# Annual Report of the Central and Regional Arecanut Research Stations

**1st July 1964 to 30th June 1965**


**Central Arecanut Research Station, Vittal,**
**Mysore State, India**

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## CONTENTS

# ANNUAL REPORT OF THE CENTRAL AND REGIONAL ARECANUT RESEARCH STATIONS

1ST JULY 1964 to 30TH JUNE 1965

## 1. INTRODUCTION

The Central Arecanut Research Station, Vittal, was started by the Indian Central Arecanut Committee in April 1956, with the main object of carrying out fundamental and applied investigations on Botany, Physiology, Agronomy, Soil Chemistry and Pests and Diseases of arecanut crop in addition to solving the regional problems of its cultivation and production. This Central Institute for arecanut is also to plan and co-ordinate the work of the Regional Research Stations which are set up in the five major arecanut tracts of India.

The Central Station is located in the Vittal village, Buntwal taluk of South Kanara District of Mysore State, 41 8 km. from Mangalore Railway Station on the Mangalore--Vittal–Puttur Highway, and 51.5 km. from Kasaragod on the Kasaragod-Mangalore Highway. It lies on 12° 15″ N. latitude and 75° 25″ E. longitude The altitude of the Station ranges from 75.00 to 90.00 m. above mean sea level. The soil at the Station is typically lateritic and is admixed with sand, alluvium and gravel, in varying proportions in different locations. It is generally acidic with a mean pH of 5.25. The total area of the Station is 48.37 ha.

The Regional Station, Peechi, is at Kannara of Trichur District in Kerala State and is situated about 19.3 km. east of Trichur Railway Station. Geographically it is located at 10° 30″ N. latitude and 76° 10″ E. longitude. The altitude of the Station ranges from 49 to 55 m. above mean sea level. The upper layers of the soil are mainly of the alluvial type with good admixture of sand and silt and the lower layers are lateritic. The pH of the soil ranges from 5.6 to 6.8. The total extent of the Station is 14.16 ha.

The Regional Station, Hirehalli, is located near Hirehalli, Railway Station of Tumkur District (Mysore State), on the Bangalore-Poona National Highway, 58 km from Bangalore. It lies on 13° 5″ N latitude and 77° 7″ E longitude It is about 854 m. above mean sea level. The soil of the Station is clayey to clayey loam with a mean pH of 6.2. The total area of the Station is 16.24 ha

The Regional Station, Kahikuchi, is located near the Gauhati Air Port at a distance of 22 km. from Gauhati Railway Station in Assam. The altitude of the Station is 48 m above mean sea level, the latitude and longitude being 20° 11″ N and 91° 47″ E. respectively. The soil is new

alluvium with lower strata of laterite and has a pH of 4.4 to 4.8. The total area of the Station is 12.14 ha.

The Regional Station, Mohitnagar, is located in Mohitnagar Farm at a distance of 9.66 km. north-west of Jalpaiguri Railway Station on the Jalpaiguri-Siliguri road. It lies on 26° 31″ N. latitude and 88° 43″ E. longitude. The soil is acidic and has a pH range of 4.5 to 6.0. The total area of the Station is 10.11 ha.

The Regional Station, Palode, is located in Palode village (77° 2″ E. longitude and 8° 4″ N. latitude) of Nedumangad taluk of Trivandrum District, Kerala State. It is 36 km. away from Trivandrum. The altitude of the Station ranges from 210 to 240 m. above mean sea level. The soil is mainly lateritic with a pH ranging from 4.2 to 5.0. The total area of the Station is 11.77 ha.

## II. SUMMARY OF WORK DONE

The following is a summary of the work done at the Central and Regional Arecanut Research Stations:

### Botany

At the Central Station, seedlings of the 17 exotic species and types introduced from eight foreign countries and planted in the mainfield during 1961-62 along with the local type were under detailed observation. Data gathered with a view to assess the initial productive potential of the different introductions showed that the type introduced from Indonesia *(A. triandra)* produced the maximum number of female flowers per inflorescence. Of the different types of *A. catechu*, those from China, Fiji and Saigon appear to be promising. Twelve exotic types and species transplanted to the mainfield during the previous year were maintained. Seednuts of three exotic types introduced during the same period were planted in pots from the secondary nursery. During the year seednuts of two more exotic types were introduced from Nassau (Bhama Islands) and Andaman. The market evaluation of six exotic types was done during the year when it was found that excepting Ceylon (1) all the other types fetched higher price than the local. *A. triandra* (Indonesia -2) which has not been reported so far as useful for chewing has also fetched almost as good a price as that of the local.

Ten seedlings in each of the eight indigenous types planted during the year 1962-63 recorded satisfactory growth. The indigenous types collected from Mahuva (Gujarat), Hirehalli (Dwarf) and Thirthahalli (Oblong) were planted to the main field during the year. Three more indigenous types, one each from Sreewardhan (Colaba District) and Dapoli

(Ratnagiri District) of Maharashtra State, and from Thirthahalli of Mysore State collected during the previous year were maintained in the secondary nursery. Gap filling was done in the seedlings of two mother palms of the local type planted at the two Fruit Research Stations of Coorg District of Mysore State, for the study of their performance at higher altitudes.

In order to finalise a sampling technique for the cultivar study, measurements of fruits of the same palms that were under observation during the previous year were recorded and statistically analysed. It was seen that the fruit size remained unchanged from year to year. The survey work was commenced in Cannanore District during the year. Twelve private gardens of Tellicherry and Thaliparamba taluks of the District were surveyed. Ten cultivars were isolated after a similar survey taken up at the Regional Station, Hirehalli. Studies on the floral biology were continued in the main garden of the Station. It was observed that at the Central Arecanut Research Station, the number of inflorescences produced in a tree ranges from nil to eleven, and the largest number of trees produced inflorescences ranging from four to eight. Similar studies at Peechi showed that the majority of the palms produced four to six inflorescences. Studies on the month-wise variation in flowering showed that the percentage of inflorescences to leaves shed was maximum during 1962-63 and that there is a gradual decrease in the same thereafter. It was also observed that the maximum percentage of inflorescences was produced in the months of February to May. Similar studies on floral biology taken up at the Regional Station, Peechi gave almost identical results. A study on the yielding behaviour of the progenies of different mother palms showed that the progenies in the high yielding group are much more steady in their yielding habit as compared to the other two groups. Dissection of the crowns with a view to study the floral initiation showed that inflorescences in the first two to three leaf axils were aborted.

At the Central Station, germination studies of pollen grains of arecanut were continued during the year. A medium consisting of 0·5% sucrose and 0·1% agar was found to be ideal for pollen germination. It was also observed that ordinary sugar is as efficient as chemically pure sucrose. Studies on humidity and pollen viability continued during the year showed that the pollen stored at a humidity level of 15 to 20 per cent maintains high viability up to 35 days of storage. Pollen grains stored at zero per cent and 45 per cent humidity levels were found to lose their viability after four and 12 days respectively. Trials conducted to find out the viability of pollen kept at 17 per cent humidity and at a temperature of 12 to 15°C. showed that the pollen viability was not enhanced appreciably.

Studies on standardisation of crossing technique showed that the spray application of pollen can be adopted for crossing work.

Selfing of the flowers of the mother palms whose progenies are under study was commenced. Selfed nuts obtained from exotic palms were ready for transplanting to the secondary nursery. Crosses were also effected between certain palms of outstanding performance of the local type as well as between the local and Thirthahalli types for combining high yield and regular bearing habit. From a comparative study of selfed, crossed and open pollinated nuts it was observed that due to crossing there was a significant increase in length of kernel and size of embryo. It appears that pollen influences kernel and embryo growth in arecanut.

Preliminary studies on the progeny behaviour of mother palms were continued and the data gathered showed that the range of variation in respect of the female flower production is more or less the same as compared to that of the previous year. The experiment designed to find out how far the selection of mother palms and seednuts influence germination and turn over of quality seedlings as well as their performance in the mainfield, laid out during the previous year was continued. The growth measurements of the sprouts gathered from this experiment showed that even though the treatment differences are not significant there is a trend in favour of selection of seednuts. The experiment was repeated during the year with the same set of treatments as in 1963-64 using the same mother palms as well as in a slightly modified form with four more treatments. The germination data and growth measurements of the sprouts gathered from the experiment showed that there is a trend in favour of selection of seednuts as in previous year.

Studies on leaf anatomy and cytology were continued. Trials with assisted pollination repeated during the year showed that a slightly higher fruit-set could be obtained when natural pollination is supplemented. A fresh batch of seednuts were irradiated with different doses of Gamma rays for inducing genetic variability. Trials with Gibberellic acid showed that fruit-set could be increased by the spray application of this hormone at 2,000 ppm.

**Agronomy**

Experiments to find out the necessity or otherwise of shade for arecanut nurseries were continued during the year both at the Central as well as at the Regional Arecanut Research Stations. Germination data gathered at the Central Station showed that the germination under open condition is significantly less than that under partial and complete shade. However, the difference in germination was not found to be significant in similar trials conducted at the Regional Stations. Observations made at the Central Arecanut Research Station showed that the mortality of sprouts as well as seedlings was significantly more in open nurseries. Seedlings under partial and complete shades have recorded significantly more girth, height and

number of leaves at the Central Station. Similar results were obtained in the same trial laid out at the Regional Station, Hirehalli. Trials laid out in the different Stations in general did not show any significant difference in regard to germination percentage between seednuts possessing different floating habits. However, as in earlier years, seedlings from vertically floating nuts recorded more height. The pooled analysis of data on the trial to compare the efficacy of sowing unsprouted and sprouted seeds on seedling performance showed that sowing unsprouted seednuts gives seedlings with significantly more height and girth. Similar trial conducted at the Regional Arecanut Research Station, Mohitnagar, has also given more or less identical results.

In the trial to compare the effect of different media and methods of raising seed beds on germination of seednuts it was again found that raised beds were equally good as trenches for sowing seednuts, thus suggesting the suitability of the former method for the localities where the soil is heavy and poorly drained. In the trial on the comparative efficacy of different methods of shading arecanut nurseries conducted at the Central Arecanut Research Station, the superiority of banana and *Coccinia indica* as shade crops over ordinary pandal thatched with coconut or arecanut leaves has been proved.

In the spacing experiment planted in 1958 at the Central Arecanut Research Station, studies on the influence of spacing on (i) sun-scorch of stems, (ii) rate of leaf-fall and production of spadices, (iii) number of female flowers produced and set, (iv) yield and (v) precocity of flowering were made. It was observed that the percentage of palms affected by sun-scorch is more in the widely spaced plots. The mean number of leaves shed, number of spadices produced per palm, percentage of spadices to leaves shed and the number of female flowers per spadix increased with increase in spacing. The percentage of fruit-set was also very low in 6′ x 6′ treatment plot. Regarding yield it was found that 12′ x 12′ planting gave the lowest yield. With regard to precocity it was observed that while 90.6 per cent of the palms only flowered in 6′ x 6′ treatment plot, there was cent per cent flowering in plots planted at 9′ x 9′, 9′ x 12′ and 12′ x 12′ spacings. Results as above in respect of sun-scorching were obtained in the case of spacing trial laid out at the Regional Arecanut Research Stations at Peechi and Hirehalli. Rate of leaf-fall was also found to be increased with increase in spacing in the garden at the Regional Arecanut Research Station, Peechi.

Among the different cover crops tried, *Pueraria javanica* and *Calapogonium muconoides* continued to show their superiority over others both at the Central and Regional Arecanut Research Stations. In the observational plot on intercrops maintained at the Central Arecanut Research Station,

Guinea grass and arrow-root were found to come up well under the shade of arecanut palms. In the trial to find out the effect of growing banana in arecanut gardens for different durations laid out at the Central Arecanut Research Station in 1963, the growth measurements (height, girth and number of leaves) did not reveal any significant difference between the different treatments. The planting of the mixed garden of arecanut and coconut was completed by planting arecanut seedlings during the year. A similar trial was planted at the Regional Arecanut Research Station, Palode also. At the Central Arecanut Research Station an observational garden was planted with arecanut and cacao plants to find out their relative performance when grown as mixed crop.

The third year dose of manures was applied to the palms under N.P.K. experiment. The growth measurements of palms recorded in the experiment showed that Nitrogen had significant influence on girth, number of leaves and number of exposed nodes of the palms. Green leaf was also found to have significantly influenced the characters like girth, height and number of leaves. Similar trial laid out at the Regional Arecanut Research Station, Peechi showed that Nitrogen had significantly increased the number of leaves, height and girth of palms. Green leaf also had significantly increased the height and girth of palms. The trial at the Central Arecanut Research Station did not reveal any significant effect in respect of Phosphoric acid and Potash, whereas at the Regional Arecanut Research Station, Peechi, Potash plots alone recorded significantly more number of leaves The second year dose of different manures was applied to the palms under the experiment on the "Effect of applying N.P.K. in organic and inorganic forms on palm performance".

The observational trial on the effect of different mulches on the soil moisture in arecanut garden showed that the moisture retained is more in the mulched plots as compared to the control (no mulch) plot both in the sub-soil and surface soil. The area for planting the experiment to study the effect of depth of transplanting seedlings-cum-intervals of irrigation was kept ready and the required seedlings were also raised. Similar trial already planted (in 1962) at the Regional Arecanut Research Station, Peechi indicated that palms planted at 36" depth and receiving irrigation once in three days perform significantly better than others. The palms under no irrigation were stunted in growth.

The harvesting trial taken up at the Central Station to study the quality of cured produce (Biligotu) as influenced by maturity of fruits showed that the fruits from the lower bunch (higher maturity) give a higher percentage of cured produce of better quality as judged by the higher price obtained.

At the Central Arecanut Research Station, collection of yield data from marked palms in private gardens for determining the shape and size of plot for field experimentation was continued. A similar trial was also initiated in the progeny garden of the Station by selecting a group of 144 palms. The observations made in the private garden has again revealed that increasing the number of trees per plot beyond 12 does not give any appreciable gain in the precision. Similar results were obtained from the data analysed in respect of the palms of the progeny garden of the Station. Other mainfield observational trials initiated during the earlier years were in progress.

Investigations on the control of weeds were in progress at some of the Regional Stations. At Peechi, it was seen that Dowpon and Bladex 'O' were quite promising. Trials at Hirehalli showed that Simazine, Prometryne and Dacthal are effective against most of the weeds.

**Statistics**

All the experiments laid out at the Central as well as at the Regional Arecanut Research Stations were statistically analysed. In the study to find out the relationship between different measures of yield, it was seen that there was significant correlation between the number of nuts harvested per palm per harvest, their wet weight and kernel weight. This relation, however, was found to differ with the season of harvest. The months of harvest could be arranged into three groups in such a way that the above relationship was not significantly different within a group. A high correlation was found to exist between girth at collar and girth at 5 cm. below last leaf axil. To evaluate the out turn of cured produce from a given lot, it was found sufficient to select randomly two 12 kg. samples and find out their kernel weight after appropriate drying.

**Soil Chemistry**

In order to study the initial fertility status and subsequent effect of application of manures and fertilizers composite soil samples from each experimental plot at three depths (0-15, 15-45 and 45-90 cm.) of the N.P.K. trial were collected in the year 1962 and 1964. The samples were analysed for percentage organic carbon content. In general the data revealed that the plots differ widely in their initial organic carbon content and that the application of green leaf has increased the organic carbon content. The decrease in percentage of organic carbon with depth was also seen in most of the experimental plots.

Soil samples in duplicate collected from the experiment on 'different methods of raising arecanut gardens on hill slopes' laid out at the Regional Arecanut Research Station, Palode, were analysed with a view to study the effect of individual treatments on the maintenance of soil fertility. From the analytical data for organic carbon it was observed that samples from

the treatment 'cover cropping with manuring' has higher percentage of organic carbon than the rest.

Preliminary investigations carried out in connection with the causes of yellow leaf disease showed that there is a certain amount of nutritional imbalance existing in the tissues of the affected trees.

**Plant Physiology**

A Comprehensive Package Plan Trial on the yellow leaf disease of arecanut was initiated during the year.

**Pests and Diseases**

Investigations on the control of different pests and diseases of arecanut were continued both at the Central as well as at the Regional Research Stations. Trials repeated at the Central Station with different miticides indicated that Kelthane, Trithion and Tedion treatments were effective in the control of mites and in their subsequent re-establishment. Similar results were obtained from the trials conducted at the Regional Research Stations. Studies on the biological control of mites were initiated at the Regional Arecanut Research Station, Hirehalli in collaboration with the Commonwealth Institute of Biological Control, Bangalore.

The high incidence of white grubs in package plan plots could be checked by large scale applications of 'Intox-8' liquid. In the trials on the control of Koleroga the comparative efficacy of the fungicides could not be evaluated due to non-incidence of disease. Laboratory screening trials were initiated to evaluate the efficacy of different proprietary copper fungicides against *Phytophthora arecae*. Investigations into the causes and method of control of button shedding and tender-nut fall confirmed the association of insects and fungi. Large scale spraying trials taken up against button shedding and tender-nut fall indicated that a combination spray of Bordeaux mixture (one per cent) plus Endrex gave the maximum increased fruit retention of 19.2 per cent over the control. Another trial laid out at the Central Station, against button shedding using different proprietory compounds indicated that 'Cuman', a carbamate fungicide was able to reduce the shedding of female flowers considerably. Laboratory tests done to screen, 'Cosan' a sulphur compound against *Cuvularia* leaf spot revealed that the chemical was not effective even at 0.3 per cent strength. This was confirmed by field trials.

Long strips of heavy gauge polythene film made opaque by painting them with white enamel paint afforded good protection to stems against South-western sun when tied around them on the exposed side. Similar results were obtained at the Regional Arecanut Research Station, Hirehalli. Field trials laid out to determine the effect of micro and macro-nutrients on the general yellowing and weakening of the arecanut palms showed that the conditions of the palms improved considerably due to the treatment.

Studies on the biological antagonism of certain soil fungi against *Ganoderma lucidum* indicated that *Trichoderma* sp. (Orissa isolate) exerted the strongest antagonistic action towards the growth of the test fungus. Isolates of fungi obtained from shoot-rot affected plants from Kadur area were identified as *Glomerella cingulata* (a perfect stage of *Gloeosporium*). Examination of soils from the bases of yellow leaf disease affected palms revealed the presence of large population of the reniform nematode (*Rotylenchus reniformis*)

Studies on the yellow leaf disease were continued at the Regional Arecanut Research Station, Palode. Observations on the symptomatology of the disease were carried out both under open and controlled conditions. Disease transmission work with leaf sap was taken up on arecanut as well as a number of different host plants. Studies on the effect of applying micro nutrients like Fe , Mg., Mn. and B. into plant tissue on the disease were initiated.

**Development and Extension**

**Results of research which are of practical utility to the cultivators:**

A few important results which are the outcome of research carried out at the Central and Regional Arecanut Research Stations and are of practical utility to the arecanut growers were as follows:-

1. **Nursery technique**

Even though banana is grown as the most common shade crop for arecanut nursery, it had been observed that the full harvest of the bunches cannot be had by the time the seedlings are removed thus necessitating the retention of the shade crop alone in the field. Trials taken up at the Central Arecanut Research Station have shown that *Coccinia indica*, a vegetable crop was as good a shade crop as banana under the conditions existing at the Research Station.

2. **Control of mites**

Mite (red and white) is a major pest of the arecanut palm. These dwell in colonies on the under surface of the foliage, suck the sap and weaken the plants. They infect young and old plants and are severe during summer months especially under exposed conditions. Trials conducted at the Central as well as the Regional Arecanut Research Stations have brought out that Kelthane, Trithion and Tedion sprayed at 186, 126 and 200 cc. of the chemicals respectively in 100 litres of water are effective in checking the pest. The spray application may be repeated after about 20 days if found necessary. The cost of one round of Kelthane spray to the nursery will be about Rs.50/- and to the mainfield Rs.81/- per hectare.

**3. Control of white grubs**

White grub (the larvae of a cockchafer beetle) is another major pest on the arecanut palm feeding on the roots of palms and bringing about huge losses of plants. Their incidence is very severe under ill drained soil conditions. Trials carried out at the Central Arecanut Research Station have indicated that this pest can be successfully controlled by drenching the plot with Chlordane 75 EC at 0.5 per cent strength i.e. 50 cc. in 100 litres of water. Twenty litres of the concentrate are required to cover one hectare of garden. The cost of one round of this treatment will be about Rs. 380/- per hectare. Normally one application per year will be sufficient.

## III DETAILED REPORT

**Botany**

### I. Breeding and genetics of Areca

**1 Introduction and maintenance of indigenous and exotic species and types of Areca for selection and hybridisation.**

EXOTIC TYPES COLLECTION AT THE CENTRAL STATION - 1957 PLANTING.

The four palms introduced in the year 1957, i.e. Indonesia I, Indonesia II, Nicobar and Andaman types continued to flower during the year. Annual growth measurements such as height, girth at permanent mark and last node, number of nodes etc. were recorded. The internodal distance in the case of two Indonesian types continued to be lesser than the other two types, the measurement at the last node being 1.6 cm. for Indonesia I and 2.1 cm. for Indonesia II as against 6.2 cm. for the Nicobar and 3.3 cm. for the Andaman types.

**1961-62 planting**

This collection plot consists of 16 species and types introduced from eight foreign countries viz, Saigon, Indonesia, Fiji, China, Ceylon, Mauritius, Singapore and British Soloman Islands and the local The planting was done on a randomised block design with single tree plots. The palms were manured and cultural operations were attended to as per schedule. All the palms continued to record satisfactory growth.

Data recorded on the production of suckers showed that the rate of production in the different types of *Areca triandra* ranged from 2.2 to 7.3 suckers per palm with an over-all mean of 3.4, as against a mean of 7.5 in *Areca concinna*.

Regular recording of leaf-fall and production of spadices and related data were taken up in all the palms, with a view to assess the productive potential of the various introductions as compared with the local

type. It was observed that of the different types of *A. catechu* introduced, the types from China and Saigon (Saigon I) have produced a mean maximum of 8 spadices per palm. As regards female flower production a mean maximum of 217 flowers per inflorescence has been produced by the type from Fiji. *Areca triandra* from Indonesia produced a mean maximum of 670 female flowers per inflorescence.

**Market evaluation of exotic types**

The fruits of six exotic types harvested during the year were dried separately. The kernel obtained was put in the market and evaluation of each was done along with that of the local. The results showed that excepting Ceylon (I) all the other types have fetched higher price than the local. It was also interesting to note that *Areca triandra* (Indonesia (2)) which has not been reported so far as useful for chewing had also fetched almost as good a price as that of the local. The following were some of the factors that were responsible for determining the price.

1. The nuts of Ceylon type has demand mostly during the monsoon period only and less during other months. The persistant white colour added to its value.

2. The nuts of Nicobar fetch low price during monsoon but during other parts of the year it has good demand. They are bold and heavy nuts.

3. *Areca triandra* nuts are small and heavy and compare favourably with local 'Lindi' type, even though the astringency is low.

4. The nuts of Saigon type have good colour and have similarity to indigenous 'Sreevardhan' type.

**1963-64 planting**

Ten types of *A. catechu* and two species of *Areca (A. normanbyii*, and *A triandra)* received from Australia, Fiji, Saigon and Andaman were transplanted to the main field in June 1964, on a randomised block design using single tree plots. One plant introduced from Aden was also planted in the main field. They were manured and cultural operations were attended to as per schedule.

**1964-65 planting**

Seven seedlings of Malayan type Wangi, introduced from the Agricultural Research Station, Thaliparamba were planted in a separate block along with ten Nicobar seedlings during July, 1964. Twenty one seedlings of Indonesia (I) were planted in October, 1964 in the exotic multiplication plot. Three seedlings of the type from New Guinea (LAE) and one seedlings of Wangi (selfed) were planted to pots from the secondary nursery.

**1964–65 introduction**

During the year, fresh consignments of seednuts were received from Nassau (Bhama Islands) and Andaman. Of the forty seednuts of *A. langloisiana* received from Nassau thirty were sown and the remaining ones preserved after recording the measurements. Out of the 30 sown only 9 have germinated. All the 20 nuts of the Andaman type sown failed to germinate.

**Indigenous types collection**

The eight ecotypes from (1) Khasi and Jayantia hills, (2) Mohitnagar (3) Mettupalayam, (4) Chickmagalur, (5) Hirehalli, (6) Thirthahalli, (7) Peechi, and (8) South Kanara planted in the main field were growing well. The indigenous types collected from Mahuva (Gujarat), Hirehalli (dwarf), and Thirthahalli (oblong) were planted to the main field during the year. Indigenous types from Colaba (Sreewardhan), and Ratnagiri (Dapoli) Districts of Maharashtra State and from Thirthahalli of Mysore State collected during the previous year and which were in the secondary nursery are ready for transplanting to the main field.

During the year one more indigenous type ('Chandradikkae'-red kernelled) was also added to the existing collections. The 'Sweet areca' type has started flowering. Daily recording of leaf-fall and production of spadices were continued.

Out of the 58 seedlings of two mother palms (CARS 605 and NGB 9) planted at the Fruit Research Station, Chethalli and Athur (3,000 ft. above mean sea level) of Coorg for the study of their performance at higher altitudes only one seedling of CARS (605) and 14 seedlings of NGB (9) got established. The gaps were filled with the seedlings of appropriate mother palms during the current year.

The performance of different exotic and indigenous types and species is also being tested at the different Regional Stations. At the Regional Station, Hirehalli where progenies of a dwarf palm are being maintained, it was observed that eight out of the twelve progenies continue to show the dwarf character of the mother palm.

**2. Survey of arecanut gardens to select superior types and assessing genetic variation**

Statistical analysis of the length and breadth measurements of fruits recorded during 1963–64 had shown that a sample size of 12 nuts is sufficient for the above survey. Fruit measurements of the above palms were again recorded during the current year and the data statistically examined in order to see whether the fruit size remained unchanged from year to year. The data were tested by using student's 't' test. The results showed that there is no significant difference in size of fruit (length and breadth) from year to year.

The survey work was commenced in Cannanore District during the year. Twelve private gardens selected at random from six selected villages of Tellicherry and Thaliparamba taluks of the District were surveyed. Ten palms at random were selected from each garden and 12 nuts were collected from each of these marked palms. Their length and breadth measurements were recorded. The survey will be continued and completed for taking up analysis of the data.

Similar survey work as above was conducted in 'Maidan' parts of Mysore, Anantapura and Mettupalayam areas covered by the Regional Station, Hirehalli and 10 cultivars were isolated.

**3. Floral biology of Areca**

a, b) STUDY OF THE RANGE OF VARIATION IN FLOWERING FROM TREE TO TREE INCLUDING MONTH-WISE VARIATION IN FLOWERING IN THE SAME GARDEN.

The above study was undertaken in the bulk garden of the Central Station planted in the year 1957 where the palms were being given uniform cultural and manurial treatments An abstract of the observations made on 200 palms is given below:

TABLE 1

**Frequency distribution of production of spadies and yield**

| | No. | Percentage over total. | Total yield from palm in each group (No. of nuts). | Percentage of yield to total. |
|---|---|---|---|---|
| Palms which produced no spadices. | 9 | 4.5 | Nil | Nil |
| ,, one spadix. | 3 | 1.5 | Nil | -- |
| ,, two spadices | 9 | 4.5 | 9 | -- |
| ,, three spadices | 16 | 8.0 | 1061 | 3.3 |
| ,, four spadices | 23 | 11.5 | 1867 | 5.8 |
| ,, five spadices | 29 | 14.5 | 6131 | 19.1 |
| ,, six spadices | 27 | 13.5 | 5805 | 18.1 |
| ,, seven spadices | 41 | 20.5 | 7810 | 24.3 |
| ,, eight spadices | 24 | 12.0 | 5988 | 18.7 |
| ,, nine spadices | 14 | 7.0 | 2824 | 8.8 |
| ,, ten spadices | 4 | 2.0 | 516 | 1.6 |
| ,, eleven spadices | 1 | 0.5 | 89 | 0.3 |
| Total | 200 | 100.0 | 32100 | 100.0 |

It will be seen from the above data that the number of inflorescences produced ranged from nil to eleven and that the majority of trees produced spadices ranging from four to eight. During the previous year also an almost identical trend in production of spadices was observed. As regards yield the maximum number of nuts was contributed by the palms, producing seven spadices which is in conformity with the previous year's observation.

Studies on the month-wise variation in flowering were also made in the same garden. The observations made during the current year as well as in the previous three years are given in the following table (vide. P. 15). It will be seen from the table that the percentage of inflorescences to the leaves shed was maximum during 1962-63 and, thereafter there is a gradual decrease in the same. It is also seen that a very high percentage of leaves shed in the months of January to March have inflorescence in their axil. Of the inflorescences produced in different months, the maximum percentage of the total production was observed during the months of February to May. Studies similar to the above made at the Regional Arecanut Research Station, Peechi indicated that the majority of palms produced 4 to 6 inflorescences with three and eight as minimum and maximum. It was also seen that the maximum number of spadices was produced during the months of February and April.

c) THE FREQUENCY DISTRIBUTION OF NUMBER OF PALMS FLOWERING PER WEEK DURING ALL THE WEEKS AND CORRELATION OF EARLY FLOWERING WITH FRUIT PRODUCTION.

The yield data of the 3207 progenies of 41 mother palms grown in the bulk garden under uniform agronomic conditions were classified into three groups based on their progeny performance. Yield data gathered for the year 1963-64 and 1964-65 are given in the following table (vide P.16). From the table it will be seen that the progenies in the high yielding group are much more steady in their yielding habit when compared to the other two groups. Progenies of SDK (15) have given the mean maximum yield during 1963-64 as well as during the current year.

d) FLORAL INITIATION

Dissection of crowns of seven trees which had flowered showed that every leaf had one inflorescence in its axil, but in the case of the fully opened leaves the first two to three inflorescences were found to be aborted. Length and breadth measurements of the inflorescences were taken and the data are given in the following table (vide P.17). It will be seen from the table that the development of the first two to three inflorescences which are the oldest is rather poor as compared to the rest indicating the aborted nature of these inflorescences. The factors responsible for the abortion of the spadices will have to be elucidated so as to rectify the same wherever possible.

TABLE 2

**Month - wise Variation in Flowering.**

| Month | Percentage of inflorescences produced to leaves shed. | | | | Percentage of monthly production of inflorescences to the total | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | 1961-62 | 1962-63 | 1963-64 | 1964-65 | 1961-62 | 1962-63 | 1963-64 | 1964-65 | |
| July | 11.20 | 45.35 | 65.90 | 81.11 | 2.70 | 4 70 | 7.30 | 6.70 | |
| August | 21.80 | 52 45 | 50.10 | 29 00 | 5.60 | 5.90 | 5.60 | 2.60 | |
| September | 35.80 | 71.96 | 55.80 | 36.60 | 6.20 | 5.00 | 6.30 | 3.30 | |
| October | 54.00 | 74 80 | 64.00 | 46.60 | 9.50 | 6.90 | 7.20 | 4.40 | |
| November | 61.97 | 84.64 | 74.90 | 59-00 | 9.50 | 8.80 | 8.40 | 5.30 | |
| December | 76.19 | 84.76 | 82.40 | 78.07 | 13.80 | 7.90 | 9.20 | 9.50 | |
| January | 89.03 | 90.64 | 87.90 | 90.00 | 8.20 | 10.30 | 9.90 | 6.60 | |
| February | 87.45 | 94 06 | 93.70 | 92.30 | 10.50 | 11.90 | 10.50 | 10.20 | |
| March | 58.13 | 90 00 | 88.30 | 94.10 | 12.00 | 11.60 | 9.90 | 11.90 | |
| April | 69.68 | 83.81 | 84.80 | 91 30 | 10 70 | 11.80 | 9.40 | 15.90 | |
| May | 37.47 | 67.60 | 66.00 | 84.40 | 5.00 | 7.20 | 7.40 | 17.40 | |
| June | 35 26 | 79.20 | 76.80 | 65.80 | 5.40 | 8 00 | 8 60 | 6.20 | |
| Mean | 48.40 | 77.35 | 74.22 | 70.27 | | | | | |

TABLE3

**Mean Progeny yields**

| High yielding (Mean progeny yield above 6000 gm. per palm) | | | Medium yielding (Mean progeny yield between 4000 gm. and 6000 gm. per palm) | | | Low yielding (Mean progeny yield below 4000 gm. per palm) | | |
|---|---|---|---|---|---|---|---|---|
| Mother palm | Yield 1963-1964 | Yield 1964-1965 | Mother palm | Yield 1963-1964 | Yield 1964-1965 | Mother palm | Yield 1963-1964 | Yield 1964-1965 |
| SDK 15 | 8668 | 9159 | KMJ 6 | 5979 | 5079 | KKF 19 | 3848 | 3678 |
| KMJ 3 | 8136 | 7997 | KKF 23 | 5862 | 5814 | KMN 2 | 3775 | 4996 |
| SDK 16 | 7997 | 6915 | SDK 1 | 5696 | 5780 | KMJ 12 | 3710 | 4136 |
| SRJ 7 | 7812 | 8681 | SDK 4 | 5646 | 6502 | KMJ 18 | 3654 | 6085 |
| KMJ 8 | 7466 | 8002 | SRJ 9 | 5618 | 6930 | KMN 11 | 3102 | 4831 |
| KKF 28 | 7288 | 6876 | KKF 3 | 5440 | 4777 | KKF 6 | 2984 | 4915 |
| SDK 2 | 7169 | 6611 | KMJ 14 | 5275 | 7097 | SRJ 13 | 2485 | 7535 |
| SDK 14 | 7031 | 7528 | SDK 6 | 5253 | 6924 | SRJ 15 | 2151 | 7599 |
| KKF 18 | 6943 | 8299 | SDK 7 | 5253 | 4854 | | | |
| KMJ 5 | 6926 | 6510 | KKF 2 | 5007 | 5990 | | | |
| KKF 12 | 6812 | 6130 | KKF 9 | 5003 | 6467 | | | |
| KKF 24 | 6689 | 7424 | SDK 13 | 4974 | 5316 | | | |
| SRJ 8 | 6688 | 5836 | SRJ 2 | 4877 | 4316 | | | |
| SDK 17 | 6205 | 6746 | KKF 13 | 4685 | 5163 | | | |
| SRJ 5 | 6145 | 5524 | KKF 16 | 4667 | 5641 | | | |
| | | | SDK 11 | 4400 | 3572 | | | |
| | | | SRJ 6 | 4343 | 5117 | | | |
| | | | KKF III | 4300 | 5747 | | | |

TABLE 4

**Inflorescence Development in Arecanut**

| Palm A | | | Palm B | | | Palm C | | | |
|---|---|---|---|---|---|---|---|---|---|
| Sl. No. | Length (cm.) | Breadth (cm.) | Sl. No. | Length (cm.) | Breadth (cm) | Sl. No. | Length (cm.) | Breadth (cm.) | Remarks |
| 1 | 2.6 | 4.9 | 1 | 3.3 | 4.4 | 1 | 7.0 | 5.0 | Leaf axil |
| 2 | 3.0 | 3.0 | 2 | 10 6 | 6.0 | 2 | 3.4 | 4.6 | ,, |
| 3 | 3.6 | 2.8 | 3 | 6.2 | 5.1 | 3 | 2.7 | 4.3 | ,, |
| 4 | 4.9 | 4.7 | 4 | 3.7 | 4.5 | 4 | 5.0 | 5.8 | ,, |
| 5 | 3.1 | 3.8 | 5 | 2.8 | 4.1 | 5 | 3.8 | 4.4 | ,, |
| 6 | 3.6 | 3.5 | 6 | 2.6 | 3.5 | 6 | 2.8 | 3.8 | ,, |
| 7 | 1.3 | 2.6 | 7 | 1.5 | 2 7 | 7 | 2.1 | 3.4 | ,, |
| 8 | 1.5 | 1.9 | 8 | 1.2 | 1.1 | 8 | 1.8 | 3.1 | ,, |
| 9 | 0.8 | 1.3 | 9 | 0.5 | 1.0 | 9 | 1.3 | 2.5 | Spindle |
| 10 | 0.4 | 0.8 | 10 | 0.3 | 0.9 | 10 | 1.1 | 2.0 | Leaf not emerged |
| 11 | 0.4 | 0.6 | 11 | 0.2 | 0.5 | 11 | 0.7 | 1.5 | ,, |
| 12 | 0.2 | 0.4 | 12 | 0.2 | 0.4 | 12 | 0.4 | 0.9 | ,, |
| 13 | 0.1 | 0.3 | 13 | 0.1 | 0 2 | 13 | 0.4 | 0.7 | ,, |
| 14 | Primordia | | 14 | Primordia | | 14 | 0.1 | 0.4 | |
| | | | | | | 15 | Primordia | | |

In order to find out the days interval between leaf emergence and leaf-fall so as to gauge the age of inflorescences present in the concerned leaf axil ringing of the spindle was continued in four palms of the local type. Some of the ringed leaves in certain palms started shedding and it was observed that the longevity of the leaf in the crown of the above palms vary from 385 to 414 days.

Studies on the month-wise variation in flowering were taken up in 300 progenies, so as to see whether the abortion noted is reflected in the spadix production and the data gathered are given below:

TABLE 5

**Month-wise production of spadices**

| Month | % of spadices produced to leaves shed | Month | % of spadices produced to leaves shed |
|---|---|---|---|
| July | 36.5 | January | 92.5 |
| August | 42.0 | February | 97.7 |
| September | 41.3 | March | 95.7 |
| October | 44.3 | April | 93.6 |
| November | 57.6 | May | 86.5 |
| December | 68.4 | June | 61.0 |

From the above it will be seen that the percentage of spadices produced to the leaves shed is the lowest in the months of July to October.

e) STUDY OF POLLEN

*(i) Storage and viability of pollen*

With a view to find out the relationship between the humidity in the storage chamber and germination, freshly collected arecanut pollen (male flowers) was stored at room temperature in a desiccator containing calcium chloride. The desiccator was completely sealed and the humidity inside was recorded using a hair hygrometer. The germination percentage was tested at weekly intervals in different concentrations of sucrose, with and without agar. The mean germination percentages obtained are given below:

TABLE 6

**Germination of pollen after different intervals storage**

| Day | Humidity % at room temperature. | 0.5% Sucro- se. | 1% Sucro- se. | 2% Sucro- se. | 5% Sucro- se. | 0.5% Sucro- se +=0.1% Agar. |
|---|---|---|---|---|---|---|
| Fresh | — | 29.5 | 34.3. | 21.5 | 24.8 | 79.1 |
| 7th day | 14 | 42.5 | 15.8 | 29.3 | 35.5 | 49.3 |
| 14th day | 20 | 51.6 | 77.8 | 82.2 | 55.7 | 41.8 |
| 21st day | 17 | 40.0 | 29 7 | 39.4 | 38.4 | 56.4 |
| 28th day | 15 | 30.5 | 32.8 | 37.3 | 45.8 | 45.0 |
| 35th day | 16 | 27.0 | 35.3 | 14.9 | 14.7 | 25.6 |
| 42nd day | 16 | 3.9 | 3.8 | 1.4 | nil | nil |

From the above it will be observed that the pollen stored at a humidity level of 15 to 20 per cent maintains high viability upto 35 days of storage. The longevity of pollen under the present storage studies has been found to be increased by about 14 days as compared to that of the previous years trial which might probably be due to the more or less constant humidity level maintained inside the chamber.

Viability of pollen stored at zero per cent humidity (concentrated sulphuric acid) as well as at 45 per cent humidity ($MgCl_2$) levels was also tested. The data gathered showed that under zero humidity condition pollen loses viability after four days of storage, while at 45 per cent humidity level the viability is lost by about twelfth day of storage. Since pollen loses its viability quickly under the above two humidity levels and in view of the fact that at 15 to 20 per cent humidity the viability was much more prolonged, the optimum level of humidity may be somewhere round about 20 per cent.

Trials were also conducted to find out viability of pollen kept at 17 per cent humidity at a temperature of 12°C. to 15°C. The germination percentage recorded at weekly intervals progressively decreased from 64.5 for fresh pollen to 16.25 at the end of 35 days storage. It is thus evident that storage of pollen at lower temperature of 12 to 15°C. has not enhanced viability over its storage at room temperature.

*(ii) Evolving suitable media for pollen germination:*

Trials taken up during the previous year had shown that a medium consisting of 0.5% sucrose and 0 1% agar was an ideal medium for pollen germination. With a view to substitute sucrose and agar with more

easily available materials of similar nature, trials were taken up during the current year with sugar and jaggery as substitutes for sucrose and rcie and tapioca flour for agar. It was observed that ordinary sugar is as efficient as chemically pure sucrose. None of the flours was found to be as good as agar.

*(iii) Pollen viability in exotic types:*

Viability of pollen of eleven exotic types was tested during April, '65 in 0.5% sucrose plus 0.1% agar medium and the results showed that excepting in the case of *Areca triandra* and the type from British Soloman Islands which recorded 22 and 15 per cent germination respectively, pollen viability in other types was normal.

**4. Hybridization and selection :**

a) STANDARDIZATION OF CROSSING TECHNIQUE:

With a view to find out whether the spray application of pollen could be used for hastening the process of hybridization, pollen suspended in three types of media i.e. 0.5% sucrose alone, 0.5% sucrose + 0.1% agarl and 0.5% sugar + 0.1% agar, were sprayed on 5 bunches, leaving equa portions as control (open pollination). A fruit-set of 20.5% 29.2% and 25% respectively was obtained in flowers sprayed as against 30.2% fruit-set obtained in open pollination, indicating that the spray method can be adopted for hybridization.

b) PRODUCTION OF INBRED LINES IN DISTINCT TYPES :

With a view to produce inbred lines selfing of the flowers of the mother palms whose progenies are under study was commenced. A total of 2,698 female flowers were selfed on 11 mother palms

*(i) Distribution of exotic seedlings (selfed):*

A total of 332 seedlings of exotic varieties were supplied to the different Regional Research Stations during the year. With a view to study the performance of the exotic types under varied soil and climatic conditions 22 seedlings of Indonesia (I) and (II) were distributed to a few selected growers.

*(ii) Comparative studies of selfed, crossed and open pollinated nuts:*

In a study to find out the influence of selfing, crossing (with a known pollen parent) and open pollination on kernel and embryo size it was observed that there is no significant difference in kernel or embryo size between the nuts obtained from the former two, while there was a significant increase in the length of the kernel and size of embryo (length X breadth) in the case of nuts obtained from cross, over that from open pollination. It, therefore, appears that pollen influences kernel and embryo growth in arecanut.

c) HYBRIDIZATION BETWEEN DISTINCT TYPES AND SELECTED PALMS TO COMBINE HIGH YIELD AND REGULAR BEARING AND STUDY OF PROGENIES:

With a view to combine high yield and regular bearing habit, crosses were made between selected mother palms of outstanding performance. Crosses were also effected with a view to study qualitative characters such as sweet and red kernel in arecanut as well as for combining the large size and large number of the South Kanara and Thirthahalli types respectively.

**5. Preliminary studies on progeny behaviour of mother palms:**

These studies initiated in 1960–61 in the progeny garden of the Central Station are intended to find out the extent to which the mother palm characters are inherited and how these characters differ among the progenies. For this, studies on 200 progenies of 10 mother palms selected in the above garden were discontinued from the observation and a fresh set of 300 progenies of ten mother palms which are now existing in the private gardens were selected. The progenies were grouped into the following four strata based on their yield performance in 1963–64:-

| | | | | |
|---|---|---|---|---|
| Strata | I | Palms yielding. | 0 | nuts. |
| ,, | II | ,, | 1-150 | ,, |
| ,, | III | ,, | 151-300 | ,, |
| ,, | IV | ,. | 300 and above | nuts. |

The rate of production and shedding of leaves and productive characters, such as number of female flowers produced, nut set etc. were recorded. Data gathered are given on page 22.

From the table it will be observed that there is considerable variation between the progenies of different mother palms as regards both the percentage of inflorescence produced to the leaves shed as well as the number of female flowers produced. Even though 50% of the progenies now under observation are different from those of the pervious year, it is interesting to note that the range of variation in respect of the female flower production is more or less the same as compared to that of the previous year. A similar study is also in progress at the Regional station, Peechi with 80 progenies of four mother palms. It was observed that out of the four mother palms, progenies of two (numbers 147 and 182) were late to commence flowering. While the percentage of progenies which commenced flowering was 60 for mother palm number 128, it was only 15 in the case of mother palm number 147, the other two falling in between. Variation among progenies of different mother palms was also observed as regards characters like production of inflorescence, leaves shed, production of female flowers and percentage of nut-set.

TABLE 7

**Preliminary Studies on Progeny Behaviour of Mother Palms**

| Sl. No. | Mother palm No. | Total No.of leaves shed | Total No.of inflore-scences produced | Percentage of inflore-scence produced | Mean No.of female flo-wers produc-ed per palm | Percentage of set (Recorded after two months) |
|---|---|---|---|---|---|---|
| 1 | SDK 4 | 213 | 133 | 62.40 | 936.00 | 29.50 |
| 2 | SDK 6 | 201 | 126 | 62.60 | 897.00 | 22.83 |
| 3 | SDK 14 | 219 | 166 | 75 70 | 1017.93 | 18.05 |
| 4 | KMJ 13 | 200 | 120 | 60.00 | 852.73 | 19.03 |
| 5 | SRJ 6 | 216 | 190 | 87.40 | 1088.17 | 20.14 |
| 6 | KKF 9 | 189 | 131 | 69.30 | 977.47 | 18 83 |
| 7 | KKF 23 | 205 | 146 | 72 40 | 971.60 | 18.87 |
| 8 | KKF 28 | 213 | 165 | 77.40 | 1136.97 | 20.50 |
| 9 | KKF 24 | 201 | 136 | 69.10 | 1366.40 | 18.32 |
| 10 | KKF III | 225 | 177 | 79.10 | 1247.30 | 18.86 |

**6. Effect of selection of seednuts on germination and future performance:**

This experiment was initiated during 1963-64 with a view to find out how far the selection of mother palms and seednuts influences germination and turn over of quality seedlings in the primary and secondary nurseries as well as their performance in the main field. The experiment was laid out with the following treatments on a 4 x 6 randomised block design.

Tr. 1. Unselected bulk nuts.
Tr. 2. Selected bulk nuts.
Tr. 3. Unselected nuts from mother palms.
Tr. 4. Selected nuts from mother palms.

All the sprouts after germination were transplanted to the secondary nursery during the month of July, 1964. Growth measurements of individual seedlings were recorded in June, 1965 and the data statistically analysed. The results showed that the treatment differences do not have any significant effect on the growth measurements of the seedlings. It was, however, observed that in respect of all growth attributes studied there is a trend in favour of selection of seednuts which is in conformity with the results obtained in the primary nursery of these seedlings.

The same experiment was repeated during the current year with the same set of treatments as in 1963-64 using the same mother palms. Fifty nuts were sown under each treatment after recording the weight of individual nuts and the germination data recorded. The sprouts when about six months old were classified as vigorous, normal and rejected groups and transplanted to the secondary nursery. The growth measurements of the sprouts were also recorded prior to planting. The data were statistically analysed and the results are given in the table on page 24. It will be seen from the table that excepting for Bartlett's index none of the other characters are statistically significant. Results obtained during the previous year had shown that there was significant difference in respect of all the attributes studied excepting the percentage of rejected seedlings. However, the percentage of germination obtained during the current year show a trend in favour of selection of seednuts which is in conformity with that obtained in the previous year.

During the current year the above experiment was also further modified with the addition of four more treatments and laid out on an 8 x 3 randomised block design with the following treatments:

Treatments 1 Unselected bulk nuts.
,, 2 Selected bulk nuts.
,, 3 Unselected nuts from mother palms.
,, 4 Selected nuts from mother palms.
,, 5 Unselected nuts from non-prepotent mother palms.

TABLE 8

**Germination and Growth Measurements. (1964-65)**

| Treatment | Germination Percentage | Bartlett's index | Diameter (cm.) | Height (cm.) | No. of leaves | Percentage of vigorous sprouts | Percentage of rejected sprouts |
|---|---|---|---|---|---|---|---|
| 1 | 92.7 | 0.81 | 0.92 | 38.33 | 2.38 | 39.49 | 2.88 |
| 2 | 97.0 | 0.82 | 0.94 | 39.25 | 2.35 | 36.89 | 2.08 |
| 3 | 95.3 | 0 75 | 0.94 | 37.74 | 2.26 | 29.06 | 2.13 |
| 4 | 96.3 | 0.77 | 0.85 | 37.05 | 2.28 | 27.91 | 5.38 |
| S.E. per plot. | 3.35 | 0.05 | 0.11 | 2.95 | 0.14 | 14.76 | 2.41 |
| Overall mean | 95.65 | 0.79 | 0.91 | 38.12 | 2.32 | 33.34 | 3.12 |
| C.V. (%) | 3.50 | 6.33 | 12.00 | 7.74 | 6.00 | 44.00 | 77.00 |
| S.E. per treatment mean | 1.37 | 0.02 | 0.04 | 1.20 | 0.06 | 6.02 | 0.98 |
| C.D | .. | 0.05 | .. | .. | .. | .. | .. |

Treatments 6 Selected nuts from non-prepotent mother palms.
„ 7 Unselected nuts from prepotent mother palms.
„ 8 Selected nuts from prepotent mother palms.

Fifty nuts were sown under each treatment after recording the weight of individual nuts. The germination data were recorded and the sprouts were transplanted to the secondary nursery on the same design, after classifying them into vigorous, normal and rejected groups. The growth measurements of the sprouts were recorded prior to transplanting and the data statistically analysed. The results are given in the table (Vide P. 26). From the table it will be seen that the treatments do not differ significantly except for the percentage of vigorous sprouts. It will also be observed that there is a distinct trend in favour of selection of seednuts in respect of germination percentage and number of leaves. While discussing the results obtained in the previous year it had been indicated that the ineffectiveness of mother palm selection then observed might probably be due to the fact that the mother palms involved were the ones having poor progeny performance. Accordingly in the present experiment based on the progeny performance prepotent and non-prepotent mother palms were included. It will be observed from the data that both these sets of mother palms have given higher percentage of vigorous seedlings. The improved performance of the non-prepotent mother palms is now found to be due to the fact that the progenies of these mother palms have improved in their yield during the current year and thus being not actually non-prepotent ones as originally thought to be.

## II. Root studies

### 1. Root studies at different ages and under different soil conditions in adult palms

In order to gather comprehensive information on the rate of development and the pattern of growth of the root system of areca palms in different types of land and under different soil conditions, it was decided to plant arecanut seedlings in each of the following three types of land on which arecanut is planted in this tract, for study of the root development at periodical intervals.

1. 'Bettu' or single crop paddy land.
2. Newly terraced hill side.
3. Low lying land subject to occasional water logging.

The 85 plants planted in 'Bettu' land, two years back were maintained by giving timely cultural and manurial operations. The remaining plantings will be taken up as soon as the required land becomes avilable.

TABLE 9

**Germination and Growth Measurements**

| Treatment | Germination Percentage | Bartlett's index | Diameter (cm ) | Height (cm.) | No. of leaves | Percentage of vigorous sprouts | Percentage of rejected sprouts |
|---|---|---|---|---|---|---|---|
| 1 | 92.0 | 0.81 | 0.90 | 38.19 | 2.18 | 22.05 | 2.14 |
| 2 | 96.0 | 0.81 | 0.97 | 39.19 | 2.26 | 38.52 | 3.51 |
| 3 | 95.3 | 0.79 | 1.02 | 40.21 | 2.27 | 32.56 | 1.39 |
| 4 | 96.7 | 0.75 | 0.83 | 38.69 | 2.35 | 28 74 | 5.14 |
| 5 | 94.7 | 0.73 | 0 98 | 38.21 | 2.49 | 41.16 | 6.25 |
| 6 | 96.7 | 0.71 | 0.97 | 39.06 | 2 66 | 52.54* | 4.23 |
| 7 | 90.0 | 0.74 | 0.87 | 35.49 | 2.24 | 39.68 | 3.56 |
| 8 | 94.6 | 0.75 | 0 94 | 36.87 | 2.39 | 36.92 | 5.42 |
| S. E per plot | 4.64 | 0.04 | 0.10 | 2.79 | 0.17 | 8.47 | 4.43 |
| Overall mean | 94.49 | 0.76 | 0 95 | 38.24 | 2.36 | 36.52 | 3.96 |
| C. V. (%) | 4 91 | 5.26 | 1.08 | 7·30 | 7.20 | 23.19 | 111.87 |
| S. E. per treatment mean | 2.68 | 0.03 | 0.06 | 1.01 | 0.09 | 4.89 | 2.55 |
| C. D. | .. | .. | .. | .. | .. | 14.30 | .. |

*Significant at 5% level.

**2. Root studies in seedlings at different ages:**

For the above studies roots of seedlings of different ages were collected and fixed in FAA.

**3. Root studies in plants showing symptoms similar to 'Band':**

Eight seedlings showing 'Band' symptoms transplanted in the main field along with equal number of normal seedlings were under observation during the period. Roots were collected from a diseased palm and stored for taking up the study.

## III. Anatomical studies

**1. Structure and development of fruit in arecanut growing under high and low altitudes:**

A preliminary survey of higher altitudes of Coorg District was undertaken during the previous year with a view to find out the maximum altitude upto which arecanut was grown in this District. Arecanut was found to be grown upto 3,900 ft above mean sea level. Fruits from different altitudes will be collected for anatomical studies.

**2. Study of the structure of roots in diseased and healthy plants:**

Roots of healthy palms were collected and fixed.

## IV. Cytological studies

**1. Standardisation of cytological techniques:**

In order to find out a suitable fixative for PMC studies, Carnoy's solutions having different proportions of alcohol, chloroform and acetic acid were tried. It was observed that Carnoy's solution having a proportion of 6:3:1 (alcohol:chloroform:acetic acid), give better smears than the rest.

**2. Study on meiosis in different ecotypes and species of arecanut:**

Male flowers of appropriate age of *Areca triandra* and different types of *Areca catechu* were fixed for study. Microsporogenesis of the different exotic species using the usual acetocarmine smear technique will be taken up

## V. Physiological studies

**1. Studies on fruit setting and shedding:**

SUPPLEMENTING NATURAL POLLINATION BY SPRAY METHOD TO IMPROVE SET

In order to find out the economic feasibility of assisted pollination a large scale trial was initiated during the current year. Pollen suspension was made in 0.5% sucrose + 0.1% agar medium and the female flowers were sprayed by using a pressure sprayer The trial was taken up on 132 palms with an equal number of palms as control. Data gathered on nut set were statistically analysed, when it was seen that the

treatments do not differ significantly. However, assisted pollination gave an increase of 2% of fruit-set over the control.

**2. Inducing mutations in arecanut:**

With a view to increase genetic variability in the existing materials so as to get types with reduced height (dwarf) and types having less astringency and disease resistance particularly against yellow leaf disease and 'koleroga' the following treatments with mutagenic agents were initiated in 1960–61.

a) BY IRRADIATION OF SEEDNUTS WITH THERMAL AND PILE NEUTRONS

Seedlings obtained from seednuts irradiated with Thermal neutron and planted in the main field were under observation.

b) BY IRRADIATION WITH GAMMA RAYS

During the current year 200 seednuts were irradiated at the Gamma cell of the Indian Agricultural Research Institute, at intensities of 5000 r. and 10000 r. and were sown for germination. The nuts gave 87.0 and 86.3 per cent germination respectively.

c) BY CHEMICALS (COLCHICINE)

During the year 1963-64, 250 sprouts were treated with colchicine and the seedlings are in the secondary nursery. A total number of 22 seedlings obtained from earlier treatments were planted in the main field during the year.

**3. Effect of plant regulators on growth:**

In order to find out the effect of Gibberellic acid on fruit-set as well as on fruit growth, female flowers were given two rounds of spray with different concentrations of Gibberellic acid (50, 250, 500 and 1000 ppm.) during the previous year on four bunches in four palms, different rachis of the same bunch getting all the treatments. The nuts under the trial were harvested and their measurements recorded. The results showed that though none of the treatments are significantly superior to control, spraying of inflorescence with Gibberellic acid at 1000 ppm. gives about 10% increase in fruit-set over control. Unlike N. A. A. in which increased fruit-set was accompanied by abnormal decrease in fruit size, in the case of Gibberllic acid fruit size has not been affected by the increased set. The same experiment was repeated during the current year with a slightly different concentration of Gibberellic acid for confirming the observations made earlier on fruit-set and fruit size. Female flowers which were given two rounds of spray with Gibberellic acid at concentrations of 500, 1000, 2000 and 3000 ppm. gave a fruit-set of 46.0, 48.8, 52.6 and 40.6 respectively, the fruit-set in the control being 35.1%. It will thus be seen that bunches treated with Gibberellic acid at 2000 ppm. have given an increased fruit-set of 14% over the control It will also be observed that the 1000 ppm. concentration has given a 10% increase similar to what was obtained in the previous year. Higher concentration of 3000 ppm. has reduced the set.

**Miscellaneous**

**Polyembryony**

The 19 twin seedlings which were separated and planted were manured and cultural operations were attended to as per schedule.

**Technical Programme For 1965-66**

| Item No. in the technical programme | Name of the experiment | Venue of work |
|---|---|---|
| **I Breeding and genetics of areca** | | |
| 1 | Introduction and maintenance of indigenous and exotic species and types of areca for selection and hybridisation | Vittal, Palode, Hirehalli, Peechi, Kahikuchi and Mohitnagar |
| 2 | Survey of arecanut gardens to select superior types and assessing genetic variation | ,, |
| 3 | Floral biology of areca | |
| (a,b) | Study of the range of variation in flowering | Vittal and Peechi |
| (c) | Studies on early bearing habit and its correlation with fruit production | ,, |
| (d) | Floral initiation | Vittal |
| (e) | Study of pollen | Vittal |
| 4 | Hybridisation and selection | |
| (a) | Production of inbred lines of distinct types | Vittal |
| (b) | Hybridisation between distinct types and selected palms to combine high yield and regular bearing, and study of progenies | Vittal |
| (c) | Hybridisation between exotic and indigenous types | Vittal |
| 5 | Preliminary studies on progeny behaviour of mother palms | Vittal and Peechi |
| 6 | Effect of selection of seednut on germination and future performance | Vittal |
| **II Anatomical studies** | | |
| 1 | Structure and development of fruit in arecanut growing under high and low altitudes | Vittal |
| 2 | Study of the structure of roots of diseased and healthy plants, with a special reference to 'Band' disease | Vittal |
| 3 | Study of the anatomy of the leaf of the different ecotypes | Vittal |

III **Cytological studies**

| | |
|---|---|
| 1 Study of meiosis in different ecotypes of arecanut | Vittal |
| 2 Karyomorphological studies in different types and species of areca | Vittal |

IV **Physiological studies**

| | |
|---|---|
| 1 Studies on fruit setting and shedding | Vittal |
| 2 Inducing mutations in arecanut | Vittal |
| (a) By irradiation of seednuts (thermal and pile neutrons, X-ray and Gamma rays) | |
| (b) By chemicals | |
| (c) By the use of irradiated pollen in pollination | |
| 3 Effect of plant regulators on growth | Vittal |

**Agronomy**

VI **A. Standardisation of nursery practices**

Experiments for standardising the nursery practices were in progress at the Central and Regional Stations.

1 **Sowing experiments:**

c, f) EFFECT OF DIFFERENT SPACING-CUM-EFFICIENCY OF SOWING UNSPROUTED AND SPROUTED SEEDS ON SEEDLING PERFORMANCE.

This experiment is intended to find out the effect of sowing seed arecanuts directly in the secondary nursery as against transplanting the sprouts after germination, on seedling growth and the optimum spacing that is to be given in the secondary nursery when these methods are adopted. The experiment was initiated at the Central Station in 1959-1960 and repeated in 1960-61 and 1961-62. In each year, the trial was laid out on an 8 X 4 randomised block design with the following treatments.

A. Nature of the seed arecanut:

1 Unsprouted
2 Sprouted

(in both cases the sowing was done on the same day).

B. Spacing given

1 9″ X 9″,
2 12″ X 12″,
3 15″ X 15″ and
4 18″ X 18″.

The growth measurements of seedlings for the three years were analysed and the results furnished in the annual reports of the respective years. The data for the three years were pooled and analysed for height, girth and number of leaves. The means pooled over the three years are given on page 32.

It will be seen from the table that sowing unsprouted seednuts gives seedlings with significantly more height and girth than those from sprouted seednuts. In the case of number of leaves, though the treatments difference is not significant the trend is in favour of sowing unsprouted seednuts.

Spacing does not have any significant influence on the growth measurements examined. However, 12" x 12" spacing recorded increased height and number of leaves as compared with other spacings. The experiment has been concluded.

The above experiment had also been laid out at the Regional Arecanut Research Station, Mohitnagar. The results obtained at this centre also showed that unsprouted seeds when sown produce seedlings with more height, number of leaves and girth than sprouted seeds.

e) EFFECT OF DIFFERENT INTENSITIES OF SHADE IN SEED BED AND SECONDARY NURSERY BEDS ON GROWTH PERFORMANCE OF SEEDLINGS:

This experiment is a modification of the trial, "Effect of different intensities of shade in the seed bed and in the secondary nursery on the growth performance" conducted in earlier years. The three treatments viz. no shade, partial (filtered sun light through unplaited coconut leaves) shade and complete (no light) shade given to the nuts in the primary nursery of the original trial were continued, but in the secondary nursery the following treatments were given:-

| | | |
|---|---|---|
| 1 | No shade in the primary nursery | and no shade in the secondary nursery. |
| 2 | ,, ,, | and partial shade in the secondary nursery. |
| 3 | ,, ,, | and complete shade in the secondary nursery. |
| 4 | Partial shade in the primary nursery | and no shade in the secondary nursery. |
| 5 | ,, ,, | and partial shade in the secondary nursery. |
| 6. | ,, ,, | and complete shade in the secondary nursery. |
| 7 | Complete shade in the primary nursery. | and no shade in the secondary nursery. |
| 8 | ,, ,, | and partial shade in the secondary nursery. |
| 9 | ,, ,, | and complete shade in the secondary nursery. |

TABLE 10

Mean Growth Measurements

| Spacing B | Height (cm.) | | | Girth (cm.) | | | No. of leaves | | |
|---|---|---|---|---|---|---|---|---|---|
| | Un-sprouted | Sprouted | Mean | Un-sprouted | Sprouted | Mean | Un-sprouted | Sprouted | Mean |
| | A | | | A | | | A | | |
| 9" x 9" | 56.23 | 48.35 | 52.29 | 1.66 | 1.06 | 1.36 | 3.48 | 3.41 | 3.44 |
| 12" x 12" | 58.88 | 52.75 | 55.82 | 1.86 | 1.59 | 1.72 | 3.71 | 3.63 | 3.67 |
| 15" x 15" | 57.63 | 47.32 | 52.47 | 2.02 | 1.42 | 1.72 | 3.64 | 3.46 | 3.55 |
| 18" x 18" | 56.79 | 48.52 | 52.65 | 2.19 | 1.56 | 1 87 | 3.54 | 3.42 | 3.48 |
| Mean: | 57.38 | 49.73 | — | 1.93 | 1.41 | — | 3.59 | 3.48 | — |
| S.E per treatment per year | | 9.50 | | | 0.36 | | | 0.47 | |
| Mean per treatment per year | | 53.31 | | | 1.71 | | | 3.53 | |
| C.V. (%) | | 17.82 | | | 21.65 | | | 13.31 | |
| S.E. of treatment mean | A | 2.74 | | | 0.10 | | | 0.14 | |
| | B | 3.88 | | | 0.15 | | | 0.19 | |
| | AB | 5.48 | | | 0.21 | | | 0.21 | |
| C.D. for A(P=0.05) | | 7.59 | | | 0.28 | | | — | |

The above modified trial was initiated at the Central Station in 1962-63 and repeated in 1963-64 and 1964-65 adopting a randomised block design replicated four times.

The germination data recorded in 1964-65 were analysed and the results show that nuts sown under no shade give significantly less percentage of germination than under either partial shade or complete shade. The mean germination percentage being 78.0, 95.0 and 94.9 respectively. It was also observed that under open conditions there was severe damage to the sprouts due to sunscorch. A count of the damaged sprouts made revealed that there was mortality upto 89.8 per cent under open whereas there was no such loss under the shaded conditions. Similar results were obtained in the trial conducted during 1963-64.

The growth measurements of seedlings of 1962-63 trial (recorded in 1963-64) were analysed and the results indicate that shade in the secondary nursery has significant influence on girth, height and number of leaves. In all the cases seedlings under no shade have recorded significantly less height, girth and number of leaves. There is no significant difference between the seedlings under partial and complete shades. The interactions between the treatments given in the primary and secondary nurseries is also not significant. Observations were also recorded on the mortality of seedlings under different treatments. It was observed that the percentage of seedlings dead in the secondary nursery is significantly more in exposed conditions, while there is significant difference between the other two treatments. The percentage of mortality under no shade, partial shade and complete shade being 87.5, 21.9 and 19.3 respectively.

The growth measurements of 1963-64 trial recorded during the year under report were statistically analysed. The results proved that, as in 1962-63 trial, no shade in the secondary nursery has significantly reduced the vigour i.e., height, girth, and number of leaves, of seedlings. Between partial and complete shades it can be seen that height of seedlings is significantly more in the latter. There is also no significant interaction between the shades provided in the primary and secondary nurseries. The data regarding the mortality of seedlings and the percentage of good seedlings fit for planting in the mainfield recorded also confirmed that as in the previous year no shade in the secondary nursery gives significantly higher percentage of mortality than both the other treatments. Similarly no shade in the secondary nursery gives significantly lesser number of quality seedlings than those under partial and complete shade. The percentages of plantable seedlings available under no shade, partial shade and complete shade being 9.9, 60.9, and 74.0 respectively.

This trial was also in progress at the Regional Centres. At the Peechi Station it was observed that different intensities of shade had no significant

effect on the percentage of germination of seednuts. As regards growth measurements it was seen that the seedlings under partial shade and complete shade were significantly taller than those in the open. Seedlings under open and partial shade produced significantly better girth and more number of leaves than those in complete shade.

The results obtained at the Hirehalli Station were more or less similar to that obtained at Peechi. The treatments did not have any significant effect on the germination percentage. Seedlings raised under complete or partial shade in the secondary nursery have recorded significantly more height and number of leaves than those under other treatment.

At Mohitnagar also similar results as above were obtained.

At the Kahikuchi Station also there was no significant difference with regard to germination as in other centres. But unlike in other centres, the difference in the growth measurements of seedlings in the secondary nursery was also not significant.

h) DETERMINATION OF OPTIMUM AGE OF TRANSPLANTING SEEDLINGS - CUM - SOWING *in situ vs.* TRANSPLANTING OF SINGLE, DOUBLE AND TREBLE TRANSPLANTED SEEDLINGS IN THE NURSERY:

Arecanut growers of different tracts use seedlings of different ages for transplanting in the main field. The practice of directly sowing the nuts *in situ* as well as transplanting seedlings raised in nurseries are also in vogue, This experiment is intended to study the relative performance of plants obtained from the seednuts which are sown *in situ* in the main-field as well as of seedlings of different ages also transplanted to the mainfield both directly as well as after transplanting them once, twice or thrice in the nursery prior to the main field planting. An observation trial to study these aspects was laid out at Central Station during 1961 with the following 8 treatments.

1 Directly sowing the seednuts in the main field.
2 Transplanting one year old seedling.
3 Transplanting two year old seedling.
4 Transplanting three year old seedling.
5 Transplanting four year old seedling.
6 Transplanting two year old seedling which had been transplanted once in the nursery.
7 Transplanting three year old seedling which had been transplanted twice in the nursery.
8 Transplanting four year old seedling which had been transplanted thrice in the nursery.

The nuts for treatment number-1 were sown in pits fo 3 feet cube at a spacing of 9′ × 9′. The seednuts of remaining treatments were sown in

the nursery beds. The germination of nuts was satisfactory and the plants were in healthy condition. From the nursery the seedlings relating to treatment 2 were planted in 1962, and 3 and 6 in July, 1963 to the main field. The seedlings pertaining to treatment number 8 were again transplanted in the tertiary nursery during July, 1964 The seedlings of treatment number 4 and 7 were planted in the mainfield during July, 1964. The seedlings of treatment number 8 and 5 will be planted in the main field during the month of July, 1965.

The growth measurements viz. girth, height and number of leaves of all seedlings of different treatments will be recorded during July, 1965.

A more or less similar trial with six treatments initiated during the previous year at the Regional Station, Kahikuchi was continued.

**Other Studies**

a) EFFECT OF DIFFERENT MEDIA AND METHOD OF RAISING SEED BEDS ON GERMINATION OF SEEDNUTS AND SUBSEQUENT ESTABLISHMENT OF SEEDLINGS IN THE SECONDARY NURSERY:

The object of the experiment is to select the best medium for the germination of seed arecanuts which will also provide the optimum conditions for the development of roots of the young sprouts so as to enable them to withstand the shock while lifting from the seed bed and to establish better in the secondary nursery after transplantation. The trial is also meant to find out the best method of forming seed beds. The media consisted of soil, sand, sand + soil (50 : 50), and burnt earth, with two types of seed beds (raised beds and trenches).

The trial first laid out during 1963-64 on a 8 x 4 randomised block design was repeated during the year at the Central station. Fifty seed arecanuts were sown under each of the above treatments. Germination counts of the seednuts were recorded once in four days. The results showed that there is no significant difference between the treatments with regard to percentage of germination and period taken to complete the same. The results are in confirmity with that of the previous year.

A trial similar to the above was conducted at the Regional Station, Mohitnagar. The results indicated that the different media had no significant influence on the growth measurements of seedlings.

b) CRITERIA FOR SEEDNUT SELECTION: INFLUENCE OF FLOATING HABITS ON PERFORMANCE OF SEED ARECANUTS.

Seed arecanuts when allowed to float in water show different floating habits It is believed that fruits that float vertically are superior as seed material to others. The trial conducted earlier at the Central Station did not show any significant difference with regard to germination of seednuts, within a bunch, possessing different floating habits. Of the

different growth measurements of the seedlings that were studied, there was no significant difference for girth and number of leaves The experiment was slightly modified and laid out during the year. Seednuts possessing different floating habits (vertically floating, horizontally floating and nuts floating at an angle-slanting) were separated out from the bulk lot of selected seednuts harvested from several mother palms, and the trial laid out on a 3 x 8 randomised block design.

The germination data in respect of the trial carried out in 1964-65 were statistically analysed. The results showed that the treatments do not have any significant effect on germination percentage. The sprouts have been transplanted to the secondary nursery.

The above trial was conducted at the different Regional Stations also. The results were in general similar to those obtained at the Central Station.

c) STUDY ON THE COMPARATIVE EFFICIENCY OF DIFFERENT METHODS OF SHADING ARECANUT NURSERIES:

The trial conducted earlier have indicated that *Coccinia indica* can be a good shade crop for arecanut nurseries. During the year the study was further extended to know how far the above shade crop compared with the usual shading practices like growing banana or putting 'Pandal'. A field trial consisting of the above three types of shades was laid out. At the end of the secondary nursery period a count of the seedlings fit for planting in the main field was made. The percentage of seedlings that are available under the different treatments were, (a) artificial shade - 88 8; (b) *Coccinia indica* - 87.3; and (c) banana - 86.7.

Thus it is evident that *Coccinia indica* is also an equally good shade crop as the common banana or pandal.

**Other nursery trials**

1. STUDIES ON THE PERFORMANCE OF NUTS GATHERED AT DIFFERENT STAGES OF MATURITY FOR SEED PURPOSE:

This experiment was taken up to study the germination capacity of nuts of different stages of maturity in order to arrive at the optimum maturity of seednuts for sowing purpose. The results of the trial conducted at the Hirehalli Station showed a significantly higher percentage of germination in the case of seednuts of 11 months maturity than those of 9 or 10 months. However, the seedling raised therefrom did not show significant difference in their vigour. Similar trial conducted at Kahikuchi recorded varying effects on the germination percentage under different treatments, though there was no significant difference in respect of growth measurements of seedlings. The results obtained at Mohitnagar also revealed no significant influence of the treatments (9 to 10½ months maturity) on the growth measurements of seedlings.

## VI. B. Cultural experiments:

### 1. Determination of optimum spacing in the main field.

The experiment is intended to determine the spacing to be given to arecanut palms in the main field to obtain optimum yield, and was planted in November 1958 at the Central Station. A randomised replicated design with six replications and a uniform plot size of 36′ x 72′ (5.69 cents) for all the treatments was adopted. The trees commenced flowering in 1962-63. The first crop of the garden was harvested in 1963-64 and the second crop in 1964-65.

Studies on the following aspects were continued to be made in the experimental garden.

Influence of spacing on (1) sun-scorch of stems; (2) leaf-fall and production of spadices; (3) number of female flowers produced and set; and (4) yield.

*(1) Influence of spacing on sun-scorch:*

Observations made during the earlier years had indicated that the number of palms affected by sun-scorch was different in different treatments, and therefore counts of the number of palms affected were repeated during this year also. The data gathered are given below:

TABLE 11

| Treatment (spacing) | Percentage of palms affected by sun-scorch | |
|---|---|---|
| | Border | Experimental |
| 6′ X 6′ | 12.04 | 0.91 |
| 6′ X 9′ | 6.77 | 3.06 |
| 6′ X 12′ | 32.77 | 19.69 |
| 9′ X 9′ | 24.30 | 10.32 |
| 9′ X 12′ | 45.94 | 54.76 |
| 12′ X 12′ | 44.44 | 66.66 |

It will be seen from the above that the percentage of palms affected by sun-scorch is higher in the widely spaced plots. The results are almost in confirmity with that of the previous year.

*(2) Influence of spacing on leaf-fall and production of spadices:*

Observations on shedding of leaves and production of spadices in individual palms of the different treatments were made throughout the year in order to study the effect of the different spacings on leaf-fall, rate of production of spadices as well as on the relationship between them. The data gathered are summarised in the table.

TABLE 12
**Leaf fall and spadix production (1964 - 65)**

| Treatments | Mean leaf-fall per palm | Mean spadi-ces per palm | Percentage of spadi-ces produced to lea-ves shed |
|---|---|---|---|
| 6′ × 6′ | 5.3 | 2.7 | 51.1 |
| 9′ × 6′ | 5.9 | 3.8 | 63.5 |
| 12′ × 6′ | 7.0 | 4.3 | 60.7 |
| 9′ × 9′ | 6.7 | 5.2 | 77.8 |
| 12′ × 9′ | 6.6 | 5.3 | 79.3 |
| 12′ × 12′ | 6.9 | 6.0 | 86.5 |

It can be seen from the above table that the number of leaves shed per palm as well as the number of spadices produced per palm increases with spacing. The percentage of spadices produced to leaves shed also increases as spacing is increased.

*(3) Influence of spacing on number of famale flowers produced and set:*

Recording of observations were confined to five trees in each treatment in each of the six replications. The data gathered are summarised and presented below:-

TABLE 13
**Production of female flowers and fruit-set (1964-65)**

| Treatment (spacing) | Average number of female flowers per spadix | Percentage of flowers set |
|---|---|---|
| 6′ x 6′ | 132.4 | 15.01 |
| 9′ x 6′ | 138.2 | 32.81 |
| 12′ x 6′ | 162.7 | 23.93 |
| 9′ x 9′ | 158.8 | 30.31 |
| 12′ x 9′ | 170.8 | 34.46 |
| 12′ x 12′ | 172.6 | 27.39 |

From the table it will be seen that there is a progressive increase in the number of female flowers produced per spadix with increase in spacing. However, the percentage of fruit-set does not show such a trend. In only one treatment (6' x 6') the fruit-set is comparatively very low.

*(4) Influence of spacing on yield:*

The second crop of the garden was harvested during the year. Data on the yield of individual palms were maintained. The yield data were statistically analysed and the results are given below:-

TABLE 14
**Yield data**
**Table of means (per plot)**

| Treatment (spacing) | 1964-65 No. of nuts | 1964-65 Weight (kg) | Cumulative yield of fruits-number for two years | % of increase of yield in 2nd year over Ist year |
|---|---|---|---|---|
| 6′ × 6′ | 2,943 | 98.54 | 4552 | 82.98 |
| 9′ × 6′ | 3,233 | 108.56 | 5005 | 82.47 |
| 12′ × 6′ | 2,794 | 93.83 | 4201 | 98.46 |
| 9′ × 9′ | 3,234 | 121.61 | 4320 | 197.92 |
| 12′ × 9′ | 2,350 | 79.56 | 3621 | 85.00 |
| 12′ × 12′ | 1,619 | 52.86 | 2051 | 274.11 |
| S. E. per plot. | | | 1,142.50 | 41.13 |
| Overall mean. | | | 2,696 | 92.50 |
| C. V. (%) | | | 42.38 | 44.46 |
| S. E. of treatment means. | | | 466.42 | 16.79 |

It will be observed from the table that treatment differences are not significant. From the trend it is seen that while 9′ x 9′ planting gives the maximum yield (both in number as well as wet weight) 12′ x 12′ planting gives the lowest yield. It will also be observed that the cumulative yield is lowest in 12′ x 12′ treatment. The pattern of increase in yield is almost uniform in all the treatments except in 9′ x 9′ and 12′ x 12′.

The yield per plot from the main harvests in the different treatments of the six replications were dried and husked separately to assess the effect of spacing if any on the out-turn and quality of the final produce The quality of the produce was evaluated at the Mangalore market The study revealed that spacing has no appreciable effect on the quality of the finished product as judged by the weight of first quality nuts *(Biligotu)* and second quality nuts *(Koka)* obtained from the different treatments and the average rates obtained.

Influence of spacing on the precocity of flowering of palms was also studied. It was seen that while 90.6 per cent of palms only flowered in 6′ x 6′ treatment plot, there was cent per cent flowering in plots planted at 9′ x 9′, 9′ x 12′ and 12′ x 12′ spacing. The percentage of palms which yielded fruits during the period was also minimum in 6′ x 6′ plot.

The spacing trial with the same treatments and design as above was also laid out in the Regional Stations at Peechi, Hirehalli, Kahikuchi and Mohitnagar in the subsequent years. The palms at Peechi have commenced bearing. The palms at Mohitnagar suffered heavy casualties due to the adverse weather conditions which prevailed in 1963 and the experiment had to be abandoned. In all the centres observations similar to those made at the Central Station and growth features of the palms were recorded.

At Peechi the leaf-fall recorded in 6′ x 6′ treatment plots was the minimum while it was maximum in 9′ x 12′ plots. The mean number of spadices produced per tree was found to be maximum in 9′ x 9′ spacing while it was minimum in 6′ x 6′ spacing. The percentage of palms flowered was also found to be maximum and minimum in 9′ x 9′ and 6′ x 6′ spaced plots respectively. Regarding flower production per tree, the same increased with increase in spacing. The percentage of flower-set was maximum in 9′ x 9′ plots. The results of observations on sun-scorch were also more or less similar to that of Central Station.

The palms of the corresponding experiment at Hirehalli and Kahikuchi were still in the pre-bearing stage.

**2. Effect of depth of transplanting seedlings - cum - intervals of irrigation:**

The depth at which arecanut seedlings are planted in the main field and the intervals of irrigation vary considerably from tract to tract and with different soil conditions. This experiment was, therefore, initiated to determine the effect of depth of planting areca seedlings in the main field and the intervals at which irrigations are to be given under the conditions prevailing in the different regions. The planting of the experiment was done in 1962 at the Peechi Station, adopting a 4 x 3 x 5 split plot design with four intervals of irrigation, and three depths of planting. The main treatment – irrigation - was superimposed from the second year after planting. Growth measurements of the palms were recorded annually. The observations made during the third year were analysed and the results are given in table below.

TABLE 15

**Growth measurements of palms**

atments: *Main treatments*

1. No irrigation
2. Irrigation once in three days.
3. Irrigation once in six days.
4. Irrigation once in nine days.

*Sub-treatments*

1. Planting at 12" depths.
2. Planting at 24" depths
3. Planting at 36" depths.

i) Height (cm )

| Main treatments | Sub-treatments | | | Mean |
|---|---|---|---|---|
| | S1 | S2 | S3 | |
| M1 | 255.44 | 282.78 | 309.78 | 282.67 |
| M2 | 310 33 | 336.89 | 386.58 | 344.60 |
| M3 | 314.31 | 329.55 | 376.44 | 340.10 |
| M4 | 301.66 | 323.62 | 358.28 | 328.50 |
| Mean. | 295.44 | 318.71 | 357.75 | 323.97 |

ii) Girth at collar (cm.)

| Main treatments | Sub-treatments | | | Mean |
|---|---|---|---|---|
| | S1 | S2 | S3 | |
| M1 | 30.09 | 34 31 | 33.82 | 32.74 |
| M2 | 41.24 | 41.71 | 44.55 | 42.50 |
| M3 | 41.58 | 41.55 | 42.13 | 41.76 |
| M4 | 37.73 | 38.47 | 40.11 | 38.77 |
| Mean. | 37.66 | 39.01 | 40.15 | 38.24 |

iii) Number of leaves

| Main treatments | Sub-treatments | | | Mean |
|---|---|---|---|---|
| | S1 | S2 | S3 | |
| M1 | 7.83 | 7.49 | 7.62 | 7.55 |
| M2 | 7.82 | 8.04 | 8.44 | 8.10 |
| M3 | 7 60 | 7.97 | 8.29 | 7.95 |
| M4 | 7.67 | 8.11 | 8.24 | 8.01 |
| Mean. | 7.65 | 7.90 | 8.15 | 7.90 |

| | Height | Girth | No. of leaves |
|---|---|---|---|
| S. E. of difference of two means for main treatments. | 9.00 | 0.85 | 0.15 |
| C. D. for main treatments. | 19.61 | 1.85 | 0.33 |
| S. E. of difference of two means for sub-treatments. | 5.99 | 0.85 | 0.11 |
| C. D. for sub-treatments. | 12.23 | 1.74 | 0.22 |
| S. E. of difference of two means for interaction M x S | 18.96 | 1.70 | 0.20 |
| S. E. per plot. | 18.96 | 2.69 | 0.31 |
| General mean. | 323.97 | 38.94 | 7.90 |
| C. V. (%). | 5.85 | 6.65 | 3.92 |

It can be seen from the table that main treatment number 1 (no irrigation) has significantly reduced the height, girth and number of leaves of palms. The values for these characters were maximum in plots receiving irrigation once in three days. Planting at 36″ depth has given significantly greater height and number of leaves than planting either at 12″ or 24″ depth. Planting at 12″ depth has recorded significantly poor performance of the seedlings as judged by height and number of leaves. The same experiment was initiated at Kahikuchi and Mohitnagar in 1962-63 and at Hirehalli in 1963-64 with slight changes in the intervals of irrigation and depths of planting depending upon the conditions prevailing in each region The main treatment intervals of irrigation has not been superimposed in those centres.

At Central Station the field for planting the experiment was prepared and the required seedlings were raised.

**4. Study of inter crops in arecanut gardens.**

This study is intended to find out whether growing of certain inter and associate crops in arecanut gardens has any adverse effect on the performance of the palms. The trial was laid out at the Peechi Station in 1964 adopting a 5 x 5 Latin square design. The treatments consisted of (1) control (no intercrop), (2) banana, (3) colocasia *(Colocasia antiquorum)*, (4) pineapple and (5) elephant-foot-yam *(Amorphophallus campanulatus)*. Observations made on the growth measurements of the main crop of arecanut palms did not reveal any significant effect of the inter-crops on the former. Only elephant-foot-yam and colocasia came to harvest during the period and the performance of elephant-foot-yam was quite satisfactory. The estimated yield from the two crops were 10,855 kg and 3.445 kg per hectare respectively.

A similar trial as above was also initiated at Kahikuchi using five inter crops viz. banana, pineapple, ginger, guinea grass and betelvine.

At the Central Station specimen plot consisting of banana, pine-apple, ginger, arrow-root, and guinea grass was planted for studying their performance.

**5. Comparative studies of different green manure-cum-cover crops for arecanut gardens:**

The trial was laid out at the Regional Station, Peechi, with four treatments, viz. (1) control (no crop), (2) *Calapogonium muconoides*, (3) *Pueraria phaseoloides*, and (4) *Mimosa invisa*. The effect of the cover crops on the performance of arecanut palms was studied. There was no significant difference in the rate of growth of palms in plots grown with cover crops. The maximum green matter yield of 14.9 tonnes per hectare was obtained from *P. phaseoloides*.

An observational trial with nine crops carried out at the Central Station indicated that crops of *Pueraria javanica*, *Calapogonium muconoides*, and *Stylosanthes gracilis* can come up well under the canopy of areca palms.

**7. Effect of growing banana in arecanut gardens for different durations:**

Banana is the most common intercrop grown in arecanut gardens of almost all the arecanut growing tracts. It is a food crop which gives an income of nearly Rs. 200/- to Rs. 300/- per acre per annum when grown as an intercrop. In addition, the crop is also believed to benefit the arecanut crop by providing microclimatic and soil conditions optimum for the growth of the arecanut palms. The trial is intended to find out the effect of growing banana as an intercrop in arecanut gardens.

The planting of the experiment was taken up at the Central Station in September-October, 1963, on a 8 x 4 randomised block design with the following treatments:-

1 No banana throughout the period of experiment (i.e pure plantation of arecanut crop).
2 Banana as intercrop throughout the period of experiment at full level.
3 Banana upto the end of the 3rd year at full level and no banana thereafter.
4 Banana upto the end of 3rd year at full level and at reduced level for the rest of the period of the experiment.
5 Banana upto the end of 3rd year at full level and at reduced level till the end of 6th year and then no banana thereafter.
6 Banana upto the end of 6th year at full level and no banana thereafter.
7 Banana upto the end of 6th year at full level and at reduced level thereafter for the rest of the period.
8 Banana upto the end of the 6th year at full level and at reduced level upto the end of 10th year and thereafter no banana.

*Note:* The third year corresponds to the period when majority of the palms would have formed distinct nodes. Sixth year corresponds to the period when more than 50% of the palms would have flowered. Tenth year corresponds when the garden would have attained the full bearing capacity.

The arecanut seedlings were planted at a spacing of 9′ x 9′ adopting 20 plant plot per treatment with border rows all round. The number of banana plants per plot at full level was 17 and at half level ten. Mysore poovan variety of banana was planted. Both the crops were given the cultural and manurial operations as per the schedule.

The data on growth measurements of areca palms viz. girth, number of leaves, and height recorded both in 1963-'64 and 1964-'65, showed that there is no significant difference between the two treatments (banana and no banana-the only two treatments available for comparison) in respect of any of the growth measurements studied.

A similar experiment was also initiated at the Regional Station, Kahikuchi in 1963-'64 with five treatments. The growth measurements of the arecanut plams recorded with a view to find out the effect of growing banana on the arecanut palms revealed that the former did not have any adverse affect on the vigour of the latter at the end of one year period.

**10. Mixed garden of arecanut and coconut:**

Arecanut and coconut are found grown as mixed plantations in certain areas. The object of this trial is to find out the desirability of such a practice as against raising them as pure crops. An observational trial with two treatments viz. (1) arecanut and coconut as mixed crops; and (2) arecanut as pure crop, repeated twice was laid out at Central Station during 1964. Eight coconut seedlings were planted in the trial plot during 1964. The arecanut seedlings were planted in 1965.

The arecanut seedlings were planted at a spacing of 9′ x 9′ with border plants all round and the coconut plants were planted at a spacing of 27′ x 27′.

A similar trial was also in progress at the Regional Station, Kahikuchi.

**11. Relative performance of seedlings obtained from different bunches and different positions in the bunch of mother palms of different ages:**

This is one of the trials initiated at the Central Station as a follow up of the nursery trial "Effect of age of trees, order of bunches and position of seednuts in the bunch on seednut performance". The trial is aimed at determining the performance in the main field of stock derived from seeds collected from palms of different ages (young-10 to 15 years, middle

aged – 30 to 35 years, and old palms – above 50 years). Thirtysix seedlings derived from two palms (18 seedlings per palm) for each of the above three age groups were planted out in the main field in 1962–63 at a spacing of 9′ x 9′. Each group of 18 seedlings were in turn from nuts collected from three bunches of the palms at the rate of six nuts each. These nuts were in turn from nuts selected from the bottom, middle and top portions of the concerned bunch at the rate of two each. There are thus 108 seedlings for the trial. All the plants are coming up well.

**12. Studies on the performance of nuts gathered at different stages of maturity:**

With a view to find out the performance in the main field of palms derived from nuts collected at different stages of maturity such as nine, nine-and-a-half, ten and ten-and-a-half months, an observational main field trial was laid out at the Central Station during 1962-63. Fifteen seedlings were planted under each treatment. The planting material for the above trial was obtained from a corresponding nursery trial conducted earlier and thus this is a follow up of the nursery trial. The palms were given uniform cultural and manurial treatments during the year and they recorded satisfactory growth.

**13. Effect of different spacing and method of lay out on the incidence of sun-scorch on arecanut palm:**

Arecanut palms are highly susceptible to sun-scorch, particularly in situations where the plantations are exposed to the south-western sun. This is more so in South Kanara and North Kerala regions. In advanced stages of scorching the stem breaks off and the tree dies. There is a belief among the growers that aligning the trees in north-south direction reduces such damage due to the protection that each successive tree in the row gives to the next tree. This experiment initiated at Central Station to find out to what extent this belief is true, was laid out in November, 1960. The plants were spaced at 8′ x 8′, 9′ x 9′ and 12 x′ 12′ quincunx. One set of such trees was aligned in north-south direction and another set at an inclination of 20° to north-south direction. The palms have not attained the height and spread required to give the expected protection to the neighbouring palms. Yet a count of palms showing symptoms of sun-scorch was made. The data showed that there is appreciable variation in the number of palms showing bronzing due to sun's rays. The protection afforded is maximum in 12′ x 12′ (Quincunx) plot planted north-south, and minimum in 9′ x 9′ - 20° to north-south.

**14. Mulching trial—A comparison of different mulches in arecanut gardens.**

A trial to compare the utility of different mulching materials for arecanut gardens was laid out in the bulk garden of the Central Station

adopting a complete randomised block design with four plots per treatment. The following treatments were imposed:-

1 Mulching with chopped arecanut leaves.
2 Mulching with Guatemala grass.
3 Mulching with arecanut husk.
4 Mulching with dry leaves collected from forest.
6 No mulch (control).

The mulching materials were respread during the year. Observations on soil moisture retention in the trial plots at two intervals after irrigation during summer months were made with a view to reduce the number of irrigation if possible. Soil samples were taken from two depths viz. (1) 0 to 6" and (2) 6" to 12"; twice (1) in the middle of two irrigations and (2) just before the succeeding irrigation, the interval between two irrigations being seven days and moisture determined. It was observed that moisture retention is more in the mulched plots as compared to the control (no mulch) plot both in the sub-soil and surface soil. It was also seen that of the different mulches used, chopped arecanut leaves had helped to conserve moisture better than the rest. From observations made with regard to weed growth which is common in arecanut gardens under irrigated conditions, it was seen that the mulches have suppressed the weed growth considerably. Studies on the effect of mulching on fruit-set and shedding was also commenced during the year.

VI. **C. Manurial experiments:**

**2. N.P K. Manurial experiment on arecanut:**

This experiment was laid out both at Central and Regional Stations to find the N.P.K requirements of arecanut palm under varied soil and climatic conditions. It was laid out in 1961 at the Central Station on a $3^4$ confounded factorial design as a single replicate in nine-plot blocks with 20 palms per treatment The plots have been provided with a common guard-row, but separate guard-rows have been provided between blocks.

The following are the treatments:-

| Nutrients or manure: | Levels: | | | |
|---|---|---|---|---|
| Nitrogen (N) | 0 | 25 | 50 | Kilograms per 500 palms (full dose) |
| Phosphoric acid ($P_2 O_5$) | 0 | 20 | 40 | |
| Potash ($K_2 0$) | 0 | 35 | 70 | |
| Green leaf (G) | 0 | 3400 | 6800 | |

The growth measurements viz. girth at last exposed node, height number of functioning leaves and number of exposed nodes were recorded. Collection of soil samples was done prior to the application of manures. Composite samples of soil were collected at three depths viz. O to 15 cm, 15 to 45 cm, and 45 to 90 cm, (o to 6", 6" to 18", and 18" to 36"). Application of the third year dose (3/5 of the full dose) of different manurial ingredients was done in the month of October, 1964 as per schedule.

The data on the growth measurements. were statistically analysed The results are presented in pages 48 and 49.

From the above data the following inferences may be drawn in respect of the influence of the manuring on various growth measurements.

*(a) Nitrogen (N):* The main effects of nitrogen are significant for girth at the last exposed node, number of leaves as well as number of exposed nodes of the palms. Both the levels of nitrogen have significant influence on the above growth characters although difference among themselves is not significant.

*(b) Phosphoric acid* ($P_2 O_5$) *and Potash* ($K_2 O$): The influence of both these nutrients has not been significant on any of the growth measurements studied.

*(c) Green leaf (G):* Green leaf at both levels has influenced significantly the characters such as girth at the last exposed node, height, and number of leaves. The influence of $G_1$ and $G_2$ are not significantly different among themselves.

*(d) Interactions:* In the case of the interactions, only NK and PK have significantly influenced the production of the number of leaves.

Thus the above results go to broadly indicate that nitrogen has significant influence on all the growth characters except height while green leaf has influenced characters like girth, height and number of leaves of the arecanut palm.

Out of 1620 experimental palms a total of 47 have flowered and out of 1118 border palms 40 have flowered.

Observations on leaf-fall of individual palms are being recorded. The general condition of the individual palms also is being recorded prior to commencement of manuring.

The above experiment with same treatments and design was laid out at Peechi in 1961. The results of analysis of growth measurements of seedlings gathered are given in the table on page 50.

TABLE 16

**Growth Measurements (1964-65)**

**Treatment means**

**(i) Table of main effects**

| | Height (cm) | | | Girth (cm) | | | No. of leaves | | | No. of exposed nodes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 | 2 |
| N | 287.19 | 324.16 | 317.24 | 28.06 | 30.44 | 30.33 | 6.52 | 6.66 | 6.94 | 6.35 | 7.25 | 7.05 |
| P | 297.68 | 311.36 | 319.54 | 28.84 | 29.72 | 30.28 | 6.71 | 6.76 | 6.87 | 6.53 | 6.94 | 7.20 |
| K | 305.75 | 312.88 | 309.96 | 29.65 | 29.79 | 29.40 | 6.87 | 6.78 | 6.67 | 7.07 | 6.89 | 6.71 |
| G | 283.89 | 314.63 | 330.06 | 27.34 | 29.97 | 31.53 | 6.41 | 6.80 | 7.11 | 6.67 | 6.97 | 7.04 |

**(ii) Table of two factor interactions**

**(a) N x K Table**

| | Height (cm) | | | Girth (cm) | | | No. of leaves | | | No. of exposed nodes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $K_0$ | $K_1$ | $K_2$ | $K_0$ | $K_1$ | $K_2$ | $K_0$ | $K_1$ | $K_2$ | $K_0$ | $K_1$ | $K_2$ |
| $N_0$ | 287.07 | 293.08 | 281.22 | 28.35 | 28.56 | 27.27 | 6.62 | 6.63 | 6.40 | 6.46 | 6.40 | 6.20 |
| $N_1$ | 337.53 | 307.07 | 327.86 | 31.80 | 29.30 | 30.22 | 7.28 | 6.60 | 6.70 | 7.75 | 6.90 | 7.11 |
| $N_2$ | 292.64 | 338.28 | 320.79 | 28.81 | 31.50 | 30.73 | 6.81 | 7.12 | 6.89 | 6.99 | 7.37 | 6.81 |

(b) P x K Table

| | Height (cm) | | | Girth (cm) | | | No. of leaves | | | No. of exposed nodes | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $K_0$ | $K_1$ | $K_2$ | $K_0$ | $K_1$ | $K_2$ | $K_0$ | $K_1$ | $K_2$ | $K_0$ | $K_1$ | $K_2$ |
| $P_0$ | 271.29 | 298.79 | 322.96 | 27.50 | 29.13 | 29.89 | 6.49 | 6.74 | 6.91 | 6.19 | 6.53 | 6.87 |
| $P_1$ | 323.52 | 319.55 | 291.01 | 30.58 | 30.50 | 28.06 | 6.99 | 6.86 | 6.45 | 7.59 | 6.97 | 6.27 |
| $P_2$ | 322.44 | 320.79 | 315.90 | 30.87 | 29.73 | 30.25 | 7.12 | 6.76 | 6.63 | 7.43 | 7.18 | 6.99 |
| Overall mean | | 309.53 | | | 29.61 | | | 6.77 | | | 6.89 | |
| S.E. per plot | | 60.90 | | | 2.92 | | | 0.47 | | | 1.06 | |
| C.V. (%) | | 20.00 | | | 10.00 | | | 7.00 | | | 15.00 | |
| S.E. for different N, P, K and G | | 16.57 | | | 0.79 | | | 0.13 | | | 0.29 | |
| S.E. for different N. P. | | 28.70 | | | 1.38 | | | 0.22 | | | 0.50 | |
| C.D. for G (P = 0.05) | | 33.47 | for N & G | | 1.60 | for N and G | | 0.26 | | for N | 0.59 | |
| C.D for PK and NK | | — | | | | | | 0.44 | | | | |

TABLE 17

**Growth Measurements 1964 - 65**

**Table of main treatments (adjusted)**

| | No. of leaves | | | Girth | | | Height | | |
|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 0 | 1 | 2 | 0 | 1 | 2 |
| N | 7.71 | 8.08 | 8.17 | 45.47 | 47.21 | 47.82 | 456.55 | 476.09 | 484.75 |
| P | 8.09 | 8.04 | 7.85 | 46.82 | 47.39 | 46.28 | 472.62 | 473.62 | 471.16 |
| K | 7.74 | 8.04 | 8.18 | 46.70 | 46.59 | 47.20 | 465.57 | 471.47 | 480.36 |
| G | 7.93 | 7.99 | 8.05 | 46.13 | 46.26 | 48.10 | 465.61 | 467.61 | 484.17 |

**Table of interaction (adjusted)**

N x P Table

| | No. of leaves | | | Girth (cm) | | | Height (cm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | $P_0$ | $P_1$ | $P_2$ | $P_0$ | $P_1$ | $P_2$ | $P_0$ | $P_1$ | $P_2$ |
| $N_0$ | 7.96 | 7.78 | 7.39 | 45.54 | 46.72 | 44.14 | 458.92 | 458.95 | 451.80 |
| $N_1$ | 7.92 | 8.00 | 8.34 | 46.74 | 46.87 | 48.02 | 460.87 | 470.51 | 496.90 |
| $N_2$ | 8.38 | 8.34 | 7.81 | 48.18 | 48.59 | 46.69 | 498.07 | 491.41 | 464.78 |

| | No. of leaves | Girth (cm) | Height (cm) |
|---|---|---|---|
| Mean S.E. of difference of two means for N.P. & G. | 0.15 | 0.71 | 6-74 |
| ,, NP, PK, etc. | 0.26 | 1.23 | 11.67 |
| Mean C.D. for | $N_1$ K. 0.29 | $N_1$ G. 1.39 | $N_1$ G. 13.21 |
| ,, NP. | — | — | 22.87 |
| Mean S.E. per plot | 0,55 | 2,60 | 24.77 |
| General Mean | 7.99 | 46.83 | 472.47 |
| C.V. (%). | 6.88 | 5.34 | 5.24 |

It can be seen that the effect of N. P. K. and green leaf on the vigour of seedlings is broadly in agreement to that observed at Central Station, excepting for the main effect of K and interaction of N and P. The higher levels of K ($K_1$ and $K_2$) have significantly increased the number of leaves. The interaction of $N_1 P_2$, $N_2 P_0$ and $N_2 P_1$ increased significantly the height of palms as compared to the influence of other interactions. The application of P at higher levels along with $N_2$ showed gradual reduction in the height of palms, $N_2 P_2$ being significantly lesser in height than that of $N_2 P_1$ and $N_2 P_0$. It is also interesting to observe that the percentage of palms flowered as well as the mean number of spadices produced per plot progressively increased with increase in levels of N., K. and green leaf (G).

The same experiment was initiated at Hirehalli and Kahikuchi in 1962–63. Annual growth measurements of the palms were recorded.

**4. Effect of applying N. P. K. in organic and inorganic forms on palm performance:**

There is a common belief among the growers that application of inorganic manures if continued for a very long time, exhausts the palms and shortens their economic life. There is also a belief that if a garden which has been receiving fertilisers is changed over to organic manures, the tree refuses to respond. This experiment was programmed for the Central Station to determine how far the above notions are correct.

The experiment was commenced during the year 1963–64 with four treatments and five replications. Each treatment plot consists of six experimental palms with a common border row.

The following are the treatments:-

1. N. P. K. in the form of organic manures from the end of sixth year till the end of 15th year.
2. N. P. K. in the form of inorganic manures from the end of sixth year till the end of 15th year.
3. N.P.K. in the form of organic manures till the end of 10th year and then inorganic manures till the end of 15th year.
4. N.P.K. in the form of inorganic manures till the end of 10th year and then organic manures till the end of 15th year.

The above treatments are superimposed over a uniform basic dose of green leaf and cattle manure (or compost) at 12 kg. per palm.

Doses of manures:-

| | | | |
|---|---|---|---|
| N | .. | 25 kg. | per 500 palms |
| $P_2 0_5$ | .. | 25 kg. | |
| $K_2 0$ | .. | 40 kg. | |

Form:-

Inorganic - Ammonium sulphate.
Super phosphate.
Muriate of potash

Organic - Fish meal and Wood ash

The second dose of manures was applied during the month of October, 1964.

The soil samples of different plots representing the depths 0"-6", 6"-18" and 18"-36" were collected for analysis.

The growth measurements viz. girth at permanent mark, girth at last node, number of nodes above the mark, height from the mark to the last node and number of functioning leaves were recorded. The yield data of individual palms were also recorded. Studies were also initiated to find out to what extent the fertilisers will have effect on flower production and set.

VI. D. Miscellaneous

1. Uniformity trials: Collection of yield data of palms:

*(a) In private gardens:* (progenies of unkown mother palms)

This study which was initiated at the Central Station in 1958-'59 in a private garden is intended to determine the optimum number of palms required for the experimental plots and the shape of such plots. Five hundred and seventy palms of fairly uniform age and growth were selected initially. These palms were being given uniform manurial and cultural treatments from the time of planting.

Yield data of these palms were regularly recorded since 1958-59 season onwards upto 1962-63 season, and the same got analysed. For the purpose of analysis a compact block of 12 rows x 12 columns (144 palms) where four trees formed a 8½ ft square was taken as a sample. It was seen that increasing the number of trees per plot beyond 12 did not give any appreciable gain in the precision. It was also seen that long and narrow plots were less efficient as compared with square plots.

Data on the yield of 144 palms recorded during 1964-65 were analysed and the results showed that as the plot-size is increased the co-efficient of variation decreases. The decrease in the co-efficient of variation is found to be more rapid along the rows. Increasing the plot-size beyond 12 palms (per plot) does not result in any appreciable reduction in co-efficient of variation except for the combination of 4 x 4 i. e , 16 trees. In general, compact blocks are found to be as efficient as long narrow plots. The study is being continued.

*(b) In the progeny garden of the Central Station:*

With a view to find out whether the observed plot size of 12 trees is required in the case of selected progenies of known mother palms as those used for the various main field experiments, this study was taken up in the progeny garden (Block II) of the Station. A compact block of 144 palms (progenies of six known mother palms) was marked and yield data of individual palms recorded. The palms (144 in number) arranged in 12' x 12' quincunx, all plants in an individual column belonging to one mother palm. The 12 columns belonged to six different mother palms.

The yield data of palms for the year 1964-65 were analysed and the results showed that the co-efficient of variation in general decreased with the increase in plot size in either direction. But when arranged in columns, increasing the plot-size beyond 12 trees does not give an appreciable reduction in co efficient of variation. Long, narrow plots are more efficient than compact plots. The same result holds good for arrangement in rows also.

When six trees per row are taken, i.e., when the plots consist of the same proportion of plants from different mother palms, the co-efficient of variation becomes constant for more than three rows. This means that the efficiency is not increased by increasing the number of palms beyond 12, when they are so arranged that all the plots contain the same proportion of palms from different mother palms. It was also seen that the variability of the yield data is of the same order as that of the yield data in the private garden where the palms were of the same age. The study is being continued.

2. & 5). **Harvesting trials:**

*a) Season-wise variation in quality of produce:*

This study was in progress at the Regional Arecanut Research Station, Peechi, for finding out the difference in quality of processed tender arecanut obtained from harvests made in different seasons of the year. A representative sample of 2000 nuts of appropriate maturity collected from 50 pre-marked palms were cured in each season of harvest. At the close of the harvest season, the produce from the diferent harvests were simultaneously evaluated. It was observed that the produce from the first harvest in August fetched the maximum price though the quantity obtained was less than that obtained from the second harvest. The produce obtained from the last harvest in November fetched the lowest price. The weight of kernel from November harvest was also low.

*(b) Quality of produce as influenced by degree of maturity:*

Areca growers are in the habit of harvesting two successive bunches at one and the same time while attending to the harvest of ripe

bunches. These two bunches would necessarily be of different maturity, the lower one being of higher maturity, than the upper in the same tree. This trial was initiated at the Central Station during 1963-'64 with a view to find out whether there is any difference as regards the quality and output of the cured produce *(Biligotu)* obtained from the fruits thus harvested from two bunches. The results indicated that nuts from the lower bunch (higher maturity) gave higher out-turn of the produce.

The trial was repeated during the current year and the results obtained showed that the fruits from the lower bunch give a higher percentage of cured produce. The quality of the produce obtained from the lower bunch was also better than that obtained from the upper bunch, the increase in price obtained being 6.7%.

**13. Mixed garden of Areca and Cacao:**

Cacao *(Theobroma cacao)* is currently assuming a great deal of importance in this country. For optimum performance, the crop requires shade both in the nursery as well as in the main field and is, therefore, grown in association with other tall growing species. Arecanut also requires shade for optimum performance, especially on the south western side to prevent scorching of the stem by the rays of the sun during the summer months. This trial has been initiated to examine the effect of cacao as an inter crop in arecanut plantation and its effect on the growth and yield of both arecanut and cacao.

The garden was planted in October, 1964 at the Central Station as an observation plot with three treatments i. e. (1) areca-cacao - 50 : 50, (2) areca alone, and (3) cacao along the borders alone. A total of 33 cacao plants and 106 areca seedlings have been planted adopting a spacing of 3 x 3 meters in the Quincunx method.

**VI C. 3 Simple manurial trials on arecanut in ryots' gardens**

All the 12 units of simple manurial trials laid out around the Central Station in the growers' gardens in 1960-61 were continued and yield data recorded. Out of the 12 units five were deleted and not manured further, as there were a number of experimental palms either broken or difficult to climb. Seven units are being continued and the application of scheduled doses of fertilizers, and recording growth as well as yield data will be taken up.

Data on yield of palms under the trial recorded during 1964-65 were analysed and the results showed that the treatment differences are not significant. However, treatment 5 (i. e. palms applied with 222 gm. of ammonium sulphate, 202 gm. of super phosphate and 136 gm. of muriate of potash per palm) had given an increase in yield of 19.92 per cent over the control.

The above trial was also in progress in ryots' gardens round about the Regional Stations.

**Control of weeds in areca garden**

Trials on the control of weeds using proprietary weedicides was taken up at the Regional Stations, Peechi and Hirehalli. Among eight formulations tried at Peechi, only Dowpon and Bladex 'O' were found promising. At Hirehalli, Simazine was found effective in controlling both monocot and dicot weeds.

**Technical Programme 1965-66**

| Item No. in the technical programme | Name of the experiment | Venue of work |
|---|---|---|
| (1) | (2) | (3) |
| VI. A. 2. | **Sowing experiments** | |
| e) | Effect of different intensities of shade in seed bed and secondary nursery beds on growth performance of seedlings. | Vittal, Peechi, Hirehalli and Kahikuchi |
| h) | Determination of optimum age of transplanting seedlings-cum-sowing *in situ* vs transplanting of single, double and treble transplanted seedlings. | Vittal and Kahikuchi |
| VI. B. | **Cultural experiments** | |
| a) (1) | Determination of optimum spacing in the main field. | Vittal, Peechi, Hirehalli, Kahikuchi and Mohitnagar |
| (2) | Effect of intervals of irrigation at different depths of planting arecanut seedlings. | - do - |
| (3) | Effect of different methods of intercultivation on the productivity of palms. | Vittal, Peechi, Hirehalli and Mohitnagar |
| (4) | Study of intercrops in arecanut gardens. | Vittal, Peechi, Hirehalli and Kahikuchi |

| (1) | (2) | (3) |
|---|---|---|
| | (5) Comparative studies of different green manure and cover crops for arecanut gardens. | Vittal, Peechi, Hirehalli and Mohitnagar |
| | (6) Investigations on different types of areca under rainfed and irrigated conditions. | Vittal |
| | (7) Effect of growing banana in arecanut gardens for different durations. | Vittal and Kahikuchi |
| | (8) Drainage experiments. | Vittal |
| | (9) Mixed garden of arecanut and coconut. | Vittal, Palode and Kahikuchi |
| | (10) Relative performance of seedlings obtained from different bunches and different positions in the bunch of mother palms of different ages. | Vittal |
| | (11) Studies on the performance of nuts gathered at different stages of maturity. | Vittal |
| | (12) Effect of different spacings and methods of layout on the incidence of sun-scorch on arecanut palms. | Vittal |
| | (13) Mulching trial - A comparison of different mulches in arecanut gardens. | Vittal |
| | (14) Study of different methods of raising arecanut gardens on hill slopes. | Palode |
| **VI. C. Manurial experiments** | | |
| | (2) N. P. K. manurial experiment. | Vittal, Peechi, Hirehalli, Kahikuchi and Mohitnagar |
| | (4) Effect of applying fertilizers to supply N. P. K. in organic and inorganic forms on palm performance. | Vittal |
| | (5) Relative merits of different nitrogenous fertilizers. | Vittal |
| | (6) Study of exhaustion of nutrients by adult bearing palms. | Vittal |

| (1) | (2) | (3) |
|---|---|---|
| **VI. D. Miscellaneous** | | |
| (1) | Uniformity trials - Collection of yield data of palms. | Vittal |
| (2 & 5) | Harvesting trials. | Vittal and Peechi |
| (a) | Season-wise variation in quality of produce. | - do - |
| (b) | Quality of produce as influenced by degree of maturity. | Vittal |
| (6) | Simple manurial trials on arecanut in ryots' gardens. | Vittal, Peechi, Hirehalli, Kahikuchi, Mohitnagar, and Palode |
| (7) | Weedicidal trial | Peechi and Hirehalli |
| **VI. E. Crop weather study** | | Vittal, Peechi, Hirehalli, Palode, Mohitnagar and Kahikuchi |
| **VI. F. Root studies** | | |
| (1) | Root studies at different ages and under different soil conditions in adult palms. | Vittal |
| (2) | Root studies of seedlings. | Vittal |

**Statistics**

**VII. a) Planning, analysis and interpretation of experiments**

Statistical analysis and interpretation of results in respect of all the experiments conducted at the Central as well as the Regional Research Stations were taken up during the year. Designs for new experiments to be initiated in all the Research Stations were suggested.

**b) Refinement of experimental technique**

**1. Study of variability of relationship between alternative measurements of yield**

Yield in arecanut can be represented either by the total number of nuts or total wet weight of nuts or the total weight of the final produce. In case all these three measures have the same relationship in different seasons of harvest, it will be sufficient if any one of them is recorded and conversion formula worked out based on the sample. With the above object in view correlations were worked out between the above three characters represented by X, Y and Z, where X = the number of nuts yielded in a harvest/palm, Y = the wet weight of nuts in a harvest/palm and Z = the kernel weight of nuts in a harvest/palm.

For this purpose all the harvests of 200 progenies of the progeny garden recorded during 1963-64 were used. The harvests were grouped monthwise and correlation for individual set worked out. The results showed that all the correlations are positive and highly significant. But on performing the $X^2$ test it was seen that the correlations for different months were significantly different in all the 3 cases indicating thereby that though all the three variables are related the degree of relation varies. The mean number of nuts per harvest per tree, their wet weight, kernel weight as well as those for 100 nuts in different months of harvest are given below.

TABLE 18

**Monthwise variation in yield and yield attributes**

| Month of harvest | Mean per harvest per tree | | | Wet Weight of 100 nuts (in gm) | Weight of 100 kernels (in gm) | Percentage of Kernel Weight to Wet Weight |
|---|---|---|---|---|---|---|
| | No. of nuts | Wet Weight (in gm) | Kernel Weight (in gm) | | | |
| November | 49.93 | 1538 | 400 | 3080 | 801 | 26.0 |
| December | 49.13 | 1575 | 410 | 3206 | 835 | 26.0 |
| January | 47.34 | 1628 | 411 | 3440 | 868 | 25.2 |
| February | 40.48 | 1474 | 349 | 3640 | 862 | 23.6 |
| March | 38.30 | 1363 | 339 | 3557 | 884 | 24.8 |
| April | 26.67 | 975 | 234 | 3657 | 876 | 23.6 |

From wet weight of 100 nuts and their kernel weight tabulated above it is seen that there is a great fluctuation of these values in different months of harvest. However it was seen that when certain months are grouped together the percentage of kernel weight to wet weight does not differ significantly within a group. The months could thus be grouped as Group 1 — November and December, Group 2 — January and Group 3 — February, March and April. Hence when samples are to be taken for determination of kernel weight to wet weight it is sufficient to take samples once in each of the above groups. The study will be repeated for confirmation.

**2) An alternative measurement to replace girth at collar**

It has been the practice till now to record the girth at collar of the seedlings at the time of planting and subsequently every year. Due to the silting that takes place at the base of the palms it has been found that the recording of the measurement in subsequent years requires removal of soil

by digging. In addition, it was also seen that the exact point at which girth was originally taken was not easily recognisable thus bringing in error in the different observations. This study was therefore taken up with a view to find out an alternative measurement which bears a strong relation to the girth at collar and which at the same time is free of the above defects.

Girth at 5 cm below last leaf axil as well as the girth at collar were recorded in respect of three groups of seedlings and correlations were worked out between the two measurements. The results obtained showed that all the correlations were positive and highly significant. Girth at 5 cm below last leaf axil can therefore be taken as an alternative measure for girth at collar.

**3. Determination of sample size for estimating percentage of kernel weight to wet weight of a lot**

Due to the existence of fluctuations in the relationship between kernel weight and wet weight of nuts harvested in different seasons or under different treatments in an experiment it becomes necessary to determine the percentage of kernel weight to wet weight for each of the harvests separately. For this purpose it will be advantageous to use the technique of random sampling. With a view to determine the exact sample size required to estimate the above percentage, 96 lots of 4 kg each of ripe arecanuts were dried separately and the kernel weight recorded. Samples of various sizes were formed by taking together random lots from the above 96 lots and the following results were obtained.

TABLE 19

| Wet weight of sample (in kg) | No. of samples in population | C.V (%) | Minimum number of samples to get 5% precision |
|---|---|---|---|
| 4 | 96 | 4.5 | 3 |
| 8 | 48 | 3.1 | 2 |
| 12 | 32 | 2.7 | 1 |
| 16 | 24 | 2.5 | 1 |
| 24 | 16 | 2.1 | 1 |
| 32 | 12 | 1.9 | 1 |
| 48 | 8 | 2.2 | 1 |
| 64 | 6 | 1.8 | 1 |
| 96 | 4 | 1.9 | 1 |
| 128 | 3 | 2.1 | 1 |
| 192 | 2 | 0.9 | 1 |

From the above table it will be seen that there is no appreciable reduction in coefficient of variation by increasing the sample size beyond 12 kg. A precision of 5% is also obtained by taking one such sample.

But to get an estimate of efficiency, it is necessary that at least two samples are taken each time. Thus the following method of sampling can be adopted If N is the number of 12 kg samples contained in the bulk, after mixing the bulk nuts thoroughly two samples of 12 kg each are to be chosen at random and dried separately. If $X_1$ and $X_2$ are the percentage of kernel weight to wet weight obtained from these lots an estimate of the percentage of kernel weight to wet weight of the bulk is given by $\frac{X_1 + X_2}{2}$

and its variance is given by $\frac{N-2}{2} \left\{ \frac{X_1 - X_2}{2} \right\}^2$

The study will be repeated for confirmation in different seasons of harvest.

**Technical programme 1965-66**

| Item No. in the Technical programme | Name of the experiment | Venue of work |
|---|---|---|
| VII (a) | Planning, analysis and interpretation of experiments. | Vittal |
| | | Vittal |
| (b) | Refinement of experimental technique. | Vittal |
| (c) | Biometrical studies | |
| 1 | Correlation and heritability studies | |
| 2 | Selection index and discriminant function. | |

**Soil Chemistry**

**VIII. A. Analysis of soil samples**

**1. Soil fertility studies**

*(a) Determination of optimum N.P.K. requirements in the main field*

In order to study the initial fertility status of the experimental plots that are under the N.P.K. manurial trial at the Research Station, composite soil samples from three depths viz. 0-15, 15-45 and 45-90 cm had been collected from each of the 81 treatment plots in 1962 prior to the application of the different manures. Subsequently, in the year 1964 samples were again collected as above from all the plots to see the effect of application of manures and fertilizers on fertility status. All the soil samples collected were analysed for organic carbon content. The results

showed that the variation in organic carbon content is very wide from block to block, the range being 0.22 to 1.09, 0.58 to 1.09 and 0.24 to 0.70 for 0 - 15, 15 - 45 and 45 - 90 cm depths respectively. However, the decrease in organic carbon content with depth has been observed in all the blocks except in blocks I and II where the disturbance caused due to levelling operation before planting appears to have affected the same.

As regards the effect of application of green leaf on organic matter content, it was observed that as compared with the initial values, the application of green leaves has shown an increasing trend in organic carbon content. It was also observed that the effect of application is more pronounced at lower depths which is due to the fact that the leaf application is now being done below surface layer in the pits that have been formed for planting the seedlings.

*(b) Different methods of raising arecanut gardens on hill slopes*

The above experiment has been laid out at the Regional Arecanut Research Station, Palode with the following treatments:

1 No cultivation, no manuring.
2 Clean cultivation with manuring.
3 Cover cropping with manuring.

The soil samples in duplicate from each treatment at 0 to 22½ and 22½ to 45 cm depths were collected every month and analysed for organic carbon content. The results of analysis are given below.

TABLE 20

**Effect of methods of cultivation on soil fertility**

(% organic carbon)

| S. No. | Date of receipt of sample | 0 to 22½ cm | | | 22½ to 45 cm | | |
|---|---|---|---|---|---|---|---|
| | | I | II | III | I | II | III |
| 1 | 18-1-65 | 1.23 | 1.23 | 1.25 | 1.17 | 0.97 | 1.21 |
| 2 | 16-2-65 | 1.28 | 1.34 | 1.23 | 1.03 | 1.10 | 1.27 |
| 3 | 14-3-65 | 1.80 | 1.85 | 2.19 | 1.09 | 1.17 | 1.86 |
| 4 | 28-4-65 | 1.86 | 1.72 | 1.79 | 1.54 | 1.36 | 1.40 |
| 5 | 21-5-65 | 1.65 | 1.65 | 1.71 | 1.39 | 1.25 | 1.71 |
| 6 | 29-6-65 | 1.65 | 1.83 | 1.90 | 1.79 | 1.44 | 1.48 |

I – no cultivation, no manuring
II – clean cultivation + manuring
III – cover cropping + manuring

It will be seen from the table that there is an increase in organic carbon content in respect of second and third treatments over no cultivation no manuring Further analysis is in progress.

**II. Investigations on yellow leaf disease**

With a view to find out whether deficiency or toxicity of certain elements are associated with the yellow leaf disease of arecanut certain preliminary trials were carried out in Palode area.

*(a) Leaf dipping experiment*

Leaf tips of healthy and diseased palms were selected and were dipped in different concentrations of ferrous, manganese and magnesium sulphate solutions, since it was felt from the symptoms observed in the diseased palms that these might be the elements involved in the nutritional imbalance. Observations were made for toxicity symptoms or recovery from the yellowing of the diseased leaves, if any. The different concentrations of the solutions tried ranged from 0.005 to 25 per cent. The observations recorded in the field were inconclusive. It was, however, observed that iron solution is definitely toxic, giving a burning appearance to the leaves, even at the lowest level of 0.03% concentration in 48 and 72 hours of dipping in the case of healthy and diseased palms respectively. In the case of manganese and magnesium the toxic effect was not seen at lower concentrations. In few cases these have shown some recovery from yellowing also. The combination of Mn + Mg at 1% level was found to be more effective in redueing the yellowing in diseased leaves.

*(b) Analysis of leaf tissues*

The leaf tissues from healthy and yellow leaf diseased palms were analysed qualitatively for pH, iron, CaO and MgO content. The results obtained showed that the diseased palm tissues have low pH, more water and hydrochloric acid soluble iron content and higher CaO/MgO ratio as compared to the healthy one. It appears that there is certain nutrient imbalance in the diseased tissues and the results obtained have to be checked up by further analysis of more number of samples. The magnesium content is very low in diseased tissues bringing about a very wide difference in CaO/MgO ratio, the average value for healthy and diseased leaves being 1.14 and 8.37 respectively.

*(c) Root feeding experiment with ferrous sulphate solution*

Since the analysis of the diseased leaf tissues showed excess accumulation of iron than the healthy one, it was felt that feeding of the healthy palms with suitable iron compound in solution to the extent to disturb the plant metabolism might develop the symptoms characteristic of yellow leaf disease. With this in view nine healthy palms were selected at the Central Station and were fed with ferrous sulphate solution of three different concentrations viz. 1.0, 0.5 and 0.1 per cent through roots from 1-1-1965 onwards. Even though on an average

1600 ml. of each of the solutions was absorbed by each plant till 5-6-65 when the experiment was discontinued due to rain, no visible symptoms could be observed. This might be due to the fact that the amount of iron absorbed by the plants had not reached the limit required to disturb the plant metabolism.

(d) SOIL APPLICATION OF BORON

Reports were made by a few workers that the symptoms due to induced boron toxicity and yellow leaf disease were more or less similar. To verify this report boron as boric acid was applied through soil to bearing and young palms at the rate of 8 oz. in two gallons of water per palm. The young plant started showing scorching of the tips of the leaves within 15 days of application while bearing palm took 25 days to show yellowing symptom. The symptoms observed were critically compared with those observed in the yellow leaf disease of arecanut and were found to be different.

**Technical programme 1965-66**

| Item No. in the Technical programme | | Name of the experiment | Venue of work |
|---|---|---|---|
| VIII. | 1 | Analysis of the soil samples. | Vittal |
| | 2 | Preliminary studies with soil from important arecanut growing areas of different states. | |
| | 3 | Tissue testing. | |
| | 4 | Plant analysis for the purpose of (a) nutrient exhaustion study, (b) correlation with crop response at various doses of fertilizers that are being applied and (c) finding out the critical nutrient level of the palm. | |
| | 5 | Analysis of the cured products. | |
| | 6 | Analysis of irrigation water. | |
| | 7 | Pot culture studies. | |
| | 8 | Permanent observational plot to study the composition changes in soil and plant. | |

**Plant Physiology**

**IX. Comprehensive package plan trials on yellow leaf disease**

This scheme intended to study the effect of application of different micro and macro nutrients on yellow leaf disease affected palms was initiated towards the close of the year.

| Item No. in the Technical Programme | | Name of the experiment | Venue of work |
|---|---|---|---|
| IX. | 1 | Field survey of the package plan unit areas for the following:- | Annamanada, Punalur, Koothattukulam and Jayapura |
| | (a) | visual symptoms (symptomatology), | |
| | (b) | spread of the disease, | |
| | (c) | influence of rainfall, soil type, topography and water table on disease incidence and | |
| | (d) | influence of cultural practices. | |
| | 2 | Field lay outs - laying out the experiment in the fields. | |
| | 3 | Chemical analysis of soil and plant tissues and nuts. | Vittal |
| | 4 | Pot culture study. | Vittal |

**Pests and diseases**

**X. A. Trial with proprietary fungicides and insecticides to find out effective control measures for all diseases and pests:**

1 Control of white and red mites *(Paratetranychus indicus* and *Raoiella indica)*.

Spraying trials conducted at the Central Station during the previous year had shown that Kelthane, Trithion and Tedion are effective in checking the reinfestation of mite colonies. The trials were repeated during the current season with a set of 15 plants per treatment, each plant being treated as a replicate. Kelthane EC. (Indofil Chemicals - 186 cc/100 litres), Tedion (Mico - 200 cc/100 litres), Trithion (Mico - 126 cc./100 litres), Akar - 338 (Tata Fison - 100 cc/100 litres), Wettable sulphur (Bharat Pulvarizing Mills - 1000 gm/160 litres), Cosan (Ciba, Bombay - 300 gm/100 litres) Dimecron (Ciba, Bombay - 20 cc/100 litres), Rogor - 40 (Tata Fison - 100 cc/100 litres) and Ekatin (Sandoz - 100 cc/100 litres) were included in the trial.

The chemicals were sprayed in three different rounds in different periods on the same set of plants. Observations on the kill as well as reinfestation were made 24 hours and 20 days following the application of the spray. It was seen that all the chemicals gave an immediate kill of the mites in 24 hours. A summary of the observations on reinfestation recorded 20 days after the spray application is given below.

TABLE 21

| Treatments | Mean percentage of | |
|---|---|---|
| | Infestation before spraying | Reinfestation after spraying |
| 1 Kelthane EC | 68.75 | 25.00 |
| 2 Tedion | 89.58 | 60 41 |
| 3 Trithion | 77.08 | 29.15 |
| 4 Akar-338 | 83.33 | 60.40 |
| 5 Wettable sulphur | 87.50 | 85.35 |
| 6 Cosan | 85.41 | 79.15 |
| 7 Dimecron | 89.58 | 81.75 |
| 8 Rogor-40 | 89.58 | 79.16 |
| 9 Ekatin | 87.50 | 81.25 |

From the above it can be seen that Kelthane EC and Trithion treatments have been quite effective in checking the reinfestation for a longer period, Tedion coming next in order. A similar trial conducted at Hirehalli, proved the superiority of Akar-338 and Ekatin over other miticides tried.

**2 Control of white grub.**

The white grub of a cockchafer beetle *(Leucopholis bermeisteri)* has been found to feed on the roots of arecanut palms causing severe damage to the root system. The pest is assuming considerable importance in recent years. During the previous year it had been reported that application of Intox '8' liquid had been taken up in two of the package plan units where the incidence of this pest was seen to be very high. Post-treatment observations taken after 6 months indicated that this treatment had been quite effective as indicated by the plants which had put up a green and healthier crown. No stages of the pest could be found in any of the excavations made in different places in the treated plots.

**3 Trials in the control of 'Koleroga' or Mahali.**

'Koleroga' or Mahali caused by the fungus *Phytophthora arecae* is one of the major diseases of the arecanut palm and accounts for enormous losses of crops in most of the arecanut growing tracts. Trials in the control of the disease were continued during the year under report. During the previous season a field trial had been laid out on a 6 x 2 x 4 split plot design with Fytolan, Blitox, Coppesan, Microcop (all one kg in 200 litres of water), Bordeaux mixture - one per cent and control as

main treatments and adhesive (Sandovit 66 cc. per 100 litres of spray fluid) and no adhesive as sub - treatments.

Besides the above, observation trials had also been laid out where 10 palms had been sprayed with each of (1) Du Ter, (Triphenyl Tin hydroxide), (2) Brestan (Triphenyl acetate of zinc) each one kg / 800 litres of water, (3) Manol (Manganese dithiocarbamate) and (4) New Manol (Copper oxychloride carbamate) each one litre in 108 litres of water.

Manol and New Manol were applied using medium volume nozzle at 60 gallons (270 litres) of fluid per one acre of 600 palms. Since there was no incidence of the disease in the plot, the efficiency of the various chemicals employed in the trial could not be evaluated.

However, the counts of nuts retained on the trees as well as those shed recorded with a view to see whether any of the fungicides had the added advantage of reducing the fruit shedding showed that as far as retention of fruits on the tree is concerned, all the chemicals used in the trial, have almost the same effect.

The same trial taken up during the previous season had shown that fruits sprayed with copper oxychlorides, showed copper injury to varying extent. The injury was in the form of greenish brown sunken spots. It was also observed that tender fruits were less prone to this type of injury than mature ones. During the current season trials, observations noted after the second round of spray have indicated that fruits receiving 0.5 per cent Blitox spray without the addition of adhesive suffer from maximum injury, the injured nuts being split in many cases. In the case of other treatments like Fytolan and Microcop, the injury was seen to be less. It was also seen that mature nuts are more susceptible to the injury as noticed earlier.

With a view to study the incidence of air-borne spores, sporangia etc. of the fungus *Phytophthora arecae* and to correlate the same with weather data so as to study the feasibility of forecasting the occurrence of this disease, slides smeared with a film of vaseline were exposed on five aeroscopes fixed at the northern, southern, eastern and western ends as well as in the centre of the main garden of the Research Station. These were periodically collected and changed. The collected slides were examined for the presence of spores, mycelial fragments or sporangia of the fungus. But during the season under report no stages of the fungus could be detected in the slides. The study is being continued.

During the year 1965 preliminary laboratory screening trials to evaluate the efficacy of the various fungicides like Fytolan, Coppesan, Microcop, Blitox and Bordeaux mixture against *Phytophthora arecae*, were initiated.

**4 Trials to investigate causes and methods of control of button - shedding and tendernut-fall.**

The large scale spraying trial initiated against button shedding and tender-nut fall during the previous year was continued in the private gardens. A final count of the nuts retained on the palms was made in October. The percentage retention of fruits on the bunch in each treatment is furnished below.

TABLE 22

| Sl. No | Treatment | Percentage of fruit retention |
|---|---|---|
| 1 | One per cent Bordeaux mixture + BHC 50% | 62.8 |
| 2 | One per cent Bordeaux mixture + Endrex. | 69.2 |
| 3 | One per cent Bordeaux mixture | 61.7 |
| 4 | Half per cent Bordeaux mixture + Endrex. | 57 4 |
| 5 | Half per cent Bordeaux mixture + BHC 50% | 60.7 |
| 6 | Unsprayed control | 50.0 |

The data were subjected to statistical analysis applying the student's 't' test. It was seen that all the treatments except No. four i.e half per cent Bordeaux mixture plus Endrex have given significantly higher percentage of fruit-set than control. Spraying the bunches with a combination spray of one per cent Bordeaux mixture plus Endrex (treatment two) in two rounds gave the maximum of 19.2 per cent increase in the fruit-set over the control. The trial is being repeated in another private garden on the same lines to confirm the observations on hand. In order to study the efficacy of a combination spray of Cuman (Zinc-dimetheyl - dithiocarbamate) plus Dimecron (phosphamidon) in comparison with that of Bordeaux mixture plus Endrex an observation trial was laid out in the main garden with (1) Cuman (100 cc/100 litres), (2) Cuman + Dimecron (Dimecron added to Cuman solution at 20 cc per litre), (3) one per cent Bordeaux mixture + Endrex (Endrex added to Bordeaux mixture at 125cc/100 litres and (4) Flit 406 two kg/100 litres.

The selected inflorescence on each palm was divided into two halves. One half was sprayed with the concerned chemical while the other half was left to serve as a control. The number of female flowers in each half of the

inflorescence was recorded before applying the spray. The spray application was taken up when the flowers were about to open and was repeated after a month. The female flowers shed from the bunches were collected daily and examined for the presence of fungi or insects. This confirmed last year's findings that the fungus *Gloeosporium* was seen infecting tips and basal portion of female flowers as well as embryo. At the onset of monsoon, a final count of the buttons retained on the bunches was recorded. A summary of the observations is given below.

TABLE 23

**Percentage of female flowers shed under various treatments:**

| Sl. No. | Treatment | Fungal infection | | Insect attack | | Other undetermined causes | |
|---|---|---|---|---|---|---|---|
| | | Treated | Control | Treated | Control | Treated | Control |
| 1 | Cuman | 0.33 | 35.29 | | | 4.62 | 25.08 |
| 2 | Cuman plus Dimecron | 24.64 | 58.75 | 1.99 | 2.90 | 7.82 | 45.05 |
| 3 | One per cent Bordeaux mixture plus Endrex | 4.30 | 50.98 | | | 6.07 | 31.57 |
| 4 | Flit 406 | 4.76 | 3.31 | | | 24.52 | 99.22 |

It will be observed from the above that Cuman has considerably reduced the shedding of female flowers both due to fungal infection as well as due to unidentified causes. This fungicide has been closely followed by Bordeaux mixture plus Endrex which is now being recommended as a combination spray.

**5. Control of yellow leaf spot:**

The yellow leaf spot caused by *Curvularia* occurs every year in the nursery as well as on the seedlings in the main field. The leaves of the affected plants are disfigured and their growth gets stunted. In the laboratory, studies were conducted to test the efficacy of *Cosan* (microfine sulphur preparation by Ciba) against the causal fungus. Plates were poured with potato dextrose agar medium and plated evenly with a spore suspension of *Curvularia*. Sterile polythene microcups were placed in the centre of the dishes in which 1/10 ml of a 3000 ppm. (0.3 per cent) solution of Cosan was put. No inhibition of the fungal growth was noticed. Field trials where the affected leaflets were sprayed with the above solution confirmed that it was not effective in checking the yellow leaf spot in the field.

A field trial was laid out in the bulk nursery with the following chemicals with 10 plants per treatment. The spray applications were repeated

at ten day intervals and observations were recorded on the number and size of spots on selected leaflets. A summary of observations recorded is furnished below.

TABLE 24

**No. of yellow leaf spots under different treatments**

| Treatment | First count | Second count | Third count | Fourth count |
|---|---|---|---|---|
| Mercurised copper-oxychloride | 152 | 151 | 123 | 63 |
| Cosan | 105 | 165 | 134 | 102 |
| Cuman | 160 | 169 | 141 | 141 |
| Mercurised copper-oxychloride plus zinc | 197 | 205 | 143 | 91 |
| Control | 170 | 219 | 218 | 69 |

From the above it will be seen that there was a general reduction in the number of leaf-spots in respect of almost all the treatments as well as the control. None of the fungicides tried appeared to be effective in reducing the incidence of the spots.

**6 Studies in the control of sun-scorching of stem:**

Damage to the stems of arecanut palms caused by sun-scorch on the south western side of the palms accounts for huge losses of trees annually in arecanut gardens all over the country. Collection and tying of arecanut leaf-sheaths and leaves, jute stems and jungle leaves which are in vogue are laborious. In order to find out a suitable alternate material for protecting the stems, trials with heavy guage polythene films were taken up Long strips of polythene films (400 guage) rendered opaque by painting them with white enamel paint were tied round the stems of eight arecanut palms under conditions of full exposure to south western sun so as to afford protection to the stem. An equal number of stems were protected by tying leaf-sheaths of arecanuts. Observation on the extent of protection afforded by the film as well as leaf-sheath were made every month. The films and sheaths were removed at the beginning of the monsoon. It was seen that polythene films had afforded protection equal to that afforded by the leaf-sheath and that the films could be used for more than one season.

The studies are being continued.

**7 Observations on exploratory demonstration plots where package treatments were laid out:**

In 1961–62 exploratory demonstration plots had been laid out in six private gardens where the general health condition of the palms was

poor and the yield subnormal, in order to study the effect of package treatment consisting of application of a combined dose of all the essential micro and macro nutrients coupled with plant protection and cultural practices, on the trees. Two of the above units were discontinued during the previous year since the palms reverted to normal condition as soon as the drainage in the garden was improved.

Application of macronutrients in the form of (1) lime–where soil is acidic–(454 gm), (2) green-leaf (12 kg), (3) ammonium sulphate (142 gm), (4) super phosphate (227 gm) and (5) muriate of potash (114 gm) and micronutrients in the form of (1) ferrous sulphate (56.70 gm), (2) sodium borate (2.26 gm), (3) Manganese sulphate (68.04gm), (4) copper sulphate (22.68 gm), (5) zinc sulphate (22.68 gm) and (6) sodium molybdate (2.26 gm) were taken up as per schedule.

Observations on the condition of the palms were recorded. Suitable control measures against the white grub pest noticed to be virulent in these units were also taken up. These included providing of deep drainage channels, besides treating the bases of palms with pesticides like Intox '8'. Resorting to the application of the above nutrients as well as taking up control measures against the root grub have invariably improved the condition of the palms in all the units. Observations have been since concluded.

**8. Studies on organisms other than Phytophthora that cause rotting of fruits and impair their keeping quality:**

During the previous year selected inflorescences at the rate of 10 per treatment had been sprayed with (1) Blitox (one kg/200 litres of water), (2) Dithane Z–78 (one kg/200 litres of water) and (3) Flit 406 (One kg/500 litres of water). An unsprayed control had also been maintained. Ripe fruits were collected from these bunches and attempts were made to isolate micro-organisms from the samples. The results were erratic. The studies are being repeated.

**9. Susceptibility of arecanut to Koleroga at different stages of maturity:**

Earlier trials taken up at the Research Station had shown that there is a wide variation in the susceptibility of nuts of different levels of maturity to the infection by Koleroga fungus The trial was repeated during the year. Bunches on four palms were marked out for this purpose. Nuts of different maturity levels i.e , 100, 125, 150, 175, 200 and 225 days were inoculated with *Phytophthora* using 12 nuts per bunch.

The inoculated nuts were kept under a polythene cover for maintaining humidity. The results were not conclusive since stray nuts only took infection. The studies are being continued.

**11. Studies on the biology of *Ganoderma lucidum* and trials on the control of Anabe disease:**

*Ganoderma lucidum* which causes the Anabe disease of arecanut palm is responsible for large scale death of palms in certain arecanut growing

areas. Being a soilborne fungus, the control of the same is rather difficult. Studies on the antagonistic behaviour of soil fungi like *Trichoderma* sp. against this fungus were initiated, with a view to use the antagonistic fungus in the control of the pathogen. Subcultures of an isolate of *Ganoderma lucidum* obtained from the Forest Research Institute, Dehra Dun were used in the experiments, as the test organism. Plates were poured with potato dextrose and malt agar media and the following treatments were tried using *Trichoderma* sp. (Orissa strain) in order to find out a suitable method for assessing the extent of antagonism.

(i) Test organism and the antagonist are planted at the periphery of the dish in two diagonally opposite positions.
(ii) Test organism and the antagonist are placed at the centre of the plate 2 to 4 cm apart.
(iii) Test organism is planted in the centre and the antagonist planted at the periphery in two diagonally opposite positions.
(iv) Test organism is planted in the centre and the antagonist planted in three different radial positions along the periphery.

In each case the planting of the two organisms were done as follows:

(i) On the same day.
(ii) Antagonist six days after the test organism is planted.

It was seen that in general the growth of the two organisms was better on malt agar than potato dextrose agar. It was also seen that the first planting method (planting the test organism and the antagonist in two diagonally opposite positions, the antagonist being placed six days after the test organism has been planted) was quite suitable for the study in view of the comparatively slower growth of the test organism in the plates.

Preliminary screening trials with soil fungi like *Trichoderma* sp. (Orissa strain), *T. Koningii*, and *Mucor* (violet strain) showed that *Trichoderma* sp. (Orissa strain) exerted maximum antagonistic effect towards the test fungus.

In order to study the comparative rates of growth of the antagonist fungi and the test organism plates were poured with malt agar. The different micro-organisms were planted in these and the diameter of the colonies was measured from 2nd day onwards. The growth attained by each of these in six days is given below.

| Organisms | Growth diameter of colony in cm after 144 hrs |
|---|---|
| 1. *Trichoderma* sp Orissa strain | 7.5 (full dish) |
| 2. *Mucor* sp. violet strain | 5.1 |

| | | |
|---|---|---|
| 3. | *Trichoderma Koningii* | 4.9 |
| 4. | *Mucor* sp. Black strain | 3.5 |
| 5. | *Ganoderma lucidum* | 3.0 |

It can be seen that the Orissa isolate of *Trichoderma* sp. has filled the plate completely in six days whereas *Ganoderma lucidum* has attained only half this growth.

To study antagonistic effects plates were poured with malt agar and these were planted with the test organism. After four days the antagonist organisms were planted just opposite the test fungus colony at the periphery of the plate. Clear signs of antagonism were visible in the *Trichoderma* plates in six days. The fungus grew faster and over the test mat and formed zonations of growth. Sporulation was concentrated at this region. There was a zone of inhibition around the point of inoculation of the antagonist organism. Hyphae of the test organism were seen to degenerate. In the case of *Mucor* the growth of both the organisms stopped right in the centre of the plate and there was a flattening of the test fungus mat along the fringe where the two fungi met, thus indicating mutual antagonism. The studies are being continued.

**12. Other problems evoked during the studies:**

(a) INOCULATIONS WITH SHOOT ROT FUNGI *Gloeosporium* sp. AND *Nigrospora sphaerica*

During September–October, 1963 arecanut plants in certain gardens of Chickmagalur-Kadur area were reported to be affected by a fungus disease which caused considerable damage to the plants. Dark brown lesions appeared on the tender open leaves as well as spindle. These coalesced to form bigger patches. The infection then spread to the bud and killed the plant. A fungus identified as *Gloeosporium* was isolated from the tissues. Another fungus identified as *Nigrospora sphaerica* was also obtained at the Regional Arecanut Research Station, Hirehalli, from the diseased material. Inoculations were done in order to find out the pathogenecity of the two fungi and to compare the symptoms produced by them with those occurring in nature.

The inoculations were done on young as well as two and a half year old seedlings with subcultures of *Nigrospora sphaerica* obtained from Regional Arecanut Research Station, Hirehalli, as well as *Gloeosporium* sp. (isolated at Vittal). A group of six small plants as well as two grown up seedlings were allotted for each treatment lot, sufficient number of controls being separately maintained Treated plants were kept in polythene humid tents. Symptoms developed in five to six days. The symptoms were as follows:

*Gloeosporium:* Black, slightly sunken, linear, irregular, patches, on the peteoles.

*Nigrospora sphaerica:* Greenish brown spots with light brown margins. No sporulation occurred in any of the spots.

The symptoms produced by *Gloeosporium* were similar to the ones seen in nature. The fungus was reisolated from the inoculated spots.

(b) IDENTIFICATION OF SPECIMENS

Sub-cultures of a fungus isolated out of shoot-rot affected plants from Kadur at the Regional Arecanut Research Station, Hirehalli as well as similar cultures isolated at Vittal were sent to the Commonwealth Mycological Institute, England, where they were identified as *Glomerella cingulata* a perfect stage of *Gloeosporium* sp.

A powder post beetle seen to be boring into the stems of arecanut palms was got identified as *Xyleborus perforans* Woll.

A specimen of a white grub found on the root system of arecanut palm was got identified as *Leucopholis bermeisteri* Brske.

(c) NEMATODES IN SOILS COLLECTED FROM YELLOW LEAF DISEASE AFFECTED GARDENS

Soil samples from the bases of yellow leaf disease affected and disease free plants were collected and sent to the Nematologist, Agricultural College and Research Institute, Coimbatore for screening work with reference to nematodes. The examination revealed the presence of reniform nematodes, *Rotylenchus reniformis* the populations of which were found to be higher in soils from the bases of disease affected plants than in those from disease free ones.

**XI Investigations on the yellow leaf disease**

The Regional Station at Palode has been established for investigating the yellow leaf disease of arecanut. The report of work attended to during the year is presented below.

**A. Pathology**

**1. Symptomatology:**

*a) In open field:* A preliminary survey was conducted to locate observation plots to study the sequence of symptom expression on palms under different age groups in different localities

*b) Under controlled conditions:* The 30 seedlings under sap transmission trials in the insect proof house at the Central Coconut Research Station, Kayamgulam were kept under observation to study the symptom expression, if any. No disease symptom could be obtained during the period.

**2. Mycological studies:**

All the stock cultures reported earlier were maintained. Foliar infection with *Exosporium arecae* Subramonian was noticed in the farm and the fungus was isolated and kept in pure culture.

**3. Study of virus association:**

a) SAP TRANSMISSION STUDIES

*i) On arecanut palms:* Sixty-eight six year old palms located in two spots in the station farm were under the sap transmission study

previously. The transmission was conducted by the "Rawlins and Tompkins method, 1936", the abrasive used being carborandum. The crude sap for mechanical transmission was prepared by extraction of the diseased leaf in phosphate buffer at pH 8. Equal number of palms was left as control. In the manurial-cum-irrigation experimental plot, 125 six-year old palms were inoculated with diseased leaf sap at monthly intervals, leaving proper controls. Observations recorded during the period under report revealed that a few palms under the trial in the manurial-cum-irrigation experimental plot have shown yellowing akin to that of yellow leaf disease. However the yellowing did not follow any regular pattern with reference to treatment or sap transmission. It is too early to arrive at a definite conclusion regarding infection. All the palms were kept under observation.

*ii) On other host plants:* Host plants such as 1) Cowpea (new era variety), 2) *Cassia* spp., 3) *Vinca* sp., 4) *Jatropha curcas*, 5) *Ageratum conyzoides*, 6) *Sebastiana chamaelea*, 7) *Emilea* sp., 8) *Canavalia ensiformis*, 9) *Naregamia* sp. and 10) *Stachytarpheta* sp. were inoculated with diseased leaf sap by abrasion method. None of the plants gave clear indication of the transmissibility of the disease.

Seedlings of *Vigna sinensis, Lycopersicum esculentum, L. pimpinellifolium, Datura stramonii, D. tatula* and *D. fastuosa* were raised.

b) SEED TRANSMISSION STUDIES. The 32 seedlings raised from seednuts collected from three diseased and one healthy mother palms were kept under observation in the insect proof house at the Central Coconut Research Station, Kayamgulam. However, this study has been deferred till more information is obtained regarding the cause of the disease.

**5. Physiological studies in relation to incidence of the disease:**

Arrangements were being made to construct R.C. tubs for growing experimental seedlings for the study.

**9. Study of weeds in arecanut gardens with special reference to virus disease symptoms manifested by them:**

Weeds such as (1) *Ageratum conyzoides*, (2) *Sebastiana chamaelea*, (3) *Hyptis* sp., (4) *Boreria hispida*, (5) *Eupatorium urticaefolium*, (6) *Stachytarpheta* sp., (7) *Elephantopus scaber*, (8) *Emelia* sp., and (9) *Hemidesmis indicus* showing symptoms like virus disease were collected from arecanut gardens.

**10. Studies on the effect of administering micronutrients into the plant tissue through roots and leaves:**

The study was undertaken to investigate the effect of feeding the arecanut palm with micronutrients in the form of solutions through foliage and roots. During the period under report the following nutrients were tried on healthy and diseased palms.

Iron in the form of $Feso_4$ (0.005 to 5.00%), manganese in the form of $MnSo_4$ (0.005 to 25.0%) and magnesium in the form of $MgSo_4$ (0.005 to 25.0%) were fed to the palm through the leaf by the leaf dipping method. Indications regarding the toxic levels of these nutrients on healthy and diseased palms were obtained.

Manganese and magnesium in the form of $MnSo_4$ (0.25 to 1.0%) and $MgSo_4$ (1.0 to 5.0%) respectively were fed to the palms through roots. No conclusive results could be obtained. The work is being continued.

Boron in the form of boric acid at concentrations of one and five per cent solutions was fed to the healthy plants though roots. The plants showed clear foliar yellowing. The leaves which developed after the root feeding was stopped were found to be normal. The same effect was produced when boric acid solution was applied at the base of the palms (226.8 gm in 9 litres of water).

**B. Botany**

**1 & 2 Collection of indigenous and exotic species and types of arecanut for ..aying their performance with special reference to the incidence of disease:**

A trial was initiated in the main field in 1961–62 on a randomised block design with 6 replications of 25 single tree units to find out the relative performance and degree of resistance of these types to diseases and pests. The following types were planted and they have commenced flowering.

| | | |
|---|---|---|
| Indonesia (ii), Ceylon, Assam | 1 | cultivar each. |
| West Bengal | 3 | cultivars: |
| Mysore | 8 | ,, |
| Kerala | 10 | ,, |
| Madras | 1 | ,, |

It is too early to draw any conclusion regarding their resistance to the disease.

The following indigenous and exotic types obtained from different arecanut tracts were planted in 1964 in the main field on a 13 x 5 randomised replicated block design in order to study their performance in relation to yellow leaf disease.

1 Andaman (selfed)
2 Indonesia (i)
3 Indonesia (ii)
4 Nicobar
5 Tirur.
6 Kumaranellur
7 Pengamuck.
8 Tolur.
9 Wangi.
10 Thirthahalli.
11 Hirehalli (i)
12 Hirehalli (ii)
13 Local.

3. **Study of performance of Vittal type of arecanuts under different ecological conditions:**

Twenty seedlings raised from seednuts obtained from Central Arecanut Research Station, Vittal were transplanted in the main field.

4. **Trials of seed materials irradiated with X-ray, ultraviolet rays etc. to isolate strains resistant to yellow leaf disease:**

Out of 150 seednuts each collected from diseased and healthy palms and irradiated with Gamma rays (1,000 rads) and planted, only four of former and 12 of the latter have germinated. The seedlings were transplanted in the main field.

5. **Histopathological studies:**

Anatomical studies of stem and root of healthy and diseased palms under different age groups were undertaken to study the anatomical variations if any, consequent to disease incidence.

## C. Agronomy

1 **Cultural experiments (main field):**

i INFLUENCE OF APPLICATION OF MACRO AND MICRO NUTRIENTS AND IRRIGATION ON THE INCIDENCE OF YELLOW LEAF DISEASE

This experiment was laid out in a levelled plot in 1961–62 on a 5 x 5 randomised block design with the following treatments:

1 No manure and no cultivation.
2 N.P.K. fertilizers with irrigation.
3 N.P.K. fertilizers without irrigation.
4 N.P.K. fertilizers and micronutrients with irrigation.
5 N.P.K. fertilizers with micronutrients without irrigation.

N = 23 kg (50 lb)
P = 34 kg (75 lb)
K = 34 kg (75 lb)
} per 500 palms — Over a basal dressing of 11.4 kg (25 lb) of green leaf or compost per palm.

| Micronutrients: | | |
|---|---|---|
| | Ferrous sulphate | 23 |
| | Sodium borate | 9 |
| | Manganese sulphate | 27 |
| | Calcium oxide | 68 |
| | Copper sulphate | 9 |
| | Zinc sulphate | 9 |
| | Magnesium oxide | 18 |
| | Sulphur | 2.3 |

} kg per 500 palms

Each treatment plot consisted of 15 palms. Application of macro and micro nutrients, green leaf and cattle manure, irrigation and other cultural practices were carried out during the year. The data on the growth characters of the seedlings were statistically analysed. There was no significant difference between the treatments in respect of any of the growth characters.

The results of analysis of the previous two years' data were also in conformity with this result.

Some of the palms showed foliar yellowing akin to that of the yellow leaf disease. It may be noted that 125 palms under this experiment were subjected to sap transmission trials. However the incidence of yellowing noticed was not confined to those palms subjected to sap transmission alone. The yellowing did not follow any regular pattern with reference to either treatment or sap transmission. The palms were under observation.

ii *Effect of application of N. P. K. with and without lime on disease incidence.*

This experiment was initiated in 1964 on a 6 x 4 randomised block design in the bulk garden I (1961) with the following treatments.

1. N. P. K. at 46, 36, 68 kg respectively for 500 palms in the form of fertilizers alone.
2. Treatment 1 + lime at 2 kg per plant.
3. N. P. K. at 23, 18, 34 kg respectively for 500 palms in the form of fertilizers and the rest 23, 18, 34 kg in the form of organic manures.
4. Treatment 3 + lime at 2 kg per plant.
5. Lime alone at 2 kg per plant.
6. No lime and no manure.

A single border row was provided in between treatments and double border rows in between replications. Each experimental plot had 12 palms. The pre-treatment growth measurements of all the experimental palms were recorded at the time of commencement of the experiment. The manures were applied at the base as per schedule. Stray flowering had commenced in the garden.

**2. Manurial experiment (main field):**

*Package plan trials.*

The palms under this experiment were manured as per schedule. Growth measurements and yield data were recorded. The trials would be further continued in the comprehensive package plan trials. The data collected were under statistical analysis.

**IV. Miscellaneous agronomic investigations (main field)**

**1. Study of different methods of planting arecanut on steep hill slopes.**

This experiment was laid out in 1961-62 with a view to find out suitable methods of raising arecanut gardens on hill slopes. The following three systems of planting were adopted.

I Planting on terraces made along the contour.

II Planting on terraces made at the site of planting

III Planting on slopes not taking into account the contour.

Each of the above treatments were divided into 3 sub - treatments as follows.

1 No cultivation and no manuring.
2 Clean cultivation and manuring.
3 Permanent cover cropping and manuring.

Data on the girth, height, number of leaves and number of exposed nodes of the palms were recorded regularly from the commencement of the experiment. The data obtained during the year under report were statistically analysed and are given below.

TABLE 25

**Growth Measurements of palms**

| a) Main treatment | Girth (cm) | Height (cm) | No. of leaves |
|---|---|---|---|
| I | 40.24 | 319.91 | 6.41 |
| II | 38.88 | 322.45 | 6.34 |
| III | 41.23 | 353.91 | 6.68 |
| Students 't' for comparison of I and II | 1.10 | 0.30 | 0.17 |
| ,, I and III | 0.84 | 4.04** | 2.31* |
| ,, II and III | 2.13* | 3.96** | 2.80** |

*Significant at 5% level of significance.
**Significant at 1% level of significance.

| b) Sub-treatment | Girth (cm) | Height (cm) | No. of leaves |
|---|---|---|---|
| 1 | 37.24 | 323.89 | 6.25 |
| 2 | 44.17 | 356.02 | 6.91 |
| 3 | 38.80 | 318.90 | 6.32 |
| Students 't' for comparison of 1 and 2 | 5.78** | 3.68** | 5.74** |
| ,, 1 and 3 | 1.42 | 0.64 | 0.64 |
| ,, 2 and 3 | 4.75** | 4.60** | 5.62** |

**Significant at 1% level of significance.

From the above it can be seen that planting on slopes not taking into consideration the contour has given rise to plants having significantly more height and number of leaves as compared to the other two main treatments. Plants under this treatment have also recorded significantly more girth than those planted on terraces made at the site of planting. Clean cultivation and manuring has given rise to significantly more vigorous plants than in the other two treatments. This was in conformity with last year's results.

The experimental palms have commenced bearing. The percentage of palms flowered under the different treatments during the period under report is given below:

TABLE 26

| Treatment details | Percentage of palms flowered |
|---|---|
| I. Planting on terraces made along the contour | |
| 1 No cultivation and no manuring | 1.042 |
| 2 Clean cultivation and manuring | 14.444 |
| 3 Permanent cover cropping and manuring | Nil |
| II. Planting on terraces made at the site of planting | |
| 1 No cultivation and no manuring | 1.010 |
| 2 Clean cultivation and manuring | 12.264 |
| 3 Permanent cover cropping and manuring | 1.818 |
| III. Planting on slopes not taking into account the contour | |
| 1 No cultivation and no manuring | Nil |
| 2 Clean cultivation and manuring | 10.256 |
| 3 Permanent cover cropping and manuring | 7.500 |

From the above it could be seen that the maximum flowering is recorded in the plots under clean cultivation and manuring. However, it is too early to draw any conclusion.

Soil samples from the different treatment plots from depths of 0–9″ and 9″—18″ were collected at fortnightly intervals and were being analysed at the Central Arecanut Research Station, Vittal for moisture and nutrient contents.

**Technical Programme 1965-'66**

| Item No. in the Technical Programme. | Name of the experiment | Venue of work |
|---|---|---|
| (1) | (2) | (3) |
| | **Pests** | |
| 1 | Control of mites. | Vittal, Peechi, Hirehalli |
| 2 | Control of white grub. | Vittal |
| 3 | Studies on the biology and control of *Tirathaba mundella* the caterpillar pest on the inflorescence. | Vittal |

| | | |
|---|---|---|
| 4 | A study of the red ants in arecanut gardens, their symbiotic relationship with the scale insect and methods of control. | Vittal |
| 5 | Study of the stem borer pest *(Xyleborus perforans)* of arecanut palms and modes of control. | Vittal |
| 6 | Association of insects in the tender-nut fall. | Vittal |

**Diseases**

| | | |
|---|---|---|
| 1 | Trials in the control of Koleroga or Mahali using fungicides with and without adhesives. | Vittal |
| 2 | Trials to investigate the causes and method of control of button-shedding and tender-nut fall. | Vittal, Peechi & Hirehalli |
| 3 | Control of yellow leaf spot of arecanut. | Vittal |
| 4 | Study of collar-rot of seedlings and influence of soil micro-organisms. | Vittal |
| 5 | Studies in the control of sun-scroching of stem. | Vittal, Peechi, Hirehalli & Kahikuchi |
| 6 | Studies on the retention of copper compounds on sprayed fruits in the field. | Vittal |
| 7 | Susceptibility of arecanuts to Koleroga at different stages of maturity. | Vittal |
| 8 | Studies on organisms other than *Phytophthora* that cause rotting of fruits and impair their keeping quality and germination. | Vittal |
| 9 | Study of palms showing symptoms similar to 'Band' in the primary and secondary nurseries and their behaviour in the main field. | Vittal |
| 10 | Studies on the biology of *Ganoderma lucidum* and trials on the control of 'Anabe' disease. | Vittal |
| 11 | Investigations on the yellow leaf disease (of Kerala). | Palode |

A PATHOLOGICAL ASPECTS

1 Symptomatology
2 Mycological studies
3 Study of virus association
5 Physiological studies in relation to the incidence of the disease
6 Transmission of disease
7 Study of insect, mite population etc. in relation to the incidence of the disease
9 Study of weeds in arecanut gardens with special reference to virus disease symptoms manifested by them
10 Study of the effect of administering micronutrients into the plant tissue through roots and leaves

B BOTANICAL ASPECTS

1 & 2 Collection of indigenous and exotic species and types of arecanut for studying their performance with special reference to the incidence of the disease
3 Survey of arecanut gardens in the disease affected areas for selection of outstanding palms and testing for disease resistant progenies
4 Trials of seed materials irradiated with X-ray, ultraviolet rays etc. to isolate strains resistant to yellow leaf disease
5 Histopathological studies

C AGRONOMICAL ASPECTS

1 **Cultural experiments (Main field)**

i) Influence of application of macro and micro nutrients and irrigation on the incidence of yellow leaf disease.
ii) Effect of application of N.P.K. with and without lime on disease incidence

## IV GENERAL

**1. Seasonal conditions.**

A total of 3192.70 mm rainfall was received at the Central Station on 110 rainy days during the period, as against an average of 4213.72 mm received in 128.1 days during the last seven years. Thus the total precipitation received was much less than the average. The rainfall received during the hot weather period (March to May) was also comparatively less during the year. The total number of rainy days and the total precipitation received during the period from November to May were 2 and 179.3 mm respectively as against an average of 19.13 and 429.71 for the last seven years. The low rainfall during the above period necessitated frequent irrigations. The hot clear days which prevailed from November onwards resulted in bronzing up of large number of palms. The maximum temperature ranged between 30.5° C. and 37.0° C. and the minimum between 14.5° C. and 19.8° C.

The month-wise distribution of rainfall and temperature recorded is given in Appendix I (a).

The total rainfall recorded during the year at the Regional Stations are given below.

| | | |
|---|---|---|
| 1 | Peechi | 3239.20 mm |
| 2 | Hirehalli | 1475.40 mm |
| 3 | Kahikuchi | 1805.70 mm |
| 4 | Mohitnagar | 3352.80 mm |
| 5 | Palode | 2841.25 mm |

The month-wise rainfall data relating to the year for the Regional Stations are given in Appendix I (b).

**2. Farm Management and Development:**

**1) Central Arecanut Research Station, Vittal:**

The total area under arecanut crop at the close of the year got increased to 8.37 ha with the addition of 0.37 ha planted during the year. The progeny garden planted in 1957 comprising of 2.23 ha yielded the fourth crop during the year. A total of 5,87,289 fruits was harvested. The crop is expected to yield an income of Rs. 28,000/. The cost of bringing up the garden, annual recurring expenditure and income obtained upto 1964-65 are given in Appendix II. The average yield per tree works out to 183 nuts. Out of 3,215 palms, a total of 2,648 palms or 82.4 per cent yielded fruits during the year. The spacing trial garden planted in 1958 yielded the second crop during the year. The garden under N.P.K. trial has just commenced to flower.

The arecanut nurseries were continued to be maintained. A total of 29,402 seedlings were distributed to the growers during the year from the 1962-64 nursery, the progressive total of seedlings distributed from

this nursery being 44,002. A total of 62,442 sprouts were transplanted (including 33,121 nos planted during the year) in the nursery of 1963-65 period.. A total of 6,853 six month old seedlings was sold from the above nursery. Seednuts numbering 75,000 were sown for the nursery of 1964-66 period. The seednuts recorded a germination of 94.33 per cent. The total number of seednuts procured during the period was 1,35,051, out of which 37,000 nos. were sent to the Governments of West Bengal and Gujarat.

In order to augment the green manure resources of the Station cuttings of *Gliricidia maculata* numbering 6842 were planted. A total number of 1164 other miscellaneous shade-tree plants, 101 coconut seedlings and 174 miscellaneous fruit plants were also planted.

The permanent improvements included constructions like an additional room and a verandah for the existing temporary godown, a cattle shed, a cemented irrigation channel of 115m length, a mud wall fence over a length of 150m and improving the roads of the Station by widening and providing one culvert.

**2) Regional Arecanut Research Station, Peechi:**

The bulk garden of the Station covering an area of 1.7 ha planted in 1960 and 1961 has yielded the first crop of 1836 ripe fruits. The arecanut nurseries were continued to be maintained and a total of 62,888 seedlings was sold during the year. A total of 75,000 seednuts was sown during the year which recorded a germination of 84.28 per cent. The subsidiary crops raised at the Station included paddy, ginger, vegetables, coconut, banana, kapok and fruit plants. Large number of cuttings of *Gliricidia* were also planted as source of organic manure. A net area of 0.56 ha was levelled and terraced and made fit for planting. Another area of 1674 sq. m. was levelled for setting up the meteorological equipments. A total length of 391m of irrigation channel was constructed with laterite stones and plastered with cement for guiding water in experimental gardens.

**3) Regional Arecanut Research Station, Hirehalli**

A total of 50,150 arecanut seedlings and sprouts was sold to growers. During the year 93,467 seednuts were sown which recorded a germination of 81.2 per cent. Miscellaneous crops like coconut, cashewnut, banana and other fruits were also raised. A total of 4500 *Gliricidia* plants, was planted. New irrigation channel was constructed to a length of 457 metres.

**4) Regional Arecanut Research Station, Kahikuchi**

A total of 10,774 seedlings was sold to growers. Out of 15,778 seednuts sown during the year, 12477 germinated, thereby recording 79.02 per

cent germination. Irrigation channel was constructed to a length of 255 metres.

5) Regional Arecanut Research Station, Palode

A total of 19,180 areca seedlings was sold, and 15,000 seednuts were sown which recorded 77.7 per cent germination. Miscellaneous fruit plants like mango, lemon, guava and papaya were planted. An area of 0.25 ha was levelled for future planting.

3. Extension work:

i) *Exhibition:* The Central Station participated at the Third National Agriculture Fair held at Ahamedabad (Gujarat) from 14-1-1965 to 11-3-1965. It also took part in the Industrial Exhibition held at Manjeshwar, the All India Industrial and Agricultural Exhibition held at Mangalore, the District Level Science Fair held at the St. Philomena's High School, Puttur and other similar exhibitions organized by the National Extension Services. The Regional Station, Peechi participated in the Trichur Pooram exhibition from 26-4-1965 to 21-5-1965 and in the Agricultural and Industrial Education and Cultural Exhibition at Chowghat from 13th to 15th December, 1964. The Research Station, Hirehalli took part in the Industrial and Agricultural Exhibition at Siddaganga. The Regional Station, Kahikuchi participated in the 'Coconut Day' at the Regional Coconut Research Station, Kahikuchi. The Research Station, Palode, participated in the Agricultural Exhibition at Vamanpuram.

ii) *Advisory work:* The officers and staff of the Stations were in intimate touch with the arecanut growers, with a view to know their problems and to suggest or find solutions for them. They visited a large number of gardens in the respective regions to render advice to the growers on laying out of new gardens, rejuvenating existing old gardens, raising of nurseries, planting and manuring and plant protection practices.

The Arecanut Spcialist and staff took part in the Agricultural Seminar organized by the Yuvak Mandal at Chokkady. Lectures were delivered on various aspects of arecanut cultivation with stress on the latest trends in plant protection. The Arecanut Specialist also visited a number of gardens in Kerala, Mysore, West Bengal and Assam states and advised the growers on timely manuring and proper upkeep of their gardens. He also participated in the Bantwal Taluk Agricultural Development Seminar held at Bantwal and the Panchayat Presidents' and members training camp organised at Panemangalore. He visited Mangalore and Coorg districts and advised the parties on the possibility of taking up arecanut plantations in certain areas.

The Agronomist of Central Station attended the Grama Sahayak Camp at Arasinamakki. He also visited gardens in Pollachi of

Coimbatore district, with a view to advise the growers on all aspects of arecanut cultivation. He participated at the District Development Seminar at Belthangady.

The number of enquiries received from arecanut growers, officials and non-officials and state departments as regards the various aspects of arecanut cultivation was on the increase, and these were attended to promptly.

A large number of arecanut growers, officials and others interested in the cultivation of the crop who visited the Stations were taken round and the items of work in progress were explained to them in detail.

iii) *Training:* Twenty-one Agricultural Assistants of the Mysore state underwent training on the scientific methods of arecanut cultivation and nursery technique at the Central Station in two batches. Agricultural Extension Officers and Grama Sevaks deputed by the state Governments were given training on scientific arecanut cultivation in the respective Regional Stations.

**4. Miscellaneous**

i) *Library:* During the period under report, 8 books and 132 periodicals were added to the Central Station library.

ii) *Publications:* The following scientific and general papers were written and sent for publication during the year under report.

1 Fungicidal spraying in arecanut during the dry weather period.—K. S. Nagaraja Rao.

2 Role of liming in soil fertility.—A. R. Kalbande.

3 Artificial pollination in the arecanut palm.—K. Shama Bhat.

4 *Nigrospora sphareica* (Sacc.) and Mason on arecanut—G.V.B. Naidu and S.N.S. Kumar

5 *Ganoderma lucidum* – A review and further observations—G.V.B. Naidu, S.N.S. Kumar and M. Sannamarappa.

6 *Morismus carinatus* Walk. A pest on areca—S N.S. Kumar and G.V.B. Naidu.

7 *Adike* – G.V.B. Naidu.

In addition, the Central Arecanut Research Station contributed materials for the 'Questions and Answers' and 'Technical News Item' sections of the Arecanut Journal. Reports of the progress of work of the Station were published regularly in the quarterly journal 'Agricultural Research' issued by the Indian Council of Agricultural Research, New Delhi.

Three pamphlets on different aspects of arecanut cultivation were revised to bring them in line with the latest findings. The two new

pamphlets on the control of spindle bug and the yellow leaf disease of areca palms in Kerala state were released. The poster on 'Anabe' was revised.

iii) *Organisation of Study Circle:* With a view to keep the research workers abreast of the latest developments in their respective fields, a Study Circle was organised at the Research Station. The first session was inaugurated by Shri C.M. John, in which the Research Officers of the various Regional Stations also participated. A seminar on "Palm Research" was also held in this connection.

iv) *Tours:* The Arecanut Specialist conducted the annual technical inspection of the Regional Arecanut Research Station, Palode, Peechi, Hirehalli, Mohitnagar and Kahikuchi. He also inspected the West Bengal state arecanut nurseries located at Putkali and Chandranagore. He visited the Sunderban area of West Bengal and advised the state Government about the suitability of the area for taking up arecanut planting. He toured the yellow leaf disease affected areas of Kerala and Mysore in connection with the review of the work that is in progress on this disease in these two states. Besides he attended the International Symposium on 'Impact of Mendelism on Agriculture, Biology and Medicine' held at New Delhi and the Work Conference on fertilizer recommendations for the Intensive Agricultural areas convened by the Kerala state Government.

The Agronomist, Soil Chemist, Statistical Officer and other members of the technical staff also undertook tours for spot inspection and advisory work.

v) *Visitors* The Central and Regional Stations had a large number of visitors during the year. These included officials of the state Department of Agriculture and batches of under-graduate and post-graduate students of the Agricultural Colleges.

vi) *Administration:*

**Central Station:**

Shri K V. Ahamed Bavappa, Arecanut Specialist, continued to be in charge of the Research Station. He assumed the charge of the post of Arecanut Specialist on 21st October, 1964.

Shri K. Shama Bhat, reported for duty as Agronomist on 3rd October, 1964 forenoon. Sarvashri A.R. Seshadrinathan, Research Assistant (Botany), P. G. Rajendran and K. B. Abdul Khader, Research Assistants (Agronomy) reported for duty on 5-10-1964, 5-2-1965 and 26-2-1965 respectively. Shri K. Jayarathnam, Research Assistant (Entomology) who reported for duty on 5-10-1964 subsequently resigned the post and he was relieved on 30-11-1964.

Shri K. J. Abraham, Farm Assistant, Regional Arecanut Research Station, Palode was appointed to the post of Farm Superintendent with effect from 11-1-1965. Shri P. K. Ravindran Pillai who joined duty as Farm Assistant on 18-1-1965 resigned the post and was relieved on 23-6-1965. Shri E. Velappan, Nursery Assistant was relieved of his duties on 6-2-1965 to take up his appointment as Research Assistant (Agronomy) at the Regional Arecanut Research Station, Palode.

Shri N. Tirumaleshwar Bhat and Kumari M. Leela, Research Assistants were promoted as Senior Research Assistants.

**Regional Stations**

Shri K. P. Padmanabhan Nambiar, Research Officer continued to be in-charge of Peechi Station. Shri G. V. B. Naidu, Research Officer was in charge of the Hirehalli Station till 10-5-1965 and thereafter Shri M. Sannamarappa, Research Assistant was in-charge of the Station. Shri R. K. Bhattacharya was officiating as Research Officer in-charge of the Regional Station, Kahikuchi. Shri S. C. Paul, Research Officer was in-charge of the Station at Mohitnagar. Shri T. S. S. Rawther, Research Officer was in-charge of the Regional Station, Palode.

K. V. Ahamed Bavappa
*Arecanut Specialist*
*Central Arecanut Research Station*
VITTAL P. O. S. KANARA

## V APPENDICES

APPENDIX I (a)

**Rainfall and Temperature data — 1964-'65**

**Central Arecanut Research Station, Vittal**

| Months | No. of rainy days 1964-'65 | Average No. of rainy days during the last seven years | Rainfall in mm during 1964-'65 | Average rainfall (mm) during the last seven years | Temperature °C 1964-'65 | |
|---|---|---|---|---|---|---|
| | | | | | Maximum | Minimum |
| July | 26 | 29.00 | 883.00 | 1,287.31 | 30.50 | 19.00 |
| August | 26 | 26.85 | 836.00 | 899.31 | 32.80 | 18.50 |
| September | 15 | 18.28 | 263.60 | 414.94 | 31.50 | 18.50 |
| October | 9 | 11.42 | 132.00 | 244.31 | 31.00 | 19.00 |
| November | 3 | 4.14 | 37.10 | 78.40 | 35.20 | 15.00 |
| December | 2 | 1.57 | 33.60 | 23.71 | 32.00 | 15.00 |
| January | Nil | Nil | Nil | Nil | 30.60 | 14 50 |
| February | Nil | Nil | Nil | Nil | 33.00 | 14.70 |
| March | Nil | 0.28 | Nil | 3.50 | 35.50 | 19.80 |
| April | 2 | 3.00 | 19.20 | 30.10 | 37.00 | 19.50 |
| May | 2 | 10.14 | 89.40 | 294.00 | 36.50 | 19.50 |
| June | 25 | 23.42 | 898.80 | 938.14 | 33.60 | 19.70 |
| Total | 110 | 128.10 | 3,192.70 | 4,213.72 | | |

APPENDIX I(b)

**Rainfall Data - Regional Stations – 1964-'65**

| Months | Peechi | | Hirehalli | | Kahikuchi | | Mohitnagar | | Palode | |
|---|---|---|---|---|---|---|---|---|---|---|
| | No. of rainy days | Rainfall mm | No. of rainy days | Rainfall mm | No. of rainy days | Rainfall mm | No. of rainy days | Rainfall mm | No. of rainy days | Rainfall mm |
| July | 22 | 899.80 | 9 | 283.8 | 20 | 330.0 | 25 | 1133.7 | 26 | 480.6 |
| August | 17 | 459.60 | 18 | 154.2 | 15 | 194.5 | 21 | 372.6 | 14 | 167.2 |
| September | 21 | 493.20 | 14 | 362.5 | 14 | 128.4 | 17 | 874.5 | 20 | 402.2 |
| October | 13 | 354.00 | 6 | 221.5 | 8 | 116.3 | 6 | 74.6 | 21 | 492.2 |
| November | 7 | 59.80 | 8 | 200.5 | — | — | — | — | 13 | 238.8 |
| December | 2 | 22.00 | 1 | 14.0 | — | — | — | — | 1 | 23.0 |
| January | — | — | — | — | — | — | — | — | 2 | 52.5 |
| February | — | — | — | — | 4 | 35.5 | 2 | 22.6 | — | — |
| March | — | — | 1 | 8.2 | 6 | 67·4 | 5 | 33.6 | 7 | 118.4 |
| April | 8 | 48.20 | 4 | 41.2 | 13 | 180.3 | 4 | 72.6 | 14 | 240.35 |
| May | 8 | 187.00 | 4 | 51.5 | 18 | 333.4 | 12 | 354.1 | 17 | 320.70 |
| June | 28 | 715.60 | 10 | 138.0 | 22 | 416.9 | 19 | 414.5 | 16 | 305.30 |
| Total | 126 | 3239.20 | 75 | 1475.4 | 120 | 1805.7 | 111 | 3352.8 | 151 | 2841.25 |

APPENDIX II

**Cost of bringing up the main garden (Block II) - 5.50 acres during the first 5 years**

| Particulars | 1957-58 | | 1958-59 | | 1959-60 | | 1960-61 | | 1961-62 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rs | P. | Rs | P. | Rs | P. | Rs | P. | Rs | P. | Rs | P. |
| Preparatory cultivation (including digging pits, and cutting drains) | 1,511-79 | | 787-75 | | 194-10 | | 46-03 | | —— | | 2,539-67 | |
| Planting seedlings, mulching and shading | 1,239-98 | | 179-34 | | 184-56 | | 93-58 | | —— | | 1,697-46 | |
| Manuring | 580-58 | | 1,285-42 | | 1,605-49 | | 1,755-05 | | 1,755-80 | | 6,982-34 | |
| Irrigation | 1,057-40 | | 1,423-89 | | 950-02 | | 1,345-92 | | 965-23 | | 5,742-46 | |
| Cultural operations (weeding, forking etc.) | 407-49 | | 987-98 | | 1,160-23 | | 1,600-09 | | 826-65 | | 4,982-43 | |
| Control of pests and diseases | 162-03 | | 248-00 | | 273-44 | | 221-15 | | 274-10 | | 1,178-72 | |
| Total | 4,959-27 | | 4,912-38 | | 4,367-83 | | 5,061-82 | | 3,821-78 | | 23,123-08 | |

**Progressive expenditure on maintaining the garden from 6th year**

| Particulars | 1962-63 | | 1963-64 | | 1964-65 | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Rs | P. | Rs | P. | Rs | P. | Rs | P. |
| Cultural operations | 721-84 | | 426-93 | | 1,356-30 | | 2,505-07 | |
| Irrigation | 929-30 | | 696-28 | | 787-70 | | 2,413-28 | |
| Manures and manuring | 2,811-34 | | 2,057-68 | | 1,879-89 | | 6,748-91 | |
| Harvesting and curing | 403-54 | | 734-05 | | 277-05 | | 1,414-64 | |
| Control of pests and diseases | 472-87 | | 390-43 | | 541-40 | | 1,404-70 | |
| Proportionate cost (1/3 of total on expenditure other than annual) | 506-34 | | 786-30 | | 2,000-17 | | 3,292-81 | |
| Total | 5,845-23 | | 5,091-67 | | 6,842-51 | | 17,779-41 | |

**Receipts**

| Year | Amount | |
|---|---|---|
| | Rs | P. |
| 1961-62 | 447 | 90 |
| 1962-63 | 8,770-21 | |
| 1963-64 | 26,212.00 | |
| 1964-65 (Expected) | 28,000-00 | |
| Progressive Total | 63,430-11 | |

APPENDIX III

## Set-up of the Central Arecanut Research Station and Regional Stations

| Name of the post | Incumbent |
|---|---|
| (1) | (2) |
| **Central Arecanut Research Station, Vittal** | |
| Arecanut Specialist | Shri K. V. Ahamed Bavappa, M. Sc. (Ag.) |
| **Botany:** | |
| Botanist | Vacant |
| Research Assistant | Shri A. R. Seshadrinathan, M. Sc. |
| **Agronomy** | |
| Agronomist | Shri K. Shama Bhat, M. Sc. (Ag.) |
| Senior Res. Assistant | Shri P. Muddappa, B. Sc. (Ag.), D. H. |
| -do- | Kumari M. Leela, B. Sc (Ag.) |
| Research Assistant | Shri P. G. Rajendran, B. Sc. (Ag.) |
| -do- | Shri K. B. Abdul Khader, B. Sc. (Ag.) |
| **Farm** | |
| Farm Superintendent | Shri K. J. Abraham, B. Sc. (Ag.) |
| Farm Assistant | Vacant |
| Nursery Assistant | Vacant |
| **Statistics** | |
| Statistical Officer | Shri P. R. Ramachander, M. A. Diploma in Statistics (I. C. A. R.) |
| **Chemistry** | |
| Soil Chemist | Dr. A. R. Kalbande, Ph. D., Assoc. I.A.R.I |
| Senior Res. Assistant | Shri N. Tirumaleshwara Bhat, B. Sc. (Ag.) |
| **Plant Pathology** | |
| Plant Pathologist | Vacant |
| Senior Res. Assistant | Shri K. S. Nagaraja Rao, M. Sc. |
| **Entomology** | |
| Entomologist | Vacant |
| Research Assistant | Vacant |
| **Plant Physiology** | |
| Plant Physiologist | Vacant |
| Research Assistant (Agronomy) | Vacant - 4 |
| Research Assistant (Chemistry) | Vacant |

**Office**

| | |
|---|---|
| Assistant Administrative Officer | Shri N. K. Srinivasa Murthy, B. Com. |

**Regional Arecanut Research Station, Peechi**

| | |
|---|---|
| Research Officer | Shri K. P. Padmanabhan Nambiar, B. Sc (Ag.), D.I.H. |
| Pathology Assistant | Shri C. S. Abraham, M. Sc. (Ag.) |
| Farm Assistant | Shri M. Vijayarajan, B. Sc. (Ag.) |
| Research Assistant | Vacant |

**Regional Arecanut Research Station, Hirehalli**

| | |
|---|---|
| Research Officer | Shri G. V. B. Naidu, B. Sc. (Hons) |
| Research Assistant | Shri M. Sannamarappa, B. Sc. (Ag.) |
| Pathology Assistant | Shri S. N. Sampathkumar, B. Sc. (Ag.) |
| Farm Assistant | Vacant |

**Regional Arecanut Research Station Kahikuchi**

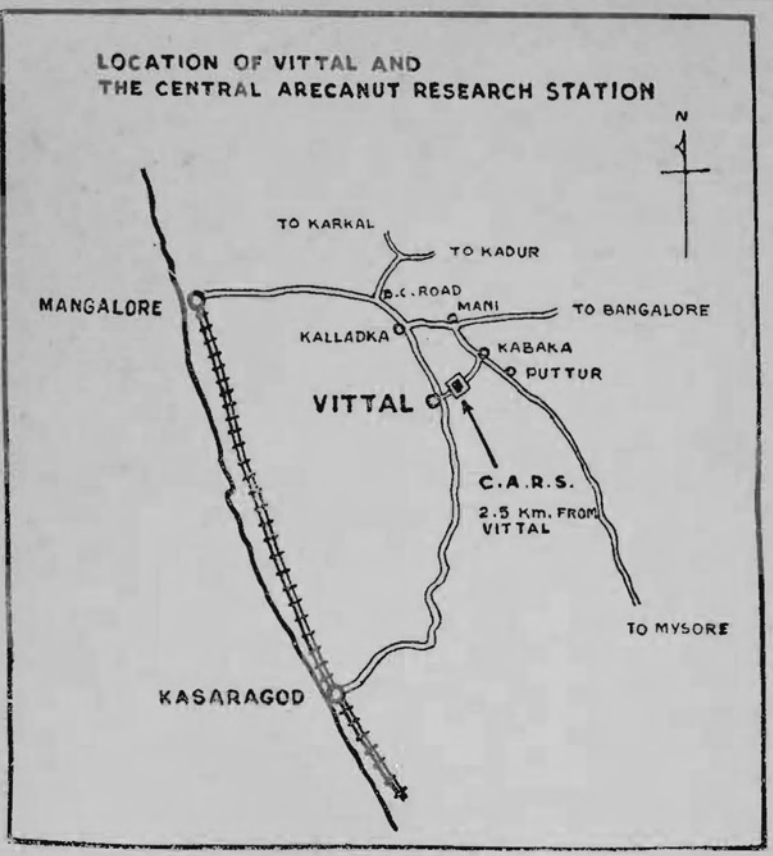
| | |
|---|---|
| Research Officer | Shri R. K. Bhattacharyya, B. Sc. (Ag.) |
| Pathology Assistant | Shri K. J. Antony, M. Sc. |
| Research Assistant | Vacant |
| Farm Assistant | Vacant |

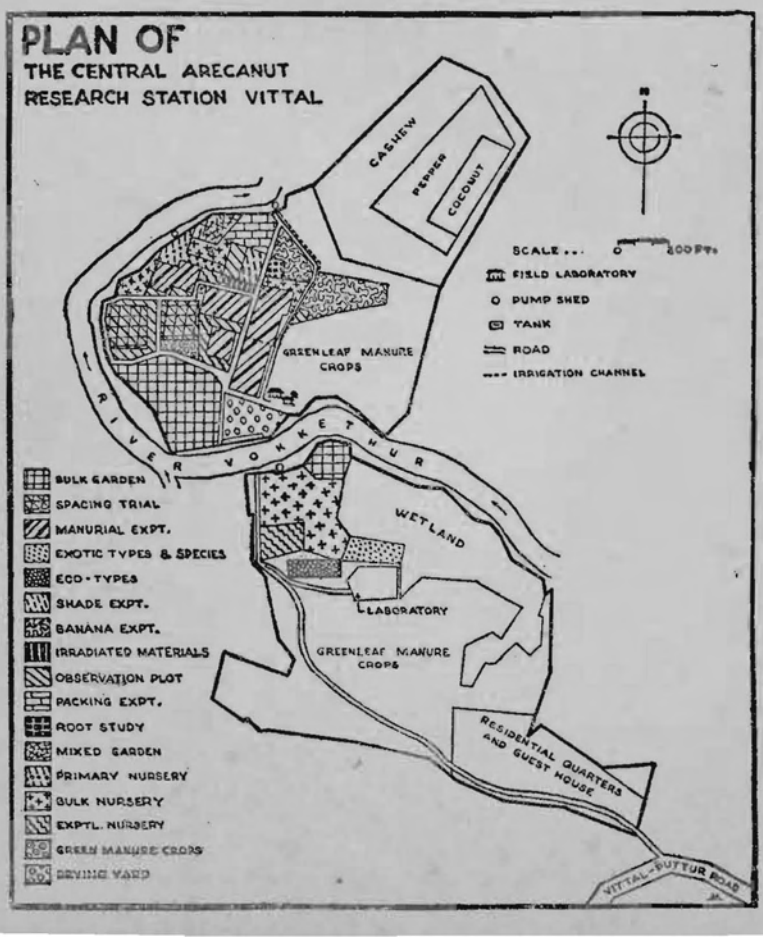
**Regional Arecanut Research Station, Mohitnagar**

| | |
|---|---|
| Research Officer | Shri S C. Paul, B. Sc., B. Ag., Assoc. I. A. R. I. |
| Pathology Assistant | Shri K. John Mathew, M. Sc. |
| Research Assistant | Vacant |
| Farm Assistant | Vacant |

**Regional Arecanut Research Station, Palode**

| | |
|---|---|
| Research Officer | Shri T. S. S. Rawther, M. Sc. |
| Senior Res. Assistant | Shri R. Balakrishnan Nair, B. Sc. |
| Research Assistant | Shri E. Velappan, B. Sc. (Ag.) |
| Earm Assistant | Shri K. Unniravi Pillai, B. Sc. (Ag.) |


LOCATION OF VITTAL AND
THE CENTRAL ARECANUT RESEARCH STATION
N
TO KARKAL
TO KADUR
MANGALORE
B.C. ROAD
MANI
TO BANGALORE
KALLADKA
KABAKA
PUTTUR
VITTAL
C.A.R.S.
2.5 Km. FROM VITTAL
TO MYSORE
KASARAGOD


PLAN OF
THE CENTRAL ARECANUT
RESEARCH STATION VITTAL
N
CASHEW
PEPPER
COCONUT
SCALE ... 0 200 Ft.
FIELD LABORATORY
PUMP SHED
TANK
ROAD
IRRIGATION CHANNEL
GREENLEAF MANURE CROPS
RIVER VOHKKETHUR
WETLAND
LABORATORY
GREENLEAF MANURE CROPS
RESIDENTIAL QUARTERS AND GUEST HOUSE
VITTAL-PUTTUR ROAD
BULK GARDEN
SPACING TRIAL
MANURIAL EXPT.
EXOTIC TYPES & SPECIES
ECO-TYPES
SHADE EXPT.
BANANA EXPT.
IRRADIATED MATERIALS
OBSERVATION PLOT
PACKING EXPT.
ROOT STUDY
MIXED GARDEN
PRIMARY NURSERY
BULK NURSERY
EXPTL. NURSERY
GREEN MANURE CROPS
DRYING YARD