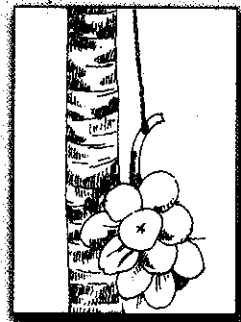
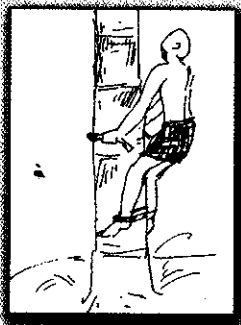


**Indigenous Knowledge
in
Coconut and Arecanut
Cultivation**



CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

KASARAGOD - 671 124, KERALA, INDIA



**INDIGENOUS KNOWLEDGE
IN
COCONUT AND ARECANUT CULTIVATION**

**S. Arulraj
C. Thamban
P. Anithakumari
S. Kalavathi**



CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

(Indian Council of Agricultural Research)

KASARAGOD - 671 124, KERALA, INDIA



Published by

Dr. V. Rajagopal
Director
Central Plantation Crops Research Institute
Kasaragod - 671 124
Kerala, India.

Cover design

Shri. C. H. Amarnath

Art credits


Shri. M. B. Sukumaran

February, 2002

Printed at Niseema Printers, Kochi - 18. Ph : 0484-403760

FOREWORD

Indigenous knowledge in agriculture and allied sectors is a valuable resource and essential foundation for the development of sustainable agriculture. Though modern research has been highly successful in generating a vast number of farm technologies for the benefit of growers, they have not completely replaced the traditional agricultural practices developed through the experience of farmers over centuries. There is a growing awareness about the need for integrating relevant indigenous farm technologies with the modern technology packages. Hence it is imperative that adequate efforts are taken for collection and compilation of relevant indigenous knowledge available among the farming community. Proper testing to unearth the rationale behind the practices also is widely recognised. In this context, I congratulate the scientists of Central Plantation Crops Research Institute, Kasaragod for their efforts in collecting and compiling the indigenous knowledge related to coconut and arecanut cultivation and bringing out a publication. CPCRI has been an illustrious example of a research institute evolving a substantial number of production technologies related to coconut, arecanut and cocoa aimed at improving the standard of living of millions of farm families depending on these crops. I am sure that the institute will be highly benefited by the present compilation of indigenous knowledge in coconut and arecanut cultivation and hope that sincere efforts will be taken for the proper testing of the scientific rationale of the relevant indigenous practices so that they can be integrated with the technology packages for recommending to growers for wider adoption. I wish every success for CPCRI for the efforts to be taken in this direction.



Dr. G. Kalloo

New Delhi
01-02-2002

Deputy Director General (Horticulture)
ICAR, New Delhi

PREFACE

The Indigenous Knowledge available among the farming community is a vital resource for exploring the challenging areas of research and enhancing the utility of technology packages for sustainable agricultural development. In the present publication, we have attempted to present the indigenous knowledge related to coconut and arecanut cultivation which will be useful to farmers, extension personnel and researchers.

The information collected from various primary and secondary sources under the Research Project entitled "Indigenous knowledge in coconut and arecanut cultivation", implemented at CPCRI during 2000-01 is presented in this book. The project was originally proposed as a complementary project to "Institution Village Linkage Project for Technology Assessment and Refinement" which provides scope for testing farmers' practice as well. We are grateful to the farmers of various coconut and arecanut growing areas for sharing with us the details of some of the indigenous cultivation practices and skills in use in their respective places.

We have extensively used the publications brought out by Dr. K.V.A. Bavappa, Former Director, CPCRI, Kasaragod; Dr. Anil Gupta, Indian Institute of Management, Ahmedabad; Mr. P. K. Thampan, Chief Coconut Development Officer (Retd), Coconut Development Board; Ms. S. P. Manju, Kerala Agricultural University; Dr. N. K. Sanghi, Director, MANAGE, Hyderabad; Dr. R. Chittiraichelvam, Faculty Member, NAARM, Hyderabad and others whose contributions for this compilation are gratefully acknowledged.

We thank Dr. V. Rajagopal, Director, CPCRI; Dr. K.U.K. Nampoothiri, Former Director, CPCRI and Scientists of CPCRI for providing useful suggestions and valuable information especially during the Staff Research Council meetings of the Institute.

Efforts are required to further revalidate the rationale of the indigenous practices so that appropriate technologies can be made available for integration with the present technology use pattern among farmers elsewhere under similar agro-eco situations.

We welcome comments on this publication and also suggestions for including additional items, which we hope, to compile as the second volume for this publication. We dedicate this compilation to the farming community in India as a token of the tireless efforts taken by generations of farmers who toiled in the golden soils in this country.

AUTHORS

plantation crops which provide livelihood to millions of farm families especially in the states of Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, Assam, Orissa and Goa.

Coconut being a multiproduct crop, the small and marginal farmers depend on it for meeting various domestic requirements such as food, fuel and shelter. Eventhough the cash earnings from coconut are inadequate to meet their demands in full, coconut culture and industry sustain the well being of nearly 10 million people of India. Besides the economic support, coconut has a significant place in the cultural and social heritage of the people of India. Eventhough the Indian population represent different cultures, they share a common culture in the use of coconut. Whether they cultivate it or not, no social, cultural or religious function will be complete without coconut or its products like inflorescence, tendernut, tender fronds or copra and its use is almost similar throughout. Coconut, is therefore inseparable from the life and traditions of the people of India. No other crop has so many legends and anecdotes centered around it as coconut and this reveals the religious significance of the palm and its intimacy with man. The people around the world, in addition to the vast knowledge on coconut farming acquired over generations, could exploit the multiple uses of coconut palm and its products. The documentation of the knowledge and wisdom of the coconut growers will contribute a lot for the farming community as well as researchers.

Arecanut palm is one of the important plantation crops in India, cultivated mainly in the states of Karnataka, Kerala, Assam, Meghalaya, Tamil Nadu, West Bengal and Maharashtra. Besides the economic importance, it is also having a prominent place in several religious and social ceremonies. The arecanut palm, the arecanut and multifarious uses of arecanut were described in many ancient literature. The practice of chewing arecanut, either alone or in combination with betel leaves, lime, tobacco, camphor or spices, the combination then being called *tambula* has been in existence from time immemorial. Areca cultivation has great antiquity in its major growing areas like Karnataka, Kerala etc. and the areca farmers over the generations have gained considerable knowledge and experience not only about farming but also on the multiple uses of arecanut palm products.

There exists a wide variety of indigenous knowledge related to various aspects of cultivation of these crops which have been evolved over a period of time and are prevalent among cultivators in different localities. A compilation of such indigenous knowledge is attempted through scanning secondary sources as well as through interaction with farmers, scientists and agricultural development personnel. Integration of the relevant indigenous knowledge with that of the technology packages evolved through formal research will be immensely benefiting the coconut and arecanut growers.



Section - I

COCONUT

CROP IMPROVEMENT

Farmers have evolved various indigenous practices for crop improvement in coconut through systematic selection and multiplication to meet their diverse needs.

Identification and selection of palms for specific purposes

- The importance of selecting suitable trees as mother palm for collecting seednuts was fully recognised by farmers in traditional coconut growing areas.
- In the unique system of coconut based homestead farming system as followed by the farmers of Kerala, care was taken by the farmers for identifying one or two coconut palms having certain desirable characteristics as mother palms for collecting seednuts.

Pakku thengu

Trees which are high yielding, regular bearers, producing medium sized nuts are identified as mother palms which are locally known as 'Pakku thengu'.

Arappu thengu

Farmers set apart a few coconut palms in the homesteads exclusively for culinary purpose which are known as 'Arappu thengu'. These trees produce medium sized nuts with thin husk and high kernel content, firm kernel suitable for easy grating and milk extraction by hand.

Enna Thengu

Farmers identify coconut palms in their homesteads suitable for copra making and oil

milling. The palms producing nuts having the characteristics similar to that of 'Arappu thengu' but with a hard kernel are considered suitable for the purpose.

Production of hybrid seedlings/Natural Cross Dwarfs

Based on the knowledge about the existence of natural cross progenies of dwarf ecotypes, traditional coconut growers in many localities are able to produce hybrid seedlings. They grow a few yellow dwarf cultivars along with the common tall palms to facilitate natural pollination. The naturally crossed dwarf progenies are identified on the basis of petiole colour. Such hybrid palms produced high yield and nuts with excellent qualities.

Varieties/ecotypes of coconut

There are several ecotypes of tall and dwarf coconut available in the farmers fields. Some of them are locally named as *Neduarayan*, *Karinthengu*, *Chenthengu*, *Pathinettampatta*, *Kappa thengu*, *Maniyan*, *Komadan*, *Vallikkodan*, *Koorithengu*, *Theyyanthirithy*, *Moovandan*, *Arikuliyen*, *Thondan*, *Neythengu*, *Sooryakanthithengu*, *Elathengu*, *Goulithengu*, *Nakkavary*, *Chavakkadan pacha*, *Chavakkadan chomala*, *Jappanam* etc. and some types are also identified by the locality in which the ecotype is available. Eg: *Arasampatti Tall*, *Tiptur Tall*, *Thangassery*, *Attingal*, *Paravur*, *Kanjirappally*, *Changanassery*, *Chavakkadan*, *Kuttyadi* etc. Farmers are aware about the salient features of such ecotypes.

PLANTING MATERIAL

In coconut, seedling vigour is highly correlated with adult palm characters such as early flowering, nut yield and copra production. As coconut is a perennial crop, the performance of the new progeny can be judged only after several years of planting. If the seednuts happen to be of poor quality, the new plantation will prove to be uneconomic, causing considerable loss of time and money to the grower. Further, being a cross-fertilized plant, coconut doesn't breed true and makes the selection of seednuts and seedlings more difficult and important. Through a series of selections made at different stages, it is possible to obtain quality seednuts and seedlings.

Coconut farmers traditionally followed certain practices in mother palm selection, selection of seed nuts, raising and selection of seedlings.

Some coconut growers are of the opinion that the palms get acclimatized to restricted environment and develop ecotypes. Hence, for raising successful plantations in a particular area, the planting material should be obtained from areas similar to it in soil and climatic conditions. It would thus mean, for example, that seedlings for planting in sandy coastal tracts and interior lateritic regions should be obtained from corresponding areas only.

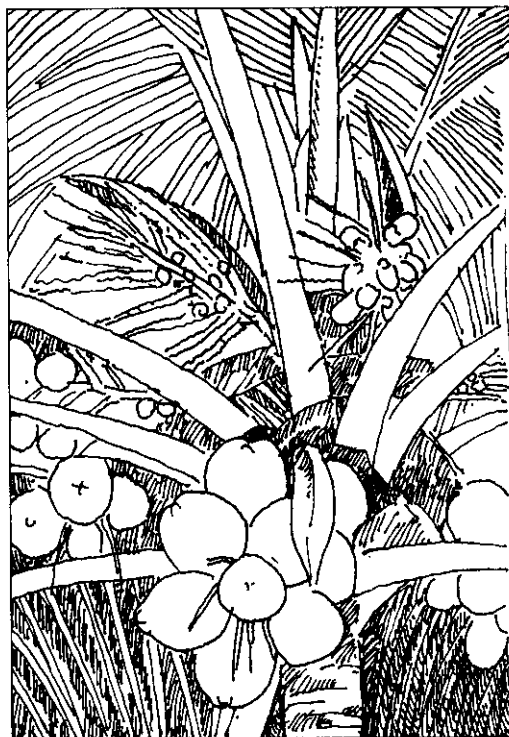
Mother palm selection

Farmers select mother palms based on the criteria such as :

- age between 25-40 years,
- high yielding with a minimum yield of 100 nuts per palm per year,

- 12-14 bunches,
- producing medium sized, round nuts because the number of nuts harvested per annum is large and also the round nuts contain more copra than the oval nuts,
- regular bearer,
- umbrella shaped crown with 35 to 40 well oriented leaves,
- and not affected by pests and diseases.

The palms possessing these desirable characteristics are identified as *pakku thengu* (pakku means seed) in some places.



Mother palm for seed nut collection

In some areas of Andhra Pradesh, farmers believe that the coconut harvested from an adult coconut tree with following characteristics should be used as seed. It should have about 35-37 total leaves, out of which 25 per cent should remain straight open towards sky, 25 per cent should remain at the angle of 135°, 25 per cent should remain parallel to the ground and remaining 25 percent should be parallel to trunk of the tree. Such arrangement of leaves helps in harnessing maximum sunlight. Tree should bear 300-350 nuts per year.

The common practice on the West Coast of India is to obtain the seed nuts from the recognized seed centres. In the erstwhile district of Malabar, the important recognized seed centres are Kunium, Annoor, Dharmadam, Tikkotti, Nammanda and Chowghat.

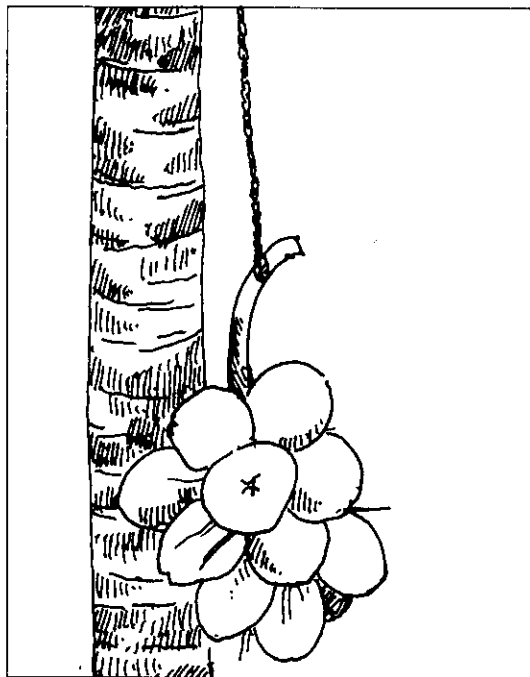
Collection of seed nuts

All the nuts from an identified mother palm are not chosen as seed nuts. Farmers believe that :

- Matured nuts from the bunches in the northern side of the crown are to be preferred as seed nuts.
- Nuts from the middle of the bunch are to be selected.
- Oblong nuts with bulged middle portion, nuts with thin husk and high copra content and nuts with larger eyes are the other criteria.
- Only fully matured nuts are to be harvested for seed nut purpose. Until then, the nuts are retained on the mother palm.

The identified bunches are lowered to the ground with utmost care using a coir rope or a coir basket. The rationale behind the practice is that the embryo would be injured if the seeds

are allowed to fall on hard ground. In sandy soil, this precaution is not required to be followed.



Lowering of coconut bunch after harvest

Time of collection of seed nuts as practised by the farmers coincides with the recommendation of CPCRI i.e., during December to April (*Vrischikam* to *Meenam* months as per the indigenous calendar year in Malayalam).

Selection of seed nuts

Farmers in some localities believe that those seednuts which stand straight with the stalk end upwards when thrown into water in a well or a pond will be better than those float horizontally.

Storage of seed nuts

Farmers believe that the harvested seed nuts are to be allowed to dry in shade for about two weeks. Then they are put in water, either in a well or a pond for about three to four weeks. This practice, they think, will help the embryo

to easily penetrate the husk so as to attain early and higher germination.

Detecting the functional eye by floating the nut in water

If the nut is put in a bucket of water, the mature nut will float on the surface almost horizontally. The side above water level was marked with a piece of chalk and the test is repeated. The marked side will always be on the upper side. Thus one can determine the location of functional eye of the nut. Nuts should be sown in the same position with the marked side facing upwards.

Detecting the functional eye by the position of smaller stalk

The nut has two stalks – one long and the other short. The position of the functional eye is in the direction of the smaller stalk.

Removal of husk near the eye to hasten germination

A little portion of husk near the eye of seed nut is carefully removed for enhancing early germination. The rationale of the indigenous knowledge is similar to that of soaking of seednuts in water and hence the practice seems to be having scientific basis.

Sowing when coconut water content reduces to half

Farmers believe that the most ideal stage for sowing seed nuts is when the nut water content is reduced to half.

Experienced farmers are able to judge this maturity stage of seed nuts. Over matured seed nut, if used for sowing, results in drying up of coconut water, which adversely affects the growth of embryo.

Nursery practices

The nuts sown inverted in the soil will germinate early with higher germination percentage.

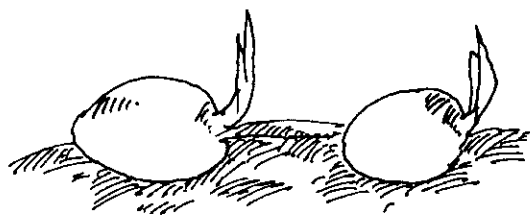
Smoking the seed nuts until the nut water dries up before sowing and then planting inverted in sand beds also will induce vigour for germination and to produce dwarf palms according to farmers belief. Once the sprout comes out, it can be kept straight.

Preparation of nursery bed

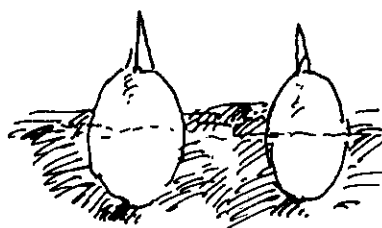
According to the practice of some farmers, a nursery bed raised to two feet height is ideal for coconut which is prepared with a mixture of soil and sand. A small quantity of ash and common salt are to be added to the nursery bed as manures. In such beds, seed nuts are to be sown leaving one-fourth of the nut exposed to the soil surface.

Sowing in nursery

Most of the farmers practice vertical sowing of seed nuts in the nursery. The practical advantage of vertical sowing as perceived by farmers is that the seedlings are more safe while lifted from nursery and transported to other locations than in the case of seedlings from the seed nuts sown horizontally. Further, the germination is delayed in the case of sowing in slanting position because the sprout has to penetrate the thick fibre to come out. In



Horizontal sowing of seed nuts



Vertical sowing of seed nuts

some areas, farmers used to hang the seed nuts in tree branches or poles on the sides of houses or cattle sheds and they believe that they will germinate early and will give vigorous seedlings.

Sowing seed nuts in gunny bags



Coconut seedling in gunny bag

Some farmers follow the practice of sowing coconut seed nuts in gunny bags filled with a mixture of top soil, sand and dried cow dung. Sowing in gunny bags, according to them, hasten the germination and produce good healthy seedlings.

Criteria for selection of seedlings

Farmers adopt various criteria for the selection of seedlings for transplanting in the main field.

- Select at least one year old seedling having a minimum of six leaves.

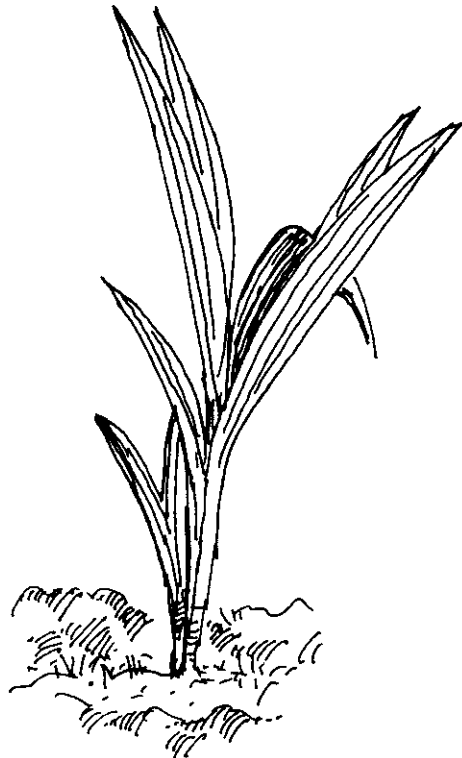
- Discard seedlings emerging after 40 days since they will be late bearers.
- Select seedlings germinating within 90 days.
- The seedling should have ten leaves with at least two leaves split.

Kannadi kanam (Collar girth)

Farmers used to select seedlings with higher collar girth (which is locally known as 'Kannadi kanam'). The seedlings with three "fingers" of collar girth (one finger is approximately one inch) are considered as the best.

Selecting seedlings with the thread(*narola*)

Narola refers to the leaf having a fibre (thread) connecting the leaflets along the margins. It is believed that the seedlings with the *narola* are healthy and early bearers.



Coconut seedling for transplanting

PLANTING AND AFTERCARE

Spacing

Farmers in Lakshadweep Islands, Andaman & Nicobar Islands and many parts of Kerala and Goa use higher planting density than the recommended rate. This may be attributed to the fact that the farmers preferred to play safe against the loss as due to non establishment of seedlings and subsequent mortality due to pests and diseases.

Farmers' practice with regard to optimum spacing for coconut palms is evident from their traditional belief that leaves of two nearby palms should not overlap; instead they should just touch only. The traditional saying "Annan chadaruthu" means squirrel should not be able to jump easily from one palm to the adjacent one. To ensure this, a spacing of 20-25 feet is followed.

Farmers grow coconuts in the side bunds of paddy field under closer planting since the palms will have sufficient space to grow on both sides utilising the sunlight.

Age of seedlings for transplanting

In waterlogged or reclaimed areas, farmers usually prefer two year old seedlings rather than the usual practice of planting one year old seedlings for better establishment.

Transplanting coconut sprouts (Mulathai)

Transplanting of coconut sprouts, which are of about 3-5 months old and leaves not separated, is practiced by farmers in some localities as against the regular practice of transplanting one year old seedlings. Farmers believe that the seedlings transplanted in this

stage (such sprouts are called *Mulathai* in some localities) establish easily as compared to older seedlings. The sprouts resemble a knife and hence the stage of growth is also referred to as the *kathi koombu* (*kathi means knife*)/*kakka mookku* (*crow beak*) stage in some places.

The rationale they attribute for this practice is that at the *mulathai* stage the roots do not pierce the outer cover of the seed. Rooting occurs directly in the transplanted pit and so, injury to roots can be avoided. Another perceived advantage of transplanting at sprout stage over the older/taller seedlings is that seedlings will not face lodging problem in areas where strong wind is experienced.

Transplanting on Bharani day of Kumbhom

Bharani is believed as the birth star of coconut. Kumbhom is the month in the indigenous calendar year which comes in the period approximately from the second half of February to the first half of March, which is the beginning of summer season. As per the opinion of farmers in west coast region, transplanting in this period has its own advantages. The seedlings become well established before the onset of heavy monsoon. The leaves separate by this time and they can function as any other normal plant.

The most usual time of planting coconut seedlings in Kerala state is on the '*pathamudayam day*' (*Malayalam month Medam 10th*). This day which comes on the 10th day of the auspicious day of 'Vishu' (second week of April) is also considered as ideal for planting. Vishu is the new year day in the indigenous calendar in Malayalam.

Transplanting in *Karkadakavarcha*

Karkadakavarcha is the period when south-west monsoon is ceased and the north-east monsoon is yet to begin.

A few farmers opined that this is a good time for transplanting coconut seedlings in west coast region. Soil is sufficiently wet after the south-west monsoon and so, seedlings can establish easily. North-east monsoon is not so heavy and irrigating the seedlings, hence, can be avoided. Before summer, the plants will be established.

This practice is prevailing in the lowland fields rather than in garden land.

Preparation of planting pit

The seedling pits are usually dug two to three months in advance of transplanting time and allowed to weather. The surface soil is kept separate and the subsoil is utilized for making a small bund all around to prevent rain water flowing into the pit.



Making planting pits

Farmers adopt a variety of dimensions for the planting pit according to varying soil types:

Square pits

Farmer take square pit of size $1\frac{1}{2}$ Kol (1 Kol = 0.7m) each side.

This much sized square pits are taken in hard soils only. If the pit size is small, penetration of roots becomes difficult.

Circular pits

A few other farmers in the coastal sandy regions take circular pits of 1 Kol radius. In sandy soils, large pits is not a necessity. Besides, circular pits can be conveniently prepared in such soils.

Rectangular pit

In certain parts, rectangular pits are taken with the longer side in the East-West direction and the shorter side in the North-South direction. This is done to minimise the direct sunrays reaching the pit.

Burning of husk or trash inside planting pits

Husk or trash is burnt in the pits prepared for planting coconut seedlings once or twice to char the sides of the pit. This prevents termite attack.

Application of common salt in planting pit

Farmers apply common salt in planting pits prepared in areas where the soil is hard laterite. It has been scientifically proved that common salt i.e. sodium chloride has the quality of improving the soil condition by way of enhancing weathering of soil in laterite areas. Pits dug in the laterite area for planting receive 2 kg of common salt at the bottom for softening the rock to aid root penetration. This practice is included in the package of practices recommended for coconut cultivation.

Application of a mixture of sand, salt and ash in pit before transplanting

Sand improves the texture of soil and facilitates easy rooting of seedlings. Salt and

ash are proven to possess germicidal properties. Ash also effectively controls termite attack. Common salt also possesses the property of improving the soil condition.

Making planting space in the pit

Farmers are aware of the small space to be made in the pit, which are traditionally known as *Mangukuzhi*, *Kallakuzhi*, *Pillakuzhi* etc. in different places, which exactly fits the nut portion of the seedling. It keeps the nut firmly in place to facilitate proper upright growth of the seedlings.

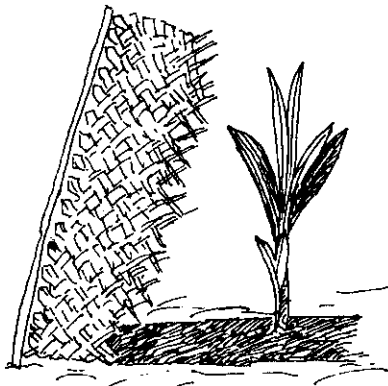
Supporting the seedlings with the help of stakes and ropes

Various methods of staking and tying are available. One, two or three stakes are used to tie the seedlings. The purpose is to prevent the seedlings from lodging.

To prevent cattle from grazing the seedlings, a common method in Tamil Nadu and Andhra Pradesh is to make a cowdung slurry and sprinkle on the plants to be protected. The animals are found to sniff at the treated plants but do not eat them.

Plaited coconut leaves for shading

Farmers erect small pandal with plaited coconut leaves kept in a slanting position against the southern side of the seedlings to provide shade in summer days.



Providing shade to seedlings by using plaited leaves

Sometimes, the whole coconut leaf is plaited and the ends are tied together in a long cylindrical shape. This is fixed around the seedling to provide shade and to protect the seedlings from grazing animals.

Pitcher irrigation (*Kudam vekkai*)

It is a traditional method of irrigation provided to seedlings and young plants based on the principle of trickle irrigation. Earthen pot specially made with minute pores is filled with water and placed near the seedlings with just the lid seen outside the soil surface to ensure very slow release of water in small quantities. Sometimes, a hole is made at the bottom of the clay pot and a cotton thread inserted into this hole. Water in the pot comes out through the thread in drops. This is placed in the seedling pit near the root zone.

This is a very effective water saving method of irrigation suitable in areas where water scarcity is experienced and also in sandy soil where loss of water through percolation is very high. One pot full of water is sufficient for two or three days.



Pitcher irrigation for coconut seedling

Planting turmeric in planting pit of coconut seedlings

Farmers in some localities used to plant one or two turmeric plants in the planting pit of coconut to prevent termite attack and root grub infestation. Though the validity of the practice

is not tested scientifically the germicidal property of turmeric is well documented.

Planting arrowroot in planting pit of coconut seedlings

Similar to planting of turmeric, farmers in some localities used to plant one or two arrowroot plants in the planting pit of coconut to prevent termite attack and root grub infestation.

Planting of banana for providing shade to newly planted coconut seedlings

Farmers in many places grow banana in the interspace of newly planted coconut seedlings with the intention to provide shade to the seedlings during summer. Banana also fetches a good income to the farmers which is important during the pre-bearing phase of coconut.

Arranging coconut husks inside planting pit

In some localities, farmers arrange coconut

husks in the planting pit with their concave surface facing upwards after transplanting coconut seedlings. The benefits of husk burial in coconut garden as a practice for moisture conservation is well documented scientifically. In addition to the conservation of moisture, some amount of nutrients are also obtained from the degrading husks especially potassium which is important in coconut nutrition.

Seedling management

Farmers do not prefer to use fresh cow dung up to three years of planting, to avoid damage due to pests. They usually apply ash, bone meal and salt during this period.

- Sprinkling of ash over the seedlings every Friday is considered good to keep away pests and diseases and to keep the seedlings healthy.
- Cow dung slurry is sprinkled over the leaves to protect the seedlings from grazing animals.

GARDEN MANAGEMENT

The coconut garden management practices include fertiliser management, cultural practices, moisture conservation, irrigation and drainage. The farmers traditionally possess a fair amount of knowledge regarding these aspects. The indigenous knowledge in this regard clearly indicate the wisdom and practical approach of farmers to select, examine and apply the technologies according to the location specificity like soil characters, availability of resources, scope of local markets etc.

Cultural operations

In the West Coast of India, gardens are dug up once or twice in a year. Sometimes, the land is dug once and again ploughed once a year.

The gardens in Mysore district of Karnataka State are generally ploughed six to ten times a year and very good tilth is maintained.

In Godavari district of Andhra Pradesh, the gardens are ploughed twice before the commencement of the south-west monsoon and four times in December.

In the coastal tract of Thanjavur district of Tamil Nadu, the gardens are ploughed four to six times in a year.

However, in the deltaic portions of Thanjavur district of Tamil Nadu, the trees are generally planted too close not to allow ploughing, making it necessary to adopt the costlier method of digging.

In the sandy soils of the West Coast of India, when the garden is dug up in November, the soil is heaped up, each heap being 1 or 2 feet

high. This is supposed to afford aeration to water-logged soils and to prevent the growth of the roots at the surface. The heaps are then levelled up in November or December.

Opening and closing the basins according to the *Njattuvela* - '*Thadamedukkal*'

There is a strong belief among the farmers that the basins of 5 to 6 feet should be opened before the *Thiruvathira njattuvela*, which they follow strictly. *Thiruvathira njattuvela* is the period between the last week of June and the first week of July. As per the opinion of experts, this is a rational practice, as maximum quantity of rain water can be collected and made available to the palms by this.



Basin opening for coconut palm

The size of the basins according to the farmers is such that the rain drippings from the leaves fall in the basin. The surface soil in the basin area will be removed by scrapping with a spade locally called *mammatty/thoomba* and collected in the circular periphery of the basins. Ash, cow dung, green leaf and kitchen waste are dumped in the basin during this time. The basins are closed just before the onset of the next monsoon. The organic materials added in the basins get decayed by following this practice.

Old roots, *potta verukal* as traditionally referred, are to be cut and removed every year as they will be active only for one year. If they are removed regularly, new roots will be initiated.

Weed control

- Farmers perceive that maintaining cattle, particularly buffaloes, in coconut gardens is very effective in controlling the obnoxious weed 'illuk' found in coconut plantations.
- *In situ* incorporation of sunnhemp and daincha enhances coconut yield and also prevents weed growth in the garden.

Manurial practices

Organic farming in coconut

The traditional system of coconut farming in many areas is considered as a classical organic farming with minimum external inputs and with maximum emphasis on recycling on-farm residues. The features of this sustainable and low cost farming system can be summarised as follows :

- Farmers usually practice application of green leaves and twigs from various available sources including forests, in the palm basins.
- Application of green manure/leaves and ash are good for getting quality nuts according

to farmers. They apply these manures in the basins regularly every year. Farmers apply manures only once in a year as they presume that organic manures are slow in releasing nutrients and will be available throughout the year.

- The commonly used green leaf sources are 'Vatta' (*Macranga peltata*), and seemakonna (*Glyricidia maculata*) etc. They adopt this practice every year.
- Farmers traditionally sow cowpea or any other pulses as a green manure in the basins and then incorporate the biomass in the coconut basins.
- Some of the farmers also grow other green manure crops and incorporate the biomass into the garden soil.
- It is also a common practice to apply farm yard manure to improve both the physical and chemical properties of soil. This practice carries special significance in coastal sandy soils which are highly porous, amenable to leaching and with low native fertility.
- Farmers also apply oil cakes in the crop basins as manure.
- Use of organic manures and recycling of all farm wastes as well as home wastes available.
- Coconut leaves and husk are used as manure as they contain nutrients as needed to coconut
- The decayed straw is considered equivalent to cow dung and hence recycled as a homestead waste.
- Organic recycling of all components of coconut biomass except shell and kernel.
- Fresh fish/fish manure application is also found to be highly beneficial. This practice

is prevailing in the coastal areas where fish is available in plenty. Many farmers believe it as very good manure and that it is better than dried fish or fish meal. The fresh fish when decays in basins, serve as hosts for certain worms. When the fish dry up these worms also decay and become additional manure to the palm. Some farmers also follow application of partly decomposed or dried fish as organic manure.

- Cattle penning is commonly practiced to enrich the soil in the low rainfall areas of Karnataka, Tamil Nadu and Andhra Pradesh states.
- Some farmers open the basins during the month of *karkadakam*, apply ash, cow dung, fish manure, oil cakes, coconut husk, coconut leaves, straw, salt etc. (all these are must) and in some places, the green leaves are spread and allowed to remain for a few days and then one more layer of green leaf manure is added. They cover half of the basin with soil. The rainwater coming through the trunk should flow directly to the roots during the south-west monsoon. The basins are fully covered during the intercultural operation in *thulam*.

Application of common salt

The application of common salt to the coconut palm, either at the base or to the crown is a time honoured agricultural practice. Some of the beneficial effects of common salt are :

- i) It contains both sodium and chlorine, the two important elements connected with the water relationships of plants enabling them to conserve water during dry periods.
- ii) Sodium acts as a substitute for potash in soils thereby delaying the effects of potash starvation.
- iii) Putting a small quantity of common salt in the axils of frond, keeps the palm cool.

Irrigation

Farmers are aware of the importance of irrigation to coconut. They believe that since coconut is unique in having water in its nuts, it needs water as a very essential factor. There is an old proverbial saying that '*Nana kondu mathram naleekeramerum*' which means that irrigation alone could enhance the coconut productivity to a considerable extent.

They are well aware of the moisture conservation practices mentioned elsewhere and they feel that flood irrigation is to be avoided in coconut.

Though the farmers in Kerala and Karnataka feel that flood irrigation should be avoided in coconut gardens, coconut farmers in coastal Andhra Pradesh and coastal Tamil Nadu follow the practice as they feel that coconut requires a large quantity of water.

There is a widespread belief among growers that gardens which are regularly irrigated, decline rapidly if irrigation is discontinued, even for a short period. It is quite possible that as a result of irrigation, the root system expands and the tree is stimulated to produce more and larger leaves resulting in increased demand for water. If this need is not satisfied, the trees naturally are bound to suffer.

Sea water for irrigating coconut palm

In the coastal sandy areas of the West Coast of India, sea water is found to be utilized for irrigating coconut palms without any apparent ill effects.

Water harvesting techniques

Preparing blocks in the plot (*Kattayum varambum*)

The whole plot is divided into small blocks by means of bunds of about ½ ft height and ¾ ft breadth. *Katta* means blocks and *varambu* means ridges/bunds. This is prepared before

the onset of monsoon. The water obtained during rains is thus collected in the plot itself and allowed to percolate into the soil. Soil, water and fertilizer runoff from the land is thus prevented.

In North Coastal Region of Andhra Pradesh, *Kunta* i.e. small size community ponds are built in high rainfall areas (having more than 1000 mm rainfall per annum) for providing supplemental irrigation to rainfed crops during long break of rainfall.

In Southern States of India, *Percolation tanks* are used in medium rainfall areas (700 to 1000 mm per annum) for recharging the underground water table so that it could provide an overall stability to agriculture.

Khadin i.e. earthen embankment is made across the gullies in low rainfall areas (having less than 500 mm annual rainfall) for recharging the soil in root zone so that the crops could be maintained well in the bed area of the embankment.

Farmers are fully aware of the importance of soil moisture in cultivation of horticultural crops and the bad effects of drought. Usually farmers follow indigenous water harvesting technologies with the help of earthen pots, trays made of arecanut sheath etc. One or two of the above mentioned containers are embedded around the trees providing small holes to it in the bottom. In certain cases, a hollow bamboo with lower end tied with plastic paper with a hole is used.

Soil management

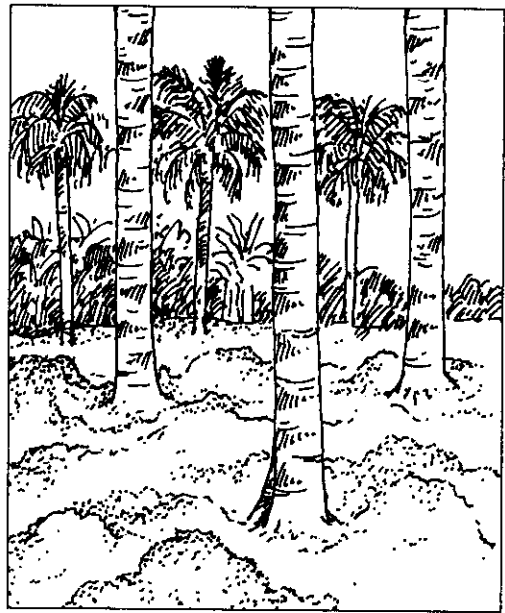
- In heavy soils, red earth is applied to the palms to improve the aeration and thereby reducing the bad effects of waterlogging.
- Farmers in the coastal region usually apply 120-150 kg of tank silt to coconut palm to improve the water holding capacity of the sandy soils.

The rationale behind these practices are :

- (i) silt is rich in organic matter and also contains small quantities of nitrogen and potassium and traces of micronutrients
- (ii) silt application improves water holding capacity of the soil.

Preparation of soil mounds (*Polikoottal/ Koombal*)

This is a practice followed by farmers in coastal and sandy regions. Sand is made into small mounds of around two feet height. The basins are levelled and the mounds are taken adjacent to the trunk itself. The farmers perceive this as one of the most important practices in coconut farming.



Soil mounds for moisture conservation

In drought prone areas of different states, where the gardens are located in light soils, the farmers raise mounds in pre-monsoon season and follow subsequent levelling in post monsoon.

The practice of making soil mounds is a traditional cultural practice followed in the

'Onattukara' region of southern Kerala. This is done in the entire plot area.

Some of the advantages of this practice are as follows :

- i) **Moisture conservation** : This is the most important purpose. It can be understood that the capillary pores through which water reaches the surface are broken twice – once during the preparation of mounds and secondly when the ground is levelled.
- ii) **Weed control** : When the mounds are prepared, the surface soil along with weeds goes to the bottom and this facilitates weed control.
- iii) **Pruning of surface roots** : As the mounds are taken from near the trunk of the palm itself, the surface roots, which are of no use to the palm are cut. Thus growth of roots growing deep into the soil is enhanced.
- iv) **Nitrogen fixation in soil** : Lightning is a usual phenomenon in the north-east monsoon season which helps in nitrogen fixation. When soil mounds are prepared all over the land, surface area would be much more. Nitrogen fixation is at a higher rate when surface area is more, which is beneficial to the palms.
- v) **Off season tillage of the inter space in coconut garden** keeps the field open for entry of rain water resulting in better moisture conditions and better crop growth.

Bunding

The practice of bunding (large earth work) around each field (along the contours to the extent possible) is considered as a soil and water conservation measure.

Deep ploughing

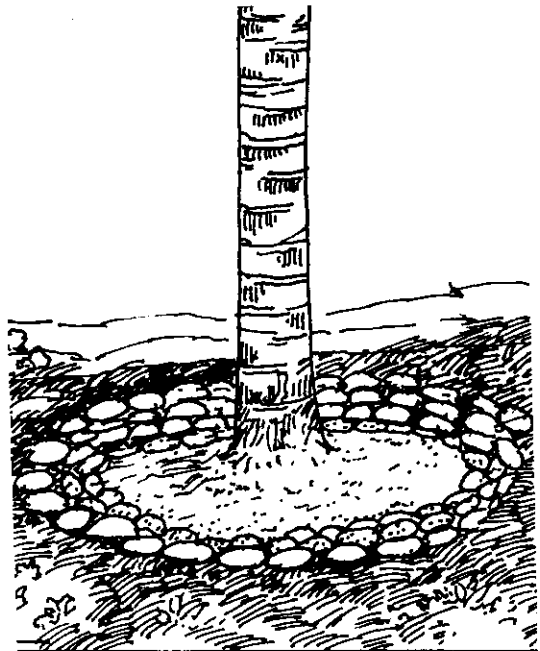
Deep ploughing is followed during summer season (by using soil turning plough) in black soils of Maharashtra for efficiently tapping the early showers at the onset of rainy season.

Shallow tillage

Shallow tillage is carried out during pre-monsoon period (by using blade harrow) in red soils of Andhra Pradesh for breaking the surface crust so that early showers could be efficiently tapped.

Husk burial

Farmers traditionally resorted to husk burial as an effective moisture conservation practice. Burying husk in the basins or in deep channels in the inter space of the coconut garden is practised by many of the farmers. Some farmers put husk in the basin or interspace as a mulch also. The advantages of husk burial in coconut garden have been scientifically proved and hence the same has been incorporated in the package of practices recommendations for coconut.



Husk burial in coconut basin

Burial of pseudostem of banana, Salvinia/ Icornia

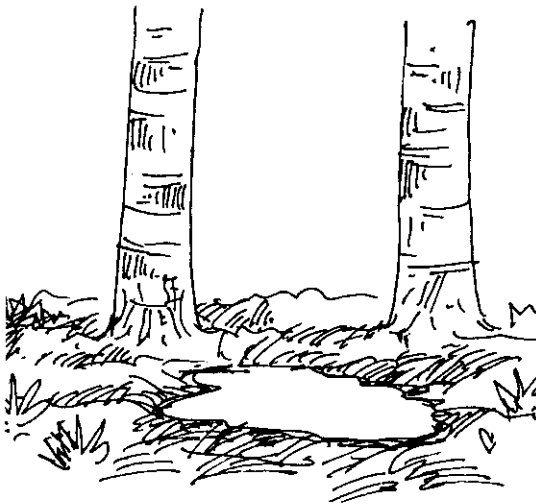
Pseudostem of banana is cut into small pieces and buried in the basins. Some farmers

do not use raw banana pseudostem for they believe that the practice may attract pests. They suggest that the well dried pieces of pseudostem should be used instead of raw ones.

Aquatic weeds like *Salvinia*, *Icormia* etc. collected from the fields or ponds are also used. *Salvinia* is otherwise a very dangerous weed to field crops especially paddy. It is successfully used as green manure cum moisture conservation technique by many farmers.

Taking “neerkuzhikal” (water conservation pits) in coconut garden

Farmers take shallow water conservation pits (locally called ‘neerkuzhikal’) which are filled with organic wastes in different locations of the coconut garden in the interspace as an effective moisture conservation practice. These pits serve as water reservoirs during the rainy season and also reduce soil erosion in slopy terrain by reducing the velocity of surface flow of water.



Water conservation pits

Mulching

Farmers traditionally adopt mulching of coconut basin with organic materials and field bunding either with the soil or rubbles in

coconut garden to conserve the soil and water. The basins dug around the palm for applying the manures and fertilizers also help in reducing the speed of the surface water flow. By putting the coconut leaves, husk and other organic materials on the soil surface either in the basin or interspace will help to prevent loss of the fertile top soil through run off and to reduce soil temperature apart from conserving moisture. These organic wastes also provide some quantity of plant nutrients to coconut palms.

Coir dust is one of the best material used for mulching. Incorporating about 50 kg coir dust per basin improves the water retaining capacity of the soil.

Removal of senescent leaves during summer

Farmers regularly cut one or two lower leaves every month with a view to reduce the loss of moisture from leaves through transpiration. They feel that removal of older leaves which are having low metabolic activities may not adversely affect the health of the palms.

Homestead farming and coconut based cropping systems

Combining subsidiary enterprises like dairy, poultry, sheep rearing and sericulture with crop cultivation is usually practised by the farmers in drought prone areas.

Coconut based homestead farming is the unique practice adopted by the farmers of Kerala, integrating a large number of enterprises with coconut as the main component. This system usually includes intercrops, mixed crops and other enterprises like cattle rearing, backyard poultry, fisheries in house ponds etc. with coconut as base crop. The primary objectives are meeting the basic needs of the farm household, maximum and sustainable utilisation of natural resources, efficient nutrient recycling and increased income from unit area.

These are agro forestry homestead gardens evolved over a long period of time and has a long tradition. Generally, these are serving as the systems for the production of subsistence crops for the farm family.

Home gardens are characterized by a mixture of several annual or perennial crops grown in association and commonly exhibiting a three to five layered vertical structure of trees, shrubs and ground cover plants, which recreates some of the properties of nutrient cycling, soil protection and effective use of space above and below the soil surface. The multi-level plantations and home garden systems, common in smaller land holdings, are analogous to a rain forest with a multilayered canopy. The systems and their components vary with location.

It is observed that all home gardens consist of a herbaceous layer near the ground, a tree in the upper layer and intermediate layers with different crops in between. The lower layer could be usually partitioned into two, with the lowermost (less than 1 m height) dominated by different vegetable and medicinal plants, and the second layer (1 - 3 m height) being composed of food plants such as cassava, banana, yam and so on. The upper tree layer, divided into two, consisted of timber and fruit trees occupying the uppermost layer of over 25 m height and medium sized trees of 10-25 m occupying the next lower layer. The intermediate layer of 3-10 m height is dominated by various fruit trees, some of which would grow taller. This layered structure is never static. Tuber crops such as taro, cassava, yam and sweet potato dominate in the home gardens, in general, because they could be grown with relatively less care as understory

species in partial shade and yet be expected to yield reasonably. A conspicuous trait of the tree-crop component in home gardens is the predominance of fruit trees and other trees having timber value.

Controlled burning of crown

Some farmers resort to controlled burning of the crown to induce regular bearing in poor yielding palms and alternate bearers.

Smoking in coconut garden

Farmers believe that smoking in the coconut garden by burning dried leaves enhances the productivity of coconut palms. The rationale behind the practice is that while burning dried leaves, a lot of carbon dioxide is produced which enhances the rate of photosynthesis thus increasing the productivity.

Risk management

Farmers have developed their own outlook for risk aversion and invariably prefer those technologies which involve low investment and provide an insurance against weather aberrations. The water harvesting for life saving irrigation, inter cropping, growing of low value crops, preferential use of monetary inputs for irrigated and more remunerative crops than for rainfed crops etc. are some of the means commonly used by farmers for risk diffusion.

Growing a number of crops anticipating yield compensation is one method of minimizing the weather induced risk. Many farmers in Karnataka cultivate 7-10 crops in their farms. Further, inter/mixed cropping is found to be more prominent in small sized farms both in terms of proportion of farmers adopting the practice and areas devoted to mixed crops.

PLANT PROTECTION

Coconut palm is affected by a number of pests and diseases. Farmers traditionally adopt a variety of indigenous practices for pest and disease management in coconut most of which are eco-friendly and sustainable in nature.

Control of diseases

Root(wilt) disease

The root(wilt) disease caused by *Phytoplasma* is widely prevalent in Kerala State and part of Tamil Nadu State. No curative measure has so far been identified against it. But farmers practice some indigenous methods :

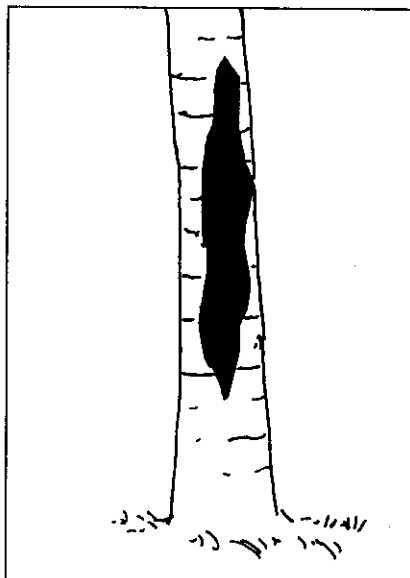
- Application of leaves of *Strychnus* (*Kanjiram*).
- Application of crushed fruits of *Mahua* (*Marotti*).
- Burial of mango leaves along with cowdung or river silt.
- Basin application of crushed onion 3 kg (waste skin of onion collected from the vegetable market is equally good) + salt 1 kg.
- Pouring the water used for boiling the tapioca into the basin or using the tapioca rind and leaves as manure to the root wilt affected palms.
- Application of a mixture of salt, ash and copper sulphate.
- Pouring gingely oil to the spindle is effective in the early stages of disease.
- Application of 5 kg prawn waste per palm per year will help to sustain the yield of root(wilt) affected palms.

- Application of a mixture of onion and sodium bicarbonate (locally called as 'karam') as a paste on the spindle is effective against root(wilt) in the early stages of infection.

Stem bleeding disease

Stem bleeding disease caused by a fungus *Thielaviopsis paradoxa* is prevalent in all the major coconut growing states of India. Farmers adopt some of the following indigenous methods of disease management :

- Application of neem cake
- Cashew Nut Shell Liquid (CNSL) application on the trunk
- Lime paste application on the trunk
- Affected portion is chiselled off and applied with coal tar



Coal tar application against stem bleeding disease

Some farmers cover the affected portion with dry leaves and burn after sprinkling kerosene.

Bud rot disease

Bud rot disease is caused by a fungus *Phytophthora palmivora*. The disease kills the palm if not controlled at the early stages.

Farmers adopt a variety of indigenous management practices as listed below :

- Burn the *neettu kakka* (calcium carbonate) and apply it along with ash to the basins.
- Application of salt and ash mixture after removing the affected portion in the crown. Salt has hygroscopic property and it can absorb water content from the applied area.
- Application of bleaching powder on the affected portion.
- Clean the affected portion and fill the cleaned cavity with paddy husk followed by covering with a mud pot. The paddy husk is used to absorb moisture and keep the protected portion dry.
- Many farmers resort to smoking in the gardens at the onset of monsoon to prevent the spread of pathogenic organisms.

Button shedding

Button shedding in coconut can be due to many factors such as pathological, insect damage, nutritional deficiencies, soil and climatic factors, genetic factors etc. The scientific recommendation is to identify the cause and adopt appropriate remedial measures. But farmers follow some indigenous practices, as listed below, which they believe to reduce button shedding in coconut.

- Application of neem cake and common salt in the coconut basin. Neem cake has the property of enhancing the growth of beneficial fungi as biological suppression

agents against disease causing fungi. As organic manure, it improves soil qualities and also provides some quantity of nutrients. Common salt supplies chlorine and substitutes potassium to a certain level which are important in coconut nutrition. Salt application also helps in enhancing soil properties, especially in laterite soils and helps in moisture conservation. According to some farmers salt has a mild antibiotic property also.

- Removal of alternate inflorescence : This practice makes available more quantity of nutrients and water to the existing inflorescence.
- Burial of banana pseudostem in the basins : Banana pseudostem and leaves are cut into small pieces and dried in sun, and then buried in the basins.
- Application of ash : Ash contains potassium and micro nutrients which will help in reducing the button shedding if deficiency of such nutrients is the causative factor.
- Application of dried fish waste + salt

Yellowing of leaves

Yellowing of leaves in coconut can be due to pathological reasons or nutritional deficiencies. As in the case of button shedding, farmers follow some indigenous practices to reduce the yellowing of leaves in coconut as listed below :

- Application of crushed onion in the palm basin is effective against yellowing of leaves.
- Drench the basin with cow urine diluted by adding 10 times of water which may increase the nutrient availability.
- Application of arrow root and *Strychnus* leaves as manure to coconut basin to reduce yellowing of coconut leaves.

Control of pests

Rhinoceros beetle

Farmers in different localities have evolved various indigenous practices to manage the infestation by rhinoceros beetle as discussed below :

- Hooking out beetle

- Use of beetle hooks to hook out beetles from leaf axils is a mechanical control measure traditionally followed by farmers. It is also one of the methods included in the recommended IPM strategy against the beetle.

- Leaf axil filling with sand, salt and ash

Farmers put a mixture of sand, salt and ash in the leaf axils of coconut palms against rhinoceros beetle damage. The practice varies among farmers from place to place. Some farmers apply only sand, some other farmers only salt and yet another practice is to apply only ash. The effect due to sand application in the leaf axil is having the rationale due to the fact that the sand particles are caught up in the cavity between the head and thorax of the pest thus preventing the free movement of head and the subsequent mechanical injury paves the way for insect control.

- Leaves of *Ailathes* (*Perumaram* or *matti*), *Vitex* (*Karinochi*) etc. are added in the cowdung pit to prevent the development of different stages of the pest. *Karinochi* is already known to have repellent properties against many pests. *Ailathes* also might possess some such properties.
- Castor cake made as a solution in water is placed in different locations of the garden as attractant. Beetles are attracted towards this and fall in the solution.
- Application of a mixture of neem cake and sand in the leaf axil prior to the onset of monsoon.
- Spraying a mixture containing equal proportion of neem oil and kerosene.

- Putting plants of '*kolinji*' (*Tephrosia purpurea*) in the primordial region of coconut trees.
- Grow '*Karpooravalli*' (*Coleus aromaticus*) a medicinal and aromatic plant, in the coconut orchard. The rationale the farmers attach to this practice is that the strong odour of this medicinal plant acts as a repellent to the beetle.
- Crush five fruits of mahua (*marotti*), mix it with a litre of rice gruel and place the mixture on small trees in the coconut garden to trap and kill the beetles.
- Regular crown cleaning of coconut palms.
- During sunset, a flat basket filled with raw cow dung mixed with dried fish is placed near the coconut tree to attract the rhinoceros beetles. When the pests gather, they are killed manually.
- To control rhinoceros beetle, plant a few *Michelia champaca* (chempakam) trees (locally known as 'sampige') in between coconut trees in the orchard. Farmers believe that the fragrance of chempakam flowers drives away the beetles.
- Hair is placed in the form of small balls at the node of the plants attacked by rhinoceros beetles. This hair twines around the legs of the beetles and has a disabling effect on them.
- Farmers spread cow dung in open spaces for drying so that rhinoceros beetle grubs can be eaten away by birds.
- A mixture of plant extract is used by some farmers with the following proportion of the ingredients :

The liquid extracted from the opium (*Cannabis sativa*) plants (locally called 'ganja') and the latex extracted from *Ficus* sp are mixed together and poured into the hole bored by the beetle. According to the farmers,

this makes the beetle to come out. The beetle can then be collected manually and killed.

- Solution of jaggery is placed at different locations in the garden as attractant. Beetles are attracted towards this and fall in the solution.
- Split areca or coconut wood pieces smeared with a mixture containing 100 g pine apple pulp, 5 g yeast and 15 ml toddy are placed in a few locations in the coconut garden to attract rhinoceros beetles.
- Application of sand in the innermost 2-3 leaf axils over which water containing *chenninayakam* or powdered neem cake or water boiled with nuxvomica seeds and roots is added.

Red weevil

Red weevil is a dreaded pest of coconut. The indigenous practices of controlling red weevil are described below :

- Cut the leaves leaving long petiole on the trunk itself to reduce the red weevil infestation. While cutting coconut leaves, some farmers retain at least 1.2 m of frond on the tree trunk as a preventive measure against red weevil infestation.
- Rationale of this practice is that if the leaves are cut close to the trunk, egg laying and subsequent easy entry of the grub into the tree trunk is facilitated, which is avoided by the retention of petiole on the trunk. This practice has been incorporated in the recommended package of control measures for red weevil.
- Some farmers use traps made of coconut petiole or coconut wood with the toddy smeared on the spilt ends to attract the weevil. This practice also has been incorporated in the recommended package of control measures for red weevil.



Retention of frond on the tree trunk as a preventive measure against red weevil infestation.

- Some farmers mix 250 gm of castor oil cake and rice gruel, place it in a wide mouthed pot and keep embedded in the soil. It will trap and kill the weevil.
- Another indigenous practice for the control of red weevil is to prepare a mixture containing 100 gm pineapple pulp, 5 gm yeast and 15 ml toddy and smear it on the spilt ends of the coconut or arecanut log to trap the weevil.
- Farmers believe that turmeric and the 'arya veppu' (neem) are effective against the red weevil.
- Use of the jaggery solution to attract the weevil.
- A farmer from Karnataka State has an innovative way of dealing with the menace of red weevils in his coconut garden. He prepares a paste by boiling two cups of

jaggery with one cup of water. After the paste has cooled, he smears it over the tuber of *Agave*. This is placed on a stone or piece of wood in a dish. The dish is filled with a couple of inches of water. Attracted by the jaggery, weevils make a hole in the tuber and stay there for a few days. They can easily be caught and disposed of. One or two such tubers are enough to trap weevils in one hectare.

Termite control

Termite damage is more in the seedlings and young palms. Farmers resort to various indigenous practices for termite control

- Application of lime in soil to prevent termite attack on seedlings.
- Application of a paste of lime on the palm to check termite attack on the adult palms.
- Application of common salt and ash in the planting pit.
- To eradicate the termites on lower portion of the trunk of coconut trees, tar is applied on it up to 30 cm height from ground level.
- While planting coconut seedlings, bulbs of *Aloe vera* are planted in the same pit to keep away termites which attack the seedlings.
- Planting wild variety of arrowroot (*Koova*) in the basins. The insect repellent property of the arrowroot may be the rationale behind the practice.
- Application of fenugreek seed in the planting pit as a repellent.
- Neem cake application in the planting pit.
- Flooding the garden to wash off the termites.
- One small heap (about 20 kg) of undecomposed farm yard manure or fresh cowdung per 0.02 ha area controls termite attack.

Control of red ants

The *Pongamia* seed cakes are used by growers in Karnataka State to reduce red ants.

Eriophyid mite

A herbal formulation had been developed for the control of eriophyid mite in coconut by a farmer in Karukkampalayam village of Tamil Nadu. The treatment method is as follows:

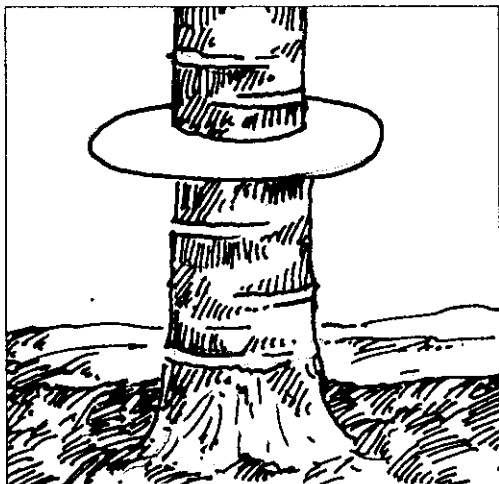
Required plant products – Custard apple leaves (*Anona squamosa*) – 1 kg ; Turmeric – 1 kg; Peenari chanku (*Clerodendron enermi*) – 1 kg; chothukatralai (*Aloe vera*) – 1 kg; nochi (*Vitex negundea*) – 1 kg; Neem kernel (*Azadiracta indica*) – 1 kg and calotropis – 1 kg. The above products are ground into a paste by adding sufficient water and about 5 litres of juice is extracted. This is diluted with another 15 litres of water to make into 20 litres finally. This herbal extract is administered in the crown region at the rate of 2 litres per palm after the harvest of nuts. This can be repeated once in two months i.e. during every harvesting time.

Mixing of jaggery in insecticidal spray solutions is a known technique used commonly in Kerala which may act as a substitute for the chemical sticking/wetting agents like 'teepol' or 'sandovit'

Rat control

Farmers' adopt many traditional practices to ward off the rat menace in coconut garden.

- Adoption of proper spacing to prevent overlapping of leaves of adjacent palms to avoid free aerial movement of rodents in the garden.
- Wrapping of trunk with polythene or tin sheets to a height of about eight feet. This practice will prevent the rat from reaching the crown by climbing the palm from ground surface.



Wrapping with tin sheet to prevent rats from climbing the palm

- Lime paste is applied around the stem up to a height of about eight feet. Farmers believe that the practice will deter the rodents from climbing coconut palm.
- Baiting with powdered prawn and cement : This is an innovative rodent control method evolved by farmers. Fried and powdered prawn is mixed with cement and kept in the tracts of rodents or in the coconut leaf axils. Dried fish is also used in some localities. The principle behind the practice is that, cement gets clotted on contact with moisture in the alimentary canal, which ultimately leads to the death of rat, by physically blocking the alimentary canal. However, it depends upon how much cement is consumed by the rodent.
- Baiting by using jaggery and cotton balls : Jaggery was mixed with cotton and made into small balls. Cotton is nothing but cellulose, which is not digestible by rats. This, on consumption, results in the death of the rodents.
- Wooden traps : Wooden traps can efficiently reduce the population of both rats and squirrels. Wooden box traps (30x12x11 cm size) are extensively used

for trapping rodents. It is found that wooden trap is more suitable for capturing the black rat, which are normally bigger in size.

- Rat trap made up of bamboo (Kumbom)
Kumbom is a rat trap made up of bamboo. This particular trap is the most common one used specially for coconut. In addition to bamboo of around 1½ ft length, iron wires, a twine/banana fibre and some feed stuff are the parts of this trap. The trap is kept on the crown of the palm. Rats are trapped in the hollow of the bamboo. Much training is needed to handle the trap.
- Sprouted paddy seeds in poison : Paddy seeds are soaked in poisoned water and are tied in damp cotton cloths for sprouting. When the seeds sprout, the radicles penetrate the cloth and stay in place. The cloth is then cut into small pieces, each bit containing the sprouted seeds and kept in the leaf axils of the palm. These poisoned seeds kill rats on consumption.
- Poison in parboiled rice : Rat poison is dissolved in water and paddy seeds are parboiled in this water. This parboiled rice is poisonous which, on consumption, kills the rats.
- Rice flour mixed with dried fish and poison : Mixture of rice flour, dried and powdered fish and rat poison is placed in the leaf axils in coconut shell containers.
- Glyricidia leaves in cooked rice : Glyricidia seeds and leaves are mild poisons. Ground Glyricidia leaves and seeds are mixed with cooked rice and a little coconut oil and made into small balls, which, on consumption kills the rates.
- An indigenous method for the control of field rat was developed by a farmer in Tamil Nadu : During hot days of the summer months (April to July) the field rats come and hide underneath the small heaps of

paddy straw. This is done with a view to protect themselves from the extreme temperature. The convenient time to catch them with gunny bags is between 10 am and 12 noon during hot days. If there is rain, they do not come out of their burrow for another 3 days.

- Providing protective covering for the tree trunk with coconut leaves and thorny twigs: This is a traditional practice acting as a mechanical barrier for preventing rats from climbing to the palm.
- Cow dung cake is used as burrow fumigant to control rats.
- Many farmers adopt “digging the field burrow to kill rats”.
- Rats are caught by using pots with cow dung slurry and bait buried at ground level and killed.
- Owls are believed to be useful as a natural agent for the control of rats.

Saving coconuts from tree dogs

Tree dogs (palm civet) climb up the tree and drink the coconut water damaging the fruit. To prevent tree dogs from damaging coconuts, a picture of a snake is drawn on the lower portion of the trunks of coconut trees. Obviously, these nocturnal animals mistake the figure for a real snake.

Other general plant protection measures

- To reduce the nematode population, grow *thakara* as inter crop.
- Allow the *olenjalikal* to build their nest in the garden. These birds will predate on caterpillars.

- Scrape the mealy bugs present on the seedlings. Apply ash and salt mixture to reduce further attack.
- Heap the dried leaves and make fire in the garden to attract and kill the insect.
- Raising arrow root as an inter crop in coconut garden reduces the root grub infestation.
- A bird, *Olanjalikili* is an effective predator of leaf eating caterpillar.
- Farmers allow plenty of birds in coconut plots by providing drinking water during summer and also by providing nesting places etc.
- Another practice is pouring ‘marotti oil’ or ‘gingelly oil’ in the spindle and upper leaf axils of the crown as a general practice against pests and diseases.
- Poultry litter releases more heat and helps to avoid insects.
- Neem seeds powdered and applied with urea help to avoid pests.
- Putting crushed marotti seeds or neem seeds in the leaf axils is also a general practice against pests and diseases.
- Controlled burning of diseased leaf parts on the crown with a burning torch is also practised by farmers.
- Palms with more powdery mass on the emerging leaf sheaths and petioles are believed to be tolerant against pests and diseases.
- Mixing of neem leaves with the stored products is an insurance against the attack of pests. This practice is almost universal in all parts of rural India.

SPECIAL PRACTICES

This section describes practices which are carried out for certain special purposes like increase in nut yield, care of unproductive palms etc.

Lime application to avoid barren nut development : Farmers feel that development of barren nut is much declined when lime is applied.

Toddy tapping : Besides extracting toddy, this practice has contribution in raising the yield of unproductive palms. Farmers used to subject less yielding palms for tapping for 1 or 2 years. After that, if the buds are allowed to develop, they give much higher yield, as compared to their earlier performance. Probably nutrients which would have been otherwise wasted in the development of

unproductive inflorescence could be saved to an extent by following this practice. This might be the reason for the increased nut yield in later years.

Stamping down the leaves : Coconut leaves positioned almost vertically upward are stamped down so that their angle with the stem becomes around 90° . This is usually practised in non-bearing young palms. The practice is very much rational as per the opinion of the scientists. Yield is highest when the leaves are positioned in such a way that maximum quantity of sunlight is reaching on them. Another contribution of this practice is that the leaf axils are usually cleaned after stamping the leaves. This may encourage an easy emergence of buds.

Injuring or shaking the palm : The palms which do not start bearing even after 7-8 years are subjected to certain treatments like injuring the trunk with a knife, beating it with pestle, shaking the palm with elephant etc. Farmers observed that the palms start bearing after giving such shock treatments.

Splitting leaf petiole (*Patta polikkal*): This is done in young palms to enhance trunk formation. The lower leaves are cut and removed from the tree. Around one metre length of the petiole is retained. This petiole is, then split longitudinally into two halves and retained on the palm.

Cutting leaves near the stem is harmful to young palms. However, this practice is carried out with minimum harm to the stem. Obviously, the petioles dry fast and fall down and an early formation of trunk is visible.



Toddy tapping

Burial of pieces of Pandanus (*Kaitha*) in basins

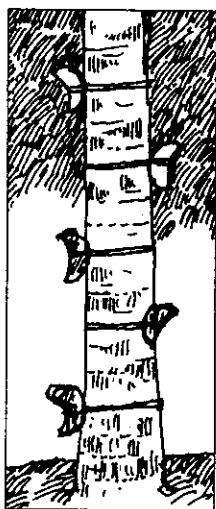
Yet another observation of farmers is that, less yielding palms give surprisingly higher yields when cut pieces of Pandanus including stem and roots are buried in the basins. Pandanus might have improved the general conditions of soil which, in turn, might have resulted in raising the nut yield.

Burning coconut residues in the basin

Coconut residues like fibre, husk, shell, dried spathe and other parts of the palm are burnt in the basin for getting higher yield. It is known that for any crop, smoking enhances flowering and fruit set and it reduces pest attack. Besides smoking, the palms also get ash by this method. According to them ash obtained from coconut wastes is of some special quality.

Tying coconut husk to trunk to aid climbing

This is a practice usually done to avoid injuring the trunk of healthy palm to aid climbing. Coconut husk is tied at given distances to the trunk with its concave side facing out. This is generally done in palms kept for the purpose of tapping toddy.



Tying husks on tree trunk for easy climbing

Burning the crown of unproductive palms

Unproductive young palms or insect/disease affected palms are subjected to this practice. Instead of cutting and removing the palm, they give the palm a last chance to survive by burning the entire crown. Once the palm survives from the fire, vegetative and reproductive growth rate of the palms are surprisingly high. The growing tip (meristematic tissues) of the palm is not much affected, if it is not already dried or decayed. Besides the advantages of smoking as already cited, this practice performs a cleaning function by removing unwanted and harmful wastes, insect pests and their larvae.

Control of monkeys

Red faced monkey is a serious pest and is a matter of concern in the coconut growing region of Tumkur district of Karnataka. These monkeys usually raid orchards in groups. They pluck far more coconuts than they can eat and play with them tossing them all around in the orchard. Killing the monkeys is forbidden by tradition and hence the only way to tackle them is to drive out the marauders from the orchards.

Application of salt and dried fish to enhance fruit set

In Saurashtra, farmers incorporate salt and dried fish in the soil around the tree. They believe that the practice helps in increased fruit setting since it provides salinity similar to the coastal regions which are the natural habitat of coconut.

Honey bee colonies for coconut pollination

In the yellow variety of coconut, male and female flowers do not mature at the same time. Hence fertilization is based on natural cross pollination by agents like honey bee. The natural cross pollination process by wind is accelerated by establishing honey bee colonies in the farm. Empty mud pots are hung upside down on trees or poles to facilitate building of

bee colonies. Natural colonies of bees are noticed within two months.

HARVEST AND POST HARVEST OPERATIONS

The ripening stages of nut and the timing of harvest for specific purposes such as consumption as tender nut, household culinary use, copra making and coir production are within the knowledge system of the traditional farming community. The stage at which the nut water will have the maximum sweetness and the kernel will be gelatinous in consistency is known to the farmers. Likewise, they are also aware of the stage of maturity at which the maximum out-turn of copra and white fibre could be obtained from each nut. It is possible for the farmers to rationalize harvesting in order to obtain the optimum output of copra on conversion as well as white fibre on retting and subsequent processing. The different processing methods developed in the past are being continued even now without any basic change. The drying methods for copra production, the extraction of coir fibre and yarn making, coconut shell carbonisation etc. are examples in this regard.

Harvesting methods

Climbing the trees manually is a perfected skill developed by traditional tree climbers. Owing to the tall growing single stem stature of the crop it is a very tedious, challenging and physically strenuous job. For facilitating manual climbing of the tree, a few traditional simple devices are being used.

Talappu is a simple technique made with either coir or cloth strip which will be adjusted in both hands and feet in order to get the required grip for the feet and hands of the climber while climbing up or down.

Eni (Bamboo ladder) : This is used by the climbers which will be positioned in slanting style in the palm trunk on which they will climb



Climbing coconut palm using 'Thalappu'

on the tree. They can shift the ladder to any position they want.

Thoty with knife tied tip is being used traditionally by the women members of the households for harvesting nuts for household purpose.

Frequency of harvest

The general practice in the west coast of Kerala State is to harvest the nuts six to eight times a year.

In Orissa, the nuts are harvested four times a year.

West Bengal is the only State in India, where the nuts are harvested only once or twice a year.

In Thanjavur and Godavari areas and in Maharashtra State, the nuts are harvested six times a year.

Seasoning of nuts

After harvest, the usual practice is to store the nuts in heaps under shade for a few days. This type of storing (seasoning) has the following advantages :

- (1) Husking becomes easier.
- (2) Shelling is cleaner and easier and the resulting shells are dry, hard and when used as fuel, burn continuously and produce less smoke.
- (3) The moisture content of the meat decreases and the thickness of the meat layer increases. Consequently, the yields of copra and oil increase.
- (4) The quality of copra produced is also superior to that of unstored nuts.

Dehusking devises

Traditionally, several devises are being used for dehusking nuts.

Vettukathy is a metal knife broader than the usual kitchen knife and is used to separate the husk manually.

Paara (crowbar) is a metal pole with sharp tip portion. The nuts are dehusked by a skilled person by striking the husk faces in the tip portion and using a little pressure to separate the husk from the shell.

Kodali (axe) is also used for separating the nuts using legs to exert pressure for separating the husk.

Copra drying

Sun drying is the most popular and the simplest method of copra making. In this process, the cups are laid out in a yard with the open side turned to the sun. After about two days of drying, the kernel or the meat gets detached from the shell. The partially dried kernel is then scooped out by means of a thin wooden lever. An experienced worker can remove the kernels from about 3000 cups in a day. The detached kernels are again arranged in the yard with the open side facing up for further drying. The drying process is to be continued for a further period of four to five days.

Extraction of oil

For the extraction of oil from copra, an indigenous device called “chekku” is used. The “chekku” or “ghana” consists of a fixed wooden or stone mortar, inside which revolves a wooden pestle, leaning against the side of the mortar. The extraction of the oil takes place within the mortar as a result of friction caused by the revolving pestle on which pressure is regulated by means of a lever and weights. The “chekku” is usually driven by one or two bullocks, but small “chekkus” are sometimes operated by human labour also. The capacity of the “chekku” usually varies according to the size of the mortar but generally a bullock-driven “chekku” crushes from about 50 kg to 80 kg of copra per day of 10 hours. The daily capacity of a “chekku” driven by human labour is about 20 kg.

Traditional skills related to coconut

- Plaiting of coconut leaves after soaking in water.
- Spinning of coir.
- Wetting husks, separating fibres and the processing.
- Cutting coconuts.
- Copra making in sunlight to the correct stage of drying.
- Separating the dried copra from the shells using local simple device made of bamboo.
- Making ladles from coconut shells.
- Skill in cutting of tall coconut palms without harming any of the homestead crops or items following cutting techniques, giving pressure variations by using ropes tied to the cutting trunk etc.

Traditional uses of coconut

Coconut leaves for broom making

After removing the lower fronds from coconut palms, the leaf stalks are separated and

used for making brooms. The leftover green leaf residue is fed to cattle, dairy animals often produce more milk on this diet.

Storing seeds within coconut shells

Fully grown coconuts with unripe kernels are selected and soaked in water for about two months. Afterwards, they are dried well in sunlight. The interior of such dried coconut is cleared by a rod inserted through the eye of the coconut. Vegetable seeds are put in through the hole. The hole is then closed with pith of coconut and covered with lime. Usually, these coconuts are stored on a shelf inside the kitchen, where it is difficult for rat and other pests to damage them. Thus seeds can be stored up to two to three years. The coconut shells can be used for several years, sometimes over generations. This practice is being used in the areas in and around Mangalore.

Manure from coir pith

Discarded coir pith obtained from coir factories can be turned into good manure. A pit of 6' x 6' x 3' size is used to make compost. The pit is filled with coir pith upto a height of half a feet. Over that, slurry from gobar gas unit is sprinkled. With every layer of coir pith, 200 ml of sour curd/buttermilk is added. In this way the pit is filled up. Thereafter the pit is covered with tank silt up to a height of half a feet. After three months, a good manure will be ready for use.

Medicinal uses of coconut

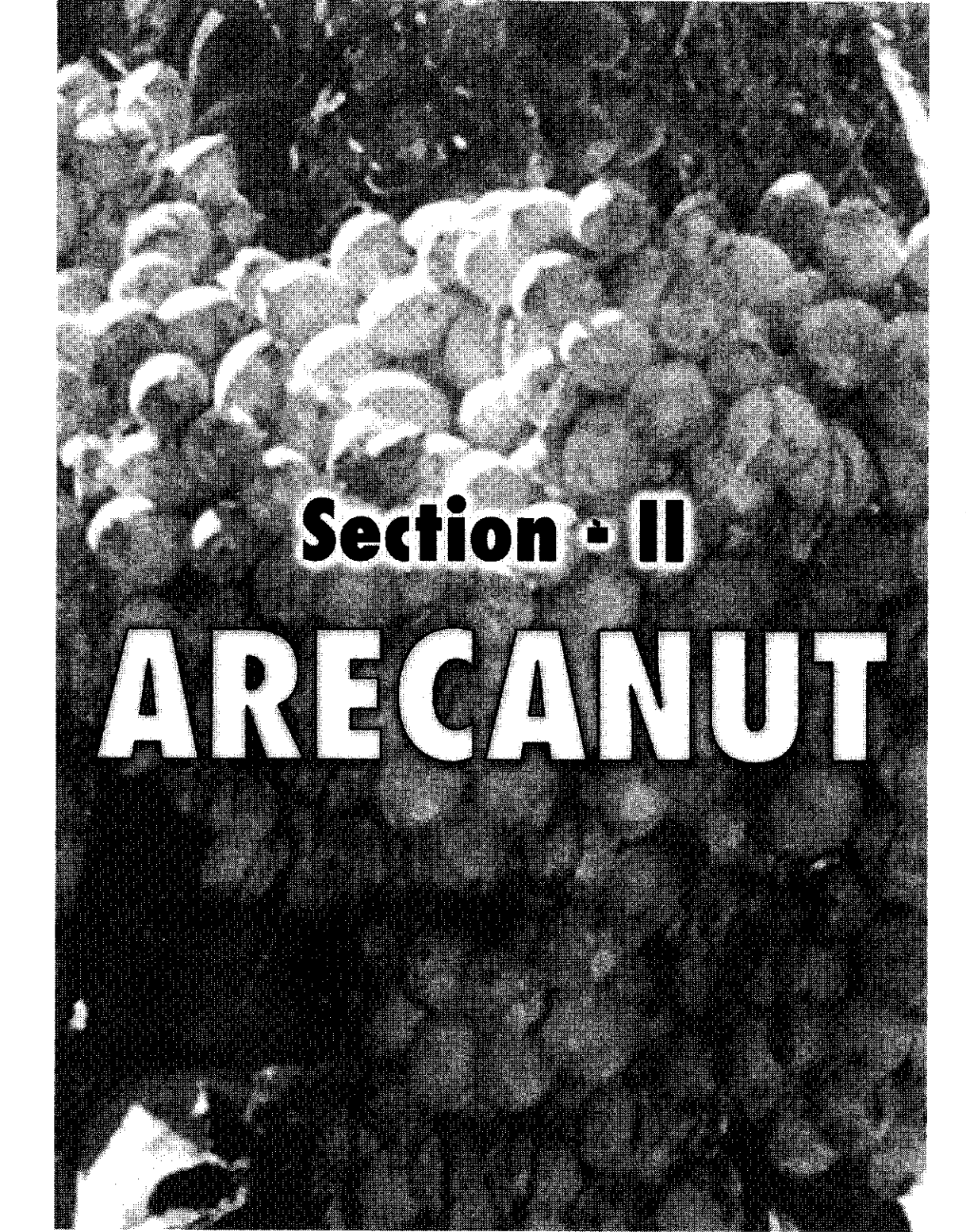
- The COD nut is chopped off at one end without spilling water. One ball of sandalwood paste of the size of a gooseberry fruit is put inside the nut water and the open end is covered by replacing the chopped piece. The fruit is then placed in a bowl containing water and kept overnight. In the morning, the nut water and the gelatinous kernel are consumed as a remedy against leucorrhoea.

- Against diabetes, the seeds of *Strychnos potatorum* are mixed in sweet toddy and consumed.
- The extract of tender leaves is administered in cases of body pain.
- The semi ripe kernel of COD nut is scraped and put in coconut oil and boiled till the water content is completely removed. This oil after cooling is applied against oral ulcer and its continued application is considered as a sure remedy against the disease.
- Likewise, coconut water is poured in wide mouthed brass vessel and kept in strong sun light until it becomes concentrated. This solution is applied against rashes and boils on the body of children.
- One local belief is that coconut palm has the quality to purify air and hence, growing palms in the vicinity of residential houses is good for the health of inmates.
- During summer, occasional washing of body with coconut water is good against prickly heat.
- Chewing the mid-ribs of tender fond is regarded as effective against heart burn.
- The paste of the plant *Phyllanthus niruri* is mixed with the water of COD tender coconut and kept overnight for consumption in the next morning. This is regarded as an effective remedy against jaundice.
- One of the widely practised household remedies against jaundice involves a combination of tender coconut water of COD, *Phyllanthus niruri* and raw camphor. One end of the tender nut is partially chopped and the plant and camphor after grating is put in the water and the chopped piece replaced. This is kept overnight and the contents are consumed in the morning.
- The contents of watery barren nut are consumed to relieve difficult urination.

- The petioles of COD are cut into pieces and boiled in water meant for bathing women after delivery. This is believed to relieve headache and cold.
- Coconut milk is used to clean the body of infants.
- For dysentery along with vomiting, tender coconut water to which some glucose or sugar is added is administered.
- For difficult urination and also kidney stone, tender coconut water of COD to which cardamom powder is added is given for a few days.
- For body injury from falls or other mishaps, the juice of leaves of seedlings or young palms is administered.
- For body sprain, one teaspoonful of fenugreek is kept overnight in the water of COD tender nut within the nut itself and the contents are consumed in the morning.
- Coconut oil to which sliced tender arecanut is added is boiled. This oil after cooling is applied on all kinds of burn injuries.
- Massaging the scalp with coconut milk is effective against dandruff.
- When heel hits upon hard thorn, nail or glass piece and gets injured, the surface of fresh coconut husk is smeared with coconut oil and heated and then placed in contact with the injured spot. This soothes the pain and when continued at frequent intervals, the wound gets healed.
- For dog bites, common salt is kept on the surface of fresh husk and then pressed against the wound. This relieves pain and accelerates healing.
- Coconut water to which rice flour and jaggery are added is boiled down to the consistency of a thick paste. This is fed to emaciated children to regain health and vigour.
- Coconut water is fermented after adding jaggery and yeast and then distilled to obtain alcoholic drink. Six litres of fermented medium yield one litre of alcohol.
- The powdery covering on the surface of the unopened spindle leaf is scraped out and applied on small wounds or cuts as it is known to hasten clotting of blood.
- The young female flowers after removing the perianth are rubbed on a hard surface to obtain a paste. This paste is applied liberally on the forehead to relieve headache.
- The modified stipule is used as a natural sieve to filter medicinal oils for separating out sediments.
- Fresh coconut oil obtained by boiling coconut milk is one of the important household medicines against skin rashes and boils in children.
- The paste prepared by rubbing buttons against a hard surface is used to remove pimples and other hard outgrowths on skin.
- Milch animals fed with sliced buttons yield more milk. The same result is obtained when fed with leaflets after removing the mid-ribs.
- Young cattle fed with the sediment of toddy for about 6 months put up good growth and are relieved of intestinal worms.
- Sweet toddy is rejuvenative and on daily use for long periods improves memory.
- Inflorescence from ripe but unopened spathe along with rice flour, jaggery and ghee is converted into a medicinal preparation in households for serving to women after delivery. This is meant for strengthening the lower back.
- The juice of fresh husk is mixed with

coconut oil and boiled to remove water content. This preparation is applied on body parts against sprain.

- Separation of butter from milk is easy if it is boiled by using dried spathes as fuel. As this fuel maintains a steady fire it is used in all household medicinal preparations including medicated oil.
- Burnt ash of spathes is used as a dentrifice and is believed to have smoothening effect on the gum.
- Shell charcoal is powdered into a fine powder and mixed with powdered common salt and pepper. This mixture is believed to have better properties as a dentrifice than many of the commercial tooth pastes.
- Against dog bite, the exocarp of fresh husk is smeared with neem oil and heated and then pressed against the wound at frequent intervals.
- The shell oil is believed to be an effective remedy against ring worm and other skin infections.
- Freshly prepared oil by boiling coconut milk is applied on head as a remedy against sinusitis.
- A popular household remedy against chest diseases is a preparation consisting of coconut milk, black pepper, dry ginger and ocimum leaves, boiled down to a thick consistency and administered in small doses.



Section - II

ARECANUT

PLANTING MATERIAL

Production and use of quality planting material is very important for ensuring a better yield from arecanut palm. Farmers follow various indigenous practices for raising quality planting material in arecanut. They are having specific criteria for the selection of mother palm, selection of seed nuts and selection of seedlings. Indigenous ways of raising nurseries are also evolved by farmers.

Mother palm selection

- Age of mother palms is an important factor considered by the farmers for selecting seed nuts.

While in northern parts of Kerala, the farmers prefer old trees for selection of seed

nuts, the farmers in southern parts of Kerala collect seed nuts from young trees.

The farmers in Assam and West Bengal States select seed nuts from bulk harvests irrespective of age of trees.

However, in Karnataka State, seed nuts are taken from trees between 25-30 years of age.

- High yield and regular bearing habit of the palm are given due weightage for selection as mother palm. High yielding and regular bearing palm which produce at least four bunches per annum with a minimum yield of 250 nuts per bunch, are selected by the farmers.

Collection of seed nuts

All the nuts from an identified mother palm are not chosen as seed nuts. Farmers adopt some selection procedure for the collection of seed nuts.

- Bunches from *naduppolikkal* (middle harvest) are to be selected for collecting seed nuts i.e., if there are four bunches to be harvested from a palm, the second and third bunches are preferred.
- Farmers also believe that if a just opened inflorescence is present in a tree, seed nuts should not be collected from that tree.

Selection of seed nuts

- According to farmers, nuts from the middle portion of the middle bunches of the tree are to be selected.
- The arecanut growers believe that nuts which float vertically with calyx end



Mother palm for seed nut collection

pointing upwards when allowed to float in water in a pond are to be preferred, since the seedlings raised from vertically floating seed nuts are more vigorous than those float either slantingly or horizontally.

- Heavier nuts from the selected bunch are to be selected. This is in line with the research-finding in which it was observed that heavier nuts give higher percentage of germination and produce seedlings with greater vigour. The percentage of quality seedlings is also higher from heavier seeds.
- Fully matured nuts are to be harvested for seed nut purpose. Until then, the nuts are retained on the mother palm. This is fully endorsed and has been incorporated in to the package of practices recommendations.
- The identified bunches are lowered to the ground with utmost care using a coir rope by the farmers in some parts of *Malnad* and *Maidan* parts of Karnataka.

In some parts of northern Kerala, the bunches after harvest from the tree top are lowered to the ground by skilled palm climbers by keeping the bunches on their thigh while climbing down. The rationale behind these practices is to minimize damage to the seed nuts and also to avoid the scattering of nuts all over the ground and seed nuts from different trees getting mixed up.

Storage of seed nuts

- After harvest, the seed nuts are smeared with cowdung slurry and are kept under shade for 2-3 days. According to farmers, this practice enhances the germination of seed nuts.
- In some localities, farmers keep seed nuts in pothi (basket) made of paddy straw and soak the bundle in water for one day.
- In some parts of Kasaragod District, farmers

dry the areca seed nuts in open sun for 1-2 days.

Nursery practices

Farmers use several media and methods for sowing seed nuts.

Seednuts are sown in baskets mulched with straw or tied in banana leaf sheath, straw (muda) or gunny bags.

Optimum moisture level is maintained in the nursery bed by sprinkling water at regular intervals.

Spacing for sowing in primary nursery

Farmers adopt a spacing of two inch between seed nuts in the primary nursery which is in line with the recommended spacing.

Transplanting to secondary nursery

As per farmers' practice, the areca sprouts are transplanted to the secondary nursery when they attain a growth of 4-6 months. This practice also has been incorporated in the package of practices recommendations.

Medium for secondary nursery

According to the practice of some farmers, a nursery bed raised to half feet height is ideal for the secondary nursery for arecanut. Along with the soil, farmers incorporate ash and dried cow dung as manures in the secondary nursery bed.

Spacing for transplanting in secondary nursery

Farmers adopt a spacing of one foot for transplanting areca sprouts in the secondary nursery.

An environment friendly nursery practice for arecanut

An innovative farmer from Sirsi taluk of Karnataka State has evolved a technique to grow areca seedlings by arranging the seed nuts inside the coconut husk. Before putting the

nuts, some top soil and organic manure is placed in the husk as a medium. The husk containing nuts are irrigated daily. Even if the irrigation is missed for a day or two, it doesn't affect the nuts since there will be moisture inside the husk. Since this technique avoids the use of plastic bags which is used in the polybag nursery method, it is an environment friendly technology. The seedlings coming out of the husks can be transplanted as such.

Mulching in secondary nursery

In some parts of Kasaragod District, arecanut farmers apply a thick mulch in the interspace of secondary nursery bed with cattle manure and green leaves.

Providing shade in the nursery

Farmers are well aware about the delicate nature of areca sprouts and seedlings which do not withstand exposure to direct sun and accordingly provide shade by various methods.

Most of the farmers provide shade in the nursery by arranging coconut leaves or arecanut leaves over a *pandal* (bower).

Sometimes farmers raise arecanut nurseries in the interspaces of arecanut garden itself so that artificial shading is not necessary.

Some farmers trail *Koval* (*Coccinia indica*), a vegetable species, as overhead bower. This practice enable farmers to provide shade to the areca seedlings in addition to income from the vegetables.

The practice of raising quick growing green manure crops like *Sesbania* in the nursery is also followed by some farmers for providing shade.

Selection of seedlings

Farmers adopt the following criteria for the selection of seedlings for transplanting in the main field :

- Select 1-1½ year old seedlings having a minimum of 5-6 leaves.
- Select seedlings with spindle leaf remaining in sword shape.
- Discard seedlings which are lanky.

PLANTING AND AFTERCARE

Selection of site

Farmers are well aware of the delicate nature of arecanut palm which can not withstand extremes of temperature and exposure to direct sun. Hence they traditionally choose valleys of hill slopes which are surrounded by forest trees for planting arecanut.



Arecanut garden in the valley surrounded by hills

In areas like *Malnad* of Karnataka where adequate natural protection is not available, farmers raise trees like coconut, mango and *Sesbania aegyptica* to create the required conditions.

Kathrikachal-for proper alignment of the rows of arecanut planting

Farmers possess the required skill in aligning the planting rows of arecanut in north-south direction and adopting quincunx system of planting so as to avoid sun scorching. Locally the alignment and system of planting is called *Kathrikachal* which means line in the shape of scissors, probably because the quincunx system of planting resembles an opened up scissors.

Spacing

Farmers give due importance to maintain optimum spacing for arecanut palms as is evident from their traditional belief that leaves of two nearby palms should not overlap; instead they should just touch only. For ensuring this, farmers of northern Kerala followed a spacing of 9-10 feet.

Preparation of planting pit

For planting arecanut, farmers prepare pits of size, one Kol (1 Kol = 0.7m) each side. But in areas where water table is high, smaller pits of 1-2 feet size are taken.

Season of planting

Depending on the drainage capacity of the main field, farmers adjust time of planting of seedlings.

In lowland areas, farmers prefer to transplant arecanut seedlings during *Karkadakavarcha* i.e., during August-September when south-west monsoon is ceased and the north-east monsoon is yet to begin.

In well drained areas, transplanting is done at the beginning of *Kalavarsham* (south-west monsoon) i.e., during May-June.

Providing drainage

Considering the importance of providing proper drainage to ensure good performance of seedlings and young palms, farmers dig 'oliya' (drainage channels) of 1' width and 3' depth @ one channel after every two rows of arecanut where the field is experiencing water stagnation.

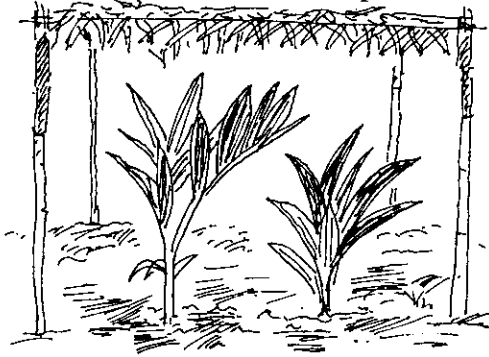
Cleaning these channels just before the onset of monsoon to facilitate easy flow of

stagnant water is a routine cultural operation followed by farmers. Locally this practice is known as 'oliya chethal' (meaning cleaning the channel).

Shading

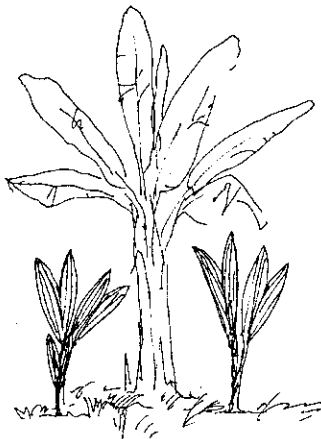
Farmers erect small *pandal* with coconut or arecanut leaves kept in a slanting position against the southern side of the areca seedlings to provide shade in summer months.

Raising banana as a shade crop



Pandal with coconut leaves for providing shade to arecanut seedlings

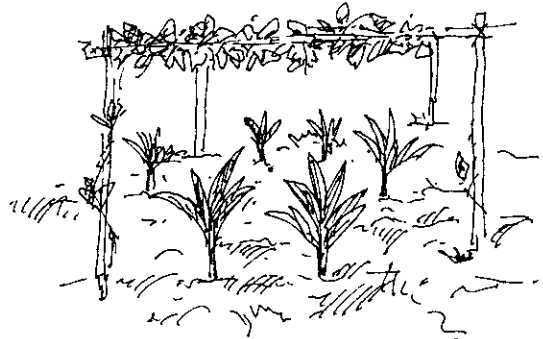
Farmers raise banana as an intercrop in young areca garden to provide shade. Besides providing shade, it fetches the farmers some additional income which is beneficial to the farmers especially during the pre bearing phase of arecanut.



Raising banana as intercrop for providing shade to arecanut seedlings

Growing 'Basale' for shade

A farmer from Puttur (Karnataka State), plants Basale plants whenever he plants arecanut. It is planted in the southern side of the areca. Both the crops grow together and Basale gives the much needed shade to arecanut and being a popular vegetable crop, it fetches the farmer some additional income.



Raising Basale for providing shade to arecanut seedlings

Protecting young palms from sun scorching

Farmers cover the stem of young areca palms with dried areca leaves during the period of October to January when sun-scorch is usually experienced. Locally this practice is called 'machippatta kettal' (means tying areca leaves) in parts of Kasaragod District.

GARDEN MANAGEMENT

Cultural practices

Cultural practices adopted by farmers vary from place to place depending on the requirement of crop under the respective regions.

Both in the *Maidan* and *Malnad* parts of Karnataka, elaborate and programmed systems of cultivation are practiced. In the *Maidan areas*, digging is done twice a year, once in May-June and again in November-January. In a few places, digging is done thrice a year. Farm yard manure is spread on the ground either before or after one of the diggings. In the *Malnad areas*, the digging is done once in three years. In one year, digging and application of farm yard manure is attended to. In the second year, farm yard manure, green leaf or earth are applied without digging. During the third year, no treatment is given. Similar elaborate practices are reported in nearby areas with the annual cultivation system involving four operations viz., digging the ground at the base of trees, spreading farm yard manure over which twigs with green leaves brought from nearby *soppinabettas* (akin to agro-forests) are piled up about one metre high over the entire inter space and finally covering the twigs with fresh earth. The whole operation is very costly and laborious and hence is confined to one-third of the garden only. The next one-third portion of the garden receives only some of the items out of the four mentioned above and the last one-third receives practically no attention except removal of weeds. The earth required for spreading over the leaves is heaped in the form of a mound of about 75-100 cm high along the middle of two

rows of palms. The mound is built up of soil obtained by digging drains and by transporting soil cut from adjacent valley sides. The soil of the mounds gets depleted slowly and in the course of 10-12 years gets exhausted completely. The stock of soil required for future use is again made up by building fresh mounds over the space, which was earlier occupied by drains in between the adjacent rows of palms. New drains are dug in the space where earlier soil mounds were running, thus bringing an interchange of position of mounds and drains. The cultivation practice is not so elaborate in the *Maidan* parts where the attention is more for removal of weeds, irrigation and conservation of moisture. The cultivation systems in the two contrasting situations of hills and valleys with torrential rainfall of *Malnad* tracts on one side and the open and flat tracts with limited rainfall of the *maidan* on the other, are so well standardized by the cultivators depending upon the situation and needs of the crop in the respective tracts.

Hardly any such operations is carried out in Assam, parts of Kerala and West Bengal whereas in other parts of Karnataka and north Kerala, the gardens are regularly cleared of all weeds and hoed once or twice a year.

Mulching

Mulching the interspaces of arecanut gardens with green or dry leaves is a common practice in the *Malnad* and sub-mountainous regions of Karnataka. The practice of spreading leaf with twigs in the heavy rainfall areas serves as a mulch, prevents evaporation from the ground recently dug, protects loose

soils from erosion during heavy rains and forms humus and manure to the soil. Dakshina Kannada district of Karnataka and parts of Kannur district of Kerala, application of green leaf with twigs is confined to the base of the palm around a radius of about 50 cm.

Some cultivators spread the interspaces of garden during the hot weather period with dry leaves collected from nearby *kumki* lands (i.e. lands adjoining the farmers' lands earmarked for growing shrub jungle).

Manuring

Farmers give much emphasis on application of organic manure in various forms to areca palms. Green leaf manuring is an accepted practice in arecanut garden.

Manuring arecanut palm is practised only in parts of Karnataka, south Malabar of Kerala and to some extent in Coimbatore district of Tamil Nadu. In these parts, green leaves and cattle manure are being applied in large doses either annually or once in two or three years.

The gardens in Mettupalayam in Coimbatore district of Tamil Nadu get plenty of silt and soil through the irrigation water from Kallar and Coonoor rivers.

Elaborate system of manuring with cattle manure and green leaves is practised in the *Malnad* and use of tank or river silt or earth from paddy fields together with farm yard manure in *Maidan* parts of Karnataka.

In Kasaragod and Kannur Districts of Kerala and Dakshina Kannada District of Karnataka, green leaves are put in the basin of arecanut palm. The practice of green leaf manuring is locally known as '*thol vekkal*' (means putting green leaves). Green leaves are collected from the nearby hillocks which are exclusively maintained for the collection of green leaves. Some farmers in these regions maintain sufficient number of plants of suitable

species of green leaf manuring plants near the boundaries of the areca garden itself. Green leaves can thus be collected easily and expenses on transportation of green leaves from distant places can be avoided.

In Kasaragod district of Kerala and adjoining areas of Karnataka, green leaves and farm yard manure are applied to areca palms. In Kasaragod region, one bundle of green leaves with twigs (locally known as *thol*) which approximately weigh 40 -50 kg is applied to two palms. Similarly one basket (locally known as *vatti*) cattle manure (locally known as *karakka valam*) which approximately weighs 20 kg is applied to two palms.

Application of lime for protection from sun scorching

Farmers in some parts of Kannur district apply lime on southern side of the arecanut palms to avoid the sun scorch. They believe that this practice is better than the conventional method of tying the arecanut leaves as it is prone to termite attack. Since the white surface is good in reflecting the sunlight, the scorching effect is minimized.

Weed control by growing jute in arecanut garden

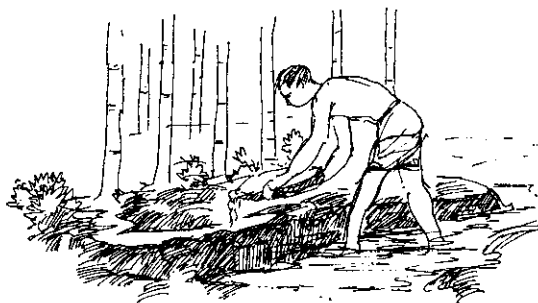
A farmer from Bhadravathi, has tried successfully growing jute as an intercrop in arecanut gardens which he claims to control weeds.

Application of ash

In some parts of Kasaragod district, farmers collect the areca leaves, sheaths, bunch wastes etc., available from the garden which will be burnt along with some earth for obtaining ash. The ash-burnt soil mixture is applied @ 1kg per palm. Farmers believe that this practice reduces the incidence of nut splitting in arecanut apart from providing nutrients.

Irrigation

The traditional irrigation method followed in arecanut garden was splash irrigation. Water from the source is guided into channels (locally called '*oliya*') dug in between rows of arecanut palms. Small ditches are dug in these channels at regular intervals and water is splashed to the basin of palms using areca sheath (locally called '*kavungin pala*'). This splashing of water is a laborious operation and thus traditionally a lot of labour is spent on irrigation of areca palms.



Splash irrigation in arecanut garden

Farmers give lot of attention in repairing these irrigation channels every year once during December by removing weeds and then plastering with mud and cow dung slurry. During the rainy season, these channels are covered with arecanut leaves collected from their garden to prevent damage to the channels due to the splashing of soil by the rain drops.

Surangam-an indigenous water harvesting structure

Surangams are seen in the hilly areas of Kasaragod district of Kerala and adjoining areas of Dakshina Kannada district in Karnataka State. Though these areas get a high amount of rainfall, the distribution pattern is so heavily skewed that a lions share of rainfall is received during the south-west monsoon period i.e., June to August.

As such there is a long spell of dry period spanning over six months resulting in shortage

of irrigation and drinking water during the summer months. Moreover tapping water from conventional wells is also not very successful owing to the hilly terrain.

Surangam is a unique indigenous technology farmer relied on to harvest ground water under the above difficult situation. It is a horizontal tunnel dug through a laterite hillock from the periphery of which water seeps out. Depending on the slope, topography and soil characteristics, some local experts used to locate suitable places in the hilly area for surangam construction. Skilled workers are usually engaged to construct surangams. Similar to open dug well, sufficient skill is required for surangam construction as well. Besides, a lot of courage also is essential for the worker to tunnel through the soil. Farmers usually entrust the work to some skilled workers on contract basis. Currently the rate ranges from 150 to 500 rupees per 'kol' (the traditional unit for measurement of length equivalent to 28"). Total cost of construction depends on how long the tunnel is made so as to get a satisfactory discharge of water. Sometimes 8-10 m will be sufficient. Sometimes excavation has to be done through much a longer distance for more than 100 m. During tunnel making if hard rocks are met with, the further direction of the surangam will be changed suitably and tunneling is continued to reach the water source. Sometimes many subsidiary surangams are excavated in addition to the main one. During construction work, candle or oil lamps are used for getting sufficient light inside the surangam. Sometimes a mirror is kept outside the surangam outlet and sunlight will be reflected to the interior part for facilitating the work. Construction is done in such a way that there will be a slight slope towards the opening of the surangam for the smooth flow of water.

Water coming from the surangam is usually collected in a small storage tank constructed near the outlet of the surangam at a slightly lower elevation from which water is guided to lower reaches for irrigating the crops. Even though the surangam yields water continuously, the discharge rate is quite low, 2 to 60 litres per minute. It would be quite difficult to operate any irrigation system with such low discharge rate. Water from the surangam is guided to the tank using arecanut stem which is shaped into a semi circular/half round channel by splitting it into two pieces longitudinally and then removing the soft core portion.

If the crops are cultivated at a higher reach, water from the storage tank will be pumped using pumpsets. Normally water from a surangam having good discharge capacity can irrigate 2-3 ha of arecanut garden twice in a week and can also provide sufficient water for domestic use. Cost of maintenance of the system is negligible. In general a surangam has 0.75 to 1.0 m width, 2.0-2.5 m height and a length of 3-300 m. Though a small tunnel is sufficient to channel the water from the source towards the periphery, usually 2 m height is maintained during excavation so as to enable the person to move inside as well as to transport the excavated soil as head load to outside. It is also not rare to see surangams having height of less than 2 m. In such cases the excavated soil is collected in areca sheath and drawn out by pulling the same.

Use of waste water for irrigation

A farmer from Karadka of Kasaragod District has evolved a technique of recycling of domestic waste water. He is suggesting a three stage filtering of domestic waste water which will finally go to the main tank. He is able to provide life saving irrigation for about 100-150 palms per day during peak summer. In a week about 800-1000 trees can be covered.

Mixed cropping in areca garden

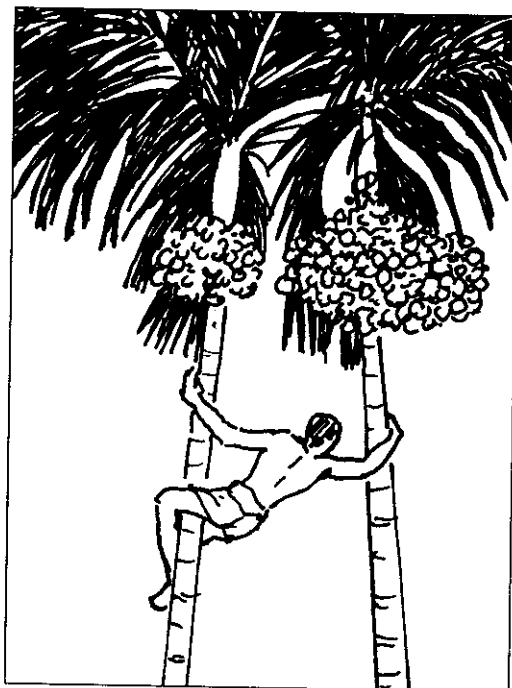
Tree crops like coconut, citrus, jack etc. are grown in arecanut gardens of the Karnataka State.

Inter cropping of ornamental plants in arecanut garden

A farmer from Honavar Taluk of Uttara Kannada district has been growing more than 100 different varieties of ornamental plants along with other conventional plants like banana, cardamom and betel vines in his arecanut garden as inter crops. As per his experience, ornamental plants as inter crops in areca garden fetch remunerative income.

Harvesting

Harvesting arecanuts is a tedious job because of the tall lanky growth pattern of areca palm. But the traditional climbers possess wonderful skill in climbing areca palms for harvesting arecanuts. After climbing one tree at one end of the garden and harvesting the



Harvesting arecanut

ripe bunches, the climber pulls the nearest palm with the help of a hook and swings to it. Like this, the climber is able to swing from one palm to another and complete harvesting of 100 palms or even more, at a stretch before coming down to the ground. Locally this style of climbing areca palms is called 'Kavungu poral'.

In certain parts of north Kerala and Dakshina Kannada areas of Karnataka, a long bamboo with a sharp sickle or hook attached to the end is also being used for harvesting the bunches.

'Doli' for collecting harvested arecanuts

A farmer from Uthara Kannada has developed an indigenous method for collecting the harvested bunches from tree top without getting scattered in the ground. He has developed a 'Doli' by stitching together about six gunny bags attaching cycle tubes at the corners which act as shock absorbers and tying them with plastic ropes. This arrangement is tied at a height of 6-7 feet to 4 areca trees. The bunches are dropped to this after harvesting. The bunches dropped do not get damaged and scattered as happen in the traditional dropping of harvested bunches from the tree top. After 3-4 bunches are dropped, the doli is cleared. The same position can be used to drop bunches of about 15 trees.

Post harvest operations

Drying of areca during rainy season

A woman farmer has evolved a unique method to dry arecanuts during rainy season by hanging the nuts on a jute string.

Dehusking

Dehusking of arecanuts is traditionally done by skilled workers using a small sharp curved knife which is fitted at the top of a wooden platform. The worker sits on this platform and dehusk the nuts. On an average

50-75 kg of dried nuts can be dehusked per day by a skilled worker using this traditional device.



Traditional method of arecanut dehusking

Storage

The harvested ripe arecanut is stored in pits or steeped in water for consumption during off-season in Assam and Kerala and to some extent, in West Bengal.

In Assam, fresh fruits, as such are preserved in thick layers of mud to elicit a moist chewing feel in the mouth when consumed.

In Kerala, fresh fruits are generally stored by steeping in water. This results in discolouration of outer husk and foul smell due to bacterial attack. However, the inner core is practically well preserved. Such water preserved nuts are favourite of many chewers who ignore its milk off-flavour.

In Assam, ripe nuts are preserved in pits covered with mud or in running water in streams.

High grades of thinly sliced processed arecanut in Kerala are mostly packed first in mats made out of palmyrah leaves and then packed in gunny bags or wooden boxes before they are despatched.

Medicinal properties

Vagbhata (fourth century A.D.) has described its use against leucoderma, leprosy, cough, fits, worms, anaemia and obesity.

Arecanut has also been mentioned for its use as a purgative and in an ointment along with several other ingredients, for the treatment of nasal ulcers.

Bhavamista (thirteenth century A.D.) mentioned the use of arecanut as a stimulant and an appetizer.

In the *Hithopadesa*, arecanut is described as pungent, bitter, spicy and sweet, and that it expels gas, removes phlegm and bad odour and kills worms.

The powdered nuts are held in repute as an antihelminthic for dogs for many centuries, for its efficacy in the expulsion of tapeworms.

Arecanut leaf-sheath used to deter rats in households

In certain parts of Kerala, the grain or seeds are put into an earthen container and hung from the wooden beams of the store room. The leaf sheath of arecanut and also that of banana inflorescence are placed right above the hanger, forming an umbrella like structure. This method is also used to store other vegetables and banana which are hung from the ceiling of the store house. This prevents the rats from entering the pots as they cannot get a grip on the sloping surface.

CROP PROTECTION

Control of Kole roga or Mahali disease

'Kole roga' or Mahali caused by a fungus *Phytophthora arecae* is the most important disease of arecanut prevalent in all areca growing tracts.

In *Malnad* region of Karnataka, farmers followed the practice of covering arecanut bunch with areca leaf sheath (locally called 'kotte').



Covering arecanut bunch with areca sheath

Covering arecanut bunch with grass (locally called 'karade') is also traditionally followed by farmers in some parts of Karnataka.

Polythene covering of arecanut bunches against Mahali disease

An innovative farmer from Sirsi taluk of Karnataka improvised the earlier traditional practice of protective covering of areca bunches against Mahali disease. He

experimented by covering the arecanut bunches with polythene bags which ensures full protection from the disease. In this innovative practice, the arecanut bunches are covered with polythene bags at the onset of monsoon. Covers of 75x60 cm size and 125 gauge thickness is preferred for this purpose.

Application of wood ash for the control of die-back and button shedding

Inflorescence die-back is a common disease of arecanut in which yellowing and drying of rachis from the tip towards the base followed by shedding of female flowers or buttons is observed as symptoms. Farmers in some parts of Kerala apply wood ash for the control of this disease.

Control of nut splitting

In nut splitting, symptoms appear as cracks at the tips of arecanuts which extend longitudinally towards the calyx exposing the kernel. Farmers adopt the following indigenous practices for the control of this malady :

- Making 1-2 inch longitudinal side slits at the base of inflorescence. Farmers believe that nut splitting is due to excess plant sap in the tree and making the slits at the base of inflorescence will drain the excess sap.
- Some farmers apply paddy husks @ ½ kg in the palm basin for the control of nut splitting of arecanuts.

Coconut water based insecticide against pests

A farmer from Hassan district has been using the paste prepared out of 'Kasaraka' (*Strychnos nuxvomica*) fruits and tender coconut water in equal proportions as an effective insecticide for arecanut.

CHAPTER 12

INDIGENOUS KNOWLEDGE FOR AGRICULTURAL DEVELOPMENT

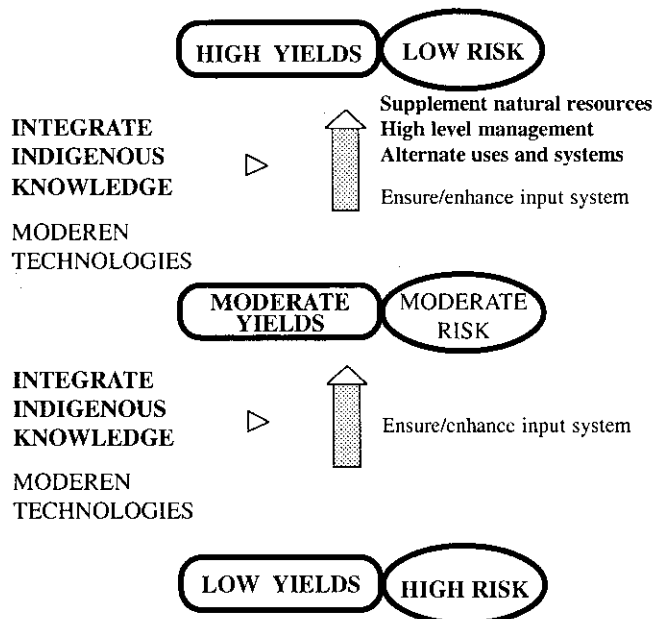
Indigenous knowledge is highly localized and restricted. Local environmental factors and cultural conditions govern the evolution of indigenous knowledge. The indigenous knowledge vary between countries, regions and even farm to farm. India is endowed with vast resources which includes a huge reservoir of indigenous knowledge also. An effort for the documentation of indigenous knowledge in coconut and arecanut cultivation was taken up as a Research Project at CPCRI. The chief considerations for undertaking the work on documentation of indigenous knowledge are

- To list the indigenous practices followed in different parts of the country.

- To understand scientific rationale as perceived by farmers.
- To accelerate technological change.
- To enable better understanding of technology development and development of newer concepts.
- To increase the awareness among the younger generation and develop appreciation for the traditional systems.
- To revive and restore pride among the farmers themselves.

To enable us to utilise the potential of indigenous knowledge available in the country, we may have to reorient our research and development strategies as given in the Figure.

Strategies for increasing agricultural production



Documentation of indigenous knowledge needs to be undertaken for all the crops on a priority basis.

While working on documentation of indigenous knowledge, three roles are envisaged for the Extension Scientists to increase the utility of such endeavours.

- i) Collecting/gathering information on indigenous knowledge and systematically document them for their utilization in technology development and for the benefit of posterity.
- ii) Analysis of indigenous knowledge in terms of productivity, sustainability, stability and equitability and the scientific rationale of the practices.
- iii) Development of a feedback mechanism to scientists from other disciplines that will enable them to develop viable, relevant and scientifically sound technologies.

However, the following five constraints are likely to interfere in the use of indigenous knowledge in the planning of agricultural research projects. They are :

- Lack of professional respect between agricultural scientists and ethnoscientists
- The way each scientific area collects data
- Difference in research publication demands
- Lack of time
- Lack of talent among agricultural scientists to gather indigenous knowledge.

If indigenous knowledge is to be brought into focus and popularised, systematic studies for documenting indigenous methods, identifying appropriate participants for the activity and monitoring the process are to be undertaken by all the Scientists in the National Agricultural Research System.

