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COCONUT

CULTIVATION PRACTICES

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COCONUT

CULTIVATION PRACTICES

1. Introduction

The coconut palm, *Cocos nucifera* L., is one of the most beautiful and useful palms in the world. It is important in that it provides a variety of useful products like food, fuel, and timber. Every part of the tree is being utilised for some purpose or the other. On account of this, it is called *Kalpavriksha* the "tree of heaven"- the tree that provides all the necessities of life.

India ranks third both in terms of area and production of coconut among coconut producing countries in the world with 1.51 million hectares and 9283 million nuts. The productivity of coconut palm in India is very low compared to its potential. The main reason for such low yield is that the cultivators do not pay much attention to its culture. In the current situation of edible oil shortage in the country, there is enormous scope for improving the existing plantations of coconut and for extending the area under this crop.

2. Climate and soil

The coconut palm is found to grow under varying climatic and soil conditions. It is essentially a tropical plant, growing mostly between 20°N and 20°S latitudes. The farther one goes from the equator, the more is the palm confined to low lands. Near the equator, productive coconut plantations can be established upto an elevation of about 1000m. The palms tolerate wide range in intensity and distribution of rainfall. However, a rainfall of about 200 cm per year and well distributed throughout, is the best for proper growth and maximum yield. In areas of inadequate rainfall with uneven distribution , irrigation is required.

3. Cultivars and hybrids

Coconut palms are broadly classified into two groups, the Talls and the Dwarfs. The Tall cultivars are the common type that occur throughout the world. The different cultivars of the Talls are known by the place where they are largely cultivated. The Tall cultivars largely grown in India are the West Coast Tall and East Coast Tall. The Dwarf varieties are shorter in stature and life span as compared to Talls. They start bearing earlier compared to Talls. The size of the nut and the quality of copra are inferior to Talls. The Dwarf cultivars occur with three nut colours, green, yellow and orange. The dwarf cultivars are generally grown for tender nuts and also for hybrid production. The common dwarfs available in India are Chawghat Orange Dwarf, Chawghat Green Dwarf, Malayan Green Dwarf, Malayan Yellow Dwarf, Malayan Orange Dwarf, Gangabondom etc. Among the Tall cultivars, Laksha dweep Ordinary gave 33% more nuts and 30% more copra yield annually over local Talls under rainfed conditions. Benaulim Green Round has given 62.3% increased nut yield over West Coast Tall in the Konkan Coast of Maharashtra.

The hybrids between Tall and Dwarf forms show hybrid vigour for growth and yield. As a consequence, hybrid seed gardens have been established or are being established in most of the coconut growing states. The hybrids are produced using Talls and Dwarfs. When the Tall is used as female and Dwarf as male they are called TxD while the reciprocal is known as D x T. Lakshaganga (LO X GB) is a T x D hybrid while Chandra Sankara (COD X WCT) is a D x T hybrid. Laksha Ganga, Chandra Sankara, Chadra Laksha (LOxCOD) are superior hybrids, and Yield over 19-42% over other combinations and their parents. Laksha Ganga and Chandra Laksha showed tolerance to droughts. VHC_2 released by the Tamil Nadu Agricultural University is a T x D hybrid between East Coast Tall x Malayan Yellow Dwarf which has given about 26% more nut yield in Tamil Nadu.

Based on the available information on the performance , the following tall cultivars are found suitable in the states noted against each:

West Coast Tall:	Kerala, Karnataka, Gujarat, Bihar , Madhya Pradesh, Lakshadeep, Orissa, Tamil Nadu, and Tripura.
Chandrakalpa(LO):	For all the States.
Andaman Ordinary:	Andamans, Andhra Pradesh, Bihar, Assam, Madhya Pradesh, Kerala, Orissa, Pondicherry, Tamil Nadu, Tripura, and West Bengal.
East Coast Tall:	Tamil Nadu, Andhra Pradesh, Bihar, Madhya Pradesh, Orissa, Pondicherry, Andamans, and West Bengal.
Tiptur Tall:	Karnataka
Benaulim:	Maharashtra and Goa.

In addition to the above talls, for seed garden establishment Chowghat Orange Dwarf and Malayan Yellow Dwarf have been suggested for all states

4. Planting materials

Selection of seednuts and seedlings is of utmost importance in coconut as the performance of the new progeny can be evaluated only several years after planting. Should the seednuts and seedlings happen to be of poor quality, the new plantation will prove to be uneconomic, causing considerable loss of time and money to the grower.The fact that the coconut is a cross-fertilised palm and that it does not breed true, makes the selection of seednuts and then of seedlings in the nursery all the more difficult and important.By means of a series of selections made at differnt stages, it is possible to eliminate poor quality seednuts and seedlings.

5.Establishing plantation

5.1 *Selection of the site:* Shallow soils with underlying hard rock, low lying areas subject to water stagnation and clayey soils are to be avoided as it will be difficult to raise successful coconut plantations under such conditions. However, in lands reclaimed by heaping alternate layers of sand and clay, coconut thrives well. Proper supply of moisture either through well distributed rainfall, or irrigation, and sufficient drainage are essential for coconut.

5.2 *Preparation of land and planting:* Preparation of land for planting coconut depends to a large extent on soil type and environmental factors. If the land is uneven and full of shrubs, the shrubs have to be cleared and land levelled before taking pits. The depth of pits will depend upon the type of soil. In laterite soil with rocky substratum, deeper and wider pits,1.2x1.2x1.2m, may be dug and filled up with loose soil, powdered cowdung and ash upto a depth of 60cm before planting. In loamy soils with low water table, planting in 1.0x1.0x1.0m pits filled upto 50cm depth is generally recommended. However, when the water table is high, planting at the surface or even on mounds may be necessary. Even while planting at the surface or mounds digging pits and filling has to be done.

Arrange two layers of coconut husk at the bottom of the pit before filling up the soil with concave surface facing up. This will help in conserving the moisture. In laterite soil adddition of 2 Kg of common salt will help in loosening the soil.

5.3 *Spacing:* Spacing of palms required careful consideration. A spacing of 7.5 to 9.0m may be adopted depending on the crown size. This will accommodate 177 to 124 palms per ha under the square system of planting. If the triangular system is adopted an additional 20 to 25 palms can be planted. Also a hedge system can be adopted giving a spacing of 5.0 to 5.5m along the rows and 9 to 10m between the rows. If wider spacing

of 20m x 10m is adopted it provides ample opportunity to put a number of perennial and annual crops in the interspaces.

5.4 *Time of planting:* In well drained soils where water stagnation is not a problem, seedlings can be transplanted with the beginning of south-west monsoon. If irrigation facilities are available, it is advisable to take up planting at least a month before the monsoon sets in so that the seedlings get well established before the onset of heavy rains. Planting can also be taken up before the north–east monsson. In low lying areas subject to inundation during monsoon periods, seedlings are better transplanted after the cessation of the monsoon.

5.5 *Care of young palms:* Sufficient attention will have to be paid to the young palms in the early years of growth. The transplanted seedlings should be shaded and irrigated properly during the summer months. Irrigation with 45 litres of water once in 4 days has been found to be satisfactory in sandy soils. Provision of proper drainage is also equally important in areas subject to water logging.

The pits should be cleared of weeds periodically. Soil washed down by the rains and covering the collar of the seedlings should also be removed. The pits should be widened every year before the application of manure. The pits should be gradually filled up as the seedlings grow. The palms should be frequently examined for any insect or fungus attack and necessary remedial measures should be taken up promptly.

5.6 *Manuring:* An application of 500g N, 320 g P_2O_5 and 1200 g K_2O per palm per year is generally recommended for adult plantations. Fertilizers like urea, ultraphos, rock phosphate, muriate of potash, Suphala, Factomphos and commonly available fertilizer mixtures may be used to supply the required quantity of nutrients. Rock phosphate (Mussoorie phos) is recommended as an ideal and cheaper carrier of phosphorus in laterite and acidic soils. Fertilizers may be applied in two split doses. After the receipt of summer showers one-third of the recommended dose or fertilizers may be spread around the

palms within a radius of 1.8m and forked in. Circular basins of 1.8m radius and 25cm depth may be dug in August-September and green leaf or compost at 50 kg per palm may be spread in the pits. The remaining two-third of the recommended dose of fertilizers may be spread over the green leaf or compost and the basins covered.

Regular manuring from the first year of planting is essential to ensure good vegetative growth, early flowering and bearing and high yields. The first application of fertilizers should be done three months after planting when the south-west monsoon ends on the West Coast, if seedlings are planted before the rains in May–June (see Table). During the second year, one third of the dosages recommended for adult palms may be applied in two split doses in May and September-October. This dosage may be doubled during the third year. From the fourth year onwards fertilizers may be applied at the rates recommended for adult palms.

Fertilizer Recommendation for Coconut (g/tree)

	May-June			September-October		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O
First year	Planting in May		June	50	40	135
Second year	50	40	135	110	80	270
Third year	110	80	270	220	160	540
Fourth year onwards	170	120	400	330	200	800

To supply the above quantity of nutrients for an adult palm it is required to apply about 1 kg urea, 1.5 kg Mussoorie phos/rock phosphate in acidic soil or 2kgs of Super phosphate in other soils and 2 kg of muriate of potash in two split doses. If coconut mixture (10:5:20) is used it is required to apply 5kg of the same in two split doses.

Under average management a minimum of 340 g N, 170 g P_2O_5 and 680 g K_2O may be applied per tree in two split doses, and one-third in May-June and two third in September-October.

When the recommended level of nutrients are applied continuously, the available P_2O_5 in the soil tends to go up. When it is more than 80ppm, applicationof P_2O_5 can be skipped off a few years till the level comes down to 60ppm.

In addition to the recommended levels of fertilizers,1.0kg of dolomite or 1.0kg of lime plus 0.5kg of magnesium sulphate per palm per year may be applied in acidic soils. Dolomite or lime may be broadcast in April–May in the basins and incorporated into the soil by forking and should not be applied with other fertilizers. Magnesium sulphate can be applied along with other fertilizers in the basins in September.

In sandy soils of Onattukara part of (Koallam and Alapuzh district) of Kerala state,500 g N +300 g P_2O_5+1000 g K_2O along with 500 g MgO (3 kg Magnesium sulphate) may be applied per palm per year.

5.7 *Irrigation and soil moisture conservation:* The coconut palm responds to summer irrigation. Under West Coast conditions 2cm irrigation through perfo- sprays once in 5 days during December-February and once in 4 days during March -May has been found to be beneficial in sandy loam soil in increasing yields. Where basin irrigation is practised 200 litres/palm once in 4 days will be beneficial. Inareas where water is scarce drip irrigation system can be adopted. This requires only 30 litres of water per day per palm. Where there is an acute scarcity of water this method can be adopted by giving 30 litres on alternate days.

Addition of coconut pith/coir dust as a mulch at 25 kg/palm basin or mulching with husk with the convex side upwards will help in conserving soil moisture.

5.8 *Intercultivation:* Regular intercultivation and adequate manuring are very essential to step up and maintain the production at a high level. Tillage operations like digging the garden with 'mammatty'(spade), plughing, forming small mounds in August September and spreading them in December-January and making shallow basins with a radius of about 2 m at the beginning of monsoon and filling up at the close of monsoon are beneficial to the trees. In sandy soils, which are generally of low fertility and do not have a luxuriant growth of weeds, regular intercultivation may not be necessary; but in other soils which permit rank growth of weeds, intercultivation will be necessary to keep weeds under control. Method of intercultivation will depend upon local conditions, availability of labour, size of holding, soil type, topography and distribution of rainfall.

5.9 *Cover cropping:* Cover cropping is recommended where inter and mixed cropping is not followed to prevent soil erosion in coconut gardens. This will also add organic matter to the soil. Leguminous crops such as *Mimosa invisa, Stylosanthes gracilis,* and *Calopogonium mucunoides* are generally recommended. Green manure crops like sunhemp *(Crotolaria gentia)* and (klinji) *Tephrosia purpurea* can also be raised and ploughed in during August–September. These crops can be sown in April–May when pre-monsoon showers are received.

5.10 *Inter and mixed cropping:* A Variety of inter-crops like pineapple, banana, Elephant foot yam, groundnut, chillies, sweet potato and tapioca can be raised in coconut gardens after the palms attain a height of 5 to 6 meters. In older plantations, cocoa, pepper, cinnamon, clove and nutmeg can be grown as mixed crops. In places where rainfall is not well distributed, irrigation may be necessary during summer months. However, these crops are to be adequately and separately manured in addition to the manures applied to the coconut palms.

5.11 *Mixed farming:* Milk is scarce in areas where coconut is extensively grown mainly because of non availability of fodder. Mixed farming by raising fodder grasses such as hybrid napier or guinea grass along with leguminous fodder crops such as *Stylosanthes gracilis* in coconut gardens has been found to be profitable. Raising the above crops in one hectare of coconut garden can support four to five dairy animals. The cattle manure generated from the system when applied to coconut garden improves the soil fertility considerably. Maintaining milch cows in coconut garden helps the farmers to enhance his income and provide additional employment to the family.

6. Plant Protection

6.1 *Pests:* The major insect pests of the coconut palm are the rhinoceros beetle, *Oryctes rhinoceros,* the leaf eating caterpillar, *Opisina arenosella (= Nephantis serinopa),* the red palm weevil, *Rhynchophorus ferrugineus* and the root eating white grub *Leucopholis coneophora.*

6.1.1 *Rhinoceros beetle:* This is the most serious pest, which has an ubiquitous distribution. The adult beetle bores through into the unopened fronds and spathes. The affected frond when fully opened will show characteristic geometric cuts. Infestation on spathes often destroys the inflorescence and thus prevents production of nuts. The beetle breeds in a variety of materials such as decaying organic debris, farm yard manure, dead coconut stumps and logs, and compost. The total duration of life cycle of this pest is about six months.

Rhinoceros beetle is a prolific breeder and it can multiply whenever there are accumulations of decaying organic debris. As such, maintenance of sanitation in coconut gardens by proper disposal of decaying organic debris is an important step in the management of rhinoceros beetle. Mechanical method of control is possible by extracting the beetles with beetle hooks, without causing any further injury to the growing point of the palm. Filling the innermost three or four leaf axils of palms with a

mixture of 5% BHC dust and sand in equal proportions is an effective prophylactic measure. Three applications in April, September and December are adequate to give sufficient protection to palms in heavily infested tracts. Treatment of all the possible breeding sites of the beetle with 0.1% BHC is an effective method of controlling the immature stages of the pest. For $3m^3$ of breeding material 350 g 50% BHC has to be used. This will help in reducing spathe attack and increasing the yield of the palms. Release of the exotic predator *Platymeris laevicollis* was found to give substantial reduction in pest infestation on the palms. Adoption of all the proven methods of beetle control in an intergrated manner would give quicker reduction in pest infestation.

6.1.2 *Leaf eating caterpillar:* Leaf eating caterpillar is another serious pest of coconut in the coastal and backwater tracts . In recent years this pest got access into certain interior tracts as well and assumed severe proportions. The caterpillars live on the under surface of leaflets inside silken gallaries and feed voraciously on the chlorophyll - containing functional tissues. This affects the health of the palm adversely and results in reduction of yield. The severity of infestation by this pest will be marked during the summer months from February to June. With the onset of south west monsoon the pest population begins to decline.

Spraying of infested palms on the lower surface of leaves with Dichlorvos (0.02%) or BHC (0.2%) so as to give a thorough coverage to the larval galleries would give satisfactory control of the pest. Chemical control treatment is generally adopted only in cases of severe outbreaks of the pest. The treatment may be done at quarterly intervals in March, June, September and December depending on the abundance of the pest in the field.

As this pest is subject to parasitisation by a good number of indigenous larval and pupal parasites its biological suppression also is quite feasible. Mass multiplication, liberation, and colonisation of indigenous and/or exotic parasites like

Parasierola nephantidis, Elasmus nephantidis, Brachymeria nosatoi and *Xanthopimpla punctata* in the infested fields would control the pest population. The parasite breeding stations established in the major pest-infested regions are mass culturing and releasing different species of larval and pupal parasites of the pest. The Bio-control laboratory at CPCRI maintains cultures of important species of parasities for supply as nucleus culture material to the parasites breeding stations in the country for mass multiplication and release in infested gardens.

6.1.3 *Red palm weevil:* Red palm weevil is the most dreaded pest of young coconut palms. Generally , palms of the age group 5-20 years are affected by this pest. At times , seedings below 5 years are also attacked by the pest. Since the pest is a tissue borer its detection in early stage of infestation is rather difficult. The major diagnostic symptoms of red palm weevil infestation are the presence of holes, oozing out of a viscous brown fluid and extrusion of chewed up fibres through the holes, longitudinal splitting of leaf bases and wilting of inner leaves. Some times the gnawing sound produced by the grubs feeding inside will also be audible. Quite often the infestation would becorne evident only when the growing point of the palm is damaged and the crown has toppled.

Affected palms can be saved by injection of Pyrethrin piperonyl butoxide (Pyrocon-E) or Carbaryl (Sevin) at 1% concentration. Ten milli litre Pyrocon-E or 20 g of 50% Sevin in one litre water per palm should be introduced into the trunck through a hole above the infested portion, using an auger and funnel. All the holes on the affected stem should be plugged after injecting the insecticide suspension to the palm. If the pest infestation is through the crown, the insecticide suspension should be slowly poured in after cleaning the crown of all affected materials. Trichlorphon 0.2% or endosulfan 0.1% is also found to be effective in controlling this pest. A prophylactic treatment of filling all the leaf axils of young palms with BHC or

Chlordane 5% dust and sand mixture in April, September and December reduces the weevil infestation.

Coconut logs 50 cm long, split longitudinally and cut surfaces smeared with fresh toddy fermented with yeast and acetic acid are effective traps. Weevils thus trapped can be collected and killed. Peeled coconut petioles arranged in trays and treated with macerated sugarcane+yeast are suitable substitues for coconut log traps. Addition of 2 g 50% BHC / trap does not only adversely affect the attractiveness of the material, but also kills the trapped weevils *in situ*. Daily examination of traps for collection and destruction of weevils can be avoided by the addition of BHC to traps.

Entry of this pest through the cut ends of leaf base can be prevented by leaving a length of 120 cm of petiole while cutting leaves, particularly from palms of the susceptible age. Cutting steps on the stems for easy climbing also has to be discouraged as a precautionary measure to avoid entry of the pest through injured tissues. Palms affected by leaf rot/bud rot diseases are more prone to weevil infestation. As such, they are to be treated with an insecticide as well, after the fungicidal treatment.

Dead palms should be cut and burnt. An integrated approach involving all the proven methods of weevil control is quite feasible in maintaining gardens free of pest infestation.

6.1.4 *Root eating cockchafer :* The soil inhabiting white grubs cause damage to the roots of coconut. Besides coconut, it infests tuber crops like tapioca, colocasia, sweet potato etc., grown as intercrops in coconut gardens. The leaves of affected palms become sickly pale yellow. In cases of heavy infestation there will be immature nutfall as well.

Tilling or deep ploughing of infested soil will reduce the pest population to a great extent. One application of heptachlor 1.4 kg ai/ha (28 kg of 5% dust) in June or two application of BHC at 5 kg ai/ha (100 kg of 5% dust) each in June and September to

be applied and raked in the top 15 cm soil, would give effective control of the pest.

6.1.5 *Minor pests:* the coreid bug (nut crinkler) *Paradasynus rostratus* has become a serious problem in many parts of Kerala. It causes damage to the buttons and tender nuts. Nuts are shed in severe cases of infestation. Even those nuts which are retained in the bunches become deformed with the characteristic crevices on the husk just below the perianth. There will also be gummy exudation from such crevices. Majority of such nuts will be totally barren or with only partial kernel development. Spraying carbaryl or BHC or Endosulfan 0.1% on the unopened spathes and bunches (except the newly opened inflorescence) will control the pest.

During summer months mealy bugs cause damage to spindle leaves, spathes and bunches and the scale insects make encrustations on the foliage. The infested leaves turn yellow and finally dry up. The mealy bugs can be controlled with two rounds of spray with 0.1% Fenthion or Monocrotophos. In the case of scale insects spraying with Dimethoate or Monocrotophos 0.05% is efficaceous.

Termites infest the trunk of palms occasionally. This can be controlled with 0.1% BHC or chlordane spray. The ant hills or termitaria, whenever present, are to be exposed and drenched with 0.1% Aldrin or Chlordane or BHC suspension.

It is estimated that nearly 20 per cent of coconut seedlings are damaged by termites, *Odontotermes obesus* Ramb. in coconut nurseries particularly in the laterite areas. Adoption of field sanitation by disposal of organic matter in nursery soil and covering the germinating nuts with a layer of river sand are some of the practices which would reduce termite infestation. Application of Aldrin or Heptachlor @ 30 g ai/100 sq.m or chlordane at 60 g ai/100 sq.m. of nursery soil is an effective measure against termite infestation.

Whenever, the slug caterpillars like *Contheylia rotunda*, *Parasa lepida* etc. which sporadically appear, assume the status of serious pests, the palms are to be sprayed with 0.1% BHC or Carbaryl to get a satisfactory control of the pests.

The lace bug, *Stephanitis typica* is not only a pest which sucks sap from coconut foliage but also acts as vector in the transmission of MLO from root(wilt) diseased palms to healthy ones. This bug can be controlled by Endosulfan or Monocrotophos 0.01% sprays.

6.1.6 *Mammalian pests:* Rats damage tender nuts and cause severe crop losses in many places. Shed tender nuts with characteristic holes can be located at the base of the affected palms. Rats can be controlled by providing mechanical barriers (bands), poison baits and traps.G.I. sheet bands, 40 cm wide, fixed around the trunk of palms at a height of 2m from the ground will serve as mechanical barriers for rats. The rats can be killed by poison baiting using either single dose acute poisons like zinc phosphide or multiple dose anti blood coagulants like warfarin/fumarin compounds. Rat burrows in the field can be fumigated with aluminium phosphide tablets. Poison baiting with 0.025% warfarin or fumarin wax block on coconut crowns at 3-4 days intervals at the rate of 30 palms (bait points) /ha reduces the rat population and damage by 94% and 100% respectively.The poison baits required for three treatments will be 105 g , 70 g and 35 g, respectively. Poison baiting on the ground level does not have much effect in controlling the rats since they seldom come to the ground.If there are residential buildings within the plantations, rat control should be under taken in both the places to check reinfestation. The best period to adopt field operation to control the rat is late summer.

Coconut bunches can be protected from the ravages of frugivorous bats*(Pteropus edwardsii)* be covering the bunches with thorny twigs of the wild plant, *Ziziphus* sp.

6.2 Diseases: The coconut palm is affected by a number of diseases, some of which are lethal while others gradually reduce the vigour of the palm causing severe loss in yield. The following is a brief account of the important diseases of coconut in our country.

6.2.1 *Bud rot:* This disease caused by a parasitic fungus, *Phytophthora palmivora* has been reported from all coconut growing states. The first symptom of the disease is the yellowing of one or two young leaves surrounding the spindle.The spindle withers and droops down. The tender leaf bases and the soft tissues of the crown rot into a slimy mass of decayed material, emitting a foul odour. The disease proves fatal if it is not checked in the early stage. Even after the death of the central bud the outer leaves and bunches may continue to remain intact for many months. Palms of all ages are susceptible to the disease, but it is more frequent in young palms.The disease is rampant during the monsoon when the atmospheric temperature is low and the humidity is high.

If the disease is detected in the early stage when the spindle is just withering, the infected tissue should be removed thoroughly by cutting the infected spindle along with two leaves surrounding it and the cut portion protected by application of Bordeaux paste. The treated wound should be given a protective covering with polythene sheet till the next normal shoot emerges.Badly affected trees which are beyond recovery should be cut and burnt. As a prophylatic measure, all the healthy palms in the vicinity of the diseased one should be sprayed with 1% Bordeaux mixture.

Preparation of 1% Bordeaux mixture: Dissolve 1kg copper sulphate crystals in 50 litres of water. In another vessel containing 50 litres of water prepare milk of lime with 1 kg quick lime. Pour the copper sulphate solution into the milk of lime slowly stirring the mixture all the while. Test the mixture before use for the presence of free copper (which is harmful to the palm) by dipping a polished knife in it. If the blade shows a

reddish colour, add more lime till the blade is not stained when dipped afresh in the mixture. Always use wooden,earthen or copper vessels for the preparation of Bordeaux mixture. For preparation of Bordeaux paste 100 g copper sulphate and 100 g quick lime each are dissolved in 500ml of water separately and mixed thoroughly.

6.2.2 *Root (wilt) disease:* The root wilt disease has been prevalent in the state of Kerala for nearly 100 years and is believed to have made its appearance after the great floods of 1882. It has now established itself almost contiguously in eight South districts of Kerala viz., Thriuvananthapuram, Alapuzha, Kollam, Kottayam, Pathanamthitta, Idukki, Ernakulam and Thrissur. It has also made its sporadic appearance in the districts of Malapuram, Palakkad, Kozhikode, Wayanad and Kannur and in some groves in the neighbouring state of Tamil Nadu.

The important visual diagnostic symptoms of the disease are abnormal bending or ribbing of the leaflets, termed as'flaccidity', a general yellowing and marginal necrosis of the leaflets. The yield is reduced considerably on account of the disease. The nuts are smaller and the kernel is thin. The oil content of copra is also reduced. Mycoplasma like organism (MLO) is the causative agent of the disease. The disease is transmitted by lace bug *Stephanitis typica*.

Since the disease is not lethal but debilitating and no curative control measure is known at present, the approach will be to manage the disease in the already infected gardens. To reduce the loss due to the disease the strategy would be to contain the disease in the six southern districts of Kerala for which the following measures are recommended.

(i) Removal of diseased palms in Thiruvananthapuram and Thrissur districts and areas of sparse incidence. In areas of heavy incidence of disease, all the heavily infected and unproductive palms (those yielding less than 10 nuts per palm per year) should be eradicated.

Within the contiguously disease affected tract, all palms in the prebearing age which have taken up disease should also be eradicated.

(ii) Replanting with recommended hybrids or high yielding WCT or Chandrakalpa is recommended.

(iii) Application of NPK fertilizers, Magnesium sulphate and organic manures at recommended dose.

(iv) Growing green manure crops in the basin and appropriate inter and mixed crops.

(v) Irrigation during the summer months.

(vi) Control of leaf rot disease which is usually noticed on root (wilt) affected palms by fungicidal spraying.

6.2.3 *Leaf rot:* This disease, caused by the fungus *Bipolaris halodes,* is mostly prevalent in the southern districts of Kerala and generally occurs on palms already affected by root(wilt) disease. The first visible symptom of the disease is blackening and shrivelling up the distal ends of the leaflets in the central spindle and in some of the younger leaves. Later, the affected portion breaks off in bits giving the infected leaves a fan-like appearance. If no protective measures are taken, each new leaf of the diseased tree gets infected with the result that a stage is soon reached when all the leaves of the tree show disease symptoms. The reduction in leaf surface adversely affects the yield.

Spraying the leaves sequentially with Bordeaux mixture (1.0%), Dithane M45 (0.3%) and Fytolan (0.5%) at quarterly intervals after removing all severelly affected leaves, reduces further incidence of the disease to a considerable extent.

6.2.4 *Leaf blight or grey leaf spot:* This fungal disease caused by *Pestalotia palmarum* is common in most of the coconut growing states. The disease symptoms develop in the mature leaves of the outer whorl. Minute yellow spots encircled by greyish bands appear on the leaf surface which later become greyish white. These spots coalesce into irregular necrotic patches. Complete drying and shrivelling of the leaf blade are

common when the infection is severe. Removal of the older affected leaves and spraying the foliage with 1% Bordeaux mixture will check the spread of the disease.

6.2.5 *Mahali or fruit rot and nutfall:* Shedding of female flowers (buttons) and immature nuts are the symptoms of the disease. Water soaked lesions appear on the young fruit or buttons near the stalk which later develop into decay of the underlying tissues.

The disease is caused by fungus *Phytophthora* palmivora. which appears as whitish webby growth on the surface of the affected part. The pathogen is more active during the rainy season when the atmospheric conditions are favourable for its growth.

A pre–monsoon spraying followed by one or two sprayings at intervals of 40 days is generally advisable. Spraying the crown with 1% Bordeaux mixture or any other effective copper fungicide such as Fytolan (0.5%) will control the disease. The shed nuts should be collected and burnt.

6.2.6 *Stem bleeding:* The typical symptom of the disease is the exudation of a reddish brown liquid through cracks developing on the trunk. The bleeching patches are generally noticed in the lower portion of the stem but they spread throughout as the disease advances. On drying, the liquid turns black. The tissues around the bleeding points start decaying first which later develop into a general decay of the tissues underneath the bark. Fatal instances of stem bleeding are not uncommon.

The fungus *Thielaviopsis paradoxa* has been found to be the primary causative agent of the disease. It is believed that some soil and physiological factors may have some role in predisposing the palms to infection by this fungus.In advanced stages, infestation with *Diocalandra* weevil can be seen which quickens the deterioration of the palms.

The damage to stems can be checked to a certain extent by completely removing the affected tissues using a chisel and dressing the wound with hot coal tar or Bordeaux paste. Apply Calixin or Bavistin 0.1% as soil drench and 5 kg neem cake per palm. Provide summer irrigation.

6.2.7 *Thanjavur wilt/Ganoderma wilt:* The disease was first noticed in the coastal areas of Thanjavur district following the cyclones of 1952 and 1955. It was now spread to all the coconut growing districts of Tamil Nadu.

Decay of root system, flaccidity of spindle leaves, browning of outer leaves, arrested fruit set and appearance of bleeding patches on the stem are the salient features of the malady. The affected palms die with in 2-3 years. *Ganoderma lucidum* and *Ganoderma applanatum* are the causative agents of the disease. The bracket of fungus are seen on stumps and diseased palms in very advanced stages.

Application of 5 kg neem cake per year, addition of organic matter and providing irrigation could check the spread of the disease. Irrigation channels should be provided between the palm rows. Adoption of phytosanitary measures like removal of dead palm, burning the affected roots and bole in the pit and isolation of the diseased palm from the neighbouring healthy ones by digging trenches all around is beneficial in checking further spread of the disease. Apply Calixin @ 2ml/100ml through root feeding at quarterly interval for one year.

6.2.8 *Tatipaka disease of Andhra:* The disease derives its name from the Tatipaka village of East Godavari District where it made its first appearance following, the cyclone of 1949. Palms in the age group of 25-62 years are most susceptible.

Development of an abnormally large crown with dark green inner leaves and higher yield is the precursor of disease incidence. Subsequently the crown becomes smaller in size producing progressively shorter leaves. The stem begins to taper. The leaves give a fasciated appearance due to improper

unfolding of leaflets. The affected tree produces smaller bunches with atrophied barren nuts. The cause of the disease is not known. Recent studies show that diseased tissues contained MLOs while the same was absent in healthy palms.

6.2.9 *Crown choking disease:* The disease is commonly observed in Assam and West Bengal. A recent survey shows that 10% of palms are affected by the disease in Assam. The disease is characterised by emergence of shorter leaves with fasciated and crinkled leaves. The leaflets show severe tip necrosis and fail to unfurl. In many cases it gives a choked appearance to the frond. Ultimately the affected palm dies. Application of 50 g borax at half yearly intervals, one in February-March and the other in September - October along with the recommended fertilizer in the basins of coconut palms in the early stage of disease helps in controlling it.

7. Economics

Coconut is a small holder crop and it is commonly raised in homestead gardens. If a farmer adopts the recommended package of practices he will realise a good and assured income from this crop. The estimated costs and returns for coconut as a mono-crop show that planting of D x T hybrid is more profitable than West Coast Tall Variety. The following assumptions have been made in order to work out the economics of coconut.

1. Agro-climatic condition – Represents South India
2. Palm population – 175/ha
3. Stabilised yield – DxT hybrid 130 nuts/palm; WCT 80 nuts /palm
4. Labour wages – Rs. 25/- per working day
5. Costs of other inputs – As per 1983-84 prices
6. Price of coconut – Rs. 2/- per nut

The cost include the value of all inputs including family labour, depreciation and interest on current bank rate.

The estimated figures reveal that in the case of West Coast Tall variety of coconut the initial investment along with the recurring expenditure, will be recovered by 12th year of planting while in the case of D x T hybrid the same will be recovered by the end of 8th year. The WCT variety can give a net profit of at least Rs.14,000/- from 13th year and D x T hybrid can give a net profit of at least Rs. 25,000/- from 10th year, by taking into consideration the yield and price fluctuations.

Estimated cost and returns from pure coconut garden (Rs. /ha)

Year	Costs(Rs.)		Returns(Rs.)	
	West Coast Tall variety	DxT hybrid	West Coast Tall variety	DxT hybrid
1st year	11300	11700	–	–
2nd year	6870	6900	–	–
3rd year	7700	7740	–	–
4th year	6620	8060	–	–
5th year	6620	8200	–	7000
6th year	6620	8350	–	14000
7th year	6710	8490	7000	21000
8th year	6825	8630	12250	26250
9th year	7050	8775	15750	31500
10th year	7340	8920	17500	35000
11th year	7340	8920	19250	36750
12th year	7340	8920	21000	38500
13th year	7340	8920	22750	40250
14th year	7340	8920	22750	42000
15th year	7340	8920	24500	45500
16th year	7340	8920	26250	45500
17th year onwards	7340	8920	28000	45500