

## Establishing coconut garden

**Coconut does best in relatively coarser textured soils like sandy loams, sandy coastal alluviums and sandy river valleys. It is found to grow well on littoral (coastal) sand which is generally unsuitable for many other crops provided it is managed carefully in the early stages with organic manuring and adopting appropriate soil moisture conservation measures. It tolerates salinity and a wide range of pH (from 5.0-8.0). Soil with a minimum depth of 1.2 m and fairly good water holding capacity is preferred for coconut cultivation. Proper supply of moisture either through well distributed rainfall or irrigation and sufficient drainage in waterlogged soil are essential for coconut.**

**C**OCONUT is essentially a tropical plant, growing mostly between 20° N and 20° S latitudes. The ideal elevation is up to 600 m above msl and because of its temperature requirements, the palms cannot grow above 750 m, even near to the equator. The ideal mean annual temperature is 27° C with 5-7° C diurnal variation and humidity >60%. Very high humid conditions right through the growth of palms is not considered good from two aspects. One is that it reduces transpiration and thereby reduces the uptake of nutrients. RH plays a very important role in pollination and fertilization, thus directly influences yield. High humidity provides congenial conditions for the rapid spread of fatal diseases such as bud rot, leaf rot etc.

### QUALITY SEEDLINGS AND HIGH-YIELDING VARIETIES

Being a perennial crop and committed to the land for decades, selection and use of quality planting material is very important in coconut cultivation. High-yielding, pest/disease-free palms could be identified by farmers themselves in their own gardens and used as mother palms for seed nut collection. Bio-priming of seedlings with bio-inoculants such as *Pseudomonas fluorescens* in nursery and transplanting such seedlings ensures better initial establishment of such seedlings in main field with enhanced growth and field tolerance to diseases. Application of talc-based preparation of *P. fluorescens* @ 50 g (10<sup>8</sup> cfu) per seedling during 4, 7 and 10

months after sowing in nursery is beneficial. At the time of planting seedlings in main field, dip coconut seedlings in 100 g (10<sup>8</sup> cfu) of talc based preparation of *P. fluorescens* in slurry mode. The seedlings in nursery, in general do not require any additional fertilizer, as the endosperm provides them with sufficient nutrients.

### Ideal Site for Planting

Availability of sunlight is one of the cardinal principle involved in farming and coconut is no exception to its requirement. For enhancing the growth and photosynthetic efficiency of palms, which leads to early flowering, the seedlings should be planted in the open space. However, under homestead cultivation, especially in Kerala, coconut seedlings are seen planted below big trees depriving them from enjoying sunlight falling on them, and for want of light, the growth becomes etiolated and such juvenile palms are invariably prone to pest and disease incidence quite rampantly. Such plants also take longer time to come to flowering stage.



Kalpasankara hybrid in field

Juvenile palms require sufficient moisture, but at the same time, could not withstand water logging. Therefore, care should be taken not to plant coconut seedlings in areas prone to water logging or ill-drained soil which in the early growth phase gets badly affected due to insufficiency in root respiration. Even if such plants recover later on, the growth gets stunted and palm



Quality seedlings in nursery

yield will be adversely affected. Ample sunlight and well aerated soil are pre-requisites for best establishment of coconut palm.

### Adequate Crop Geometry

In order to make sufficient light available to fall on coconut leaves during their growth phase and avoid over shading, when coconut is cultivated as a monocrop, spacing of  $7.5 \times 7.5$  m (for tall cultivars), and  $7.0 \times 7.0$  m (for dwarf cultivars) is recommended. Thus, as a thumb rule, one cent (40  $m^2$ ) can accommodate only one coconut seedling. Wider spacing offers scope for inter/mixed cropping in the garden.

Under the existing homestead situations, number of palms is to be further reduced to accommodate the growing trees without compromising on light. Too close planting of seedlings with reduced spacing would induce odour cues in favour of pest orientation making the palms more susceptible to

pest attack. However, by providing wider spacing at the time of planting seedlings and inter/mixed cropping and maintaining crop species diversity (crop-habitat diversification by growing plants such as nutmeg, rambutan, curry leaf, banana etc.) along the interspaces disorients the pest away from the source due to induced pest-repulsion cues. Crop heterogeneity, therefore, is ideal for continuous employment of farmers, income generation as well as pest regression.

### Aftercare

The type of soil decides the depth of pits to be taken for planting. In areas with laterite soil and rocky substratum, deeper and wider pits ( $1.2 \times 1.2 \times 1.2$  m) are to be dug and filled up with top soil, powdered cow dung and ash up to a depth of 60 cm before planting. Addition of 2 kg of common salt will help in loosening the soil in such areas. Arranging two layers of coconut husk, with concave surface facing up at the bottom of the pit before it is filled



Nursery in initial stage





Proper spacing for better growth



Planting of coconut seedling



Providing shade using plaited coconut leaf



Fertilizer application for young plants



Incorporating fertilizer in the basin



QR coded seedlings to ensure quality



Seedlings in polybags

up, helps to conserve soil moisture in the pits. Take a small pit at the centre of the filled pits (up to 3/4<sup>th</sup> depth of pit) and plant the seedlings and put fertile top soil around the seedlings and press firmly. Apply water around the seedling immediately after planting.

In loamy soils with low water table, planting in pits (1.0 × 1.0 × 1.0 m) filled up to 50 cm depth is generally recommended. However, in places where the water table is high, planting at the surface or even on mounds becomes necessary. Even under such cases, digging pits and filling has to be done. In areas subject to water logging, proper drainage is to be provided by making drainage channels. If planting is taken up in littoral sandy soil, application of 0.15 m<sup>3</sup> of red earth helps to improve the physical characteristics of soil.

Planting seedlings, during May/October, with the onset of pre-monsoon rains is ideal. In places where assured irrigation is available, planting can be done at least a month before the monsoon sets in to allow seedlings to establish well before the onset of heavy rains. In low-lying areas, take up the planting during September once the heavy rains ceases.

### Making Plants Healthy

Coconut requires extensive feeding of plant nutrients from soil reserve. The production phenology of coconut is such that once the palm starts flowering,

it continues for decades (producing a spadix in the axil of each leaf every month) and therefore, the yield in coconut depends on the number of leaves produced per year. During these years, huge quantities of nutrients are removed from the soil (through coconut leaves, stipules, spathe, bunch waste and husk etc.). Vegetative as well as reproductive growth goes on simultaneously and, hence, adequate nutrition is important all the time. For continued growth and yield, the palms require major nutrients such as N, P and K in a 2:1:3 ratio. It is, therefore, essential that a nutritionally rich environment is provided in the root zone of coconut all round the year to realize adequate yields. Soil test based nutrient application (major, secondary as well as micro) will ensure regular supply of nutrients to palms.

For rainfed areas, two splits during May-June (SW monsoon) and August-September (NE monsoon) is recommended, while in irrigated areas, more splits doses could be made. Juvenile palms should be provided with

1/10, 1/3, 2/3 dose of NPK during the first three years of planting in the main field. Judicious application of micronutrients based on soil analysis and for adult palms, application of borax @ 120 g in four split doses based on the intensity of deficiency symptom is also recommended.

The vast majority of the potassium taken up by the palm is contained in the husk and fruit water of the coconuts. Therefore, any deficiency in potash will result in considerable reduction in yield. In

cultivation systems which include cocoa, returning the cocoa shells to the site will supply sufficient potassium to balance out the extraction. The recycling of coconut husk either through basin mulching or burying in trenches will also help to partially meet the potassium requirement.

### Aftercare

The seedlings, after field planting, are to be protected from heavy wind by staking and from sunlight by proper shading using plaited coconut leaves or palmyrah leaves or any other suitable shading materials. Irrigation during summer months is necessary and in sandy soils, irrigate once in four days with 45 litres of water. It is likely that soil may cover the collar region and leaf axils of coconut seedlings due to soil washing down by the rains. Frequent removal of such soil is necessary. Widen the pits every year before the application of organic manures and gradually fill up the pits as the young plants grow. Inspect the plants at regular intervals for any insect or fungus attack and necessary remedial measures should be taken up as and when required.



Raising green manure crop in the basin for incorporation



Raising cowpea in the basin of young plant

### On-farm Biomass Recycling

A good organic base in soil is very important for the improvement of physical, chemical and biological properties as well as for enhanced availability of nutrients. Organic manuring enhances the beneficial microbial load in the soil and favours better availability of other nutrients and bio-enzymes for palm growth. With heavy rainfall experienced in most of the coconut-growing regions, sizeable quantities of the essential nutrients are leached off in the absence of good organic matter.

Raising leguminous green manure crops such as *Peuraria phaseoloides*/ *Vigna unguiculata* (cow pea) / *Crotalaria juncea* (sun hemp) by sowing seeds @ 100 g in palm basins during April-May and September-October



Mulching basin with coconut leaves

and later on incorporation of fresh biomass, when one or two plants start flowering, not only fixes atmospheric nitrogen but also enhances the C: N ratio for better growth. This practice could be done both in the early as well as later phases of growth of palms. Green manure incorporated soil will be well aerated aiding better root growth and withstands moisture stress.

The practice of growing glyricidia along the field boundaries and in the interspaces (if no other inter crop is grown) and using the cut leaves as mulch in the basin not only conserves the soil moisture and microbes, but also add organic carbon in the soil. Application of Glyricidia prunings (@10 kg green manure/palm/year) from the interspaces of one hectare of coconut garden to palms could supply around 90, 25 and 15% of the requirement of N, P and K, respectively.

### Drought and Coconut Production

In coconut, spikelets on the inflorescence are formed about 15 months before the opening of spathe and the pistillate flowers before 12 months. Even after the spathe is opened, female flowers, which become nuts, remain for about 11 to 12 months to develop into full maturity stage. Severe drought during early formative phase of the inflorescence will kill the growing points due to desiccation resulting in the abortion of spadix. Any coincidence of drought or dry spell with critical sensitive stages such as inflorescence primordial initiation, ovary development, button size nut stage, adversely affects the nut yield.

In severe drought situations, drooping of leaves due to low leaf water potentials, shedding of buttons and immature nut fall, bending and breaking of leaves etc. may happen. Drought or prolonged moisture stress, thus, affects growth and yield of coconut palms

### Vermicomposting

Technology for vermicomposting coconut leaves using *Eudrilus euginae* species of earthworms (identified by ICAR-CPCRI, Kasaragod) is available. Application of well-decomposed vermicompost (10 kg/palm) or farm yard manure (25 kg/palm), neem cake (2 kg/palm) fortified with *Trichoderma harzianum* (250 g/palm) is also recommended for improving the health of the juvenile palm in the initial phase of establishment. Composted coir pith (using coir pith, poultry manure, lime (calcium oxide) and rock phosphate along with fresh glyricidia leaves/tender stem) can also be used as organic manure.



and the impact could be seen from the year of drought till four years. Therefore, appropriate and timely moisture conservation measures should be adopted to protect the palms from impact of drought.

### Conserving Soil Moisture

In order to conserve soil moisture during summer months (November-May), measures such as mulching the basins with coconut leaves, and other weeded materials, burying coconut husks either in the basins or interspaces, preparing catch pits or contour trenches filled with coconut husk is to be adopted.

With the beginning of the monsoon, place coconut husks with concave side facing upwards in linear trenches (1.5 to 2 m wide and about 0.3 to 0.5 m deep) taken between rows of palms. Cover each layer with soil. Coconut husks are also important sources of potash, which becomes available to the palms over a period of time.

Preparing catch pits (1.5 m length × 0.5 m width × 0.5 m depth) in sloppy gardens helps to conserve soil and water. A bund is to be made at the downside using the excavated soil and plant pineapple suckers on it. Fill the pits with coconut husk while planting of pineapple. In plantations, where the land slope is high, prepare contour trenches (50 cm width × 50 cm depth and convenient length) in between two rows of coconut palms and filled with coconut husk in layers by keeping the bottom layer facing up and top layer facing down. A bund of 20 cm height and suitable width (>50 cm) is to be prepared at the downstream using the excavated soil and plant two rows of pineapple on the bund at 20 cm × 20 cm. Coconut husk kept in the trenches will retain the moisture and makes it available for plants during summer months.

The poor physico-chemical properties of littoral sandy soils of coastal areas render it non-ideal for growth and yield of coconut palms. However, adopting appropriate measures like incorporation of coconut husk and coir pith in trenches made in between coconut rows and cultivating various intercrops will lead to overall improvement of these conditions and system productivity.

### Weed Control

Generally, weeding is to be done when the monsoon recedes preferably during September-October. Depending on the intensity of weed growth, they are to be removed by hand around the palm base and the weeds in the interspace need only be slashed with sickle. As far as

possible, avoid clean weeding. While weeding, dried shoots and other thrashed materials can be used as mulch around the base of palms, which will help to conserve moisture in the ensuing dry months and help in vermicomposting process in the basin as well as in the interspaces.

Irrigation is very critical for the growth and yield of coconut palms. Drip irrigation @ 66% of the open pan evaporation (27 to 32 litres of water/palm/day based on weather conditions) during summer period (December to May) is ideally suited for coconut resulting in 34% saving of water and helps attaining the highest productivity (*"per drop more crop"*). In order to supply 32 litres/day, four drippers at a discharge rate of 4 litres/hour will be required so that daily two hours of irrigation is sufficient. Where basin irrigation is practiced, 200 litres/palm once in 4 days will be beneficial.

Adoption of drip fertigation (application of fertilizers through drip irrigation water) helps in optimizing use of water and

fertilizer nutrients. Fertilizers Urea (70 g), DAP (60 g) and Muriate of Potash (170 g) are to be used for a single dose for one palm and fertigation can be followed for seven times a year. For phosphorus application, commercial phosphoric acid can be used.

### SUMMARY

In India, small and marginal farms contribute significantly to the production and more than 90% of the holdings are below one hectare, the average size being 0.22 ha. In the west coast of India, the palm is an essential component in homestead system of farming where it is mostly grown as a rainfed crop.

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### Mulching

For mulching, coconut leaves cut into two or three pieces can be used. In order to cover 2 m radius of coconut basin, 15 to 25 fallen coconut leaves are required to spread in 2- 3 layers. Mulching with composted coir pith to 10 cm thickness (approximately 50 kg/palm) around coconut basin is also ideal method to conserve moisture as it can hold moisture five times of its weight. Because of its fibrous and loose texture, incorporation of coir pith considerably improves the physical properties and water holding capacity of soil and thereby increases the coconut productivity. The applied material may last for about 4 to 5 years. The weeded materials also can be used for mulching and should be properly dried before applying in the basins.

### Inclusive Farming

Adoption of cropping/farming system approach, depending on growth stage of palms, with different crops (annual, biennial and perennial) or enterprises (e.g. animal husbandry) harnessing maximum resources in a holistic manner ensures complete employment and continuous income to farm family. Coconut based high-density multi species cropping (HDMSCS), using different vertical (above and below ground surface), is a classical example. Adopt cropping system approach by raising compatible intercrops in rotation/adopt mixed cropping/mixed farming with recycling of organic matter for reaping sustainable income. Restructuring of canopy of other perennial tree crops to provide maximum light for the coconut palms also becomes necessary under homestead cultivation.