# B. AGRONOMY

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In India the use of arecanut and its cultivation constitute a distinct agricultural practice scarcely less important than that of other economic crops (Watt, 1908). In spite of this, arecanut did not receive adequate attention in the fields of research and development till about late fourties. The erstwhile Mysore Government was the first to start an Arecanut Research Station at Marthur, to study and solve the problems connected with arecanut (Nambiar, 1949). Since then substantial information on the management of the crop has been generated from a number of research stations established from early fifties.

Since arecanut is cultivated in a variety of soil and climatic conditions, it is difficult to formulate uniform agronomical practice suitable for all the situations alike.

## I. Climate

### 1. Altitude

The altitude at which arecanut palm grows depends to some extent on the latitude. In the North-Eastern Region of India (Assam and West Bengal) where sizeable area is under arecanut, it is mostly grown on the plains, since at higher elevation the winter temperature would be too extreme for the crop. Nambiar (1949), reported that though the palm grows at altitudes up to 1000 m above sea level, at higher levels, the quality of the fruit is not good. In Wynad (Kerala) and Coorg (Karnataka) which are places of high altitude, the endosperm (kernel) of the fruit does not develop sufficient hardness, probably due to the low temperature during the developing period of fruits. Pillai and Murthy (1973) reported that altitude affects the germination of seed arecanuts as well as quality of *chali*

(dry kernel). At altitudes above 850 m, the percentage of germination of nut and the proportion of dry weight of kernel to whole fruits are less than in the lower altitudes.

### 2. Temperature

Arecanut grows in India within a wide range of temperature, ranging from a minimum of 4°C (as in places like Mohitnagar, West Bengal) to a maximum of about 40°C (Vittal in Karnataka and Kannara in Kerala), though the palm flourishes well within a temperature range of 14°C – 36°C. Extremes of temperature and wide diurnal variations are not conducive for the healthy growth of the palms (Nambiar, 1949). Smith (1958) reported heavy damage to the foliage and even death of arecanut palm in Florida during December 1957, when the minimum temperature was below —2.8°C. Even temperature around 5°C, with low humidity cause severe foliage damage of the palm, as observed in the Dakshina Kannada district during early seventies.

### 3. Rainfall

Arecanut flourishes in tracts of very heavy rainfall such as the *Malnad* of Karnataka where the annual rainfall may go up to or even more than 4,500 mm as well as in low rainfall areas like the *Maidan* parts of Karnataka or parts of Coimbatore district in Tamil Nadu where the annual rainfall is about 750 mm. In areas where there is prolonged dry spell, the palms are irrigated.

## II. Nursery technique

Arecanut is an exclusively seed propagated crop. Being a perennial, it is essential that adequate care is bestowed in the selection of proper planting material. There are four important stages in the selection and raising of arecanut seedlings, *viz.*, selection of mother palms, selection of seed nuts, selection of proper techniques in germinating and raising seedlings and selection of seedlings.

### 1. Selection of mother palms

Age of mother palms is an important factor considered by the farmers for selecting seed nuts. Nambiar (1949) reported that while in the northern parts of Kerala, the farmers prefer old trees for the selection of seed nuts, the farmers in the southern parts of Kerala collect seed nuts from young trees. The farmers in Assam and West Bengal select seed nuts from bulk harvests irrespective of age of the trees. Aiyer (1966) reported that in the erstwhile Mysore state, seed nuts were taken from trees between 25 and 30 years of age. The experimental evidence

is that age of mother palm has no influence on the performance of seed nuts (Anonymous, 1967). Since the heritability for yield in arecanut is low (0.20), substantial increase in yield could not be expected by direct selection in a given population (Bavappa and Ramachander, 1967). All the same, based on the available information and practices in vogue, certain minimum standards will have to be followed while selecting mother palms for seed nut collection. The important criteria that goes with the mother palm characters is its age at first bearing (Bavappa and Ramachander, 1967, 1968) and regular bearing habit. Larger number of leaves on the crown, shorter internodes and high fruit set are the other desirable characters considered for selection of mother palm. Mother palms should be selected adopting the above criteria in each tract for meeting the processing and other end-product needs of the industry. Naidu (1962) opined that all cultivars are not suitable for preparing either *chali* or tender processed nuts.

**2. Seed nut selection**

The position of the bunch in the tree, the position of nuts in the bunch, the weight of nuts within a bunch, the maturity of the nuts and the floating habit of the nut are some of the factors considered by farmers for selection of seed nuts from selected mother palms. Nambiar (1949) and Aiyer (1966) reported that the common practice with the farmers is to select fully ripe seed nuts from the middle portion of the middle bunch in the tree (*i.e.*, the second and third bunches if there are four bunches). However, it was observed that the nuts selected from the middle portion of the middle bunch neither produced better seedlings, nor trees with better yield performance (Anonymous, 1963). There is no appreciable difference in germination percentage of nuts in the nursery among seed nuts ranging in maturity from $9\frac{1}{2}$ to $10\frac{1}{2}$ months (Anonymous, 1964). The nuts which float vertically with calyx-end pointing upwards when allowed to float on water are preferred, since the seedlings raised from vertically floating nuts are more vigorous than those float either slantingly or horizontally (Anonymous, 1964). About 25 per cent of nuts within a bunch are light in weight. The heavier nuts give higher percentage of germination (96 per cent against 87 per cent from lighter nuts) and produce seedlings of greater vigour. The percentage of quality seedlings is also higher from heavier seeds (Bavappa and Abraham, 1961).

In order to minimize damage to seed nuts, the bunches after harvest from the tree top are lowered to the ground by means of ropes in some parts of *Malnad* and *Maidan* of Karnataka. Naidu (1961) reported that lowering through rope

is unnecessary, since germination of seed nuts is not affected adversely whe bunches are dropped to the ground. The advantage in lowering the bunch i probably in avoiding the scattering of nuts all over the ground which will involv extra labour in collecting the nuts.

### 3. Primary and secondary nurseries

For obtaining good germination, the seed nuts are sown as whole fruit though half husked and fully husked nuts also germinate equally well (Anonymou 1959). The mean number of days required for commencement and completio of germination are 53 and 94 respectively under Vittal conditions. About tw per cent of the nuts do not germinate mainly due to embryo rot. The embryo absent in 1.7 per cent of nuts (Bavappa, Patel and Bhat, 1957). About 1.5 per ce of the seedlings in the nursery die due to various other reasons. The number d days required for germination increases according to the altitude. At high altitudes like Thirthahalli or Hirehalli, the number of days is more than tho required at a lower altitude like Vittal.

The conventional practice with the cultivators is to sow the seed nuts after allowing them to dry for a couple of days under partial shade, preferably after smearing the nuts with cow dung (Nambiar, 1949; Aiyer, 1966). Sowing nut immediately after harvest in soil or sand and watering once in two days result i early and good germination (Fig. 4B.1) (Bhat, 1956).

Farmers use several media/modes for sowing seed nuts. Seeds are sown i baskets mulched with straw or tied in banana leaf-sheath, straw (*muda*) or gunn bags and watered. Sand, soil or burnt earth (*Sudumannu*) are used as media fo sowing. Bavappa (1956) found that sprouting the seed nuts in *muda* give lower germination (85%) and less establishment (76%) in the nursery a against 96 per cent establishment in directly sown nursery. The seedlings o direct sown nuts are more vigorous than those from other methods like sowing i *muda* or baskets. Nuts when sown in the media should be vertical in positio with the calyx-end just covered (Anonymous, 1964).

The sprouts are retained in the sand beds or primary nursery for about si months. Young seedlings at this stage with two or three leaves are transplanted t secondary nursery beds of convenient width and length. Beds of about 150 cm width and 15 cm height have been found convenient (Fig. 4B.2). The spacing o sprouts in the nursery has significant influence on the growth of seedlings (Bavapp and Mathew, 1960). Seedlings planted at wider spacing of 45 cm are mor

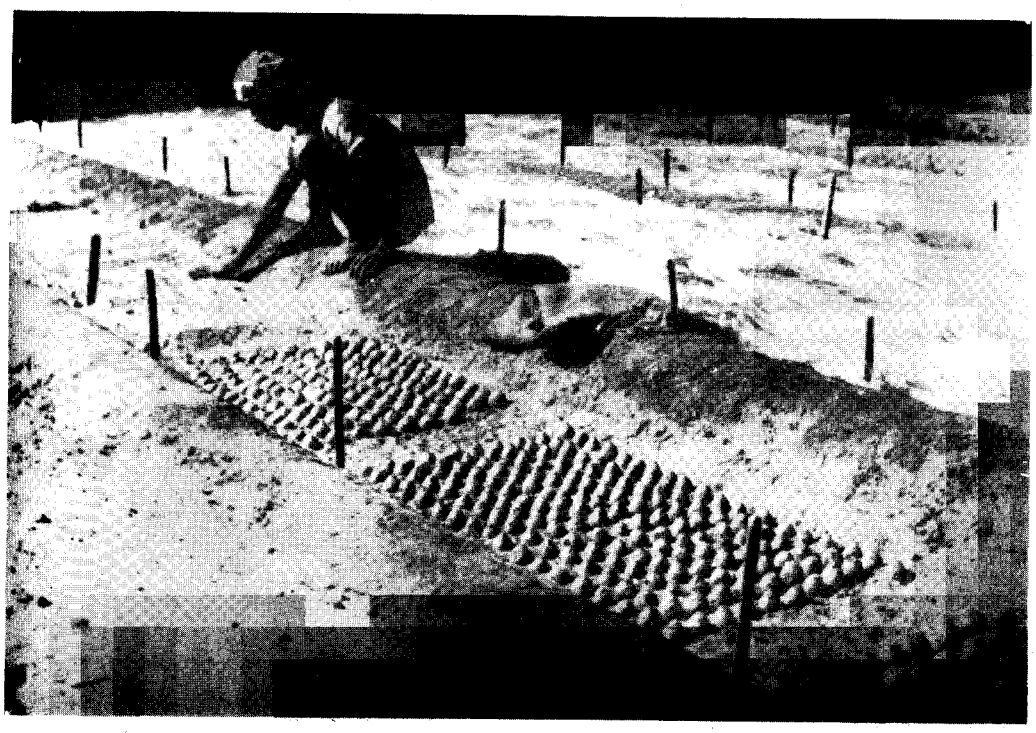

Fig. 4B.1 Sowing nuts in the primary nursery

vigorous than those planted at 15 cm. A spacing of 35–45 cm is considered to be optimum for a growth period of one year in the nursery. Instead of transplanting sprouts to the secondary nursery, they can as well be raised in polythene bags (Anonymous, 1962). Appaiah (1970) listed the advantages of polybag nursery which included a 15 per cent reduction in the seedling mortality. Arecanut sprouts and seedlings are very delicate and do not withstand exposure to direct sun. Bhat (1970) observed that the mortality of sprouts is 19 per cent in the open (fully exposed), while it is only one per cent in partial shade and only 0.13 per cent in fully shaded nurseries. The height, girth and number of leaves of seedlings in the open nurseries are significantly lower than those under shaded conditions, eventhough the percentage germination of seed nuts do not show any difference when sown either in the shaded or exposed nurseries. The percentage of quality seedlings is higher from shaded nurseries (Anonymous, 1969). The shade provided for the nursery may be either of coconut or arecanut leaves spread over a *pandal* (bower) or trailing *Coccinia indica* as overhead bower

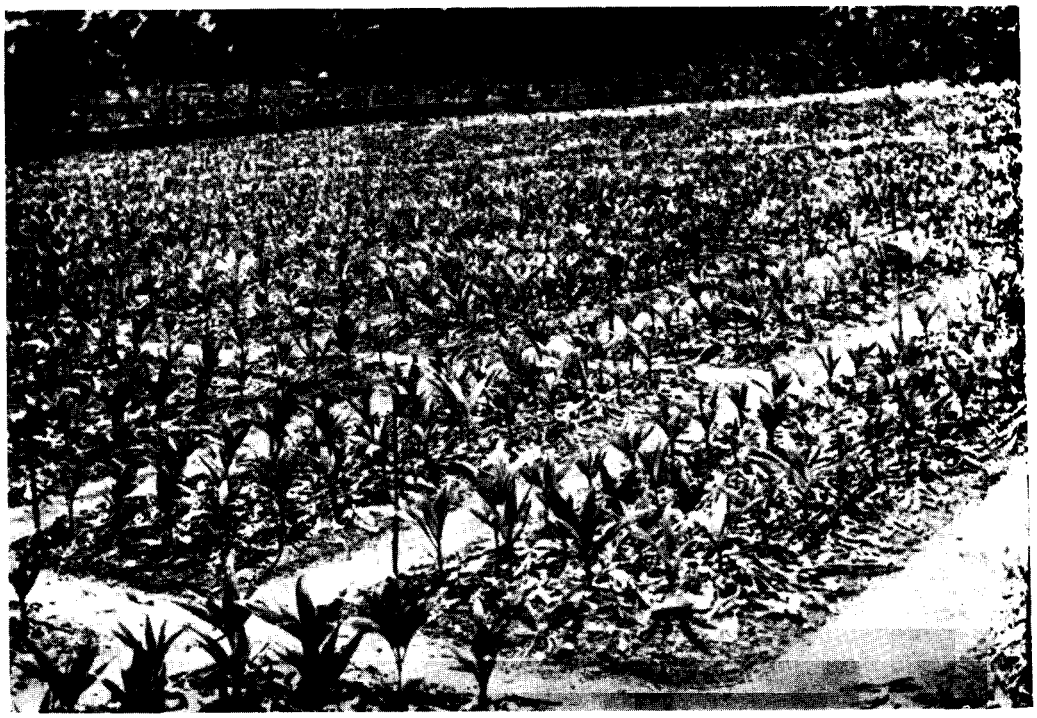

Fig. 4B.2 Seedlings in secondary nursery

For quick growing green manure crops like *Sesbania* (Fig. 4B.3) in the nursery Live shade may compete with arecanut for water and nutrients, but the advantage is the extra income the farmer gets from its produce (Anonymous, 1967). Sowing seed nuts in a primary nursery (with close spacing) and transplanting after about six months at a wider spacing in the secondary nursery is preferable for areas where the sowing season coincides with dry weather period (*i.e.*, December-February) and requires irrigation and shading. Paul (1960) recommended sowing seed nuts directly in 15 cm raised beds of 130 cm width at a spacing of 30 cm × 30 cm for the seed nuts in the sub-Himalayan region of West Bengal where the harvesting and sowing of the seed nuts coincide with the rainy season. As a shade crop for the nursery, either *Boga medeola* or *Crotalaria anagyroides* are suitable for those areas since these plants are perennial and thrive well under the low pH conditions of the region. For the *Maidan* parts of Karnataka, *Sesbania aegyptica* has been found to be the best (Naidu and Mashalkar, 1961).

Fig. 4B.3 Secondary nursery with green manure crop as shade

**4. Selection of seedlings**

Twelve to eighteen months old seedlings are transplanted in the main field. Seedling with maximum number of leaves (five or above) and minimum height are to be selected for planting (Bavappa, 1970). The selected seedlings are preferably removed with a ball of earth adhering to the roots for transplanting. Wrapping the base with the ball of earth in alkathene sheet/bag could keep the seedlings in good condition during long distance transport (Anonymous, 1964).

Seedlings of different ages (one to four years old) are used for planting in the permanent site in different regions (Nambiar, 1949; Aiyer, 1966). The practice of sowing the nuts *in situ* as well as transplanting are also in vogue (Nambiar, 1949). Palms raised from seedlings of one to two years old are more vigorous and flower earlier than those raised from seedlings kept for a longer period in the nursery. The cumulative yield of nuts from palms raised from one or two year old seedlings is also more than those raised from older seedlings (Anonymous, 1971b). Transplanting 18–30 month old seedlings is reported to be advantageous in Assam (Anonymous, 1971a).

## III. Establishing the garden

**1. Selection of site and layout**

Arecanut is essentially a garden land crop and thrives best in humid areas protected well against hot sun-burn and heavy wind. The palm does not withstand either drought or water stagnation. The site selected should, therefore, have adequate irrigation facility (in places where the moisture available is not adequate) during the dry weather period.

The soil also should be well-drained or should have drainage facilities where the water table is very high. The arecanut palm is very delicate and cannot withstand extremes of temperature and exposure to direct sun. Under highly exposed conditions, the stem particularly in the young age, gets scorched up and permanently gets damaged. So it is essential that the site selected for raising arecanut garden should have protection from southern and western sides by way of either hillocks or tall ever-green trees. It is for this reason that the traditional gardens are located in valleys of hill slopes which are protected by forest trees growing all around. Such gardens are typical of the *Malnad* parts of Karnataka (Coleman and Rao, 1918) and parts of Kerala. In other areas like the *Maidan* parts of Karnataka where adequate natural protection is not available, the required condition is created by raising trees like coconut and mango and *Sesbania aegyptica*. The soil selected should be deep (preferably not less than two

meters) to ensure well developed root system. Under well-drained, deep soils, the roots traverse down to about three meters (Bhat and Leela, 1969), whereas under ill-drained condition and in places with higher water table, the roots confine to only about 1.40 m in depth (Bhat, 1978). Thus soil depth and water table are two important aspects to be considered while selecting site for arecanut plantation. If the site selected is on hill slope or valley, bench terracing is required to conserve moisture and prevent run-off of soil and manure.

Different methods of planting *viz.*, square, rectangular, triangular and quincunx are in vogue. Aligning the rows in north–south direction and planting on quincunx system lowers the incidence of sun–scorch (Anonymous, 1971a).

### 2. Spacing

The spacing of arecanut palms depends primarily on the depth and fertility of the soil. The spacing adopted in different arecanut tracts varies from 1.25m × 1.25m to 3.6m × 3.6m (Nambiar, 1949). The number of leaves shed and spadices and female flowers produced per palm invariably increase with increased spacing (Table 4B.1).

**Table 4B.1.** *The influence of spacing on yield attributes (palm/year)*

| Spacing (m) | Leaf fall (no.) | Spadices (no.) | Female flowers (no.) | Percentage of fruit set |
|---|---|---|---|---|
| 1.8 × 1.8 | 6.51 | 3.83 | 659.8 | 11.76 |
| 1.8 × 2.7 | 6.94 | 4.65 | 878.7 | 17.49 |
| 1.8 × 3.6 | 7.19 | 5.06 | 1025.4 | 19.42 |
| 2.7 × 2.7 | 7.53 | 6.01 | 1296.7 | 24.90 |
| 2.7 × 3.6 | 7.97 | 6.27 | 1289.0 | 27.65 |
| 3.6 × 3.6 | 7.78 | 6.14 | 1396.9 | 27.62 |
| C. D. (P=0.05) | 0.30 | 0.94 | 182.2 | |

Under Vittal conditions maximum yield (the number and weight of fruits) harvested per unit area is obtained from palms spaced at 2.7m × 2.7m (Bhat, Leela and Somaiah, 1972, cited by Bhat, 1978) (Fig. 4B.4; Table 4B.2). The results of the trial at Peechi also suggest 2.7m × 2.7m as optimum spacing in central Kerala area (Anonymous, 1974). At Hirehalli maximum number of nuts per unit area is from 1.8m × 3.6m spacing closely followed by 2.7m × 2.7m spacing. The weight of nuts is however maximum in 2.7m × 2.7m spacing followed by 1.8m × 2.7m spacing. The differences in the yield of nuts among 1.8m × 3.6m and 2.7m × 2.7m and 1.8m × 2.7m are not significant (Anonymous, 1976). At Kahikuchi (Assam), the

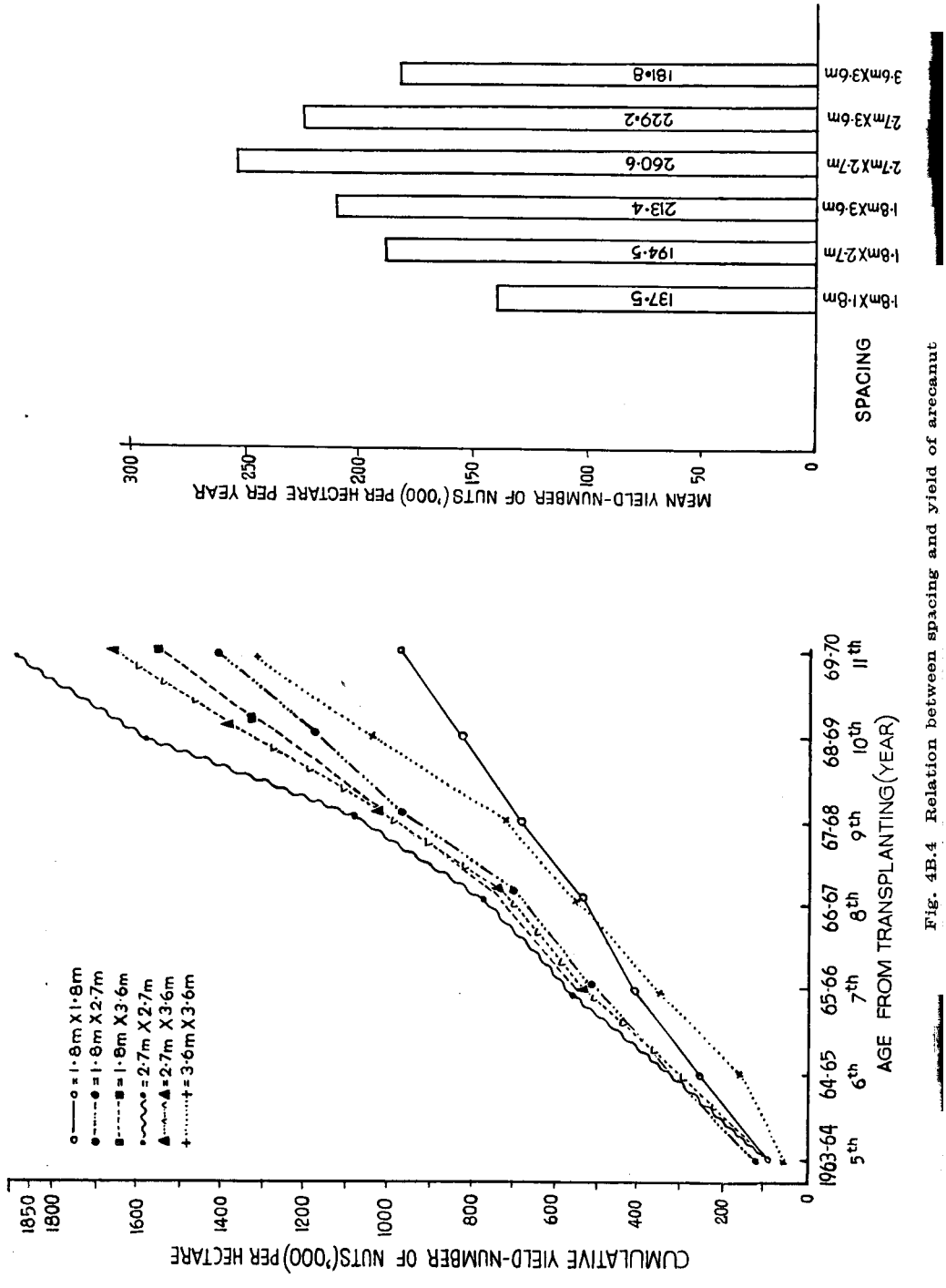


Fig. 4B.4 Relation between spacing and yield of arecanut

yield of nuts harvested per unit area is maximum in 2.7m × 2.7m spacing and is significantly higher to those obtained from 1.8m × 1.8m, 1.8m × 2.7m and 3.6m × 3.6m spacings (Anonymous, 1977).

**Table 4B.2.** *The relation between spacing and cumulative yield (first seven years at Vittal)*

| Spacing (m) | Nuts/plot (10.8 m × 21.6 m) | | Nuts/palm | |
|---|---|---|---|---|
| | No. ('000) | Wet weight (kg) | No. ('000) | Wet weight (kg) |
| 1.8 × 1.8 | 17.16 | 587.01 | 0.312 | 10.67 |
| 1.8 × 2.7 | 21.83 | 726.12 | 0.662 | 22.01 |
| 1.8 × 3.6 | 21.30 | 730.57 | 0.968 | 33.21 |
| 2.7 × 2.7 | 27.92 | 1000.57 | 1.329 | 47.65 |
| 2.7 × 3.6 | 21.84 | 750.97 | 1.559 | 53.64 |
| 3.6 × 3.6 | 16.49 | 575.65 | 1.649 | 57.57 |
| C. D. (P=0.05) | 6.63 | 222.91 | 0.440 | 14.77 |

The study on the distribution of arecanut roots under different densities of planting reported by Bhat and Leela (1969) when considered along with the yield of individual palms and yield of nuts from unit area indicates that a spacing of 2.7m × 2.7m is optimum for arecanut palm. Under wider spacings, the exploitation of soils is not full whereas in closer spacing there is heavy concentration of roots in the lower layers of soil resulting in the marked reduction in yield. Thus from an overall assessment of the result, it is justifiable to adopt a spacing of 2.7m × 2.7m in majority of areas.

### 3. Depth of planting

The basic consideration in deciding the depth of planting is the sub-soil moisture and height of water table since arecanut palms do not withstand water stagnation. In well drained soils or in fields where drainage can be provided if required, deep planting is preferred. Deeper planting besides providing a firm anchorage to the roots also provides a larger volume of space for the spread of roots. Year-after-year, the fresh nodes exposed above the bole of the palm get covered up or earthed up as the pits get slowly filled up in the course of the annual operations of manuring and intercultivation. The nodes thus covered grow out fresh roots and ramify rapidly. Where deeper planting is not practical due to the high water table or other conditions of the soil as found in the typical high rainfall areas of the *Malnad* of Karnataka, seedlings are planted in the shallow pits or in extreme cases over mounds raised for the purpose. Under these conditions, the roots get exposed and require earthing up (Fig. 4B.5). The earthing up is achieved by spreading of fresh earth cut and transported from

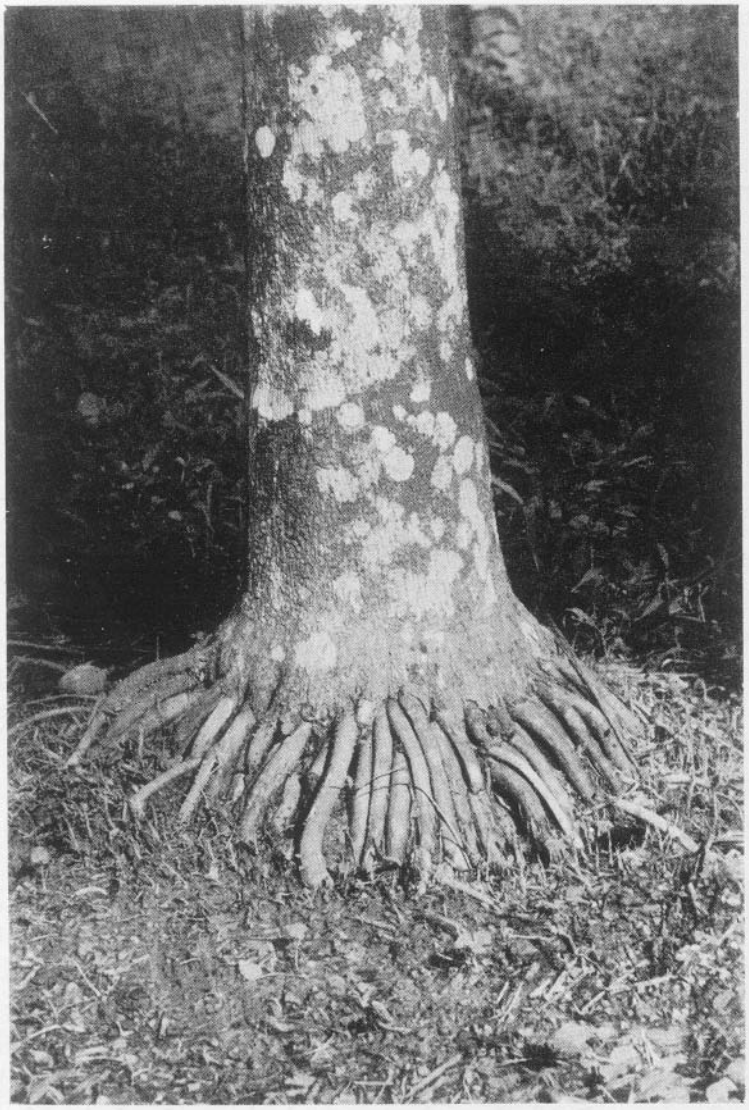

Fig. 4B.5 Surface roots due to shallow planting

nearby hillocks. This is a very laborious and costly operation. Experimental evidence shows that seedlings planted at 90 cm depth, are more vigorous and flower earlier than those planted at 30 cm and 60 cm depth (Bhat and Leela, 1968). The yield of palms also increases as the depth of planting increases from 30 cm to 90 cm (Table 4B.3) (Sadanandan, 1973). At Hirehalli and Kahikuchi, where the seedlings are planted upto 60 cm and 45 cm depth respectively, the

advantages of deeper planting is not appreciable, probably because of the heavier type of soils in those areas and added impedance for the proper drainage. Thus in soils where natural drainage can be provided (particularly during the heavy rainfall periods), deeper planting of seedlings upto 90 cm is preferred.

Table 4B.3. *Effect of intervals of irrigation and depth of planting on arecanut yield (Peechi)*

| Treatments | Depth of planting | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30cm | 60cm | 90cm | Mean | 30cm | 60cm | 90cm | Mean |
| | No. of nuts/palm | | | | Weight of nuts/palm (kg) | | | |
| No irrigation | 1.73 | 1.62 | 21.89 | 8.41 | 0.05 | 0.04 | 0.72 | 0.27 |
| Irrigation once in 3 days | 121.66 | 179.80 | 278.49 | 193.32 | 3.56 | 5.49 | 8.27 | 5.77 |
| Irrigation once in 6 days | 67.35 | 108.53 | 204.84 | 126.91 | 1.82 | 3.09 | 5.99 | 3.63 |
| Irrigation once in 9 days | 91.64 | 112.89 | 165.89 | 123.47 | 2.74 | 3.57 | 4.64 | 3.65 |
| Mean | 70.67 | 100.71 | 167.78 | | 2.04 | 3.05 | 4.91 | |
| CD (P=0.05) for irrigation | | 45.04 | | | | 1.18 | | |
| CD (P=0.05) for depth of planting | | 30.60 | | | | 0.79 | | |

**4. Season of planting**

Planting seedlings in the permanent site is done either in the months of May-June or September-October, depending upon the very heavy and in river banks where there is the likely danger of inundation, it is advisable to plant at the fag end of the South-West Monsoon in the month of September-October. In other places where the South-West Monsoon is not severe, planting may be advantageously done in May-June.

**5. Drainage**

The successful establishment of the seedlings and the performance of young palms depend on two important factors, *viz.*, perfect drainage and protection from sun-scorch. In order to ensure that adequate drainage is provided it is essential that one drainage channel is dug for every two rows of palms. The channels should be at least 15–30 cm deeper than the depth at which the seedlings are planted (Fig. 4B.6). At the beginning of monsoon each year these drains are to be cleaned to have an easy flow to stagnant water. Even the planted pits are to be provided with outlets and emptied to the drains.

**6. Shading**

During hot-weather period beginning from October, the young seedlings may be protected against direct exposure to sun by providing artificial shade of either arecanut or coconut leaves or by raising a shade crop of banana (Fig. 4B.7). Raising banana crop during the early years helps the farmer to get some income as the areca trees will take four or five years to give any revenue.

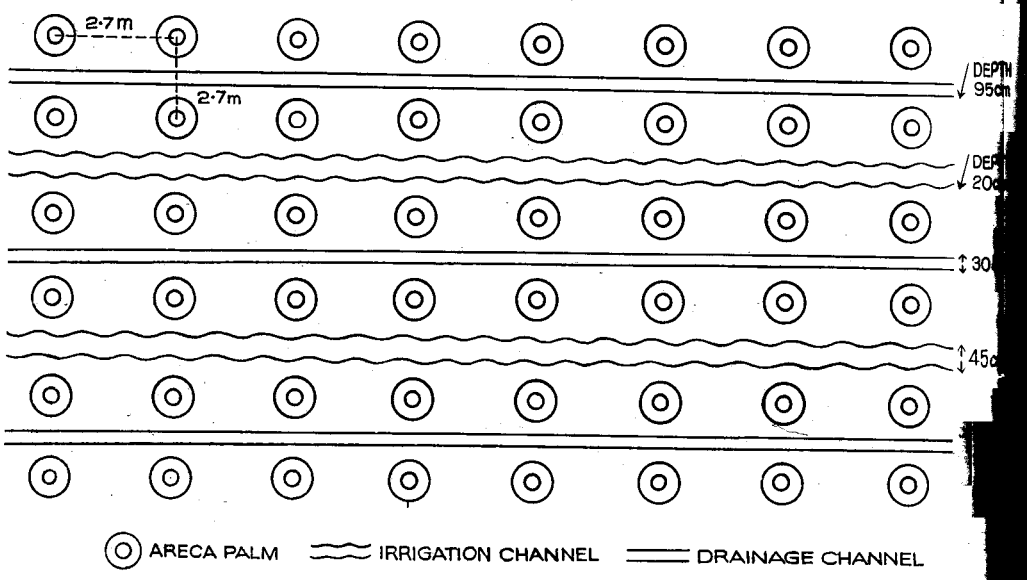


Fig. 4B.6 Lay-out of an arecanut garden showing irrigation and drainage channels

Protecting the stems of young palms from sun-scorch is also importa since the part once lost or got damaged cannot be recovered. Sun-scorch mostly seen during the months of October to January. Hence from the beginni of October the exposed stems of individual palms are to be protected by coverin with materials like dry leaves of arecanut or white opaque polythene film (Bha and Leela, 1968). When there is no natural protection, the exposure of palm to direct sun can be avoided by raising a belt of quick-growing trees on the western and southern aspects of the garden. If the soil moisture is not adequate or in places where there is dry spell, the palms are to be irrigated.

## IV. Garden management

### 1. Cultural operations

The cultural practices followed by the cultivators in different parts of India differ widely. Both in the *Maidan* and *Malnad* parts of Karnataka, elaborate and programmed systems of cultivation are practised (Coleman and Rao, 1918). In the *Maidan,* 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. Coleman and Rao (1918) did not favour spreading farm yard manure after digging, since the practice has a tendency to encourage surface roots which dry out during summer. In the

Fig. 4B.7 Banana as a shade crop to protect seedlings in the main field

*Malnad* 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. Aiyer (1966) also described a similar elaborate 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 meter high over the entire interspace 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 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 75-100cm 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 get depleted slowly and in the course of 10-12 years get 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 standardised by the cultivators depending upon the situation and needs of the crop in the respective tracts.

Hardly any such operations are 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. According to Nambiar (1949), experienced arecanut cultivators all over the country are of opinion that intercultivation increases productivity of palms by 10–20 per cent. During 1967–1975, experiments were conducted at the Research Centres in Peechi and Hirehalli to determine the role of different cultivation practices. At Peechi, there was no significant yield differences among the plots receiving different methods of intercultivation (no intercultivation; digging once in an year; digging twice in an year and digging once in two years). At Hirehalli, digging the garden twice a year (in June and December) had given higher yield of arecanut as compared to other methods, *viz.*, (1) scything grass and weeds twice a year (June and December); (2) digging once a year (December) followed by scything weeds (June); and (3) scything weeds twice a year (June and December) and digging once in two years (Table 4B.4) (Sannamarappa, Kumar and Nagaraj, 1976).

In southern Kerala where the gardens are not irrigated, the problem is to conserve soil moisture. A trial to study the effects of different methods of raising arecanut gardens on hill slopes with three systems of planting (planting on terraces made along the contours; planting on terraces made at the site of planting and planting on slopes not considering the contour) was carried out at Palode under rainfed conditions during 1961–1974. Each of the above three treatments had nine sub-treatments consisting of various combinations of cultivation, manuring and cover cropping.

Table 4B.4. *Effect of different methods of tillage on the yield of arecanut and yield components (Hirehalli)*

| Treatments* | Year | | | | Mean |
|---|---|---|---|---|---|
| | 1971–'72 | 1972–'73 | 1973–'74 | 1974–'75 | |
| | | BUNCHES (No./palm) | | | |
| 1 | 1.20 | 1.37 | 2.05 | 2.18 | 1.70 |
| 2 | 1.15 | 1.60 | 1.37 | 2.03 | 1.54 |
| 3 | 1.92 | 2.00 | 2.65 | 2.32 | 2.47 |
| 4 | 0.65 | 0.62 | 0.33 | 1.43 | 0.76 |
| CD (P=0.05) | 0.61 | 0.70 | 0.80 | 0.83 | 0.61 |
| | | NUT (No./palm) | | | |
| 1 | 118.0 | 225.0 | 343.0 | 335.0 | 255.0 |
| 2 | 100.0 | 191.0 | 164.0 | 287 0 | 186.0 |
| 3 | 225.0 | 369.0 | 515.0 | 597.0 | 427.0 |
| 4 | 26.0 | 78.0 | 39.0 | 176.0 | 80.0 |
| CD (P=0.05) | 107.0 | 130.0 | 135.0 | 173.0 | 107.0 |
| | | WET WEIGHT OF WHOLE NUT (kg/palm) | | | |
| 1 | 1.89 | 3.84 | 4.44 | 5.21 | 3.84 |
| 2 | 1.60 | 3.35 | 2.79 | 4.48 | 3.05 |
| 3 | 3.79 | 6.19 | 7.75 | 8.96 | 6.67 |
| 4 | 0.42 | 1.17 | 0.67 | 2.49 | 1.19 |
| CD (P=0.05) | 1.57 | 2.34 | 2.19 | 2.72 | 1.88 |
| | | LEAVES FALLEN (No./palm) | | | |
| 1 | 4.5 | 5.8 | 6.1 | 5.8 | 5.5 |
| 2 | 4.3 | 6.2 | 5.6 | 5.9 | 5.5 |
| 3 | 5.1 | 6.7 | 6.3 | 6.5 | 6.2 |
| 4 | 3.4 | 5.9 | 3.8 | 5.8 | 4.7 |
| CD (P=0.05) | 0.8 | NS | 0.8 | NS | 0.7 |

*1. Scything weeds twice a year in June and December.
2. Digging once a year in December, followed by scything weeds in June.
3. Digging twice a year in June and December.
4. Scything weeds twice a year and digging once in two years.

The final results showed that clean cultivation and manuring once in two years (100g N + 40g $P_2O_5$ + 140g $K_2O$) gave the maximum yield closely followed by cover crops (cut and spread) plus manuring. Palms planted along the contour recorded highest yield. The production was minimum in palms planted on slopes without considering the contour (Anonymous, 1975).

Mulching the interspaces of arecanut gardens with green or dry leaves is a common practice in the *Malnad* and sub-mountane 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 (Coleman and Rao 1918). In Dakshina Kannada district of Karnataka and parts of Cannanore 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). In recent years, efforts are being made to utilize other waste materials like arecanut husk and chopped arecanut leaves as mulch (Anonymous, 1957). The plots spread with arecanut husk not only improved the texture of the soil but also helped to conserve moisture. A trial to compare four types of mulching materials (1) chopped arecanut leaves, (2) Guatemala grass *(Tripsacum laxum)* cut and spread, (3) arecanut husk, and (4) dry leaves collected from forest lands was conducted at Vittal. The loss of moisture from the mulched plots was considerably lower than plots without mulch. The weed growth was also suppressed in the mulched plots (Anonymous, 1967, 1969).

**2. Manuring**

Nambiar (1949) reported that manuring arecanut palm was 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 were being applied in large doses ~~either~~ annually or once in two or three years. The gardens in Mettupalayam get plenty of silt and soil through the irrigation water from Kallar and Coonoor rivers. Of late, ~~the~~ growers ~~in this~~ area are applying farm yard manure besides groundnut cake and fertilisers.

Coleman and Rao (1918) outlined the elaborate system of manuring with cattle manure and green leaves 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. Aiyer (1966) also mentioned the extensive manuring system practised in the *Malnad* using green leaves cut from *soppinabettas*.

The first scientific attempt to determine the manurial requirement of arecanut crop was made at the Marthur Farm in Mysore (Karnataka) primarily with the objective of finding out the extent to which fertilisers could be used and thereby lessen the dependence on green leaves and cattle manure (Coleman and Rao, 1918; Iyengar, 1954; Aiyer, 1966). Aiyer (1966) reported that based on the experiments during 1920–1936 at Marthur, application of 10 cartloads of farm yard manure to be covered with earth and leaves at five cartloads per 400 palms was recommended. This was to be followed by application of a mixture of

90.9 kg groundnut cake, 36.4 kg of ammonium sulphate, 90.9 kg of concentrated superphosphate and 136.4 kg of potassium sulphate every third year. Iyengar (1954) summarizing the results of manurial experiments of Marthur Farm stated that the indications in general were that a garden once brought to good yielding condition may be manured once in three years and that an yield of over 876 kg can be obtained by an application of 56.0 kg nitrogen, 84.0 kg phosphoric acid and 112.0 kg potash per hectare using groundnut cake as a source of nitrogen.

The second set of experiments were commenced only during 1950 under the aegis of erstwhile Indian Central Arecanut Committee in the form of Simple Manurial Trials in cultivators' fields (Lakshmanachar, Biddappa and Paulose, 1966). The experiment was conducted in the sub-mountane and coastal regions of Kerala and Karnataka and plains of Karnataka, West Bengal and Assam. The N, P and K sources were ammonium sulphate, superphosphate and muriate of potash respectively. The levels of nutrients added were N at 22.7 kg and 45.4 kg, $P_2O_5$ at 18.1 kg and 36.3 kg and $K_2O$ at 34.0 kg and 68.0 kg per 500 palms. The fertilisers were applied for three years, 1961–'62 to 1963–'64. In Kerala, the fertilised plots in the sub-mountane regions recorded on an average 20 per cent and in coastal regions 11 per cent increased yield during the experimental period, while during the post-experimental period, the increase in the mean yield in the fertilised plots was 52 per cent for sub–mountane and 24 per cent for coastal regions. In the sub-mountane region of Kerala, application of 22.7 kg of nitrogen, 18.1 kg of phosphoric acid and 64.0 kg of potash for 500 palms was found to be economical. In the coastal regions of Kerala and Karnataka, 22.7 kg of nitrogen, 18.1 kg phosphoric acid and 34.0 kg of potash for 500 palms was economical.

With the establishment of Central and Regional Arecanut Research Stations, comprehensive experiments to determine the manurial requirements of arecanut palms were laid out under different agroclimatic conditions at Vittal, Hirehalli, Thirthahalli, Peechi, Mohitnagar and Kahikuchi. The treatments consisted of N at 0, 50, 100 g; $P_2O_5$ at 0, 40, 80 g; $K_2O$ at 0, 70, 140 g and green leaf at 0, 7, 14 kg per palm per year at all the centres except Mohitnagar. At Mohitnagar, treatment consisted of N at 0, 100, 200 g; $P_2O_5$ at 0, 40, 80 g and $K_2O$ at 0, 140, 280 g per palm as main treatments and lime at 0 and 1 kg per palm as sub–plot treatment. At Vittal and Peechi, the doses were revised in 1971 to include higher levels (double the original levels) of nutrients. At Peechi, the revised schedule included lime as a sub–plot treatment. N and green leaf in the original levels increased the yield of nuts significantly over no

fertiliser at Vittal, Hirehalli and Kahikuchi. At Vittal, though there was increa in yield at higher levels of N (in the revised levels), the difference was n significant. The effect of green leaf application on yield of nuts was signific in most of the years and the maximum yield was obtained in the highest level 21 kg per palm. Application of potash had significant effect on number a weight of nuts at Mohitnagar and Kahikuchi. Lime application at 1 kg per pal adversely affected the growth of palm as well as yield at Mohitnagar (Anonymou 1977). Sadanandan (1972, cited by Bhat, 1978) reported that at Peechi nitrog and green leaf application significantly and individually increased height, girt and leaf production while potash significantly increased only height an leaf production. N at 100 g and $K_2O$ at 140g per palm individually increase the production of spadices and percentage of spadices to leaf fall, nut productio and its relative weight significantly. N at 100 g per palm increased earliness flowering significantly. The influence of P was not significant on any of th characters studied except on an initial increase of height and percentage spadices to leaf fall. Green leaf at 14 kg per palm significantly increase spadices production, percentage of spadices to leaf fall and relative individua weight of nuts. In the revised schedule, green leaf at 21 kg per palm increased significantly the number of nuts than at 7 kg per palm (Anonymous, 1976).

Another experiment to determine the effect of applying the nutrients N, P and K in organic and inorganic forms on the performance of palms was carried out at Vittal during 1963–1969. The yield data for the various years showed no significant difference between the two forms of nutrients (Anonymous, 1971a). Based on the results of the manurial trials, annual application of 100g N, 40g $P_2O_5$ and 140g $K_2O$ in the form of fertilisers and 12kg each of green leaf and compost per bearing palm is recommended. Fertilisers are applied in basins around the palm dug to a depth of 15–20 cm and 0.5–1.0 m radius leaving 20 cm from the base of the palm (Fig. 4B.8). After application, the soil is rolled up and covered with organic matter (green leaves/compost) and soil.

Application of fertilisers in split doses in March-April and September-October did not show any significant effeet on yield under central Kerala (Peechi) conditions (Anonymous, 1976).

### 3. Irrigation

Arecanut palm is very sensitive to drought. Irrigation is essential in areas with long dry spell. In places with high sub–soil moisture and in areas where the rainfall is well distributed, throughout the year no irrigation is practised. In West

Fig. 4B.8 Manuring arecanut palm

Bengal, Assam, northern parts and southern parts of Kerala, the crop is grown as rainfed crop. In certain parts of Kerala and Karnataka the arecanut gardens are irrigated. In the traditional system, wherever irrigation was required the source of water was tanks situated at the head of gardens from where the water used to be guided by gravitational flow. Later lift irrigation from wells and rivers came into practice. Presently large number of gardens are being irrigated using pump sets run by oil or electricity. Deep bore wells as source of irrigation water is also being tapped in recent years.

The methods of irrigation are also undergoing changes. In the traditional system, irrigation is done by bunding and storing the water in the drainage or irrigation channels and water is allowed to percolate. Irrigation in a majority of the gardens is by splashing water guided into channels (Fig. 4B.9). In recent years sprinkler (Fig. 4B.10) and perfo methods of irrigation are slowly entering into practice. Drip or trickle irrigation method is still in experimental stage.

Fig. 4B.9 Splash irrigation in arecanut garden

Experiments on the irrigation requirement of arecanut and on the frequency of irrigation were initiated at Peechi, Hirehalli, Mohitnagar, Kahikuchi and Vittal from early 1960. At Peechi, all irrigation treatments led to substantial yield increases, the 3-day interval being better than 6 and 9 days intervals (Table 4B.3) (Sadanandan, 1973). According to him, the water requirement of arecanut during four dry months was 82.5 cm. At Vittal, where four intervals of irrigation (5, 10, 15 and 20 days) were tried (between 1966 and 1972), irrigations at intervals of 5 and 10 days were superior throughout.

The irrigation schedules at Vittal were modified in 1973–'74 and the treatments were based on cumulative potential evaporation (CPE). The results showed that an irrigation of 30 mm depth when CPE is 30 mm is the best. At Kahikuchi, where three intervals of irrigation *viz.*, 7, 14 and 21 days with no irrigation were tried, the closer intervals of irrigation, *viz.*, once in 7 days

Fig. 4B.10 Sprinkler irrigation in arecanut garden

and 14 days, showed superiority over irrigation once in 21 days or no irrigation. At Hirehalli, where four intervals of irrigation, (5, 10, 15 and 20 days) were under comparison, there was no significant difference among the treatments (Anonymous, 1969, 1970, 1971a, 1971b, 1976, 1977). At Palode where arecanut gardens are normally not irrigated, irrigation increased the yield by 2-3 times (Anonymous, 1976). Experiment with a view to economising in the use of water by adopting drip irrigation method has been conducted at Vittal during 1978-'80 by Khader (Personal communication). He reported that drip irrigation system improved the soil water regime by minimising the fluctuations in the soil water content, minimised weed growth and increased yield significantly.

## V. Harvesting

The stage of harvesting depends upon the type of produce to be prepared for the consuming markets. There are two main types *viz.*, one prepared out of immature green nuts and the other from ripe nuts. In each case the maturity at which the fruit is harvested and the season of harvest affect the quality of the

Fig. 4B.11 Lowering harvested arecanut bunch by a rope

processed nut considerably. Trials conducted at Peechi showed that the proportion of *vellai choor*, which fetches higher price than other trade varieties like *choor kora* was more when the fruits were harvested at six months maturity level than harvested at higher maturity level of seven months (Anonymous, 1971a). In another study it was found that the quality and quantity of kernel *(chali)* processed out of fully

ripe fruits were much better than those fruits which were not fully ripe. The former gave 8.6 per cent increase in weight of *chali* and fetched 72 per cent more price than *chali* from less mature (ripe) fruits (Anonymous, 1969). The above contingency arises when two successive bunches are harvested simultaneously, which have different maturity level.

Fig. 4B.12 Climber swinging from one palm to another for harvesting

Various methods are followed for harvesting arecanut bunches. regularly spaced garden, the climber climbs a tree at one end of the garden, harve the bunch and sends it down by a rope (Fig. 4B.11) or gunny bag or drops do the bunch to the ground. The climber pulls the nearest palm with the help o hook and swings to it (Fig. 4B.12). It is not uncommon to see a climber harvesti 50–100 palms or even more, by swinging from one to the next, at a stretch bef coming down to the ground. In certain parts of north Kerala and Dakshina Kanna areas of Karnataka, a long bamboo with a sharp sickle or hook attached to the e is also being used for harvesting the bunches. It is reported that monkeys specia trained for the purpose harvest arecanut bunches in Malay (Nambiar, 1954).

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