising farming system involving compatible components. Guinea grass, Hybrid napier grasses comes up well in the coconut garden and can be grown as mixed crops to use as a feed for dairy animals. Residues obtained in the system can be recycled into the garden, which ensures additional benefit for soil health and crop yield over the years.

**SUMMARY**

Integration with suitable cropping/farming system in root (wilt) affected garden ensures additional employment and income for a farmer and recyclable organic waste for recycling in the garden, which ensures sustainable productivity of the system over the years.