PLANTATION CROPS

Tea. Tea *(Camellia spp.)* is an important beverage and the world drinks more of it than any other beverage. It is made from the tender or young leaves and unopened buds of the evergreen tea-plant, popular as a 'healthful herb'. The tea plant is in the polymorphic species *Camellia sinensis* Kuntz, but recent findings show that this plant of commerce is derived from more than one species. Two distinct varieties of tea-plant are generally recognised, the small-leaved China *(sinensis)* and the large-leaved Assam *(assamica)* which have been raised to a specific rank by a well-known tea botanist. Carefulfield observations, however, reveal that more than one or two species are involved in the evolution of the present-day tea-plant of commerce. Considerable interspecific hybridization has taken place in nature. Thus, the taxonomy of the tea-complex is confounded.

The tea-plant, in the natural state,grows into a small or medium-sized tree, but in commmercial plantations it is pruned and trained to form a many-branched low bush and is encouraged to produce vigorous vegetative growth by adopting an appropriate schedule of fertilizer applications.

The important tree growing countries are India, Sri Lanka and East Africa; Japan and Indonesia also produce sizeable quanties of tea. It is also grown in Bangladesh, China, Georgia, Argentina and some other countries. In India, the crop is grown in Assam, West Bengal, Kerala, Karnataka and Tamil Nadu, and to some extent in Tripura and Himachal Pradesh. The total area under tea in our country is about 3,58,000 hectares and over 468 million kilograms of product is obtained anually. Over one million workers are employed by the tea industries.

Yeilds have steadily increased during two decades. Tremendous progress has been made on the selection of clones and those with high yeilds and improved quality have been released to the industry. The tea planters are encouraged to uproot poor section of their plantation and replant them with improved planting material.

CLIMATE. Tea is grown on plantation scale in many areas of the world in warm and moist climate. These range from Georgia (USSR) to Corrientes (Argentina). It is grown from sea level to about 2460 m. A well distributed rainfall is essential for its cultivation. The rainfall varies from 125 cm to 750 cm in the tea-growing regions in this country.

SOIL. tea is planted on soils of widely different geological origin and of almost all physical types. a well drained, deep and friable loam or forest land rich in organic matter is ideal. Tea soils are acidic (pH 4 to 6), low in calcium and generally rich in iron and manganese.

CULTIVATION. Tea is propogated from seed, but high yielding clonal material has also become popular. The plants are initially raised in nurseries to produce healthy plants. 1 to 1 and 1/2 year old nursery seedlings are used for planting in the field. The vegetative propogation of selected tea-plant cuttings, each with a leaf and an internode has been standardized and progressive planters now raise colonial nurseries on a large scale.

The area intended for planting is first cleared of forest growth and adequate steps are taken to preventsoilerosion.Planting lines are traced(as at present on contour on hill slopes) and pits of a convenient size(generally 30-45 cm deep and 24 cm wide) are dug. The normal accepted spacing is 120 X 75 cm, accomodating about 10,000 plants in a hectare. The soil is heavily mulched during the initial one or two years.

Weeds compete with the tea plant for nutrients, and weed control is important in tea plantations. In recent years , the control of weeds with chemicals has gained popularity. Grasses and broad-leaf dicot weeds are kept under check. Pests and diseases are effectively controlled with chemicals.

A manuring scheme is followed from the nursery stage upto maturity. A special 1:1:1 NPK solublefertilizer mixture is used in the nursery; a 4:3:3 NPK mixture in the first 3 years in the clearing and thereafter the dosage of the fertilizer applied is varied, depending on the type of tea, its performance,soil fertility and the yield potential of the crop. On an average 10 kg of nitrogen is applied for every 100 kg of the crop.

Tea readily responds to the application of nitrogen and potassium. Potassium is applied at the rate of 40 to 50 percent of the amount of nitrogen applied, depending on the soil type and weather conditions. In southern India tea responds to nitrogen upto 300 kg per hectare applied to some high-yielding varieties of tea, whereas in northern India, the application of nitrogen is limited to about 120 kg whereas 30 to 40 kg of phosphate per hectare is adequate.

Zinc deficiency is a limiting factor in crop production in most areas and a schedule of foliar application of zinc sulphate usually 11 kg per hectare in alternate years is recommended.

TRAINING, PRUNING AND PLUCKING. The tea-plant is initially trained into a small bush by centring low within a few months of planting, by removing the central leader stem in order to encourage development of lateral branches. The lateral branches are cut to a convenient height of 40 to 50 cm and the growth above this is periodically cut. Thus a small, compact bush is formed. New shoots are allowed to grow unhampered and these shoots are tipped, leaving a growth of 20 to 30 cm above the pruning cut, depending on that kind of plant. The crop is then harvested at regular intervals.

In southern India, the pruning cycle extends over a period of 4,5 or 6 years depending on the elevation and growth. In some caes, a 'skiff' is given at a cinvenient height and the pruning cycle extended for 2 or 3 years. Pruning and skiffing are done periodically to keep the height of the bush at a cinvenient level for the pluckers to operate and to encourage vegetative growth. Annual pruning is a practice in northern India (Assam), but even there the present trend is toward an extended pruning cycle. After a series of pruning cycle, the bushes are rejuvenated by hard pruning, removing all cankered anddiseased portions of the stem.

In northern India, the economic life of the tea bush is generally 40 to 50 years and therefore 2 to 2 and a 1/2 percent of the area is uprooted and replanted every year. In southern, such regular uprooting and replanting is not practiced, because economic yields are obtained from sections which are 80 years or more old. Usually plucking is restricted to the terminal bud and two expanded leaves, or to the bud and three succulent leaves, known as fine or medium plucking. Coarse plucking includes extra leaves. In northern India the tea bush is plucked at weekly intervals from April to December and there is a dormant season during winter. In southern India the crop is harvested during the cold and dry months (December to March)

TEA MANUFACTURE. The shoots may be prepared in several ways to make black or green tea. To make the former, the leaf is usually withered and rolled or distorted by rolling in the conventional tea rollers, or is passed through tea machines, the 'rotorvane' and CTC rollers which exert drastic action on the withered leaves. The juice of the leaf cells is exposed in the air to oxidize (fermentation) when important changes take place. When the optimum fermentation is reached, the action of enzyme is arrested by drying the fermented leaf in a current of hot air in suitable tea-dryers. In the production of green tea, the shoots are steamed as soon as possible after plucking and the leaf oxidized is soon destroyed so that fermentation does not take place on rolling.

The processed tea is passed through a series of meshes, sorting out leaf grades and dust. The tea leaves are sorted into different grades , for example, pekoe, Orange pekoe, Flowery pekoe, Broken Orange pekoe and Fannings.

Tea intended for export is packed in plywood chests and shipped directly to various centres or sold through auctions at centres like Calcutta and Cochin.

Instant tea, soluble in water, tea bag and ready mix tea are new developments.

COFFIEE
HARVESTING AND PROCESSING

Quality is a summative index of many characteristics of coffee, such as its appearance in the raw, roast tastes and its liquor qualities comprising factors like aroma , body and acidity. Quality can be influenced by nutritional factors and weather conditions during the development stages of the beans. Correct processing techniques are essential to prevent deterioration in quality. Coffee is processed in two ways: (a)wet processing by which plantation or parchment coffee is prepared, and (b)the dry method by which cherry coffee is prepared.

Parchment coffee prepared by using the wet method is generally favoured by the market. Cherry coffee, due to its very nature of preparation and longer contact with the mucilage and fruit skin, is usually associated with a characteristic fermenting flavour.

Harvesting. For the preparation of both parchment and cherry types of coffee, picking of the right types of fruit forms an essential part of processing. Coffee is picked when the fruits are just ripe. Under and over-ripe fruits cause deterioration in quality, the former gives "immature beans" and the latter "foxy" coffee. They may be dried seperately for making cherry coffee. the bags used are frequently washed and dried. Bags in which fertilisers, pesticides and fungicides are stored should never be used for this purpose.

Preperation of parchment coffee

PULPING. The preperation of coffee with the wet method requires pulping equipment and clean water supply. Fruits are pulped on the same day to avoid fermentation. The pulper should be checked everyday to prevent cuts. The pulper-nipped beans and other deformed beans will result in defective parchment.

Fruits may be fed into the pulper through a sipho arrangement to ensure uniform feeding and to seperate lights and floats from sound fruits. Uniform feeding ensures the proper removal of skins and prevents cuts, choking of the pulper etc. The pulped parchment should be sieved to eliminate any unpulped fruits and skins.

The skins seperated by pulping are led away from the vats into the collection pits, so that their microbial decomposition will not affect the bean quality when they get mixed with the bean.

DEMUCILAGING AND WASHING. The mucilage on the parchment skin can be removed by using any one of the following methods: (a)natural fermentation, (b)treatment with alkali, and (c) frictional removal in machines like 'Raoeng' and 'Aqua pulpa'.

Natural fermentation is the most commonly used method for demucilaging coffee. The mucilage breaks down in the process of fermentation. In the case of arabica, it is complete in 24 to 36 hours. Fermentation takes longer in cool water than in warm weather. If the parchment is under fermented, the sticky mucilage is left on the parchment. This condition leads to the absorption of moisture by the bean and to m[ustiness in the final product. When correctly fermented the mucilage comes off easily and the parchment does not stick to the hand after washing. The beans feel rough and gritty when squeezed by hand.

The robusta coffee has more of sticky mucilage. Fermentation will not be complete even after 72 hours. Quite often the mucilage breakdown is not complete even after a very long period. Thus we resort to alkali treatment or frictional removal of the mucilage.

UNDERWATER SOAKING. Wherever water supply is abundant and additional vats are available, the parchment is soaked for 12 hours and then given a final wash. This improves the quality both in appearance and in the cup.

DRYING the next stage in processing consists of drying the parchment in the sun until the moisture content is sufficiently reduced to permit the storage of beans till they are despatched to curing works.

When coffee is being dried it is necessary that all naked beans , pulper-nipped and bruised beans are sorted out and despatched to curing works seperately.

The coffee is then bagged into clean new gunnies. The coffee of different lots should be bagged seperately. New gunnies should always be turned inside out and well aerated before use , as otherwise coffee will absorb natural oils and off odours from the bag and give rise to an 'acrid' cup.

PREPARATION OF CHERRY

For preparing chery the fruits should be spread evenly with a thickness of about 8 cm on clean drying ground. it is desirable that drying is carried out on tiled or concrete floors. Coffee should be stirred and ridged at least once every hour. As in the case of parchment the coffee may be heaped up and covered every day in the evening and spread again the next morning. The cherry is dry when a fistful of the drying cherry rattles when shaken . the cherry should be dried completely at the end of 12 to 15 days in bright weather. Each lot is bagged seperately in new gunnies.

Stripping. After harvesting, some green fruits of coffee may still be clinging to the plants. They are stripped off completely, dried and sent to the curing works seperately. This coffee must be marked and bagged distinctly as strippings.

STORAGE AND DISPATCH

Stores should be well ventilated and dry. The bags containing dried parchment or cherry should be stored on raised platforms to ensure circulation of air beneath the bags. The parchment and cherry coffee should not be stored together. Other materials like fertilizer etc should not be stored in the same room.

The bagged coffee should be dispatched to the curing works at the earliest possible. The bags must bear labels in respect of their grades, lot numbers and other details with instructions to cure them seperately.

All gleanings and floats should be packed and sent seperately for curing.

Cacao. The cacao plant is a perennial dicotyledonous plant which has been under cultivation since pre-historic times. The centre of origin has been placed in the tropical forests of the Amazon Valley in South America. It is now extensively grown in the continents of Africa, Asia, South America and in parts of North America.

Cacao is cauliflorous. Flowers and fruits arise at cushions which were originally leaf axils. The flower is pink to whitish, reguler, hermaphrodite and has 5 sepals, 5 petals, ten stamens in 2 whorls of which only one is fertile and a superior ovary of 5 united carpels. The andrecium consists of 5 long pointed staminodes and 5 fertile stamens which are positioned opposite to the petals. Flower abciss at the constriction at the base of pedicel.

The fruit is a berry containing 20 to 40 seeds each surrounded by a pulp which is a transformation of the outer integument of the ovule. The outer cells release a highly mucilaginous substance at full growth and is one reason for preventing fermentation of beans after harvesting.

CLIMATE AND SOIL. Cacao is cultivated on commercial scale in the tropical lowlands where the maximum temperature does not fall below 15deg celsius, the absolute min not below 10 deg celsius. The main production centres are confined to 10 deg north and south of the equator. It is grown upto altitudes of 1000 metres where the low temperatures are the limiting factor. The rainfall should be uniform through the year a min of 90 to 100 mm per month is required and an annual precipitation of 1500 to 2000 mm unless supplemented by irrigation. The micro climate is significant. The trees prefer cool moist soil and air around them. The shade requirements are related to the soil nutrient. On a poor soil too much light may affect the yields adversely.

Cacao thrives on a wide range of soil types, with pH ranging from 4.5 to 7. It requires a deep soil. Impervious soils or those with hard substrata are unsuitable. Clayey soils or mixtures of clay and sand are preferable. Ill-drained soils are very inimical to cocao trees. Divalent bases, calcium and magnesium play a significant role in the nutrition of cacao. In India where a monsoonal type of climate exists it is difficult to find ideal locations comparable with those in West Africa. There are a number of relatively small areas in various parts of southern India where conditions are suitable. Normal irrigated land is too expensive for a crop at present. The more suitable areas in southern India are those which get rains during the major part of the year and have a very short dry.

CULTIVATION. Cacao is grown in regulated shade. development of one main trunk only is allowed. The trees are grown close so that the foliage forms a canopy to keep the air cool and damp around the trees. Regular weeding before harvesting and removal of unwanted basal 'chupons' is taken up.

NURSERY. fresh beans are to be used for sowing as they lose their viability after the pod is broken. They are planted with the pointed end upwards, sown either in bamboo baskets or polythene bags or raised beds. if sown on raised beds the young seedlings are usually transplanted in containers about 2 weeks after sowing. The seedlings will be in the nursery for 6 to 8 mths before they are transplanted to the main field. Other methods of propogation include grafting, budding and layering.

Cacao can be cultivated as an intercrop in coconut and arecanut gardens. Mixed plantations can be raised on an area 4mx 4m the cacao seedlings occupying the centre of the square or with the normal spacing of 2.7m x 2.7m for area. Pits of 90cm^2 with compost are used for planting the seedlings. Both require artificial shade during the first one or two hot-weather periods. Banana can be profitably grown as a shade crop during the first 2 years. Subsequently, the shade cast by the arecanut trees will be sufficient for the cacao plants. The cacao plants can be manured with 100g of N, 40g of $P_2O_5$and 140g of K_2O per tree annually in 2 split doses. The plantation is irrigated at weekly intervals in the hot months. All the fan branches are cut to a height of one metre from the ground level. This operation is very important for obtaining good yields.

In coconut plantations spaced at about 7.5 metres cacao may be planted either in a single row alternating with coconut or in double rows in triangular positions between the rows of coconut. Thiscrop combination of cacao and coconut has synergistic effect on the yield of both the crops.

Rubber.

Natural rubber is found in the latex of as many as 895 species of plants belonging to 311 genera of 79 families. Of these Hevea Brasiliensis (Euphorbiacaeae), the para rubber tree is the most important source of rubber. Others are glaziovii (Euphorbiacaeae), Ficus elastica (Moracaeae), Parthenium argentatum and taraxacum kok-saghyz (compositae). Many other species such as euphorbia intisy (Euphorbiacaeae), cryptostegia grandiflora, and landolphia sp. have been tried as possible minor sources of natural rubber.

PROPOGATION. The earlier plantations were raised from unselected seeds. The yielding capacity of these trees being low the production was poor in many of the plantations. Hevea is propogated through seeds and only by adopting vegetative methods. The viability of the seeds being short, it is necessary to sow them as soon as possible. Planting is done in specially prepared nursery beds. The soil is dug up, mixed with fertilizers and beds of 30-120cm width and of convenient length are prepared. The germinated seeds are then planted about 30x30cm apart. The seedlings are kept in the nursery till they attain a diameter of 20 to 25 mm above the collar.

The seedlings are usually transplanted in the field in june-july. Healthy seedlings are selected and stumped at a height of 50cm. After pulling out the roots of the seedling are trimmed and then planted in position in prepared pits about 4.5m apart to accomodate an initial stand of about 500 plants per hectare. Sometimes the seeds are sown in situ in the fields, using 2 or 3 seeds per pit.

Bud grafting is done using buds from selected mother trees. Budwood nurseries to supply budwood stumps are established simultaneously with the rootstock nurseries. Nursery seedlings can be bud grafted when they attain the required girth above the ground. Budded stocks are ready to be stumped about 4 weeks after budding. They are cut 10 to 15cm above the bud patch and the stumps are pulled out and transplanted in the field. Green budding with the buds stripped from green shoots has also been practiced. The plant density recommended is 420 to 450 plants per hectare. After planting the field it takes 7 years for the trees to come into tapping. The fitness for tapping is guaged by the girth of about 55cm and a height of 125 cm from the bud union. When 50-70% of the trees have reached this size, tapping is commenced.

MAINTENANCE. The majority of the rubber trees grown in India are confined to a narrow belt from Kanyakumari district to the coorg district of Karnataka in the north and in the west of the Western Ghats. They are grown mainly in lateritic soils which are very porous, well drained and acidic. A ground cover of a leguminous crop is raised between the trees to prevent soil erosion, keep down soiltemperature, conserve soil moisture and to add humus and nitrogen to the soil. The clean weeding of plantations is not now recommended.

Rubber trees should be regularly manured with balanced fertilizer mixtures from time of planting to ensure maximum production. During the first year of planting, single dose of 225g of 10:10:4:1.5 NPKMg mixture is applied to each plant. The dosage increases 900g and 1100g in two split doses during the second and third years respectively. From the fourth year onwards the application of 900g of the mixture per plant in two split doses is recommended. For trees under tapping N:P:K 10:10:10 mixture at the rate of 900g per tree is applied annually during april-may.

Abnormal leaf fall caused by phytophthora pulmivora and P. meadii the powdery mildew caused by oidium hevea and the pink disease caused by corticium are some of the major diseasesaffecting rubber in southern India. These disease form a limiting factor in the growth of the trees and the yield of latex, and plant protection methods have to be adopted. Prophylactic spraying with 1% Bordeaux mixture or the oil-based copper oxychloride is the control measure recommended against abnormal leaf fall. Powdery mildew is controlled by dusting with sulphur (70:30 sulphur talc mixture). The pinkdisease is checked by using Bordeaux paste in the early stages of infection.

TAPPING. Latex is obtained from the bark of the rubber tree by tapping. Tapping is a process of wounding during which thin shavins of the bark are removed to induce flow of latex. The barkof the rubber tree has an outer hard portion and an inner zone which is soft. The latex vessels are arranged in a series of concentric rings within the bast. Their number increases towards the cambium. they are disposed almost vertically at a slight angle to the right. Tapping cuts extends to half the circumference of the tree and leads to a vertical groove at the base of which a zinc spout is fitted. Below this a coconut shell is placed to collect the latex. Tapping commences early in the morning when the latex flow is high. After 2-3 hours when the flow stops, the flow stops the latex is collected in buckets and taken to the collection shed or factory. The tapping should be

deep but the cambium is not cut. Tappings are done once in 2 days(alternate days S/2 d/2) for budgrafted plants and half spiral once in three days (S/2 d/3) for clonal seedlings.

A higher intensity of tapping often leads to brown bast, physiological disorder. However on older trees, intensive tappings are practised. Synthetic hormones are also used to stimulate yield. A new yield stimulant "Ethrel" when applied almost doubles the yield of rubber. The yield of the rubber tree varies according to the type of material planted, the age of the tree, the fertility of soil, the climatic conditions and the skill of the tapper. During the south westerly monsoon many tappings are lost, however by fixing polythene rain-guards the non-tapping period can be reduced. During the wintering and refoliation period a rest of about 4 weeks is given. A rubber tree can be tapped for 25 to 30 years.

PROCESSING. The important forms in which the crop from rubber plantations is marked are the following:
1.preserved latex and latex concentrates
2. Dry ribbed sheet rubber
3.Dry creped rubber
Dry solid block rubber.

The crop collected in the form of liquid latex can be processed into any of the above forms. But thecrop collected in the form of tree lace, shell scrap, and earth scrap is processed only into crepe or solid block rubbers.

Preserved latex concentrates are generally in 2 concentrations-- The latex between 36% to 50% drc and that between 51% and 60% drc. Latex is concentrated either by creaming or centrifuging. It is preserved by adding ammonia and other chemicals to prevent coagulation and deterioration.

The major quantity of natural rubber produced in the country is marketed in the sheet form. When the latex reaches the factory, it is weighed, seived and estimated using a metrolac (hydrometer). The latex is then standardized by adding water, allowed to stand and again seived. Then it is poured into aluminium trays of std size or into bigger tanks to which formic acid or acetic acid is added to coagulate it into a soft mass, washed in running water and passed between rollers to squeeze out the water. Finally the sheets are passed between grooved marking-rollers. The wet sheets are hung on reapers in the shade to get rid of the excess water and then moved into smoke houses for drying. After 4 to 5 days at a temperature of 43 to 60 deg celsius the sheets are graded and packed for dispatch to manufacturers. Besides the smoked sheets pale crepe and smoked crepe are also made using different processes. In order to improve the image of natural rubber in the world market, new methods of processing and presentation are also adopted. This involves coagulation, size reduction, dewatering, dirt removal, drying baling and grading.

VARIETIES. Many clones have been evolved in South-east Asia and South America. The eastern clones are high yielding and named after the plantation from which they have originated. Most of the introduced clones in India are from Malaysia (RRIM), jaya(tjir, BD), Sumatra (AVROS), and Sri Lanka(mil, wagga, hil). Indian clones developed by the rubber research institute of India (RRII) are comparable with the foreign clones and are now being distributed for small-scale planting. The potential yield capacity ranges from 2000 to 3000 kg or more per hectare per year.

The production of natural rubber during 1973-74 in India amounted to 125153 tonnes and the consumption is 130302 tonnes.

Coconut.

is a majestic perennial palm. It is grown in numerous islands and also in the humid coastal tracks of tropical countries. India ranks second in the world production of coconuts 6088 million nuts from 108 million hectares.

The coconut palm, or 'kalpa vriksha' provides many necessities of life like food and shelter. of all the tropical palms it is the outstanding one. It is mainly cultivated for the nuts from which 2 important products 'copra' and fibre are obtained. Copra yields oil and oil-cake. The trunk of the mature palm is used as timber for houses and the leaves are used for thatching houses, fencing etc. The unopened spathe is tapped for toddy called 'neera'. Sweet toddy can be converted into jaggery and sugar, fermented toddy is a mild alcoholic drink and vinegar can be made from it. Water from tender coconut is a refreshing drink. In kerela the extraction of coir from the husk of nuts and the manufacture of coir products provides employment for thousands of people. The coconut shell is largely used for fuel and for the production of charcoal and making a variety of curios. The shell flour is used as a filler for plastics. Thus every part of the palm is useful in one way or the other.

CLIMATE. Coconut is essentially a crop of the humid tropics. It is mainly grown in the coastal plains. Rainfall is the most important factor affecting its growth. A rainfall for 100 to 225 cm per annum, evenly distributed is most important.

Coconut requires an equable climate. The optimum mean annual temperature for its best growth and maximum yield is 27 deg celsius. frost and low humidity adversely affect the yield of the palm. Persistent high humidity is also harmful and bud rot is more common under such conditions. The palm requires bright sunshine of 2000 hrs a year.

SOIL. The coconut palm adapts itself remarkably well and thrives in almost all types of well-drained tropical soils, such as coastal sand, red loam, laterite, alluvial and reclaimed soil of the marshy lowland. A water table that is too high and remains static for too long is harmful.

PLANTING MATERIAL. Since coconut is a cross pollinated perennial crop the selection of seeds is of vital importance. Selection has to be made at the mother-palm level and at the seedling stage. The mother palms should be healthy, high yielding and regular in bearing. Also factors such as proportion and distribution of female flowers, high setting percentage and a high copra content should also be taken into consideration. if prepotent palms can be identified by progeny testing the yielding ability of the planting material can be further assured. A careful selection of the seedlings is important. The seedlings should be healthy and have a minimum of six leaves when they are one year old. The early splitting of leaves is a desirable character. Nine month old seedlings having a minimum of four leaves can also be planted.

HARVEST AND YIELD. The coconut palm is unique in that once it attains the normal bearing stage , it continues to bear a bunch of nuts in every leaf axil almost at monthly intervals all year round and throughout its life extended over 50 to 60 years. The nuts mature nearly one year after fertilization. Generally, harvesting is done once in 45 to 60 days. Tender nuts in demand as a delicious drink in West Bengal and Maharashtra are best harvested at the age of 6-7months. Large scale harvesting of the tender nuts is not being done in other parts of the country. Nuts for culinary purposes, for making cup copra and good quality fibre are harvested at the age of about 11 months whereas those for ball copra and coarse coir are harveste only when they are fully ripe.

The average yield per hectare varies from 10,000 to 14,000 nuts per annum. From a well maintained garden an annual yield of 25,000 nuts per hectare can be obtained. Nearly one-third of the annual yield is harvested during the three months-- march, april amd may--in conditions obtaining on the west coast.

Arecanut. or betelnut

is an extensively cultivated tropical palm the nuts of which form a popular masticatory in India, the Middle east, and Far East. India produces annually 150,000 tonnes of arecanut from an area of 18,34,000ha. it is a tall stemmed erect palm, reaching varied heights, depending upon the enviromental conditions. Palms attaining a height of 30 metres are not uncommon.

CLIMATE. The altitude at which the arecanut palm can, be successfully grown varies to some extent according, to the latitude of the place. Though it grows at altitudes up to 1,000 m above the sea-level, at higher altitudes it is not at all productive. The cultivation is mostly confined to 28' North and South of the Equator. It is unable to withstand extremes of temperatures and wide diurnal variations. The range of temperature at which it can flourish is from about 15' to 38' C.

Areca thrives well in a variety of soils, the laterite soils of the West Coast, the red loamy soils of the Mettupalayam (Tamil Wadu), the alluvial of Assam and West Bengal and the loans of Orissa. The foremost factor that has to be considered in establishing an arecanut plantation is that the site selected should have adequate facilities for irrigation. The soil also should be deep and ,well drained, without a high water-table. Being, highly susceptible to a sun-scorch, the areca palms need adequate protection from exposure to the south-western sun.

SELECTION AND RAISING THE PLANTING-MATERIAL. It is important to select genetically superior planting- material for which mother-palms possessing characters of high heritability, correlated with high yield are to be identified. Of the many mother-palm characters studied, the age at first bearing and the percentage of the nuts set were found to be correlated with yield and having high heritability. The selection of seed nuts may be commenced only after the stabilisation of yield of the palm.This stabilisation generally takes 4 to 5, years from the first bearing. Only fully ripe nuts should be selected as seed nuts, discarding underdeveloped and malformed ones.

NURSERY. The selected seed nuts are sown soon after harvest, 5 to 6 cm apart, in beds of sand under partial shade, with their stalk-ends pointing upwards. Sand is spread over the nuts just to cover them. The nuts are irrigated daily. Germination starts about 40 days after sowing and the sprouts are ready for transplanting when they are about three months old. Nursery-beds of 150 cm width and of convenient length are prepared for transplanting sprouts. The sprouts are to be transplanted at a spacing of 30x30cm with the onset of the monsoon. A basal dose of well-decomposed cattle manure at the rate of 5 tonnes per hectare may be applied. Partial shade can also be provided with an artificial pandal or by raising crops alike coccinia indica. The seedlings are transplanted when they are 12 to 18 months old. Seedlings having max number of leaves and min height are selected for transplanting.

PREPARATION OF LAND AND TRANSPLANTING. The land is prepared well by digging or repeated ploughing and is levelled and terraced, if necessary. Channels are to be provided if the palms are to be grown under irrigation. The drainage of soil is to be attended to.

Pits of 90cu cm dug at 2.7m apart both ways are used for planting seeds. The seedling is to be planted in the centre of the pit covered with soil upto the collar.The soil is to be pressed on all sides. Planting is done usually in May-June in well-drained soils, but in clayey soils, subject to water-logging, planting can be postponed till August-September to obtain a better establishing of plants. A shade crop like banana can be raised which gives good return. A proper alignment of the plantation will prevent scorching of the stem. In the square system of planting at a spacing of 2.7x2.7m the north-south line should be deflected at an angle $35^{o}$to the west. The outermost row of plants on the southern and south-western side can be protected by growing tall and quick growing shade trees.

MANURING AND INTERCULTURE. A steady and high yield will depend much on the adequate availability of plant nutrients in the soil. This is all the more important in the case of such a perennialcrop. Since almost all the arecanut-growing areas are in heavy-rainfall tracts the soils are liable to leaching and erosion thus making them poor in major plant nutrient and organic matter.

The annual application of 100g of N, 40g of P_2O_5 and 140kg of K_2O in the form of fertilizers and 12 kg each of green manure and compost and cattle manure per bearing palm is recommended. The fertilizers may be applied in two split doses .For young palms a full dose of green manure and compost or cattle-dung may be applied from the first year of planting . The second dose of fertilizer can be applied to the base of each palm all around and mixed by a light forking. The soils are mostly acidic. The application of lime cerrects this , increases availability of soil nutrients, reduces the phosphorus fixation and enhances the general condition of the soil. The application of lime has to be completed at least three weeks before manuring in September-October.

The palms may be irrigated once in 3-5 days. In souhtern Kerela where arecanut is mainly grown it has been found that manuring along with irrigation gives three times more yield than manuring alone. Adequate drainage should also be provided since the palms cannot stand water-logging. The main cultural operations are performed close to monsoon generally in October-november. Where the landis slopy terracing has to he done to prevent soil erosion. The raising of green manure crops, such as Mimosa invisa, Stylosanthes gracillis and Calopogonum mucunoids was also found to be advantageous. Owing to the long pre-bearing age of this palm, practically no income is obtained during the first several years. Intercropping with suitable crops, such as elephant foot-yam, banana, guinea-grass or mixed cropping with cacao, pepper and betelyine can be taken up in areca gardens without any detriment to the yield of the main crop. The culling out of uneconomic trees and replacing them with good seedlings is important in maintaining a high level of productivity (of the garden).

HARVESTING. The pre-bearing age of the palm ranges from 5 to 8 years. Though inflorescence initiation has been observed in every leaf axis, there is absorption of infloroscences to about 5 per cent. The plant is monoecious, producing both male and female flowers on the same tree. The spedix of a grown-up palm produces on an average, 294 female flowers. The colour of the fruit during its growth changes from green to different shades of Yellow and red during ripening. In some places, tender cuts are harvested, whereas in others, both immature and mature nuts are harvested. Tender nuts are harvested from July to December and ripe nuts from December to March or from May to July. Three or four pluckings are, done during the whole season.

PLANT PRODUCE AND PRODUCTS. Arecanut is consumed both as a raw/ripe nut (adaka or Kacha tamul) as dried ripe nut (chali supari) and as semi-mature cut and processed varieties 'Batoldike" or 'Kalipak'. There are over 150 trade types, differing in maturity, processing conditions and varying in their taste characteristics as per market conditions prevailing at different centres of the country. The drying of the whole fruits for making chali supari requires up to 40 to 45 days of good sun- shine, so as to get a moisture level of about 10 per cent. Drying ripe nuts on cement floors reduce fungal infection of the nuts to a minimum level of about 5 per cent. A drier designed recently has been found to be most suitable to produce good quality chali supari. The cup shaped nuts are prepared by boiling tender arecanuts after husking and cutting into halves. Frequant

additions of the decoction commonly known as chogaru obtained by the pressure boiling of tender nuts are added to the nuts. Later the nuts are dried over mats in the sun for about 7 days. An important by-product is the husk of the nuts which can be utilized for making boards , paper etc. The spathe covering the infloroscence and the leaf sheath can be used for making caps and for packing. The palm trunk is a useful building material.

VARIETIES. Of the several varieties of the genus areca, *A. catechu* is the most commonly cultivated species. Five exotic introductions viz. VTL2,11,12,13,17 and an indigenous one 'mohitnagar' have been found to be superior to the local variety in economic attributes. Of these VTL3 has been released by the Central Variety Release Committee under the name 'mangala'. 'Mangala' is an introduction from the orient . it is a semi-tall early-bearing variety, about 70 percent more than the local variety.