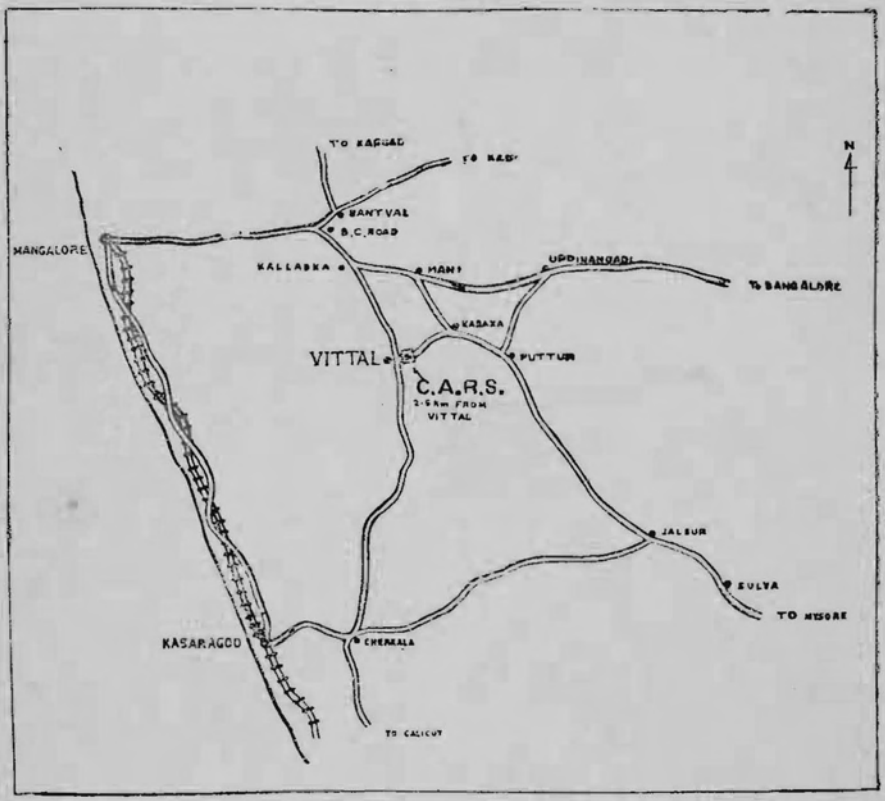
# Annual Report of the Central and Regional Arecanut Research Stations

1969


**Central Plantation Crops Research Institute,**
**Regional Station, Vittal**
**Mysore State, India**
**1971**

# LOCATION OF
# CENTRAL ARECANUT RESEARCH STATION, VITTAL.



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# ARECANUT REGIONS AND CENTRES OF ARECANUT RESEARCH

# I. DIRECTOR'S INTRODUCTION

## A BRIEF HISTORICAL INTRODUCTION

The Central Arecanut Research Station, Vittal was started by the erstwhile Indian Central Arecanut Committee in April, 1956. It is located in Vittal Village, Bantwal Taluk of South Kanara District of Mysore State, 45·0 km from Mangalore Railway Station on the Mangalore-Vittal-Puttur highway. It lies on 12·25° north latitude and 75·42° east longitude. The altitude of the Station is about 200 m above mean sea level. The rivulet Vokkethur is the main source of irrigation. The soil at the Station is typically lateritic and is admixed with sand, alluvium and gravel. It is acidic with a pH value around 5·25. The total area of the Station is 57·67ha.

Besides the Central Station, there are five Regional Stations located at Kahikuchi, Mohitnagar, Hirehalli, Peechi and Palode, all started by the erstwhile Indian Central Arecanut Committee.

The Station at Kahikuchi was started in 1958. It is located near 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 26.18° north and 91.78° east respectively. The soil is new alluvium with lower strata of lateritic and has a pH of 4·4 to 4.8. The total area of the Station is 12.14 ha.

At Mohitnagar, the Station was started in 1958. It is located near the Mohitnagar Farm of West Bengal Government at a distance of 9.6 km north-west of Jalpaiguri Railway Station on the Jalpaiguri-Siliguri road. It lies on 26.52° north latitude and 88.72° east longitude. The soil is alluvium and has a pH range of 4.5 to 6.0. The total area of the Station is 10.11 ha.

The Station at Hirehalli started in July, 1958, is located near Hirehalli Railway Station, Tumkur District (Mysore State) on the Bangalore-Poona National Highway, 58 km from Bangalore. It lies on 13.08° north latitude and 77.12° east longitude. It is 854 m above mean sea level. The soil of the Station is clay to clay loam with a mean pH of 6.2. The total area of the Station is 16.24 ha.

The Station at Peechi was started in October, 1958. It is at Kannara of Trichur District in Kerala State and is situated 19·3 km east of Trichur Railway Station. It is located at 10·50° north latitude and 76·17° east

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 Station at Palode was started in 1959 and is located at Palode Village in Nedumangad Taluk of Trivandrum Distrtict of Kerala State and is 36 km away from Trivandrum City. It lies on 77.03° east longitude and 8.07° north latitude. The altitude of the Station ranges from 210-240 m above mean sea level. The soil is mainly lateritic with pH ranging from 4 2 to 5.0. The total area of the Station is 14.43 ha.

The Central and Regional Stations were under the control of the Indian Central Arecanut Committee and on its abolition they were taken over by the Indian Council of Agricultural Research in April, 1966.

## OBJECTIVES

The Central Station is charged with the functions of (i) conducting fundamental and applied research in the fields of Agronomy, Botany, Chemistry, Physiology,Pathology and Entomology as related to arecanut crop; (ii) guiding and coordinating the research work carried out at the different Regional Arecanut Research Stations in the country, (iii) solving the Regional problems confronting the arecanut crop and (iv) serving as a centre of information on all matters relating to the arecanut crop. The Regional Stations at Kahikuchi, Mohitnagar, Hirehalli, and Peechi are to deal with the various agronomic and pests and diseases problems relating to the arecanut crop peculiar to the respective regions as well as to serve as testing centre of the research findings of Central Station for adoption in the region. The Stations are also to supply quality planting materials to the growers. The Research Station at Palode was started mainly to tackle the yellow leaf disease of arecanut palm which is a serious problem of the tract and also to handle some of the important agronomic problems of the region.

## ORGANISATIONAL STRUCTURE AND CHANGES

Research at the Central Station is being carried out in seven sections viz., Agronomy, Botany, Chemistry, Physiology, Pathology, Entomology, and Statistics. The work of each section is under the immediate charge of the concerned Section Head, who is assisted by Research Assistants. The Regional Stations are under the immediate charge of the respective Research Officers who are assisted by Research Assistants. The administration of the Central and Regional Stations is being carried out with the help of a separate Administrative Section. The overall control of the Central and

Regional Stations rests with the Arecanut Specialist, who is the head of the Central Station.

The Central Station has a library which is accessible to the research workers of Regional Stations as well. The Regional Stations also have each a small library for immediate reference.

## DISTINGUISHED VISITORS

A large number of scientists from different organisations both from within and outside the country, Minister of Agriculture from Union as well as State Governments, Officials of State Department of Agriculture, students from different academic and Agricultural Universities, Directors of various Research Institutes and progressive farmers from different localities visited the Central and Regional Stations during the year under report. The important visitors to Central Arecanut Research Station, Vittal, included Shri Annasaheb P. Shinde, Union Minister of State for Food and Agriculture; Shri B. Rachaiah, Minister for Agriculture, Mysore State; Shri B. Vittaldas Shetty, Minister for Food and Civil Supplies, Mysore State; Shri H. C. Linga Reddy, Minister for Fisheries and Ports, Mysore State; Shri K. P. A. Menon, Secretary, Indian Council of Agricultural Research; Shri P. S. Hariharan, Additional Secretary, Indian Council of Agricultural Research; Shri S. Natarajan, Director (Budget, Audit and Accounts), Indian Council of Agricultural Research; Shri N. K. Dutta, Under Secretary, Indian Council of Agricultural Research; Shri S. L. Katyal, Deputy Agricultural Commissioner (Hort.), Indian Council of Agricultural Research; Shri Daljit Singh, Deputy Commissioner (Hort.), Government of India; Dr. B. R. Murthy, Project Coordinator (Millets), Indian Agricultural Research Institute, New Delhi; Dr. Harbajan Singh, Head, Division of Plant Introduction, Indian Agricultural Research Institute; Dr. F. J. Simmonds, Director, Commonwealth Institute of Biological Control, Trinidad; Dr. V. P. Rao, Entomologist-in-charge, Commonwealth Institute of Biological Control, Bangalore; Dr. G. Rangaswamy, Dean, University of Agricultural Sciences, Bangalore; Dr. P. S. Rao, Head of the Utilisation Research, Forest Research Laboratory, Bangalore; Dr.W. Schellmann and Mr. F. Schawffele, Geological Survey of Germany, Hannover, West Germany; Shri M. Janardhanan Nair, Chief Agronomist, Fertilizers and Chemicals Travancore Ltd., Alwaye; Shri T. T. Paulose, Deputy Director, Regional Office, Arecanut and Spices Development, Calicut; Shri K. A. Muthanna, Cacao Adviser, Cadbury Fry (India) Private Ltd., Chundale; Mr. K. C. Shaddock, Cadbury Fry (India); Private Ltd., Bombay; Mr. K. M. Samuel, Sua Betong Estate, Malaya; Mr. Figuloa Robert, Elsalvador, Central America; Shri B. P. Kadam, M. L. A., Karwar; Shri M. S. P. Rajes, Cauvery Peak, Yercaud; Bishop Mar Athana-

sios, Thiruvalla; Board of Directors, The Sampaje Areca Plantations (Private) Ltd., Sampaje; Shri G. K. Shenoy, Principal, Vivekananda College, Puttur and Rev. Fr. Benjamin D'Souza, St. Joseph's Agricultural Colony, Belve.

Among the visitors to various Regional Stations, mention may be made of the visit of Sri A.H.S. Sharma, Retd. Extension Specialist, Agricultural College and Research Institute, Coimbatore; Shri P. Kumara Pillai, Principal, Agricultural College and Research Institute, Vellayani, Trivandrum and Dr. R. Gopalakrishna, Deputy Chief Agronomist (Res.), Fertilizers and Chemicals Travancore Ltd., Alwaye, to Regional Station, Peechi, of Dr. A.B. Joshi, Deputy Director General (CS), Indian Council of Agricultural Research; Dr.M.R. Gopalakrishnan Nair,Prof. of Entomology, Agricultural College and Research Institute, Vellayani and Shri V. Krishnamoorthy, Assistant Meteorologist, Poona, to Regional Station, Pilode and of Shri M. C. Nambiar, Director, Central Coconut Research Station, Kasaragod; Shri K. S. Banerjee, Director of soil conservation and Ex-Officio Joint Director of Agriculture, Jalpaiguri and Smt. Nalini Ranjan Sarkar, Principal, Government Junior Basic Training College, Jalpaiguri to Regional Station, Mohitnagar.

## IMPORTANT EVENTS OF THE YEAR

The sixth Farmers' Week Celebration organised from 3rd to 5th January, 1970 was inaugurated by Shri A. P. Shinde, Hon'ble Union Minister of State for Food and Agriculture and presided over by Shri C. M. Poonacha, M. P. and Ex. Union Minister for Steel and Heavy Engineering. Shri H. C. Linga Reddy, Minister for Fisheries and Ports, Mysore State, opened the exhibition covering all aspects of arecanut crop as well as a number of allied crops and subjects. The demonstration of sprinkler irrigation organised by the Manipal Industries and the electrically operated arecanut dehusking machine are some of the items worth mentioning.

The project system in various research fields as envisaged in the technical programme was put into operation. The unique feature of the Research Council Meeting during the year was group discussions on various projects by concerned Project leaders and associates and finally having a Full Session to scrutinise all the projects and reorient the project/s if found necessary.

In order to increase the amenities to the staff members at the Central Station, a canteen was started as a part of the Central Arecanut Research Station Employees' Consumers' Cooperative Society. An amount of Rs. 8,73,941/- was sanctioned by the Indian Council of Agricultural Research for the Construction of quarters for the staff members of the Central Station.

## RESEARCH COLLABORATION AT NATIONAL LEVEL

Training was imparted to research workers in various aspects of arecanut cultivation at the Central Station. Shri P. D. Bopanna, Graduate Assistant and Shri K V Nagaraj, Assistant Chemist deputed from the Horticultural Farm, Thirthahalli were given training for a period of three days in June, 1969. Shri Mahammed Isaque and Shri Devarajan, Arecanut Development Assistants, Mettupalayam and Thondamputhur respectively, deputed by the Government of TamilNadu were imparted training for a period of five days in September, 1969. Seeds of exotic varieties of areca were introduced through Indian Agricultural Research Institute, New Delhi. The Director of Horticulture, Lalbagh, Bangalore, supplied cacao planting materials Field facilities were provided for the Central Tuber Crops Research Institute, Trivandrum, for laying out field experiments with tapioca and sweet potato varieties

## RESEARCH COLLABORATION AT INTERNATIONAL LEVEL

Collaboration with Commonwealth Institute of Biological Control, Bangalore, was obtained for the supply and rearing of the predator for the biological control of mites. Some specimens were got identified by the Commonwealth Entomological Institute, London. Introduction of cacao seed material (Criollo variety) was made from Sabah through Messers Cadbury Brothers Ltd., England.

## FELLOWSHIP AND STUDENTSHIP

Two of the staff members joined for M.Sc. and Ph.D. courses in Pathology. The Ph.D. scholar was awarded a senior fellowship by the Indian Council of Agricultural Research. During the year three staff members completed their post-graduate courses and rejoined duty at Central Station, Vittal and Regional Station, Palode.

## RESEARCH ASSOCIATIONS

The fourth Research Council Meeting of Central and Regional Research Stations was held on 7th, 8th and 9th January, 1970 at the Central Station, Vittal. Discussions were held on the individual projects by the concerned Project leaders and associates during the first two days. The full session on the third day i. e. on 9th January, 1970 was presided over by Dr. A. B. Joshi, Deputy Director General (CS). The Research Council was attended by Director and some of the staff members of Central Coconut Research Station, Kasaragod, the Deputy Director, Regional Office (Arecanut and Spices Development), Calicut, the Research Officers and staff members of different Regional Arecanut Research Stations, the Superintendent,Regional Arecanut Research Station, Thirthahalli(State) and the Heads

of Sections and research staff of Central Station. Every project under the technical programme was discussed in detail and some of them reoriented. Under the aegis of the Study Circle five meetings were held in April, June, August, September and November, which were addressed by scientists like Dr. N. Hrishi, Cytogeneticist,Indian Agricultural Research Institute, Regional Station, Coimbatore, Dr. P. S. Rao,Head of Utilisation Research,Forest Research Laboratory, Bangalore, Shri S. L. Katyal, Deputy Agricultural Commissioner (Hort.), Indian Council of Agricultural Research and Dr. G. Rangaswamy, Dean,University of Agricultural Sciences,Bangalore. Research papers and review articles were presented at the meeting and discussed.

## ADVISORY SERVICES RECEIVED AND PROVIDED

The Central Station gave suggestions in drawing up of the technical programme of Mysore State Regional Arecanut Research Station, Thirthahalli. The Arecanut Specialist was member of the Development Council for Arecanut and Spices, Calicut, Arecanut Sub-Committee of the Indian Standards Institution, New Delhi and Coconut and Arecanut Committee, of the Kerala Research Council. He attended the meetings and gave suitable advice on various technical matters. The Agronomist was a member of the Sub-Committee to review the report of Pilot Sample Survey for Correct Estimation of area and production of arecanut.

Besides the normal activities of research, suitable advice was given on numerous enquiries that were being received by the Central and Regional Stations on problems connected with the crop such as cultivation practices, spacing and layout to be adopted, fertilizers and manures to be applied, examination of plant parts affected by various diseases and pests and proper methods of their control,methods of preparation of nuts for the market, etc. Requests for spot inspections for selection of site and layout of garden and for an on-the-spot study of disease and pest problems in various gardens were also attended to wherever feasible. The Central and Regional Stations were also centres of study tour.

Research Institutes in India and abroad were consulted on problems relating to manuring of cacao, staining techniques in wood rotting fungi and identification of some insect pests.

## EXTENSION

The Research Station participated in the Agricultural and Industrial Exhibition 1969 of Sree Siddaganga Mutt, Tumkur, held from 11-2-1969 to 24-2-1969. The stall was awarded a prize by the judges. A few exhibits were sent to the Deputy Director, Regional Office, (Arecanut and Spices

Development), Calicut for display in the exhibition organised in connection with the meeting of the Indian Arecanut Development Council at Ernakulam in October, 1969. Farmers' Week was celebrated in Central and Regional Stations in which extension staff of the State Departments, Private Firms and large number of growers participated. This was of immense educative value to the arecanut growers. A total of 1,11,674 quality seednuts and 4,554 quality seedlings were distributed by the Central Station during the year. From Regional Arecanut Research Station, Hirehalli, a total of 1,024 quality seedlings were distributed.

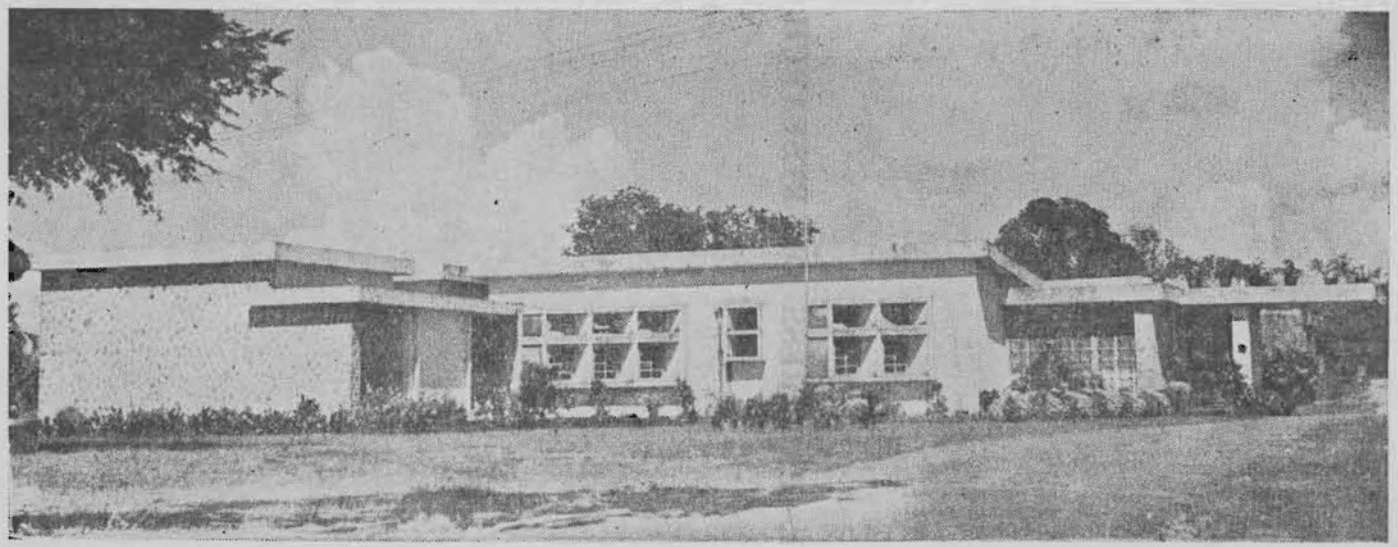
FINANCE

The sanctioned budget estimates of Research Stations for 1969-70 was Rs. 14,89,500.00. The expenditure on major heads of accounts was of the following order:

| | | |
|---|---|---|
| 1. Pay and allowance of the staff | Rs. | 5,12,594.07 |
| 2. Working expenses | Rs. | 4,94,310.44 |
| 3. Capital Works | Rs. | 4,82,322.43 |
| Total: | Rs. | 14,89,226.94 |

The revenue receipts of the Stations touched a figure of Rs. 2,43,471.02 against the target of Rs. 2,39,500.00 fixed for the year 1969-70 and against Rs. 1,71,425 realised during the corresponding period of previous year.

# II. PROGRESS OF RESEARCH



**Laboratory,**
**Central Arecanut Research Station, Vittal.**

# BOTANY

## SUMMARY OF SALIENT FINDINGS

*Twelve multilocation trials with five promising introductions were laid out for studying their performance under varying agroclimatic conditions. The* Chali *of* Areca triandra *was tested for the preparation of scented supari and found to be comparable with the local. Yield evaluation of the indigenous typesshowed that Mohitnagar(West Bengal) type has high yield potentiality. Studies on the resistance of different types of areca to the Yellow Leaf Disease showed that all of them are susceptible to the disease to varying degrees. Areca growing tracts of Shimoga, Chickmagalore, North Kanara and South Kanara districts were surveyed and thirty six common cultivars isolated. Certain inter-varietal hybrids involving indigenous and exotic types were found to be superior to both the parents in respect of number, length and breadth of leaves, number and length of leaflets, breadth of leaf sheath, girth at crown and number of inflorescences produced. A technique for studying the karyomorphology of arecanut was standardised. Spraying the bunches with Benlate and Dithane Z-78 gave better control of shedding of buttons and tendernuts.*

## (b) RESEARCHES ON HAND

### B. 1. Introduction and maintenance of indigenous and exotic species and types of areca for selection and hybridisation

(S. S. Pillai, K. V. A. Bavappa, M. Sannamarappa, A. K. Sadanandan and R. B. Nair)

*a) Exotic types collection*:The first batch of exotic types consisting of seventeen species and types from eight countries, viz., Saigon, Indonesia, Fiji, China, Ceylon, Mauritius, Singapore and British Solomon Islands and planted during 1961 in a randomised block design with single tree plots for studying their performance in comparison with the local types were maintained in good condition. The mean yield of the high yielding types and local is given in Table 1.

TABLE 1

Yield of exotic introductions (1961 planting)

| Sl. No. | Name of the type | VTL. No. | Yield in kg (ripe nuts) /palm(Mean of 5 years) | Yield indices (Taking yield of Vittal as 100-in wt) |
|---|---|---|---|---|
| 1 | China | VTL. 3 | 8.06 | 220 |
| 2 | Indonesia (6) | VTL. 11 | 9.01 | 246 |
| 3 | Saigon (1) | VTL. 12 | 8.82 | 241 |
| 4 | Saigon (2) | VTL. 13 | 10.63 | 291 |
| 5 | Singapore | VTL. 17 | 8.84 | 242 |
| 6 | Vittal | | 3.65 | 100 |

There was a slight reduction in yield among the high yielders though their yield in general was much higher (2.2 to 2.9 times) than the local. China (VTL. 3) has in addition to high yield many other desirable characters such as earliness in bearing, semi-tall nature, etc.

The second batch of exotics with ten types and two species planted during 1964 started bearing and yielded the first crop. One of the above species viz., *Areca normanbyii* has been found to possess sweet sap and efforts made to tap the same and prepare jaggery have given promising indications.

The third batch of introductions consisting of seven types and species were planted during 1968. The annual growth measurements showed that *A. macrocalyx* and Bougain Ville-2 are significantly superior for number of leaves and girth.

Multilocation trials with five high yielding introductions viz., VTL. 3, VTL. 11, VTL. 12, VTL. 13 and VTL. 17 were laid out in twelve more centres of the different arecanut growing regions of Kerala and Mysore States, in addition to the five centres laid out last year. The trial plots are under observation. *Chali* of *A. triandra* was tested for the preparation of scented supari and was found to compare well with the product of *A. catechu*.

To assess the variability in germination of different types and species of areca a sowing experiment using 17 exotic types and species with one local in four replications was conducted in 1968-'69. The variability in percentage of germination, total number of days taken for completing the germination, and total days taken for germination from commencement of germination to end of germination of all the varieties were recorded. The figures are given in Table 2.

## TABLE 2

Germination of different types and species

| Sl. No. | Treatments | | % of germination | Total days taken for completing the germination from sowing | No. of days taken for germination from commencement of germination to end of germination |
|---|---|---|---|---|---|
| (1) | (2) | | (3) | (4) | (5) |
| 1 | Fiji | VTL. 1 | 86.50 | 86.00 | 31.75 |
| 2 | Mauritius (*A. triandra*) | VTL. 2 | 93.50 | 161.25 | 50.00 |
| 3 | China | VTL. 3 | 82.25 | 94.00 | 38.75 |
| 4 | Ceylon - 1 | VTL. 5 | 72.25 | 84.75 | 32.50 |
| 5 | Indonesia - 1 (*A. triandra*) | VTL. 6 | 75.50 | 107.25 | 40.25 |
| 6 | Indonesia - 2 (*A. triandra*) | VTL. 7 | 92.00 | 128.75 | 50.00 |
| 7 | Indonesia - 6 | VTL. 11 | 81.00 | 84.50 | 35.75 |
| 8 | Saigon - 1 | VTL. 12 | 83.50 | 114.00 | 59.25 |
| 9 | Saigon - 2 | VTL. 13 | 82.50 | 101.75 | 48.25 |
| 10 | Saigon - 3 | VTL. 14 | 68.75 | 101.75 | 42.25 |
| 11 | Ceylon - 2 | VTL. 15 | 86.50 | 99 00 | 31.25 |
| 12 | Singapore | VTL. 17 | 87.75 | 85.50 | 34.50 |
| 13 | Br.Sol.Island-1 | VTL.18a | 85.00 | 101.00 | 31.25 |
| 14 | Br.Sol.Island-2 | VTL. 18b | 80.25 | 83.00 | 32.25 |
| 15 | Br.Sol.Island-3 | VTL. 18c | 84.75 | 84.75 | 35.25 |
| 16 | Ceylon-3 (*A. triandra*) | VTL. 21 | 78.00 | 142.25 | 57.00 |
| 17 | Local (*A. catechu*) | VTL. | 73.00 | 99.00 | 39.00 |
| S. E. per plot | | | 11.66 | 19.87 | 16.15 |
| Overall mean | | | 81.91 | 103.44 | 40.54 |
| C. V. (%) | | | 14.24 | 19.21 | 39.84 |
| C. D. (P=0.05) for comparing treatments with no missing value | | | | 28.31 | |
| C. D. (P=0.05) for comparing treatment 11 and all except treatment 14 and *vice versa* | | | | 30.69 | |
| C.D.(P =0.05) for comparing treatments 11 and 14 | | | | 33.05 | |

The data show that the varietal differences are highly significant only in respect of total number of days taken for completing the germination. *A. triandra* has taken maximum number of days for completing germination when compared with *A. catechu.*

The suckering habit of the different accessions of *A. triandra* were also studied. The mean number of suckers excluding the main plant is given below:

| | Mean | Range |
|---|---|---|
| VTL. 2 | 3.44 | 1-7 |
| VTL. 6 | 8.57 | 4-21 |
| VTL. 7 | 1.94 | 0-5 |
| VTL. 21 | 16.53 | 10-25 |

During the year, seednuts from Burma, Mauritius and Vientiane were received and sown at Vittal.

*b) Indigenous types collection*: Nine indigenous types from different arecanut growing tracts of the country planted in the year 1964 were tested for yield. Types from Thirthahalli and Mohitnagar have recorded the maximum yield. An evaluation of *Chali* from nine indigenous types made showed wide variation in size, shape, quality and hardness of kernel and percentage of kernel to wet weight of fruits.

Out of 52 seedlings (open pollinated) obtained from the dwarf palm-1, 25 had the dwarf character of the mother palm and the remaining 27 were tall. The seedlings have been potted for further observation.

A trial to study the resistance of different types to the yellow leaf disease had been laid out at Palode in the year 1962. The observations have shown that all the types studied are susceptible to the disease to varying degrees.

**B. 2 Survey of arecanut gardens to assess the genetic variation and selection of common cultivars**

(R. S. N. Pillai, K. N. Murthy, R. B. Nair, B. K. Sarma and A. K. Sadanandan)

The survey was taken up in the districts of South Kanara, North Kanara, Chickmagalore and Shimoga. The arecanut growing area in each district was divided into major tracts based on topography, altitude and soil type. From each tract, ten arecanut growing villages and two gardens in each village were selected randomly for the studies. In each garden ten

healthy and bearing trees were selected at random and 12 ripe nuts were collected from each palm and the size (length and breadth) of fruits were recorded. The data thus collected were analysed and a total number of 36 cultivars isolated.

Seeds collected from all the 36 cultivars have been sown in a 6 x 6 double lattice design for study.

**B. 3. Studies on the performance of progenies of known mother palms and mother palm progeny relationship**

(M. Sannamarappa, P. R. Ramachander, A. K. Sadanandan and R. S. N. Pillai)

Based on progeny studies 'prepotent' mother palms have been isolated. In order to study the repeatability of prepotency, seedlings of nine mother palms were planted during 1966 at Vittal on a compact family block design with five replications. A total of 180 progenies were being studied, and their growth measurements recorded. The results showed that the different families differed significantly for total height of plants alone.

At Hirehalli, progenies of eight mother palms locally collected were under comparison on an 8 x 4 randomised block design for isolating 'prepotent' mother palms. Data on leaf-fall, production of spadices and the yield showed that the treatment differences are highly significant for three characters viz., number of leaves shed, number of spadices produced and the percentage of spadices to leaf-fall. The treatments do not differ significantly from each other with respect to yield.

A similar study is in progress at Peechi with the progenies of four mother palms. The difference in yield (number of fruits) of progenies of the different mother palms was not significant.

**B. 4. Production of inbred lines of distinct types**

(K. N. Murthy and R. S. N. Pillai)

Selfed and open pollinated progenies of two mother palms KMJ. 13 and NGB. 293 planted during 1967 on a 2 x 16 randomised block design with two palms per plot showed significant difference with regard to height, the selfed progenies being less in height than the open pollinated seedlings.

**B. 5. Hybridisation between exotic and indigenous types and species**

(K. V. A. Bavappa and S. S. Pillai)

The inter-varietal hybrids planted in 1965 were critically studied for their growth and yield characters. The figures are given in Table 3.

TABLE 3

Growth and flowering characters of the hybrids and their parents

| | Details of cross & parents | Length of the oldest leaf cm | No. of leaflets | No. of leaves | Leaflet maximum length cm | Leaf-sheath maximum breadth cm | Girth of crown cm | Mean No. of inflorescence/ palm flowered |
|---|---|---|---|---|---|---|---|---|
| | Local | 140.36 | 28.73 | 8.82 | 62.91 | 36 36 | 36.82 | 0.00 |
| I | Local x Andaman | 157.40 | 41.10 | 10.20 | 67.00 | 47.40 | 51.60 | 2.50 |
| | Andaman | 162.47 | 44.91 | 9.47 | 73.29 | 45.41 | 46.82 | 1.80 |
| | Indonesia-2 | 136.60 | 36.90 | 9.70 | 71.50 | 40.30 | 42.90 | 0.50 |
| II | Indonesia-2 x Local | 172.00 | 38.35 | 10.10 | 76.90 | 41.20 | 42.60 | 2.08 |
| | Local | 154.90 | 38.10 | 8.80 | 71.30 | 37.90 | 37.80 | 0.75 |
| | Local | 171.25 | 41.41 | 9.31 | 76.56 | 40.13 | 43.38 | 0.45 |
| III | Local x Indonesia-1 | 172.15 | 43.29 | 10.09 | 77.82 | 49.50 | 50.76 | 2.70 |
| | Indonesia-1 | 143.75 | 35.47 | 9.25 | 70.50 | 42.19 | 44.56 | 0.00 |
| | Local | 140.88 | 34.60 | 8.96 | 66.66 | 37.56 | 38.56 | 0.72 |
| IV | Local x Indonesia-2 | 161.57 | 41.88 | 9.62 | 71.90 | 45.76 | 46.38 | 2.79 |
| | Indonesia-2 | 140.85 | 36.44 | 9.79 | 69.61 | 43.57 | 45.18 | 1.69 |
| | Local | 154.99 | 38.10 | 8.80 | 71.30 | 37.90 | 37.80 | 0.00 |
| V | Local x Nicobar | 155.50 | 40.50 | 9.40 | 72.10 | 41.40 | 41.40 | 1.04 |
| | Nicobar | 194.44 | 46.06 | 10.56 | 82.89 | 51 89 | 51.67 | 2.25 |

From the above table it will be seen that in most of the crosses the plants have shown hybrid vigour expression for length of leaf, number of leaves, number of leaflets, length of leaflet, breadth of leaf sheath and girth at crown. The hybrids also have larger number of inflorescences per flowered palm.

The annual growth measurements of the crosses, *A. triandra* x *A. catechu* and their reciprocals and parents were recorded and are given in Table 4.

TABLE 4

**Growth measurements of interspecific hybrids and $F_1$ of the respective parents**

| Year of planting | Details | *Areca triandra* | *A.triandra x A. catechu* | *Areca catechu* | *A. catechu x A. triandra* |
|---|---|---|---|---|---|
| 1967 | 1. No. of leaves | 6.0 | 5.9 | 7.0 | 6.68 |
| | 2. No. of leaf-lets | 14.38 | 14.00 | 27.25 | 21.56 |
| | 3. Girth at last exposed node(cm) | 18.5 | 15.8 | 23.9 | 20.5 |
| | 4. Girth at 5 cm below the last leaf (cm) | 24.6 | 20.2 | 30.2 | 23.6 |
| | 5. Height (m) | 1.77 | 1.62 | 2.75 | 2.03 |
| 1968 | 1. No. of leaves | 5.1 | 5.1 | 5.9 | 5.9 |
| | 2. No. of leaf-lets | 14.38 | 12.27 | 19.51 | 18.88 |
| | 3. Girth at the last exposed node (cm) | 2.6 | 3.0 | 4.6 | 4.7 |
| | 4. Girth at 5 cm below the last leaf (cm) | 3.5 | 3.8 | 6.5 | 7.2 |
| | 5. Height (m) | 1.17 | 1.19 | 1.88 | 2.06 |

The hybrids appear to be almost similar to their respective female parents in a number of cases.

Hybrids obtained from (1) China (VTL.3) x local and (2) China (VTL.3) x Sreevardhan and open pollinated progenies of the parents were planted on a 5 x 6 randomised block design with three plants per plot. The data on growth measurements of the seedlings recorded at the time of planting are presented in Table 5.

TABLE 5

**Growth measurements of inter-varietal hybrids**

| Treatments | Mean No. of leaves | Girth at 5 cm below the last leaf axil (cm) | Height (cm) |
|---|---|---|---|
| 1. China (VTL. 3) x local | 5.55 | 2.71 | 122 27 |
| 2. China (VTL. 3) x Sreevardhan | 6.06 | 3.64 | 153.94 |
| 3. China (VTL. 3) | 5.71 | 2.75 | 103.33 |
| 4. Sreevardhan | 5.44 | 3.17 | 117.50 |
| 5. Local | 5.39 | 2.96 | 136.50 |

From the above it will be seen that teatment No. 2 i. e , China x Sreevardhan is more vigorous than others. Inter-varietal and and inter-specific crosses involving exotics VTL. 48, 45, 12, 13, 17, 3, 11, 47, *Areca triandra*, dwarf and local were effected during the year.

**B. 6. Efficiency of phenotypic selection of mother palms, seednuts and seedlings**

(K. N. Murthy and S. S. Pillai)

The study was initiated during 1963-64 with a view to finding out how far selection of mother palms, seednuts and seedlings influences the performance of the progeny. The experiment was laid out on a 4 x 6 randomised block design with four treatments viz , unselected bulk nuts selected bulk nuts, unselected nuts from mother palms and selected nuts from mother palms. Subsequently two more treatments viz., selected nuts from non-prepotent mother palms and selected nuts from prepotent mother palms were also added one year later so as to form a total of six treatments.

The data on annual growth measurements namely number of leaves, girth and number of nodes analysed showed that the treatments are not significantly different from each other. However, selected nuts from mother palms (treatment No.4) have recorded the maximum mean values for all the characters.

Plants of the first batch of planting have commenced flowering.

**B. 7. Improvement by Mass-pedigree selection**

(R. S. N. Pillai and Res. Asst. Asst., Mohitnagar)

Seedlings raised from 16 palms of the selected group with two controls were planted during 1968 on an 18 x 3 randomised block design

after screening them for number of leaves. The plants were again screened for girth at collar one year after planting as per the programme and those having less girth were substituted. The annual growth measurements (total height, number of leaves and girth at collar) were analysed and treatments were found to differ significantly for all characters. The mean values for each of the characters are given in Table 6.

TABLE 6

**Growth characters (Mean)**

| Treatment No. | Palm No. | No. of leaves | Girth at collar (cm) | Height (cm) |
|---|---|---|---|---|
| 1 | 806 | 5.28 | 17.96 | 173.00 |
| 2 | 731 | 3.83 | 11.14 | 114.95 |
| 3 | 771 | 4.72 | 13.53 | 140.00 |
| 4 | 717 | 5.78 | 23.53 | 208.06 |
| 5 | 774 | 4.89 | 18.17 | 162.84 |
| 6 | 815 | 6.06 | 20.37 | 183.28 |
| 7 | 690 | 5.69 | 21.99 | 197.82 |
| 8 | 768 | 4.28 | 11.97 | 123.96 |
| 9 | 715 | 5.44 | 17.01 | 163.67 |
| 10 | 35 | 5.39 | 17.27 | 159.83 |
| 11 | 36 | 5.89 | 20.09 | 189.17 |
| 12 | 86 | 5.17 | 11.02 | 135.50 |
| 13 | 101 | 6.00 | 20.38 | 178.83 |
| 14 | 312 | 5.45 | 16.38 | 177.72 |
| 15* | 43 | 4.81 | 9.10 | 114.12 |
| 16* | 45 | 6.11 | 16.05 | 169.67 |
| 17 Control I | | 4.28 | 11.26 | 122.50 |
| 18 Control II | | 5.44 | 17.76 | 164.24 |
| S. E./plot | | 0.52 | 2.27 | 16.12 |
| Overall mean | | 5.31 | 16.39 | 159.95 |
| C. V. | | 9.79 | 13.85 | 10.08 |
| C.D.(P=0.05) for treatments with no missing value | | 0.86 | 3.77 | 26.79 |
| C.D.(P=0.05) for treatment means of 15 and others except that of 16 and *vice versa* | | 0.98 | 4.23 | 30.07 |
| C.D.(P=0.05) for treatment means of 15 and 16 | | 1.06 | 4.62 | 32.82 |

* Missing plots

All the treatments except 2, 3, 5, 8 and 15 have given significantly more number of leaves than control I, i. e., phenotypically high yielding palms - original selection. But control II,i.e., phenotypically high yielding palms - second generation, does not give significantly lesser number of leaves than any of the treatments. For girth and height, all the treatments except 2, 3, 8, 12 and 15 have given significantly higher values than control I and for all the characters control II gives significantly high value than control I.

Seedlings raised out of nuts from open pollinated and controlled crossing (*inter-se*) of the finally selected 20 palms were transplanted to the secondary nursery along with control. The selection programme was examined critically and modified suitably to include more treatments, viz., (1) palms selected based on selection index + age at bearing and (2) palms yielding 300 nuts above the garden mean + screening for number of leaves at the time of planting, girth at collar one year after planting, number of nodes two years after and age at bearing.

The seedlings of the above two sets have been transplanted to the secondary nursery along with seedlings from controlled crossing (*inter-se*) and open pollinated. Seednuts from palms selected based on selection index (best 5%) within the three superior families selected in respect of yield and other correlated vegetative characters were sent to Regional Arecanut Research Station, Peechi for trials.

An experiment consisting of 14 treatments, replicated three times has been laid out at Mohitnagar for building up the genetic stock of the selected materials sent from Vittal.

**B. 9. Structure and development of fruits in arecanut under high and low altitudes**

(R. S. N. Pillai)

A survey was conducted in South Kanara and Coorg districts of Mysore and five gardens were fixed for continuing the studies. Samples of nuts collected from four places of different altitudes (300-800 m) showed wide variation for dry to kernel weight, and the quality was found to be poor in the case of nuts collected from 800 m. Studies on the minimum and maximum temperature variation of these places are being continued.

**B. 10. Cytological and anatomical studies of types,species and hybrids of arecanut**

(K. V. A. Bavappa, S. S. Pillai and K. N. Murthy)

Cytological studies on 37 palms of exotic types and species were taken up. Analysis of VTL. 1 (Fiji) palm No. 156 showed the presence of

an extra chromosome at Metaphase I. In Anaphase I a laggard was also observed. For the other palms, the meiosis was normal.

Pollen stainability and size measurements recorded have shown that there is considerable variation in pollen fertility and size in the different types and species. Size of pollen grains of *A. triandra* was found to be smaller than those of *A. catechu.*

In order to study the karyomorphology of arecanut different techniques were tried. The following method was found to be successful in giving good spread of well stained chromosomes:

1. Collect the root tips between 9-30 A.M. and 10-00 A.M.
2. Pre-treat the root tips after removing root cap with Para-dichlorobenzene (PDB) for 2 hrs. at 5°C to 10°C.
3. Wash the root tips in tap water for 5 to 6 times.
4. Fix in 1:3 acetic alcohol for 1 hr. at 5-10°C.
5. Wash with cold N hydrochloric acid once and hydrolise in N hydrochloric acid at 60°C for 15 minutes.
6. Wash in distilled water.
7. Transfer to 3% Pectinase bufferred at 3.6 pH and keep at room temperature for 60 to 75 minutes.
8. Wash in distilled water. Take tip portion and stain with 1% acetofuchsin.
9. Destain with 30% acetic acid.
10. Squash in 30% acetic acid.

An earlier study of the $F_1$ progenies of *A. catechu* x *A. triandra* had shown a reciprocal difference in respect of suckering habit which may be due to maternal effect, cytoplasmic inheritance or interaction between cytoplasmic factors and nuclear genes. Studies of the leaf anatomy of the interspecific hybrids and parents were taken up and the results are furnished in Table 7.

TABLE 7

Leaf anatomy of interspecific hybrids and parents

| Sl. No. | Characters studied | *Areca catechu* | *A.catechu* x *A. triandra* | *Areca triandra* | *A.triandra* x *A.catechu* |
|---|---|---|---|---|---|
| 1 | No. of epidermal cells/ unit area | 155.50 | 155.43 | 104.00 | 100.20 |
| 2 | No. of stomata/ unit area | 16.33 | 17.19 | 9.85 | 8.97 |
| 3 | Length of stomatal pore ($\mu$) | 24.37 | 25 52 | 27.08 | 29.46 |
| 4 | Length of guard cells($\mu$) | 32 65 | 33 17 | 35.43 | 37.29 |
| 5 | Breadth of guard cells($\mu$) | 21.04 | 22.96 | 24.86 | 25.82 |
| 6 | Length of epidermal cells ($\mu$) | 49.60 | 47.27 | 65.96 | 75.39 |
| 7 | Breadth of epidermal cells ($\mu$) | 20.70 | 21.93 | 24.34 | 21.44 |

The above data show that there is high maternal effect in the hybrid for each of the characters studied.

**B. 11. Studies on fruit setting and shedding**

(K. N. Murthy, R.S.N Pillai and K.K.N. Nambiar)

Shedding of buttons and tendernuts causes considerable reduction in the yield of arecanut. Lack of pollination, association of insects and fungi, insufficient and irregular irrigation, etc., are the possible reasons leading to this loss.

Experiments with assisted pollination have given satisfactory results in the previous years.But the method followed was found to be uneconomical for general adoption. Hence low setters alone were isolated and trials were undertaken in such group of plants. Since most of the inflorescences had dried up due to other causes, data on nut set could not be gathered. Later the plants were divided under three yield groups namely (1) less than 20% fruit set leading to a production of 150 nuts or below (2) 20 to 40% set leading to a production of 151 to 400 nuts (3) 40% and above set leading to the production of 400 nuts and above and decided to take up trials with hormones at different concentrations.

The pattern of button shedding was studied and 25 palms were under observation. Daily counts of the shed buttons were made and it was observed that the sequence was highly variable from palm to palm, however maximum shedding was observed on 6th, 7th and 8th day after the first button was shed. Observations on such shed flowers showed that 77.56% were properly opened, 13.18% partially opened and 9.26% unopened. The causes for such defective flowers in latter categories are yet to be studied.

The shed buttons, on examination, were found to be not infected, by fungus. On the other hand majority of rachis from which buttons were shed, was infected by *Gloeosporium* sp. A spraying trial with Benlate (600 ppm), Dithane Z-78 (2000 ppm), Dithane M-45 (2000 ppm) and Bordeaux mixture (1%) was laid out. Two sprays were given at fortnightly interval and the result showed that Benlate and Dithane Z-78 give better control than the rest.

**B. 12. Inducing mutation in arecanut by**

(a) Irradiation of seednuts (Thermal and pile neutrons, X-ray and Gamma ray), (b) Chemicals and (c) Use of irradiated pollen.

(R. B. Nair and K. N. Murthy)

The irradiated materials planted during 1963 and 1965-66 in the main field both at Vittal and Falode have commenced flowering. No visible variations in characters have been recorded.

(c) RESEARCHES CONTEMPLATED

The intercrossed material of the promising types will be studied for their performance under varying agroclimatic condition. The high yielding introductions will be raised under isolation for large scale production of seednuts. Crossing programmes involving the dwarf palm, Saigon and China are also contemplated.

**Programme of work for 1970**

| Number and name of the project | Venue of work |
|---|---|
| (1) | (2) |
| B. 1. Introduction and maintenance of indigenous and exotic species and types of areca for selection and hybridisation | Vittal, Peechi, Hirehalli, Mohitnagar, Kahikuchi and Palode |

| | | |
|---|---|---|
| B. 2. | Survey of arecanut gardens to assess the genetic variation and selection of common cultivars | Vittal, Peechi, Hirehalli Mohitnagar, Palode and Kahikuchi |
| B. 3. | Studies on the performance of progenies of known mother palms and the mother palm progeny relationship | Peechi, Hirehalli and Vittal |
| B. 5. | Hybridisation between exotic and indigenous types and species | Vittal |
| B. 6. | Efficiency of phenotypic selection of mother palms, seednuts and seedlings. | Vittal |
| B. 7. | Improvement by Mass -pedigree selection | Vittal, Mohitnagar and Peechi |
| B. 9. | Structure and development of fruits in arecanut under high and low altitudes | Vittal |
| B. 11. | Studies on fruit setting and shedding | Vittal |
| B. 12. | Inducing mutation in arecanut by (i) irradiation of seednuts (Thermal and pile neutrons, X-ray and Gamma ray), (ii) chemicals and (iii) use of irradiated pollen. | Vittal and Palode |

# AGRONOMY

## SUMMARY OF SALIENT FINDINGS

*Trials conducted at Vittal and Kahikuchi indicated that early transplanting of seedlings resulted in better growth of palms. Transplanting seedlings aged more than two years delayed flowering. Analysis of the yield data of the spacing trial in progress at Vittal indicated that 2.7 m x 2.7 m spacing recorded significantly more yield (wet weight of nuts) than all other spacings. A similar trend was observed at Peechi, while at Hirehalli the maximum yield was in 1.8 m x 2.7 m spacing, the treatment difference being significant only for number of nuts. At Kahikuchi differences between the different spacing treatments were not significant. Planting at 90 cm. depth and irrigation once in 3 days gave significantly higher yield (weight of nuts) at Peechi. Growth measurements of plants of a similar trail at Vittal where irrigation intervals are slightly different to suit local practices, revealed that irrigation once in 5 days was in general superior to irrigation once in 15 or 20 days in respect of all characters studied. Neither depth nor interaction between depth and irrigation had any significant effect in respect of the characters studied. At Kahikuchi irrigation once in 3 and 6 days was on par and gave significantly higher growth measurements as compared to 9 days interval. Intercropping trials with arecanut and banana revealed that banana did not adversely effect the main crop of arecanut. At Peechi elephant-foot-yam was found to be the most profitable intercrop in arecanut garden. There was no significant difference in the performance of arecanut trees when different intercrops were raised. At Kahikuchi arecanut palms intercropped with either Guinea grass or ginger were significantly superior to palms in other plots as well as control plot. Growth of both arecanut and coconut palms were satisfactory in the mixed crop trials at Vittal, Kahikuchi and Palode. The cacao trees gave higher number of pods per tree and the arecanut palms flowered earlier in plots where arecanut and cacao were planted at 50:50 as compared to pure areca crop and cacao as border crop in the mixed cropping trial with areca and cacao at Vittal. The trial on different methods of intercultivation on the productivity of palms in progress at Palode indicated that planting on terraces made at the site of planting*

*plus clean cultivation and manuring was superior to all other treatments in regard to production of spadices and yield. In the N P K manurial experiment at Vittal, palms receiving nitrogen at $N_1$, and $N_2$ levels i.e., 50 and 100 gm of N per palm and green leaf at 6.8 and 13.6 kg per palm yielded significantly more than no N and no green leaf. At Peechi the influence of potash on yield was significant and palms receiving K at 140 gm per tree recorded higher yield than those receiving no potash. At Palode application of N P K with or without micronutrients but with irrigation was significantly superior to the same treatment without irrigation. There was no significant difference in the performance of palms receiving N P K either in organic or inorganic forms. Nuts harvested at 6-month maturity level and processed fetch better price as compared to the produce from nuts harvested at 7 and 8 months maturity levels.*

(a) RESEARCHES COMPLETED

**A. 3. Effect of different spacings and method of layout on the incidence of sun-scorch on arecanut palms**
(M. P. Somaiah and K. B. A. Khader)

Arecanut palms are highly susceptible to sun-scorch, particularly in situations where the palms are exposed to the south-western sun. In order to find out whether a proper alignment of the plantation can reduce such damage, an observational trial with 6 treatments was laid out in November, 1960 with three spacings of 2.4 m x 2.4 m square, 2.7 m x 2.7 m square and 3.6 m x 3.6 m quincunx, each aligned in north-south direction and at an angle of 20° to north-south. The data recorded for 5 years showed that there is no significant variation in between treatments though the palms planted at 3.6 m x 3.6 m quincunx in the north-south direction showed reduction in sun-scorching.

(b) RESEARCHES ON HAND

**A. 1. Determination of optimum age of transplanting seedlings-cum-sowing *in situ Vs* transplanting single, double and treble transplanted seedlings.**
(R. K. Bhattacharya and K. B. A. Khader)

Seedlings of different ages are used for the mainfield planting in different tracts. The practice of directly sowing the nuts *in situ* as well as transplanting seedlings are also in vogue. An observation trial to study these aspects was laid out at Vittal during 1961 with the following eight treatments.

1 Directly sowing seedlings in the main field

2 Transplanting one- year old seedlings

3 Transplanting two- year old seedlings

4 Transplanting three- year old seedlings

5 Transplanting four- year old seedlings

6 Transplanting two-year old seedlings which had been transplanted once in the nursery

7 Transplanting three-year old seedlings which had been transplanted twice in the nursery

8 Transplanting four-year old seedlings which had been transplanted thrice in the nursery

Observations made during the earlier years showed that palms planted in the field earlier are more vigorous than those of equal age but retained in the nursery for longer durations and then transplanted to the field. It was generally observed that planting seedlings up to two years in age whether directly or after transplanting in the nursery does not affect their initial flowering. Seedlings transplanted beyond two years age were found to be late in their flowering. The trees have not reached the full bearing stage. At Kahikuchi, where a similar trial was in progress since 1963-64, showed that palms which have been planted in the field when young (18 or 30 months old)are more vigorous than those which have been planted when they are 42 months old.

**A. 2. Determination of optimum spacing in the main field**

(K. Shama Bhat, P. G. Rajendran, N. Narayana Bhat and Gorachand Biswas)

The spacing experiment initiated at Vittal in 1958 with six spacings viz., 1.8 m x 1.8 m, 1.8 m x 2.7 m., 1.8 m x 3.6 m, 2.7 m x 2.7 m, 2.7 m x 3.6 m and 3.6 m x 3.6 m is on a randomised block design. The trees commenced flowering in 1962-63. Studies were made on the following aspects in the experimental gardens.

a) *Leaf fall and inflorescence production:* The treatment differences were highly significant in respect of leaf fall, number of spadices per tree and percentage of spadices to leaf fall. Trees spaced at 2.7 m x 2.7 m, 3.6 m x 2.7 m and 3.6 m x 3.6 m were at par in respect of leaf fall and spadices production and had significantly higher values than the rest. The number of leaves shed, spadices produced and percentage of spadices to leaf fall increased with increase in spacing.

b) *Spacing and number of female flowers produced and set:* The number of female flowers produced and set were found to show significant variation.

Trees spaced at 2.7 m x 2.7 m, 3.6 m x 2.7 m and 3.6 m x 3.6 m were at par in producing female flowers but gave higher values than others. Trees spaced at 3.6 m x 3.6 m recorded significantly more number of flowers set than all others except trees spaced at 2.7 m x 2.7 m and 2.7 m x 3.6 m

c) *Spacing and yield:* The sixth crop of the garden was harvested during the period and the yield difference between the treatments was found to be significant. Both number of fruits and wet weight of fruits harvested per plot were minimum in treatment 1.8 m x 1.8 m spacing and were maximum in treatment 2.7 m x 2.7 m spacing. The plot spaced at 2.7 m x 2. 7 m gave significantly more number of nuts than all others except trees spaced at 2.7m x 3.6 m; the same spacing (2.7 m x 2.7 m) also gave significantly more wet weight of nuts than all other spacings.

The mean data recorded on the above aspects are given in Table 8.

In order to see if the yield differences were due to fertility levels of the plots, the soils of different plots were analysed and no significant difference with regard to pH or nutrient levels except that of $K_2O$ was noticed. Plots with trees spaced at 1.8 m x 1.8 m and 2.7 m x 1.8 m had significantly more of available $K_2O$ than plots having trees spaced at 2.7 m x 2.7 m.

A similar trial was also running in the Regional Station at Peechi, Hirehalli and Kahikuchi, having different agro-climatic conditions At Peechi, where the trees were planted in 1960, the mean number of nuts and the weight of fruits harvested per plot were maximum in treatment 2.7 m x 2.7 m. The treatment differences were significant in respect of wet weight of nuts per plot, mean number of female flowers per palm and mean number of fruits set per palm. The data gathered on the above aspects are given in Table 9.

At Hirehalli the third crop was harvested during the period. The plot yield (number and weight of nuts) was maximum in treatment 1.8 m x 2.7 m, the treatment difference being significant only for number of nuts. At Kahikuchi where the planting was done in 1961-62 the yield difference between different treatments was not significant.

### A. 4. Effect of different intervals of irrigation at different depths of planting arecanut seedlings

(A. K. Sadanandan, M. P. Somaiah and G. Biswas)

The depths at which arecanut seedlings are planted in the main field and the intervals at which they are irrigated 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

TABLE 8

Determination of optimum spacing in the main field
Data on yield and other ancillary characters (1968-69, Vittal)

| Sl. No. | Treatment | Mean No. of nuts/plot (0 023 ha) | Mean wet weight of nuts/plot (kg) | Mean No.of spadices/ palm | Mean No.of female flowers/palm | Mean No.of fruit set/ palm | Percentage of fruit set |
|---|---|---|---|---|---|---|---|
| 1. | 1.8 m x 1.8 m | 2092.83 | 65.78 | 3.06 | 385.10 | 66.88 | 16.08 |
| 2. | 2.7 m x 1.8 m | 3272.17 | 97.32 | 3.98 | 652.98 | 148.08 | 23.55 |
| 3. | 3.6 m x 1.8 m | 3779.00 | 118.50 | 4.80 | 674.75 | 171.25 | 25.68 |
| 4. | 2.7 m x 2.7 m | 6397.17 | 210.60 | 5.22 | 1035.90 | 265.90 | 25.75 |
| 5. | 3.6 m x 2.7 m | 4285.33 | 142 01 | 5.63 | 1064.20 | 245.45 | 24.25 |
| 6. | 3 6 m x 3.6 m | 3768.17 | 128 05 | 6.00 | 1218.00 | 360.10 | 29.43 |
| S. E. per plot | | 2036.51 | 43.67 | 0.675 | 153.04 | 80.24 | 7.59 |
| S.E. per difference between two treatment means | | 1175.84 | 25.21 | 0.390 | 108.20 | 56.73 | 5.37 |
| Overall mean | | 3932.44 | 127.04 | 4.779 | 839.49 | 209.61 | 24.12 |
| C.V.(%) | | 51.79 | 34.38 | 14.12 | 18.25 | 38.28 | 31.47 |
| C.D. (P=05) | | 2422.23 | 51.93 | 0.80 | 230.57 | 120.89 | ... |

## TABLE 9

**Determination of optimum spacing in the main field.**

**Data on yield and other ancillary characters**

(1968--69, Peechi)

| Sl. No. | Treatments | Mean No. of nuts/ plot | Mean wet weight of nuts/plot (kg) | Mean No.of female flower/palm | Mean No.of fruit set/ palm | Percentage of fruits set |
|---|---|---|---|---|---|---|
| 1. | 1.8 m x 1.8 m | 4581.75 | 123.39 | 647.95 | 179.35 | 26.75 |
| 2. | 1.8 m x 2.7 m | 6579.25 | 172.01 | 736.30 | 259.90 | 33.13 |
| 3. | 1.8 m x 3.6 m | 6362.75 | 158.74 | 846.30 | 268.25 | 32.23 |
| 4. | 2.7 m x 2.7 m | 8103.50 | 213.90 | 1217.05 | 457.80 | 37.70 |
| 5. | 2.7 m x 3.6 m | 5528.50 | 132.48 | 1010.50 | 332.40 | 32.15 |
| 6. | 3.6 m x 3.6 m | 5040.25 | 123.52 | 1304.10 | 440.35 | 34.40 |
| S. E. per plot | | 1495.01 | 35.52 | 186.35 | 94.82 | 8.92 |
| S. E. per difference between two treatments | | 1056.97 | 25.11 | 131.75 | 67.04 | 6.37 |
| Over all mean | | 6032.67 | 154.01 | 960.37 | 323.00 | 32.73 |
| C. V. (%) | | 24.78 | 23.06 | 19.40 | 29.36 | 27.25 |
| C. D. (P=0.05) | | ... | 53.51 | 280.76 | 142.86 | .... |

and the intervals at which irrigations are to be given under the conditions prevailing in the different regions. At Peechi(central Kerala)the garden for the experiment was planted in 1962 adopting a 4 x 3 x 5 split plot arrangement with four intervals of irrigation (viz., no irrigation, irrigation once in 3,6 and 9 days) and three depths (viz., 30 cm,60 cm and 90 cm) of planting. The yield and related data collected during the year revealed significant difference between main as well as sub-treatments. Plants receiving irrigation once in 3 days gave significantly higher yield and those receiving no irrigation significantly less yield than the remaining treatments. Regarding sub-treatments it was seen that planting at 90 cm give significantly higher weight of nuts as compared to planting at 30 cm and 60 cm depths. The relevant data are given in Table 10.

At Central Station the experiment was laid out in 1966 on a 4 x 3 x 5 strip plot design with four intervals of irrigation (viz., 5, 10, 15 and 20 days) and three depths of planting (viz , 30 cm, 60 cm and 90 cm). Annual growth measurements of the palms revealed that the differences between the different levels of irrigation are highly significant for all the characters studied (viz., number of leaves, girth at last exposed node and at permanent mark and number of nodes) except for percentage of palms that had formed nodes. Irrigation once in 5 days was in general significantly superior to irrigation once in 15 or 20 days in respect of all characters studied, except in case of percentage of trees which formed nodes. Treatments, irrigation once in 5 and 10 days were at par. Neither depths nor interactions between depth and irrigation had any significant result in respect of the characters under study.

At Kahikuchi the growth measurements of the palms made showed that the main treatment differences are significant in respect of characters like girth, number of nodes and internodal distance. Irrigation once in 3 and 6 days were at par and gave significantly higher values for girth, number of nodes and internodal distance of trees than others under no irrigation and irrigation at wider intervals of 9 days.

### A. 5. Investigations on different types of areca under rainfed and irrigated conditions

(R. B. R. Yadava, K. Shama Bhat and R. B. Nair)

With a view to screening out varieties for their drought resistant qualities exotic materials together with the local have been planted at Palode in 1968 under rainfed conditions. Materials are also being establised at Mohitnagar.

## TABLE 10

**Intervals of Irrigation and depths of planting**
**Yield data for Peechi Centre (1968-69)**

| Treatment | Mean No. of nuts per palm | | | | Mean weight of nuts | | | |
|---|---|---|---|---|---|---|---|---|
| | $d_1$ | $d_2$ | $d_3$ | Mean | $d_1$ | $d_2$ | $d_3$ | Mean |
| No irrigation | 30.50 | 47.93 | 100.40 | 59.61 | 0.89 | 1.20 | 3.16 | 1.75 |
| Irrigation once in 3 days | 280.74 | 305.36 | 355.31 | 313.77 | 7.96 | 8.48 | 9.68 | 8.71 |
| Irrigation once in 6 days | 191.84 | 264.76 | 299.76 | 252.09 | 5.10 | 7.23 | 8.62 | 6.98 |
| Irrigation once in 9 days | 238.95 | 254.89 | 286.47 | 260.08 | 6.44 | 7.08 | 7.90 | 7.14 |
| Mean (d) | 185.51 | 218.25 | 260.49 | 221.39 | 5.10 | 6.00 | 7.34 | 6.15 |

| | Mean No.of nuts/palm | Weight of nuts/palm |
|---|---|---|
| S. E. per main plot | 63.98 | 1.69 |
| S. E. per sub-plot | 70.43 | 1.93 |
| Overall mean | 221.39 | 6.15 |
| C. V. (%) for main treatment | 28.90 | 27.48 |
| S. E. per difference between two main treatment means | 23.36 | 0.62 |
| S. E. per difference between two sub treatment means | 22.27 | 0.61 |
| C. V. (%) for sub treatment | 31.81 | 31.38 |
| S. E. per difference between two sub treatments at the same level of main treatment mean | 44.55 | 1.23 |
| S. E. per difference between two main treatment means at the same level of sub treatments or at different levels | 43.23 | 1.17 |
| C. D. (P=0.05) for comparing main treatment means | 50.90 | 1.35 |
| C. D. (P=0.05) for comparing sub treatments means | 45.43 | 1.24 |

## A. 6. Intercropping experiments

(K. Shama Bhat, A. K. Sadanandan, N. Narayana Bhat, G. Biswas and K. J. Abraham)

a) *Arecanut and Banana:* Banana is the most common food crop intercropped in arecanut gardens in all tracts. In order to assess the effect of growing banana as an intercrop in arecanut gardens as well as to find out the optimum number and stage up to which the former can be raised with areca, an experiment on an 8 x 4 randomised block design with the following treatments was laid out at the Central Station in 1963.

1 No banana throughout the period of experiment(i.e. pure plantation of arecanut)
2 Banana as intercrop throughout the period of experiment at full level.
3 Banana up to the end of third year at full level and no banana thereafter.
4 Banana up to the end of third year at full level and at reduced level for the rest of the period.
5 Banana up to the end of third year at full level and at reduced level till the end of sixth year and no banana thereafter.
6 Banana up to the end of sixth year at full level and no banana thereafter.
7 Banana up to the end of sixth year at full level and at reduced level thereafter for the rest of the period.
8 Banana up to the end of the sixth year at full level and at reduced level till the end of tenth year and thereafter no banana.

*Note*:- The three stages (3rd, 6th and 10th year) of the arecanut palm fixed above correspond to three distinct phases, viz., period of formation of distinct nodes,flowering and attainment of full bearing stage in the growth cycle.

Both the crops were given the normal cultural and manurial operations as per schedule for each crop.The first crop of the garden was harvested during the year. Data collected on yield and other ancllary characters (viz., leaf fall, spadices production and percentage of spadices to leaf fall) did not show any significant difference between the treatments.

A similar experiment as above with only five treatments superimposed in a three-year old garden was running at Kahikuchi since 1963-64. The first crop of arecanuts was harvested during the year. There was no significant difference between the treatments.

b) *Arecanut and other crops:* In order to explore the possibility of growing inter and associate crops in arecanut gardens without detriment to the arecanut crop, trial with various crops was in progress at the Regional Station, Peechi since 1964. The study indicated that elephant-foot-yam (*Amorphophallus campanulatus)* was the most profitable intercrop. During 1967, the trial was relaid with two substitutes viz., pepper and ginger instead of colocasia *(Colocasia antiquorum)* and banana. The yield of elephant-foot-yam, ginger and pineapple harvested during the year were 4,760 kg, 2,060 kg and 1,760 kg per hectare respectively. Yield data of the main crop (arecanut) collected during the year did not show any significant difference in the performance of the arecanut trees when the different intercrops were raised.

A similar trial with intercrops of banana, pineapple, guinea grass (*Panicum maximum*),betelvine and ginger was in progress at Kahikuchi. The performance of areca trees in plots intercropped with either guinea grass or ginger was significantly superior to palms in other plots as well as those as in control plot where there was no intercrop.

The above trial with six crops (viz., pepper, tapioca, elephant-foot-yam, *Dioscorea,* sweet potato and pineapple) was laid out at Palode under rainfed conditions.

### A. 7. Mixed cropping experiments

(K. Shama Bhat, P. G. Rajendran and K. J. Abraham)

a) *Arecanut and coconut:* To assess the desirability of growing arecanut and coconut as a mixed plantation as against raising arecanut as a pure crop, an observational trial with two treatments viz., (1) arecanut and coconut as mixed crop and (2) arecanut as pure crop was laid out at the Central Station during 1964. The coconut seedlings were planted in 1964 at a spacing of 8.1 m x 8.1 m and arecanut in 1965 at 2.7 m x 2.7 m. The growth of both arecanut and coconut trees was satisfactory and the trees have commenced to flower.

Similar trials as above were also in progress at Kahikuchi and Palode. At Kahikuchi the arecanut trees both in plots with and without coconuts continue to grow satisfactorily. At Palode some areca trees have developed symptoms akin to yellow leaf disease.

b) *Arecanut and cacao:* A mixed garden of arecanut and cacao (variety - Criollo) was planted at Vittal in 1964 with (i) arecanut and cacao at 50:50, (ii) areca as pure crop and (iii) cacao as border crop in areca garden. The third (year) crop of cacao was harvested during the year and the trees under

treatment (i) had a mean of 23.2 pods per tree and those under treatment (iii) had a mean of 4.9 pods per tree. The percentage of arecanut palms flowered in the different treatments were 88.9, 82.1 and 75.0 respectively. The first crop of arecanut was also harvested during the year.

Another experiment with six intra racial hybrids obtained from Sabha (Malaysia) was planted mixed with arecanut at Peechi under irrigated condition and at Palode under rainfed condition, adopting a 2 x 2 x 6 x 2 split plot design. The trial has two methods of alignment, two methods of manuring and six crosses for comparison.

Towards the close of the year a batch of 93 clonal progenies of Forestero variety of cacao was introduced from Malaysia and sown at Vittal.

### A. 8. Effect of different methods of inter cultivation on the productivity of palms

(M. Sannamarappa, P.G.Rajendran and K. J. Abraham)

An inter cultivation experiment with four treatments and six replications was initiated at the Regional Station, Hirehalli in 1967. The treatments consist of (i) scything weeds and grass twice a year (December and June), (2) digging twice a year (December and June), (3) digging with mammaty fork once a year in December followed by scything grass and weeds in June and (4) scything grass and weeds twice a year as in treatment (1)and digging once in two years. Data on growth characters of the palms were recorded. A similar trial as above with four treatments viz., (i) no intercultivation, (ii) digging once a year, (iii) digging twice a year and (iv) digging once in two years was also in progress at Peechi. One complete cycle of treatments was completed only during the year. The yield and other ancillary data were collected. It is too early to draw any conclusion at both the centres.

An observational trial to study the different methods of raising arecanut gardens on hill slopes laid out in 1961-62 at Palode with three systems of planting viz., (i) planting on terraces made along the contour, (ii) planting on terraces made at the site of planting and (iii) planting on slopes not taking into account the contour and with three sub-treatments viz., (i) no cultivation, no manuring, (ii) clean cultivation and manuring, (iii) permanent cover cropping and manuring was continued. Each of the sub-treatments were again split and imposed with three sub-treatments during 1968.Analysis of the data gathered during the year showed that planting on terraces made at the site of planting plus clean cultivation and manuring is superior to all other treatments as regards production of spadices and yield.

## A. 9. N P K manurial experiment

(E. Velappan, K Shama Bhat, A. K. Sadanandan, A. R. Mohapatra, G. Biswas, Narayana Bhat and K. J. Abraham)

This experiment was laid out both at Central and Regional Stations to find out the N P K and green leaf requirements of arecanut palm under varied soil and climatic conditions. It was laid out at Vittal in 1961 on a $3^4$ confounded factorial design as a single replication. The treatments consisted of 0, 25 and 50 kg nitrogen (N), 0, 20 and 40 kg of phosphoric acid ($P_2O_5$), 0, 35 and 70 kg of potash ($K_2O$) and 0, 3400 and 6800 kg of green leaf (G) for 500 palms. Data on leaf fall, production of spadices and yield (third harvest) of fruits were collected. It was observed that main effects of N and green leaf are significant in respect of yield (number and weight of fruits). $N_1$ and $N_2$ had significantly more yield than $N_0$, though the difference between $N_1$ and $N_2$ was not significant. Similarly $G_2$ and $G_1$ recorded significantly more yield than $G_0$, there being no significant difference between $G_2$ and $G_1$. Regarding interactions the trend was not consistent.

Soil samples from the above experiment were collected, one set prior to manuring (September - October, 1968) and the other four months after the application of manures and fertilizers (February, 1969) at 0-50 cm and 51-100 cm depths. The soil samples were analysed for available nutrients. The results of the analysis have been brought out as under.

*Available nitrogen:* The available nitrogen in the surface soil was significantly higher than the subsoil taking into consideration all plots for both the collections. But when individual treatments of $N_0$, $N_1$ and $N_2$ were compared, there was no significant difference in the available nitrogen levels between surface soil and subsoil layers either before or after the manuring. This shows the high mobility of available nitrogen in the soil layers. The different nitrogen levels failed to increase the contents of available nitrogen in the soil collected before manuring. In the case of samples collected after manuring, application of 50 kg of N per 500 palms ($N_2$) significantly increased the available nitrogen status of soils when compared with $N_0$ and $N_1$ treatments. Addition of organic matter at 6800 kg per 500 palms significantly increased the contents of available nitrogen in the surface soil prior to manuring when compared with $G_0$ and $G_1$ treatments. The addition of different levels of green matter did not alter the available nitrogen after four months of application. This might be due to the incomplete mineralisation of organic matter during the short period of four months.

*Available $P_2 O_5$:* Surface samples collected before manuring from plots supplied with the phosphatic fertilizer at $P_1$ and $P_2$ levels had significantly higher available $P_2 O_5$ than the subsoil samples. This difference was almost absent in the case of control plots receiving no phosphatic fertiliser. The soil samples from plots receiving phosphatic fertilizer at $P_0$ and $P_1$ levels had equal amount of available phosphorus at both the depths collected after manuring. The $P_2$ treatment had increased significantly the $P_2O_5$ content of surface soil when compared with subsoil. No beneficial effect of green leaf was noted on the availability of applied phosphorus in the soil at both the occasions of sampling.

*Available $K_2O$:* The surface soils supplied with potash fertilizer (at $K_1$ and $K_2$ levels) had recorded significantly higher available $K_2O$ than subsoil both before and after the manuring. The level was significantly higher than $K_1$ and $K_0$ levels, both before and after manuring The availability of $K_2O$ was not significantly different between the $K_0$ and $K_1$ levels before manuring whereas the difference was significant when the soils were examined after manuring.

*Organic Carbon:* The level of organic carbon in the surface soil was significantly higher than subsoil before and after manuring. The content of organic carbon in the plot receiving green leaf at $G_1$ and $G_2$ levels was significantly more than plots receiving no green leaf, the difference between plots receiving green leaf at $G_1$ and $G_2$ levels being not significant before manuring. After manuring the difference between the amount of organic carbon in the plots receiving no green leaf, green leaf at $G_1$ level and $G_2$ level was not significant.

Observations on similar lines were made at Peechi, where the trial was initiated in 1961. From the analysis of data gathered it was seen that only the main effect of K to be significant. Potash at $K_2$ level has given significantly more number of nuts per palm than at $K_0$ level.

The palms under N P K manurial experiment planted at Hirehalli in 1962 yielded the first crop during the year. Observations on leaf-fall, production of spadices and yield were made at Kahikuchi also where a similar trial is in progress since 1962. The data showed that only the main effect of nitrogen is significant on all the characters studied. The yield of fruits (number and wet weight) was significantly more in $N_1$ and $N_2$ levels than at $N_0$ level. The difference in yield between $N_1$ and $N_2$ levels was not significant.

The above experiment which was laid out on a $3^3$ x 2 x 3 factorial design at Mohitnagar in 1967 was applied with the second dose of fertilizers

during the year. Nitrogen at three levels (0, 50 and 100 kg per 500 palms) phosphoric acid at three levels (0, 20 and 40 kg per 500 palms) and potash at three levels (0, 70 and 140 kg per 500 palms) were under comparison.

The experiment laid out at Palode to determine the influence of application of macro and micro nutrients with and without irrigation showed during the third year of bearing that N P K with or without micro-nutrients but with irrigation to be significantly superior to N P K with or without micro nutrients and without irrigation.The difference in inflorescence production or yield between plots receiving micro-nutrients and without micro-nutrients was not significant. The results are in conformity with that of previous year.

Another experiment laid out at Palode to determine the effect of application of N P K with and without lime revealed no significant advantage of application of lime over no lime plots. Application of N P K in the form of fertilizers (inorganic) alone had significantly better performance than N P K - half the dose in the form of fertilizers and balance as organic manure. However, the results on the latter aspect are not consistent.

**A. 10. Effect of applying fertilizers to supply N P K in organic and inorganic forms on palm performance**

(K. B. A. Khader and E. Velappan)

The experiment was programmed to determine whether palms receiving chemical fertilizers will have any adverse effect if changed over to organic manures and *vice versa*. The treatments were superimposed in a six-year old garden at Central Station, which was receiving only cattle manure and green leaf throughout uniformly. The first application of fertilizers as per treatments was made in 1963-64 and repeated during subsequent years. The treatments consist of (i) N, P and K (25, 25 and 40 kg respectively for 500 palms per year) in organic form from 6th to 15th year, (ii) N, P and K in inorganic form from 6th to 15th year, (iii) N, P and K in organic form from 6th to 10th year and then in inorganic form till 15th year and (iv) N, P and K in inorganic form from 6th to 10th year and then in organic form till 15th year. As in the previous years the yield data for the current year also did not show any significant difference between the treatments.

**A. 11. Studies on placement and fractional application of fertilizers**

(P. G. Rajendran and A. K. Sadanandan)

The experiment which aims at determining the advantage or otherwise of application of fertilizers in split doses was initiated during 1968 adopting a 6 x 5 randomised block design with the following treatments:

1. N P K full dose in one application in September
2. N P K given in two instalments in September and January
3. N P K given in three instalments in September, January and April
4. P and K in one dose in September and N in two instalments in September and January
5. N and P in one dose in September and K in two instalments in September and January
6. P in one dose in September and N and K in two doses in September and January

The full dose is 50, 20 and 70 kg of N, P and K per 500 palms. Data on yield and other ancillary characters collected during the year did not show any significant difference between the treatments.

### A. 12. Harvesting trials

(a) Seasonwise variation in quality of produce and
(b) quality of produce as influenced by degree of maturity

(P. G. Rajendran and K. J. Antony)

Harvesting nuts at green stage is a practice in many parts of the country. The maturity at which the nut is harvested and the season of harvest affects the quality of the processed nut considerably. With a view to arrive at the optimum maturity level for obtaining the quality produce a harvesting-cum-processing trial was taken up with nuts of known maturity. It was obeserved earlier that the proportion of 'Vallavi Choor' which fetches more price than other trade varieties was more than the 'Choor Kora'when the nuts were harvested at 6 months maturity level and compared with the processed nuts harvested at 7 and 8 months maturity level. There was no monetary advantage by storing the produce and selling it at a later date. The nuts harvested and processed during the year will be evaluated.

### A. 14. Crop weather study

(S. Jayasheela Hegde, M. Vijayarajan and Harilal)

Weather data in respect of rainfall, temperature, humidity, etc. were recorded at the Central and Regional Stations. The data on rainfall and temperature are given in Table 11.

The premonsoon rains in April during the year at Vittal was 76.5 mm which was the highest precipitation recorded since 1958. A total rainfall of 3816.75 mm was recorded in 119 days as against 3267.9 mm recorded in 108

days during the corresponding period of last five years. During the first quarter of the year high temperature prevailed accompanied by a high incidence of mites.

The rainfall at Peechi was normal during the year whereas at Hirehalli the total rainfall was less by 376.99 mm when compared to the corresponding period of the last five years. The annual total rainfall at Mohitnagar was also less by 908.40 mm when compared to the mean of 3361.20 mm recorded during the last five years. The rainfall at Palode was also slightly below normal during the year.

### A. 15. Economics of areca cultivation

(M. Vijayarajan, R. K. Singh, Harilal and A. M. Shetty)

Cost of cultivation sheets for bulk gardens and maximum production plots at the Central and Regional Stations were maintained. The recurring cost of cultivation per hectare of areca garden at Vittal was Rs. 3,425/-. The net profit was Rs. 11,000.50.

## (c) RESEARCHES CONTEMPLATED

Based on the results of N P K manurial experiment in progress at Vittal and Peechi, it is proposed to revise the levels of N P K in the above experiment. Studies on the distribution pattern of roots of areca and cacao under the mixed garden condition is contemplated. The spacing trial at Vittal will be closed and the garden utilised for the study of the usefulness of hedge system of planting in arecanut.

### Programme of work for 1970

| Number and name of the Project | Venue of work |
|---|---|
| (1) | (2) |
| A. 1. Determination of optimum age of transplanting seedlings-cum-sowing *in-situ Vs.* transplanting of single, double and treble transplanted seedlings | Vittal and Kahikuchi |

| (1) | (2) |
|---|---|
| A. 2. Determination of optimum spacing in the mainfield | Vittal, Peechi, Hirehalli and Kahikuchi |
| A. 4. Effect of different intervals of irrigation at different depths of planting arecanut | Hirehalli, Vittal, Mohitnagar, Kahikuchi and Palode |
| A. 5. Investigations on different types of areca under rainfed and irrigated conditions | Mohitnagar, Vittal and Palode |
| A. 6. Intercropping experiments<br>a) Arecanut and banana<br>b) Arecanut and other crops | Vittal, Kahikuchi, Peechi, Hirehalli, Mohitnagar and Palode |
| A. 7. Mixed cropping experiments<br>a) Arecanut and coconut<br>b) Arecanut and cacao | Kahikuchi, Vittal, Peechi and Palode |
| A. 8. Effect of different methods of intercultivation on the productivity of palms | Hirehalli, Vittal, Peechi and Palode |
| A. 9. N P K manurial experiment | Vittal, Peechi, Hirehalli, Mohitnagar, Kahikuchi and Palode |
| A. 11. Studies on placement and fractional application of fertilizers | Peechi |
| A. 13. Root studies of arecanut palm of different ages and under different soil conditions | Vittal and Palode |
| A. 14. Crop weather study | Vittal, Peechi, Palode, Hirehalli, Mohitnagar and Kahikuchi |

| (1) | (2) |
|---|---|
| A. 15. Economics of areca cultivation | Vittal, Peechi, Palode, Hirehalli, Mohitnagar and Kahikuchi |

# STATISTICS

## SUMMARY OF SALIENT FINDINGS

*Dried whole arecanut* (Biligotu) *was graded into five groups based on size and put for sale in the Mangalore market in three batches. The price obtained for the biggest sized nuts (grade I, Mora) though was highest among the different grades, the overall price of the produce did not show appreciable improvement.*

## (b) RESEARCHES ON HAND

### S. 4. Marketing problems of arecanut

(K. Shama Bhat and P. R. Ramachander)

The project was initiated with the main object of investigating the factors governing the price of *'Chali'*.

As a first step the influence of grading of arecanuts on price structure was investigated. The trial sale of graded nuts made at the Mangalore market during the marketing season of 1969–70 has not given encouraging results except for the biggest sized nuts (grade I) which form only a small percentage of the total quantity. The cost (Rs. 2.33 for 50 kg) involved for grading was not compensated by the extra value realised. The mean price fetched for the different grades of areca were as follows.

| Grade No. | Common names | Mean price for 50 kg | |
|---|---|---|---|
| | | Rs. | P. |
| I | Mora | 398 | 00 |
| II | Moti (Jamnagar) | 390 | 00 |
| III | Sreevardhan | 365 | 00 |
| IV | Jini | 365 | 50 |
| V | Lindi | 364 | 50 |
| | Bulk (ungraded) | 382 | 00 |

### Programme of work for 1970

| Number and name of the Project | Venue of work |
|---|---|
| (1) | (2) |
| S. 2. Correlation, heritability and causation studies | Vittal, Peechi and Hirehalli |

| (1) | (2) |
|---|---|
| a) Correlation between morphological characters of seedlings | |
| b) Correlation between morphological and other characters of the palm with yield | |
| c) Heritability studies | |
| S. 3. Discriminant functions and selection index | Vittal |
| S. 4. Marketing problems of arecanut | Vittal |

# SOIL CHEMISTRY

## SUMMARY OF SALIENT FINDINGS

*The results of the green manure trial conducted at Hirehalli brought out that in general,* Mimosa invisa *was superior to* Pueraria javanica, Calopogonium muconoides, Centrosema pubescens *and* Crotalaria anagyroides *not only in respect of production of green matter but also in respect of nutrients content. The lowest tonnage of green matter was recorded by* Crotalaria anagyroides. Stylosanthes gracilis *did not establish under Hirehalli conditions. In order to study the changes in the soil and plant tissues due to continuous application of green leaves, manures, fertilizers and cultural practices, a permanent experiment was laid out at Vittal on a randomised block design with six treatments. Soil samples were collected from all the blocks and were separately analysed for their fertility constituents.*

## (b) RESEARCHES ON HAND

### C. 3. Comparative study of different green manure and cover crops and their organic matter addition capacity

(A. R. Mohapatra, N. T. Bhat, R. K. Singh and M. Sannamarappa)

With a view to assess the relative merits of different green manure and cover crops as regards their organic matter and nutrients addition capacities, a 6 x 4 randomised replicated experiment was laid out at Regional Arecanut Research Station, Hirehalli and Mohitnagar in June, 1969. The treatments included five cover crops, viz., (1) *Calopogonium muconoides*, (2) *Pueraria javanica*, (3) *Sesbania speciosa*, (4) *Mimosa invisa* and (5) *Stylosanthes gracilis*. The yields of many of the cover crops were very poor at Mohitnagar and, therefore, the experiment had to be discontinued. At Hirehalli, *Stylosanthes gracilis* and *Sesbania speciosa* did not establish well in spite of best efforts and these were replaced by *Centrosema pubescens* and *Crotalaria anagyroides*. The crops were harvested six months after sowing and the green matter produced was equally added to the palms. The mean hectare yield of green matter of the different green manure crops is given below.

| Sl. No. | Name of the crop | Mean yield per ha. (tonnes) |
|---|---|---|
| 1. | *Pueraria javanica* | 8.26 |
| 2. | *Calopogonium muconoides* | 7.96 |
| 3. | *Centrosema pubescens* | 15.83 |
| 4. | *Crotalaria anagyroides* | 4.25 |
| 5. | *Mimosa invisa* | 22.89 |

From the above it is seen that the production of green matter is the highest in the case of *Mimosa invisa* while *Crotalaria anagyroides* recorded the lowest tonnage per hectare.

The data on chemical analysis of the green matter of the above crops are given below.

| Sl. No. | Name of the crop | Results expressed on oven dry basis | | |
|---|---|---|---|---|
| | | % N | % P | % K |
| 1 | *Calopogonium muconoides* | 1.20 | 1.06 | 2.00 |
| 2 | *Mimosa invisa* | 2.24 | 2.34 | 1.47 |
| 3 | *Centrosema pubescens* | 1.48 | 0.92 | 1.29 |
| 4 | *Pueraria javanica* | 1.17 | 0.95 | 1.29 |

The above results show that *Mimosa invisa* is superior to others having the highest percentages of N and P. It appears that *Mimosa invisa* is the most suitable green manure crop for the *Maidan* area of Mysore.

**C. 6. Studies on composition changes in soil and plant by continuous use of fertilizers, manures and cultural practices**

(N. T. Bhat and A. R. Mohapatra)

This experiment was laid out at Vittal in order to investigate the compositional changes in soil profile and plant tissues brought about by the continuous and prolonged application of chemical fertilizers, organic manures and combination of both to arecanut crop. The experiment was started during the year under report on a randomised block design with six treatments, viz., (1) application of organic manures alone, (2) application of inorganic fertilizers alone, (3) application of organic manures + inorganic fertilizers, (4) application of organic manures + inorganic fertilizers and cultivation, (5) application of organic manures and cultivation, and 6) application of inorganic fertilizers and cultivation.

Growth data of the seedlings were recorded at the time of planting. Soil samples from all the treatment plots were collected and other operations as per schedule attended to.

c) RESEARCHES CONTEMPLATED

Studies on release of nitrogen to arecanut from different organic manures and mobility and availability of applied phosphorus in soil profile will be made. Studies on composition changes in soil and plant by continuous use of fertilizers, manures and cultural practices will be continued.

**Programme of work for 1970**

| Number and name of the Project | Venue of work |
|---|---|
| C. 1. Release of nitrogen to arecanut from different organic manures | Vittal |
| C. 2. Mobility and availability of applied phosphorus in soil profile | Vittal |
| C. 3. Comparative study of different green manure and cover crops and their organic matter addition capacity | Vittal, Mohitnagar and Hirehalli |
| C. 5. Studies on nutrient exhaustion by arecanut palm | Vittal |
| C. 6. Studies on composition changes in soil and plant by continuous use of fertilizers, manures and cultural practices | Vittal |
| C. 7. Soil survey of experimental farms | Vittal and Peechi |

# PLANT PHYSIOLOGY

## SUMMARY OF SALIENT FINDINGS

*Data colleted from the field experiments running at different units indicated that the yellowing of leaves of arecanut palms is least in the month of May and maximum in the month of August. There was slight reduction of foliage-yellowing by the application of certain treatments. However, the response to treatments was not consistent. In general, the plants under treatments I (N P K + Manganese sulphate + Magnesium sulphate and cattle manure) had lesser percentage of yellowing and higher yield when compared to diseased control. The percentage of discolouration of nuts does not seem to have any direct relationship with yellowing of arecanut leaves. Analytical data of plant samples collected from the different units showed that diseased leaves had a lower level of phosphorus, potassium and calcium contents. The soil samples were found to be very poor in available nitrogen, phosphoric acid and potassium and the soils are acidic in nature.*

*Quick tests for tissue and soil samples were carried out in ten healthy and ten diseased gardens of Palode tract in the months of May, July and October of 1969 and February of 1970 It was observed that iron and alumina concentrations in the diseased samples were more than healthy samples. The major nutrients content of the tissues was less and calcium was more in the diseased palms in comparison with healthy ones. High water table was noticed in most of the gardens giving rise to the reduction condition invariably all the year round.*

## (b) RESEARCHES ON HAND

### PP. 1. Investigations on yellow leaf disease of arecanut

(R.B.R. Yadava, A. R. Mohapatra, K.J. Abraham, C. K. Mathai, K. Vellaichamy, B. Nagaraj and C. Devaraju)

Field experiments involving application of macro and micro-nutrients laid out during 1965-66 at four centres viz., Annamanada, Koothattukulam, Punalur in Kerala State and Jayapura in Mysore State with the following 13 treatments in a randomised block design were continued.

A— N P K (Ammonium sulphate 140 g, Super phosphate 225 g and Muriate of potash 115 g) + 11 kg cattle manure

B— N P K + 1 kg lime + 11 kg cattle manure

C— N P K + Ferrous sulphate 57 g + 11 kg cattle manure

D— N P K + Sodium borate 23 g + 11 kg cattle manure

E— N P K + Zinc sulphate 23 g + 11 kg cattle manure

F— N P K + Manganese sulphate 68 g + 11 kg cattle manure

G— N P K + Magnesium sulphate 68 g + 11 kg cattle manure

H— Healthy control: receiving garden owner's usual treatments

I — N P K + Manganese sulphate 68 g + Magnesium sulphate 68 g + 11 kg cattle manure

J — N P K + Manganese sulphate 68 g + Magnesium sulphate 68 g + Zinc sulphate 23 g + 11 kg cattle manure

K— N P K + Manganese sulphate 68 g + Magnesium sulphate 68 g + Sodium borate 23 g + 11 kg cattle manure

L— N P K + Manganese sulphate 68 g + Magnesium sulphate 68 g + Sodium borate 23 g + Zinc sulphate 23 g + 11 kg cattle manure

M— Diseased control : receiving garden owner's usual treatments

Data collected from various centres on yellowing of foliage, mean number of female flowers per bunch, percentage of fruit set, kernel discolouration and yield characters were analysed statistically and the results are given below.

(i) *Yellowing of foliage:* Observations on yellowing of foliage were recorded during the months of May, June and August. The intensity of yellowing was minimum in the month of May as compared to June and August in all the centres. At Jayapura unit, the treatment G showed the minimum score for yellowing than the other treatments. The different treatments did not differ significantly at Annamanada, Koothattukulam and Punalur units.

(ii) *Female flower per bunch and fruit set:* No significant difference among the treatments was observed for this character at Punalur, Annamanada and Koothattukulam units. At Jayapura, treatment D showed better response than other treatments.

(iii) *Mean percentage of kernal discolouration:* Data pertaining to the kernal discolouration were analysed and no significant difference was observed in all the centres.

(iv) *Yield:* At Jayapura unit, treatment I followed by J and D gave better yield in comparison to treatment M though the differences were not significant. However, at Annamanada unit treatment F showed the best response. At Koothattukulam unit, the treatments did not differ significantly and very poor yield was recorded at this unit than at other units. On the other hand, at Punalur unit, the treatments F and J gave more yield than control plots but the treatment difference was not significant.

*Chemical analysis of soil, plant tissues and nuts:* Soil samples collected prior to the commencement of treatment application were analysed and found very poor in available nitrogen, phosphoric acid, potassium and calcium. The treatment differences were not significant. The soil is acidic in reaction, the pH range being 4.2—5.4 and organic carbon is medium to high.

At Punalur uuit, the plant samples for N, P, K, Ca and Mg were analysed and were found to be poor for these elements. Wide variation was found between the replication though the variations were not significant. At Koothattukulam unit, nitrogen content gave signific. values for the treatment E, H, J and L followed by other treatments. But treatment I showed least percentage of nitrogen content. Other elements such as N, P, K, Ca and Mg showed similar patterns.

In order to find out if nutrient imbalance is the cause of the incidence of yellow leaf disease of arecanut, quick tests for tissue and soil samples were carried out in ten healthy and ten diseased gardens of Palode area in the months of May, July and October of 1969 and February 1970. The results of investigation revealed that most of the soils and plant samples collected from the diseased gardens were more in iron and alumina than the healthy samples. The water table in the gardens was invariably high and within the root zone of the palms. It was also observed that the leaf tissue samples from diseased gardens were less in their contents of major nutrients and more in calcium, iron and aluminium, when compared to the tissues from healthy trees.

## (c) RESEARCHES CONTEMPLATED

Pot-culture experiment with different nutrients will be taken up. Survey for assessing the crop losses due to yellow leaf disease; physiology of growth and development of arecanut palm and fruit setting and shedding by the use of synthetic growth regulators will be taken up.

Programme of work for 1970

| Number and name of the Project | Venue of work |
|---|---|
| PP. 1. Yellow leaf disease of arecanut | Vittal and Palode |
| a) Investigations on physiological aspects | |
| i) Survey for assessing the area affected by yellow leaf disease | |
| ii) Field experiments (with macro and micro-nutrients) | |
| iii) Chemical analysis of soil and plant tissues and nuts | |
| iv) Pot-culture experiment | |
| b) Botanical and pathological aspects | |
| i) Leaf anatomy and root histology | |
| ii) Studies on the association of nematodes | |
| iii) Preliminary studies in relation to virus and mycoplasma in collaboration with Indian Agricultural Research Institute | |
| PP. 2. Physiology of growth and development of areca palm | Vittal |

# PATHOLOGY

## SUMMARY OF SALIENT FINDINGS

*Fungal infection of processed arecanuts was found to be maximum in nuts harvested and dried during October- November and least in those harvested and dried in February- March. Harvesting nuts without coming in contact with soil and drying in hot air oven at 65° C for 63 hours after surface sterilisation with formalin completely prevented fungal infection of* Chali. *Small scale trials on drying nut on different types of drying floors showed that nuts dried on cement floor had the least infection. Studies on storage of nuts indicated that infection of* Chali *was related to its moisture percentage and was least when stored in air-tight bins or polythene-lined gunny bag Studies of nuts stored in market yards (Mangalore) showed that nuts stored as* Choll supari *had more fungal infection. Among the indigenous types* Sweet areca *had the maximum percentage of infection. In addition to the fungi attacking the nuts reported already, fungi like* Botryodiplodia theobromae, Mucor *sp and* Thielaviopsis *sp. were found to infect the nuts. Amongst these fungi, maximum infection was caused by* B. theobromae. *The causal agent of* anabe, Ganoderma lucidum, *grew well on* 2% *malt agar enriched with biotin at 5 ppm concentration, or on sterilised paddy seeds previously soaked in water for 24 hrs. Studies on yellow leaf disease at the Regional Station, Palode,showed that the disease could not be transmitted by sap inoculation. The disease spreads in small patches generally. Among exotic varieties, a few plants of Nicobar, Ceylon and Saigon - 2 showed disease symptoms.*

## (b) RESEARCHES ON HAND

### P. 3. Investigations on Anabe

(K. K. N. Nambiar, S. N. Sampathkumar and B. K. Sharma)

The causal fungus,*Ganoderma lucidum* was brought under pure culture employing 2% malt agar. Further studies showed that the fungus can grow well when the above medium was enriched with biotin even at 5 ppm. The mycelial mat thickness on the medium in Petri dishes increased with increase in concentration of biotin up to 15 ppm. The fungus was also found to put forth luxuriant growth when sub-cultured on paddy seeds soaked in distilled water for 24 hours.

Inoculation of areca seedlings with *Ganoderma* was initiated. The seedlings were grown in mud pots and were inoculated with (i) infected stem blocks of 2" x 2" x 1" size, (ii) brackets 2" x 2" x 1" size, (iii) mycelial mat grown on malt extract in 500 ml conical flasks and (iv) roots of seedlings dippied in culture filtrate and planted.

The inoculation was done in November, 1969 and the seedlings are under observation.

**P. 4. Yellow leaf disease of arecanut (a) investigations on pathological aspects**

(K. J. Abraham, R. B. Nair, K. K. N. Nambiar, R. B. R. Yadava, K. Vellaichamy, C. K. Mathai and B. Nagaraj)

*Symptomatology:* Critical study on the sequence of symptom expression was continued. The yellowing of the leaves was found to be manifested in the outer whorls. The yellowing may either be confined to the tip and margin of the leaves or the entire leaf may be involved. The characteristic discolouration of endosperm believed to be a symptom associated with the disease was found only in a comparatively smaller population of the affected palms in the station. This character was also found in apparently healthy palms as well. The intensity of yellowing was found to be more prominent soon after rains and the same continues during the wet periods. Decaying of roots was also found, invariably associated with a larger population of diseased palms.

*Spread of the disease:* A closer study on the initiation and subsequent spread of the disease was made in gardens where only very few palms had contracted the disease. It was observed that the disease spreads in small patches.

Though the general pattern of spread is in patches, isolated cases of occurrence of single diseased palm were also observed. The disease incidence appeared to be more in low lying plots where water table is high during rainy seasons.

*Pathological aspect:* Isolations of fungi from roots of diseased plants were made at Palode. Studies on pathogenicity were being made. Root samples collected from yellow leaf disease-affected palms were sent to Dr. D. N. Srivastava, Deputy Agricultural Commissioner, Indian Council of Agricultural Research, New Delhi, along with healthy samples from Vittal, for isolation of pathogenic micro-organisms, if any. No conclusive results

have been obtained so far. Sap inocuation trials conducted on various plants as well as on arecanut seedlings did not transmit the disease.

*Agronomic aspects:* (i) *Influence of application of macro and micro-nutrients with and without irrigation on the incidence of yellow leaf disease:* In the experimental plot the disease has spread to a considerable extent. The percentage of incidence ranged from 8.0 to 12.0. None of the agronomic treatments was found to reduce the incidence of the disease.

(ii) *Effect of application of N P K with and without lime on disease incidence:* This experiment was laid out in 1964 on a randomised block design with the following treatments replicated 4 times. (i) N P K (full dose) in the form of fertilizers, (ii) treatment (i) + lime, (iii) N P K half dose in the form of fertilizers and half as organics, (iv) treatment (iii)+lime, (v) lime alone, and (vi) no lime and no manure. Each treatment had 48 palms. In this experimental plot also the disease has made its appearance during the year, and the percentage of palms showing the disease symptoms in the different treatments were 39.6, 20.8,6.2, 4.2., 6.2 and 2.1 respectively.

(iii) *Effect of high water table:* The arecanut and the coconut mixed garden was planted in 1965 with two replications in a low lying plot of the station. Replication I is at about 75 cm higher than Replication II in which the water table was at 80 cm depth. It was found that 7.3% of the palms were affected by yellow leaf disease in Replication I as compared to 60.4% in Replication II. It appears that water table of the garden plays an important role in the incidence of yellow leaf disease. It was also interesting to note that the highest percentage of incidence at the Station was in this garden.

*Botanical aspects:* Varietal trials have been laid out with a view to screening the varieties for disease resistance. It is seen from these trials that a large number of indigenous cultivars are susceptible to the disease. Among exotics, a few plants of Nicobar, Ceylon and Saigon 2 (VTL. 13) have shown disease symptoms. It is too early to separate out the resistant varieties if any.

**P. 5. Survey for assessing crop losses due to diseases**
**a) Koleroga, b) Anabe**

(S. Edison, K.K.N. Nambiar, S. N. Sampathkumar, B. K. Sharma and K. J. Antony)

The proforma for assessing crop losses due to the above diseases was finalised. The survey will be taken up in 1970.

## P. 7. Fungal and pest infection of processed arecanuts

(K. K. N. Nambiar and S. Edison)

Investigations made earlier had shown that fungal infection of processed nuts occurred mainly from the drying yard. It was also seen that quickening the process of drying and eliminating contact of nuts with soil by using a mechanical drier reduced infection of nuts to a considerable extent.

During the year under report nuts dried during different periods have been assessed for fungal infection and the data are given in Table 12.

TABLE 12

**Fungal infection of *Chali* during different period of drying**

| Period of drying | Percentage of *Chali* infection | | | | Temperature in °C (range) | | | Rainfall in mm |
|---|---|---|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Total | | Maximum | Minimum | |
| October-November | 16.8 | 20.8 | 19.7 | 57.3 | Oct. | 26.0 - 35.0 | 19.1 - 22.3 | 156.8 |
| | | | | | Nov. | 31.0 - 34.5 | 15.4 - 22.6 | 54.4 |
| December-January | 16.8 | 17.0 | 6.6 | 40.4 | Dec. | 31.0 - 35.0 | 12.7 - 22.9 | nil |
| | | | | | Jan. | 31.4 - 35.8 | 14.9 - 18.6 | nil |
| February-March | 13.2 | 8.6 | 3.7 | 25.5 | Feb. | 32.5 - 36.5 | 16.0 - 20.9 | nil |
| | | | | | Mar. | 33.8 - 37.8 | 19.1 - 24.1 | 1.20 |

The above data show that the fungal infection of processed nuts depends on the period of harvest and drying. The maximum percentage of infection observed in October- November may be attributed to the favourable weather conditions prevalent during the period for fungus growth.

In another experiment, the ripe nuts were harvested without allowing them to come in contact with the ground. The nuts were surface-sterilized with formalin (1:5 dilution) and dried in hot air oven at 65°C for 63 hours. The nuts were completely free of fungal infection. Thus, there seems to be no incipient infection in nuts.

Studies on drying nuts on different types of drying floors, viz.,cement, brick and soil were taken up, with four sub-treatments, (1) steeping nuts in Bordeaux mixture before drying, (2) drenching the yard with Bordeaux mixture and drying nuts on it, (3) combination of treatments (1) and (2) and (4) control. Four replications were maintained. Each replication had 150 nuts. The data are presented in Table 13.

TABLE 13

Percentage of infected nuts on different drying yards

| Main-treatment | Sub-treatment | | | | Mean |
|---|---|---|---|---|---|
| | Control | Steeping nut in Bordeaux mixture | Drenching yard with Bordeaux mixture | Combination of treatments in col. 3 & 4 | |
| 1 | 2 | 3 | 4 | 5 | 6 |
| Soil | 24.28 | 17.50 | 19.64 | 17.86 | 19.82 |
| Brick | 18.93 | 10.71 | 13.57 | 13.93 | 14.29 |
| Cement | 13.93 | 10.36 | 13.93 | 9.29 | 11.88 |
| Mean | 19.05 | 12.86 | 15.71 | 13.69 | 15.33 |

| | |
|---|---|
| S. E. for main plot | 2.35 |
| S. E. for sub plot | 4.22 |
| Overall mean | 15.33 |
| C.V. (%) for sub plot | 27.53 |
| C.V. (%) for main plot | 15.33 |
| S.E. for difference between two main treatment means | 0.83 |
| S.E. for difference between two sub treatment means | 1.72 |
| S.E. for difference between two sub-treatment means at the same level of main treatment | 2.98 |

| | |
|---|---|
| S.E. for difference between two main treatment means at the same or different levels of sub-treatments | 2.72 |
| C.D.(P=0.05) for comparing main treatment means | 2.03 |
| C.D.(P=0.05) for comparing sub-treatment means | 3.53 |

Statistical analysis has shown that both main and sub-treatments are significantly different as regards percentage of infection. Nuts dried on cement floor have significantly lesser infection than those dried either on brick or soil. Steeping nuts in Bordeaux mixture has also given significant reduction in percentage of infection than control while drenching yard does not give such a reduction in infection. The combination of steeping and drenching is not significantly different from steeping alone. Further trials with different types of drying yard on a large scale are in progress.

Studies on storage of arecanut were made during the period under report to find out the rate of increase in fungal infection in nuts under storage and its possible relationship with moisture content in nuts during different periods of storage. Dried nuts were stored in (1) ordinary gunny bag kept in a room with false ceiling, (2) polythene-lined gunny bag and kept in the above room, (3) in air tight bins at the bottom of which fused $CaCl_2$ was kept as a dehydrating agent and (4) culivators' store house. The experiment was started in May, 1969 with one lot of nuts having 16% of infection except in treatment (4). The data are given in Table 14.

TABLE 14

**Percentage of nut infection and moisture under different types of storage conditions**

| Types of storing | May, 1969 | | June, 1969 | | July, 1969 | | Aug., 1969 | | Sept. 1969 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | I | M | I | M | I | M | I | M | I | M |
| Gunny bags | 16.00 | 9.54 | 19.33 | 11.79 | 25.33 | 12.39 | 28.33 | 15.59 | 32.33 | 15.64 |
| Polythene-lined gunny bags | 16.00 | 9.54 | 16.33 | 10.99 | 19.00 | 11.54 | 20.33 | 12.59 | 22.00 | 13.09 |
| Air tight bin | 16.00 | 9.54 | 15.33 | 10.94 | 16.33 | 11.34 | 17.67 | 11.64 | 17.67 | 11.34 |
| Cultivators' store | 21.67 | 8.94 | 22.33 | 11.34 | 26.00 | 12.74 | 28.67 | 13.54 | 30.00 | 14.34 |

*Note:* I = Infection % M = Moisture %

The data show that least percentage of infection was obtained in air tight bins, where the moisture percentage was also lowest. The rate of increase in infection is more in nuts stored in gunny bags presumably due to the higher absorption of moisture by the kernel stored in gunny bags. Storing nuts in polythene-lined gunny bag is second best when percentage of infection is taken into consideration.

To study the effect of long storage on fungal infection, samples of *Chali* stored in South Kanara Arecanut Cooperative Marketing Society, Mangalore, for different lengths of time, were examined. The samples were collected during January, 1969. The data are presented in Table 15.

TABLE 15

**Fungal and pest infection of *Chali* stored for different lengths of time**

| Sample | Percentage of fungal infection | | | | %pest infection |
|---|---|---|---|---|---|
| | Mild | Moderate | Severe | Total | |
| 1968 New | 8.00 | 20.00 | 5.66 | 33.66 | 0.7 |
| 1968 Choll | 6.33 | 27.00 | 8.66 | 42.00 | 4.3 |
| 1967 New | 14.69 | 23.13 | 19.69 | 57.51 | 4.7 |
| 1967 Choll | 11.33 | 26.66 | 22.66 | 60.66 | 18.7 |

The data presented in Table 15 show that the longer the storage period, the greater is the fungal or pest infection.

In order to study how far fungal infection varied in different indigenous types of areca samples of *Chali* (300 nuts each) were examined for fungal infection. The data are given in Table 16.

TABLE 16

**Percentage of fungal infection in Indigenous types**

| Type | Percentage of fungal infection | | | |
|---|---|---|---|---|
| | Mild | Moderate | Severe | Total |
| Hirehalli | 9.33 | 11.66 | 12.33 | 33.33 |
| Chikmagalur | 14.33 | 6.66 | 4.33 | 25.33 |
| Thirthahalli | 3.66 | 2.00 | 0.33 | 6.00 |
| Peechi | 2.66 | 4.00 | 2.33 | 9.00 |
| West Bengal | 10.33 | 12.66 | 1.33 | 24.33 |
| Assam | 2.00 | 3.00 | 5.33 | 10.33 |
| Mettupalayam | 11.00 | 3.00 | 1.00 | 15.00 |
| South Kanara | 13.00 | 4.33 | 0.33 | 17.66 |
| Sweet areca | 22.66 | 28.66 | 23.00 | 74.33 |

The data presented in the above table show that fungal infection was very high in sweet areca probably due to the fact that in this type the endosperm occupies a larger area of the kernel, and this serves as a best substratum for the fungus to thrive on.

It is known now that soil-borne fungi are involved in infection of nuts in the drying yard. However, it is not known how much percentage of infection in a given lot of *Chali* is attributable to a certain fungus. Hence samples of 100 nuts are drawn from 3 lots and analysed for fungal infection with the above point in view. The results are given in Table 17.

TABLE 17

**Percentage of nut infection by individual fungus**

| Fungus | Percentage of nut infection | | | Mean |
|---|---|---|---|---|
| | Lot I | Lot II | Lot III | |
| 1. *Aspergillus* sp. | 5 | 16 | 13 | 11.33 |
| 2. *Penicillium* sp. | .... | 1 | 5 | 2.00 |
| 3. *Botryodiplodia theobromae* | 7 | 24 | 22 | 17.66 |
| 4. *Rhizopus* sp. | 1 | 3 | 5 | 3.00 |
| 5. *Mucor* sp. | 2 | .... | 2 | 1.33 |
| 6. *Thielaviopsis* sp. | .... | .... | 1 | 0.33 |
| Total infection % in each lot | 12 | 40 | 44 | 32.00 |

It can be seen from the table that maximum percentage of infection was caused by *B. theobroame* followed by *Aspergillus* sp. The infection was caused either by a single species of fungus or by two or more species of fungi simultaneously.

## (6) RESEARCHES CONTEMPLATED

The drying methods including drying floors are to be standardised to eliminate the fungal infection. A new project, P. 8. "Studies on the die-back of arecanut inflorescences" will be taken up in 1970.

## Programme of work for 1970

| Number and name of the project | Venue of work |
|---|---|
| P. 1. Investigations on *Koleroga* (*Phytopathora arecae*)<br>a) Trials on the control of *Koleroga* using low volume spray<br>b) Studies on the retention of copper compounds sprayed on the fruits in the field<br>c) Studies on the forecasting of the incidence of *Koleroga* | Vittal and Peechi |
| P. 3. Investigation on *Anabe* | Vittal, Hirehalli and Kahikuchi |
| P. 5. Survey for assessing crop losses due to diseases<br>a) *Koleroga*<br>b) *Anabe*<br>c) *Yellow leaf disease* | Vittal, Hirehalli, Kahikuchi, Peechi and Palode |
| P. 6. Study of the crown rot disease in Assam | Kahikuchi and Vittal |
| P. 7. Fungal and pest infection of processed arecanuts | Vittal |
| P. 8. Studies on the die-back of arecanut inflorescence | Vittal |

# ENTOMOLOGY

## SUMMARY OF SALIENT FINDINGS

*The calyx mite, harbouring the calyx region of nuts, was found to cause tender nut fall at Regional Station, Peechi. It was found that spraying the bunches with either Rogor 0.1% or Anthio 0.2% gave good control of the pests. A new species of mite viz.,* Oligonychus biharensis *was recorded on the foliage of arecanut. The biology of inflorescence caterpillar,* Tirathaba mundella, *was worked out. The life periods for the caterpillar, pupae and moth were found to be 12 days, 9–12 days and 3-6 days respectively. Spray with Malathion 0.25% and Hexadrin 0.25% gave cent per cent control of the pest. Rearing technique for studying biology of root grub was perfected. The eggs took more than one month to hatch. The grubs enter into pupation when they attain an approximate weight of 6-7 gm. The pupa emerges into an adult in 35-40 days. A new species of white grub viz.,* Phyllophaga fissa, *was identified during the year under report.*

## (b) RESEARCHES ON HAND

### E. 1. Biological and chemical control of mites

(B. C. Misra, S. Rajamani and K. J. Antony)

Work on biological control of mites was initiated in 1967. The study is being carried out in collaboration with the Commonwealth Institute of Biological Control, Bangalore. Predatory mites *(Phytoseiulus riegeli)* obtained from the above institute were released on plants attacked by red mites. Examination of the plant made after 24 hours of release revealed that the predaceous mites had not survived the conditions prevailing in the field. The work is being continued with fresh batch of the predators.

A new mite on arecanut fruits, distinctly different from the mite occurring on leaves was observed during the summer months of 1968 at the Regional Arecanut Research Station, Peechi. The mites are orange coloured and harbour inside the calyx of green arecanuts. They suck sap from inside the nuts. Nuts so infested by the mites shrivel and shed. A spraying trial using seven miticides was taken up at Regional Arecanut Research Station, Peechi. All the chemicals except Thimet and Temik which were applied

on soils around the base of the palms, were sprayed on the bunches. The results of the trials are summarised in Table 18.

TABLE 18

**Miticidal trial against calyx mites**

| Treatments | Concentration | Mortality percentage | | |
|---|---|---|---|---|
| | | 24 hrs. | 72 hrs. | 168 hrs. |
| 1. Thimet 10 G | 91 g per palm | 5.14 | 1.87 | 2.06 |
| 2. Temik 10 G | 157 g per palm | 0.85 | 2.83 | 2.64 |
| 3. Nuvacron 40 EC | 1 ml per lit | 24.41 | 3.20 | 11.30 |
| 4. Galacron 50 EC | 1.6 ml per lit | 52.12 | 6.76 | 19.25 |
| 5. Nuvan 100 EC | 0.8 ml per lit | 26.05 | 7.25 | 6.00 |
| 6. Anthio | 2 ml per lit. | 71.57 | 84.68 | 89.34 |
| 7. Rogor 30 EC | 1 ml per lit. | 84.90 | 98.00 | 99.59 |
| 8. Control | | 2.40 | 1.32 | 1.30 |
| S. E. per plot | | 11.70 | 3.74 | 7.06 |
| Overall mean | | 33.43 | 25.74 | 28.93 |
| C. V. (%) | | 35.00 | 14.53 | 24.40 |
| S. E. for difference between the treatment means | | 9.55 | 3.05 | 5.76 |
| C. D. (P=0.05) | | 20.48 | 6.54 | 12.36 |

It is evident from the above table that the treatment differences are significant. Rogor and Anthio have given significantly more mortality percentage than all other treatments after 7 days of spraying.

A new mite identified as *Oligonychus biharensis* has been recorded for the first time feeding on the arecanut leaves.

**E. 2. Studies on the control of inflorescence caterpillar** *(Tirthaba mundella)*

(S. Rajamani and B. C. Misra)

Detailed study on the biology of the inflorescence caterpillar was made. The eggs are laid on the tender spathe. They are oval, grayish white first and later turn to reddish yellow. In about five days the eggs hatch out. The newly hatched larvae are very small measuring 0.2 cm with a conspicuous black head. They grow to a size of 2.0 to 2.4 cm in length and 0.3 to 0.4 cm in width during period of 12 days. They are voracious

feeders on the tender inflorescence. The attacked inflorescence eventually turns to mass of dead tissue, amidst black frass bound together. Such spadices fail to open. The fully grown caterpillars are light brownish black in colour with hard chitinised head which is reddish brown in colour. The fully grown caterpillar eventually pupates in silken cocoons in the mass of frass. The pupae are brown in colour. The adult emerges after a pupation period of 9 to 12 days. Moths are grayish to grayish brown in colour with fore wings having two black patches on the dorsal side in a line along with the length of the wing. The hind wings and abdomen are light yellow. The total length of the moth is about 8.1 cm with a wing expansion of 2.25 cm. They live for two to three days.

Both laboratory and field trials using different insecticides were conducted to find out the best chemical suitable for controlling the pest.

*Laboratory test:* Commercial formulations of insecticides were prepared diluting with water to get 0.05 per cent, 0.1 per cent, 0.125 per cent, 0.2 per cent and 0.25 per cent active concentrations. Ten larvae in a petri dish per replication were sprayed with 1 ml of insecticides under Potter's tower at 6.8 kg pressure and after half an hour they were caged for 24 hours on tender inflorescences in glass jars. The mortality in different treatments was corrected by Abbot's formula for comparison. The data obtained for 0.25 per cent active concentration are presented in Table 19. In the case of other concentrations none of the insecticides gave more than 50 per cent mortality.

TABLE 19

**Mortality percentage of larve with different Insecticides**

(Laboratory condition)

| Sl. No. | Insecticide (0.25% active concentration) | Correlated corrected mortality percentage after 24 hrs. (Mean of 3 replication) |
|---|---|---|
| 1. | Malathion | 66.6 |
| 2. | Parathion | 66.6 |
| 3. | Carbaryl | 60.0 |
| 4. | Sumithion | 70.0 |
| 5. | Hexadrin | 66.6 |
| 6. | Guesrol 550 | 20.0 |
| 7. | Hexidol 950 | 10.0 |

From the above table it can be seen that Malathion, Parathion, Carbaryl, Sumithion and Hexadrin gave more than 50% kill when sprayed at 0.25% active concentration.

*Field trial:* A field trial was laid out using the same insecticides as above at 0.25% active concentration. Sprayed bunches were covered with perforated alkathene bags. The data are presented in Table 20.

TABLE 20

**Mortality percentage of larvae with different insecticides in the field condition**

| Sl. No. | Insecticide | Correlated corrected mortality percentage after 4 days |
|---|---|---|
| 1 | Malathion | 100.00 |
| 2 | Parathion | 93.00 |
| 3 | Carbaryl | 92.70 |
| 4 | Sumithion | 95.30 |
| 5 | Hexadrin | 100.00 |
| 6 | Guesrol 550 | 60.50 |
| 7 | Hexidol | 60.00 |
| 8 | Control | 0.00 |

It is observed from the above data that Malathion and Hexadrin gave 100% kill of the caterpillar, when observed 4 days after spraying.

**E. 3. Studies on the biology and control of white grub** *(Leucopholis bermeisteri)*

(B. C. Misra, S. Rajamani and S. N. Sampathkumar)

To study the biology and control of the whitegrub, *Leucopholis bermeisteri*, rearing technique was first perfected. Eggs of the grub collected from the field were kept in a test tube, filled with soil and cowdung in the ratio 3:1. The egg was placed in the tube in such a way as to be easily observable daily. It was found that the egg took more than one month to hatch. The newly hatched grubs were transferred to specimen jar filled with the above mixture (fresh cowdung and soil). Fresh roots of arecanut palm were cut into $1\frac{1}{2}$" to 2" bits and were mixed with the contents of the specimen jar. The soil was filled up to 1" below the rim and the soil surface was covered with a layer of moist cotton. Finally the open end of the jar was tied with a piece of cloth to prevent the grubs from escaping.

Observations were made daily and the cotton layer was kept moist throughout by applying water whenever necessary. The roots were changed once in two days and the soil once in four days. The grown up grubs were measured and weighed each time during their transfer to fresh soil.

When the grubs attain an approximate weight of 6 to 7 grams they stop feeding and pupate. They are now transferred to pots of 1' x 10" dimensions. Tunnels were made in soil kept in the pot and the pupae were kept in the tunnel. The top of the tunnel was closed with alkathene sheets over which a layer of soil was put. The pots were kept on a shallow pan where water is poured daily to keep adequate moisture. The pupa emerges into an adult in 35-40 days.

A new species of white grub, found attacking the arecanut roots, has been recorded during the year under report and it was identified as *Phyllophaga fissa.*

**E. 6. Survey for assessing crop losses due to pest**

(B. C. Misra, K. J. Abraham, K. J. Antony and S. N. Sampathkumar)

A proforma for estimation of crop losses due to insect pest was finalised during the year.

## c) RESEARCHES CONTEMPLATED

Survey for assessing crop losses due to important pests like mites, spindle bug, inflorescence caterpillar and root grub will be conducted.

**Programme of work for 1970**

| Number and name of the Project | Venue of work |
|---|---|
| (1) | (2) |
| E. 1. Biological and chemical control of mites | Vittal and Peechi |
| E. 2. Studies on the control of the inflorescence caterpillar *(Tirathaba mundella)* | Vittal |
| E. 3. Study on the biology and control of white grub *(Leucopholis bermeisteri)* | Vittal and Hirehalli |

| (1) | (2) |
|---|---|
| E. 5. Binomics and control of spindle bug | Vittal, Peechi and Palode |
| E. 6. Survey for assessing crop losses due to pest<br>a) Mites<br>b) Spindle bug<br>c) Inflorescence caterpillar<br>d) Root grub | Vittal, Palode, Peechi, Hirehalli and Mohitnagar |

## III. PAPERS PUBLISHED

During the period the following papers were published:

1 Abraham, K. J.
Arecanut cultivation - recent research findings. *Kerala Kurshakan* (Malayalam), 1969

2 Bavappa, K. V. A.
Recent trends in arecanut research. *Arecanut and Spices Bull.* 1 (1) : 5-8, 1969

3 Bavappa, K. V. A. and Ramachander, P. R.
Some immediate problems, possibilities and experimental approaches - Arecanut. *Indian J. Genetics and Pl. Br.* Special Symposium 28 (A) : 135-139, 1968 (Published in 1969)

4 Bhat, K. S. and Leela, M.
The effect of density of planting on the distribution of arecanut roots. *Trop. Agr. Trinidad,* 46 (1) : 55-61, 1969

5 Nair, R. B. and Rawther, T. S. S.
On the biology of *Tirathaba mundella* Wk.– a pest of areca palm. *Agric. Res. J. of Kerala,* 7 (1) : 49–50, 1969

6 Seshadrinathan, A. R.
Identical twins in arecanut. *Sci. & Cult.* 35(7) : 323-324, 1969

The following paper was accepted for publication.

1 Bavappa, K.V.A. and Annaji Rao K.
Floral initiation and abortion studies in *Areca catechu* Linn. *Indian J. agric. Sci.*

The following theses were accepted for the award of M.Sc (Ag)degree of Kerala University.

1 Nair, R. B.
Histo–morphological and biochemical studies on yellow leaf disease of arecanut

2 Velappan, E.
Investigations on the possible relationship between the nutritional status of soils and the incidence of "Yellow leaf disease of Arecanut palm *(Areca catechu* Linn.)"

# IV. EXTENSION

## a) Results of immediate practical application

(1) Harvesting nuts at green stage is a practice in many parts of the country. Studies made at Regional Station, Peechi to arrive at the optimum maturity level at which nut is to be harvested to obtain quality produce showed that nuts harvested at 6 months maturity level and processed, fetched more price as compared to nuts harvested at 8 months maturity level because of the fact that the proportion of *"Vellavi Choor"* which fetches more price than other trade varieties, was more in the former.

(2) Results of experiment to determine whether palms receiving chemical fertilizers will have any adverse effect on their performance if changed over to organic manures, and *vice versa*, showed that there is no significant difference in the performance of palms receiving N P K either in organic or inorganic forms. This indicates that for all practical purposes either of them can be chosen for the purpose of manuring.

## b) Results likely to be useful to farmers but needing further trials

(1) Studies on storage of arecanut to find out the rate of increase of fungal infection in nuts under storage and its possible relationship with moisture content in nuts during different periods of storage showed that storing whole dried ripe nuts in polythene-lined jute bags had better keeping quality and lesser percentage of fungal infection than storing nuts in jute bags alone.

(2) Of the many different types grown in the exotic collection plots, four introductions have given about three times more yield than that of the local. Large scale trials in the cultivators' field are being conducted for studying their field performance before they are released for cultivation.

(3) Deeper planting of seedlings at 90 cm depth and irrigating at three days interval was found to be better than planting at shallower depths and irrigating at wider intervals.

(4) Preliminary trials using different fungicides to control die-back of areca inflorescences causing severe shedding of buttons and tendernuts showed that spraying the bunches with Dithane Z-78 at a concentration of 4 g per litre,twice at fortnightly intervals, gave better control of the disease.

## c) Publicity activities

In order to give wide publicity to the various research findings, the Research Stations participated in several exhibitions like Agricultural and

Industrial Exhibition 1969 of Sree Siddaganga Mutt, Tumkur, Exhibition organised by the Indian Arecanut Development Council at Ernakulam, All Indian Exhibition at Trivandrum, etc.

The sixth Farmers' Week for the year was celebrated in January,1970 at the Central Station. It was inaugurated by Shri A. P. Shinde, Hon'ble Union Minister of State for Food and Agriculture and presided over by Shri C. M. Poonacha, M. P. and ex-Union Minister for Steel and Heavy Engineering. An impressive exhibition in which the State Departments and a number of private Firms participated was arranged in connection with the Farmers' Week celebration and was opened by Shri H. C. Linga Reddy, Minister for Fisheries and Ports, Mysore State. The exhibition was of great educative value to the areca growers. Group discussions were arranged to enlighten the farmers about the activities of the Research Station.

Farmers' week was also celebrated at the various Regional Arecanut Research Stations. At Regional Arecanut Research Station, Mohitnagar, the Farmers' week was inaugurated by Shri S. B, Mazumdar, Deputy Commissioner, Jalpaiguri and presided over by Shri K. S. Banerjee, Director of Soil Conservation and Joint Director of Agriculture, Jalpaiguri. A film on "Arecanut cultivation" was screened during the occasion.

Undergraduate and post-graduate students from a number of Agricultural and academic Universities visited the Central and Regional Stations to get first hand knowledge of the research work in progress. Besides, the Central Station attracted trainees from different Institutions and Departments of State Governments. Mention may be made of the intensive training on all aspects of arecanut cultivation given to Assistant Chemist and Graduate Assistant of the Horticultural Farm, Thirthahalli and Arecanut Development Assistants, Mettupalayam and Thondamputhur respectively of Tamilnadu. The very large number of enquiries seeking advice to solve various problems in arecanut cultivation were attended to promptly. In a large number of cases progressive growers came in person to the Research Stations to seek advise from the research workers on various problems. The Research Stations were also in touch with growers and trade interests through out the country for identifying the problems in the field. The Arecanut Specialist and staff members paid visits to areca gardens for on-the-spot inspections wherever found necessary.

# V. CONFERENCES AND SYMPOSIA

The Fourth Research Council Meeting of Central and Regional Stations was held on 7th, 8th and 9th January, 1970 at the Central Station, Vittal. Individual projects were discussed by the concerned project leaders and associates during the first two days. The full Session on the 9th of January, 1970 was presided over by Dr. A. B. Joshi, Deputy Director General (CS), Indian Council of Agricultural Research and attended by Deputy Director, Regional Office Arecanut and Spices Development, Calicut; Director, Agronomist, Botanist and Chemist of Central Coconut Research Station, Kasaragod; Research Officers and research staff members of different Regional Stations; the Superintendent, Regional Arecanut Research Station, Thirthahalli and Heads of Sections and research staff of Central Station. Individual projects of the technical programme were discussed in detail, some of them reoriented, and the programme of work for 1970 drawn up. Under the aegis of the Study Circle five meetings were held in April, June, August, September and November at Central Station. Scientists like Dr. N. Hrishi, Cytogeneticist, Indian Agricultural Research Institute, Regional Station, Coimbatore; Dr. P. S. Rao, Head of Utilization Rasearch, Forest Research Laboratory, Bangalore; Shri S. K. Katyal, Deputy Agricultural Commissioner (Hort), Indian Council of Agricultural Research and Dr. G. Rangaswamy,Dean,University of Agricultural Sciences, Bangalore addressed the Study Circle meetings.

The Arecanut Specialist participated in the following symposia, seminar or meetings.

1) Conference of the Coconut and Arecanut Committee of the Kerala State Research Bord on 22nd March, 1969 at Central Research Station, Nileshwar and on 6th and 7th November, 1969 at Trivandrum, (2) Meeting of the District Productivity Council at Mangalore on 22nd July, 1969, (3) Symposium on "Radiations and Radiomimetic Substances in Mutation Breeding" held at the Bhabha Atomic Research Centre, Trombay from 26th to 29th September, 1969, and (4) Meeting of the Indian Arecanut Development Council at Ernakulam on 9th October, 1969.

The Research Assistant-in-charge, Regional Arecanut Research Station, Kahikuchi, attended the First Zonal Conference of Agricultural Research Workers - Eastern Zone, organised by the Assam Agricultural University, Jorhat from 8th to 10th December, 1969.

# VI. SUMMARY OF THE REPORT

Exotic varieties were continued to be collected and during the year seednuts from Burma, Mauritius and Vientiane were received. Twelve multilocation trials with five promising introductions isolated based on cumulative yield of palms from a regular yield trial were laid out. Scented *supari* prepared from *Chali* of *Areca triandra* was found to be comparable with that from the local. *Chali* from nine indigenous types studied showed wide variation in size, shape and quality of kernel. All the indigenous types were found to be susceptible to the yellow leaf disease to varying degrees. Seeds were collected from 36 cultivars during a survey of areca growing tracts of Shimoga, Chickmagalur, North Kanara and South Kanara. Some of the hybrids between indigenous and exotic types were found to be superior to either of the parent in respect of number, length and breadth of leaves, breadth of leaf sheath, girth at crown and number of inflorescence produced. The interspecific hybrids involving *A. catechu* and *A. triandra* showed that the hybrids resemble their female parent in respect of a number of characters. The technique of studying Karyomorphology of arecanut was standardised. A high percentage of retention of buttons was obtained by giving two sprays of Benlate or Dithane Z-78 at fortnightly intervals.

Early transplanting of seedlings results in more vigorous palms and planting seedlings aged more than two years delayed flowering. The optimum spacing for the palm was found to be 2.7 x 2.7 m at Vittal and Peechi, while similar trend was not observed at Hirehalli or Kahikuchi. At Kahikuchi differences between the different spacings were not significant. At Peechi, planting seedlings at 90 cm depth and irrigating once in 3 days resulted in significantly higher yield. At Kahikuchi irrigation once in 3 or 6 days were on par in respect of growth measurements. Growth measurements made at Vittal revealed that irrigation once in 5 days was superior to irrigation once in 15 or 20 days. Intercropping with banana had no adverse effect on arecanut at Vittal. At Peechi, elephant-foot-yam was found to be the most profitable intercrop. Guinea grass and ginger were found to be good intercrops in arecanut garden at Kahikuchi. In the mixed planting with cacao, not only the areca palms flowered earlier but the cacao trees gave increased number of pods at Vittal. Planting of arecanut on terraces plus clean cultivation and manuring was superior to all other treatments at Palode. At Vittal in the manurial experiments on arecanut palms receiving nitrogen at $N_1$ and $N_2$ levels (50 and 100 g respectively) gave significantly

higher yield. At Peechi, however, palms receiving higher potash gave higher yield. There was no significant difference in the performance of palms receiving N P K in either organic or inorganic form. At Peechi nuts harvested at 6-month maturity and processed fetched more price than others. *Chali* was graded into five categories based on size and marketed. Though the price for *Mora* (biggest sized nut) was highest, the overall price of the produce as a whole did not have appreciable improvement.

In green manure trial at Hirehalli, it was observed that *Mimosa invisa* was superior to other cover crops not only for the tonnage of green matter but also for its nutrients content. The production of green matter was lowest in *Crotalaria anagyroides*. *Stylosanthes gracilis* did not survive under Hirehalli conditions. A permanent manurial experiment was laid out at Vittal with a view to studying the changes in soil and plant as a result of continuous application of green leaves, manures and fertilizers and cultural practices.

Investigations on yellow leaf disease indicated that the yellowing was less in May than in June and September. There was slight reduction of yellowing as a result of application of some trace elements like Mn and Mg. The kernel discolouration does not seem to have any bearing with yellowing of arecanut leaves. Diseased leaves had lower level of phosphorus, potassium and calcium. The soils from diseased gardens were poor in available nitrogen, phosphoric acid and potassium and they are acidic in reaction. High water table was observed in a majority of the affected gardens.

Studies on the fungal infection of processed nuts revealed that infection was maximum during October– November and least in February-March. Harvesting the nuts eliminating soil contact and drying in hot air oven completely prevented fungal infection. Nuts dried on cement floor had the least infection by fungi. Fungal infection was minimum when nuts were stored in air tight bins, or polythene-lined gunny bag. Fungi like *Botryodiplodia theobromae*, *Mucor* sp. and *Thielaviopsis* sp. were found to infect the nuts, in addition to the ones reported last year. Maximum infection was caused by *B. theobromae*. The *anabe* fungus, *Ganoderma lucidum* had more vegetative growth on 2% malt agar enriched with 5 ppm biotin. At Palode, a few plants of Nicobar, Ceylon, Saigon–2 and Mahuva B showed yellow leaf disease symptoms.

The calyx mite causing tendernut fall at Peechi was controlled by

spraying the bunches with Rogor 0.1% or Anthio 0.2%. A study on the biology of inflorescence caterpillar showed that the life periods of caterpillar, pupae and moth were 12, 9-12 and 3–6 days respectively. The pest can be effectively controlled by Malathion 0.25% or Hexadrin 0.25%. A technique for rearing root grub was perfected. New species of mite, *Oligonychus biharensis* and of white grub, *Phyllophaga fissa* were identified.

# VII. PERSONNEL

## Retirements, promotions and transfers

Shri K. Narasimha Murthy and Dr. Ram Bali Ram Yadava, Research Officers, Regional Arecanut Research Station, Mohitnagar and Kahikuchi, were appointed as Botanist and Plant Physiologist respectively and Dr. A.R. Mohapatra as Soil Chemist at the Central Station. Sarvashree K.J.Abraham and K. K. Krishnan Nambiar were appointed to the posts of Research Officer and Farm Assistant respectively on *ad-hoc* basis and transferred to the Regional Arecanut Research Station, Palode. Shri S. Rajamani was appointed to the post of Research Assistant (Entomology) on *ad-hoc* basis. Shri E. Velappan, Research Assistant (Agronomy), Regional Arecanut Research Station, Palode, was promoted to the post of Senior Research Assistant (Agronomy) at the Central Arecanut Research Station, Vittal. Shri K. Vellaichamy, joined duty on transfer from Regional Arecanut Research Station, Palode. Shri S. R. Raghavendra was appointed as Librarian. Shri M. Vijayarajan, Farm Assistant, Regional Arecanut Research Station,Peechi, was appointed as Farm Superintendent on *ad-hoc* basis and transferred to Central Arecanut Research Station, Vittal. Shri T. Kempanna was appointed to the post of Farm Assistant at the Regional Arecanut Research Station, Hirehalli. Shri E. I. Antony, was appointed as Farm Assistant at the Regional Arecanut Research Station, Peechi, on *ad-hoc* basis. Shri V. V. Subramanian was reverted to his parent department and Shri P. N. Ramadas who was appointed as Accounts Officer joined duty during the year.

Shri Gorachand Biswas, Research Assistant (Agronomy), Regional Arecanut Research Station, Mohitnagar was transferred to Regional Arecanut Research Station, Kahikuchi and Shri Ram Keshwar Singh, Farm Assistant, Regional Arecanut Research Station, Kahikuchi was appointed to the post of Research Assistant (Agronomy) and transferred to the Regional Arecanut Research Station, Mohitnagar. Shri Hari Lal, Farm Assistant, Regional Arecanut Research Station, Kahikuchi, was transferred to the post of Farm Assistant, Regional Arecanut Research Station, Mohitnagar.

Dr. A. R. Kalbande, Soil Chemist and Sarvashree M. V. Krishna Rao, Plant Physiologist, B. C. Misra, Entomologist, R. K. Bhattacharya Research Officer and S. Edison, Senior Research Assistant (Pathology), were relieved on resignation during the year.

Sarvashree E. Velappan, Research Assistant (Agronomy) and R. Balakrishnan Nair, Senior Research Assistant (Botany) and N. Tirumaleshwar Bhat, Senior Research Assistant (Chemistry) joined their respective posts after completion of Post-graduate studies.

Shri S. N. Sampathkumar, Research Assistant (Pathology), Regional Arecanut Research Station, Hirehalli, proceeded on leave for prosecuting M. Sc. (Ag.) course.

**Staff: Section - wise**

**Central Arecanut Research Station, Vittal**

| | |
|---|---|
| Arecanut Specialist | Shri K.V. Ahamed Bavappa, B.Sc.(Ag.), M.Sc.(Ag.) |
| **Botany** | |
| Botanist | Shri K. Narasimha Murthy, B.Sc. (Ag.), M.Sc.(Agri.) |
| Senior Research Assistant | Shri R. Shankaranarayana Pillai, B.Sc., M.Sc. (Ag.) |
| Research Assistant | Shri S. Sadashivan Pillai, B.Sc., M.Sc. (Ag.) |
| **Agronomy** | |
| Agronomist | Shri K. Shama Bhat, B.Sc.(Ag.), M.Sc. (Ag.) |
| Senior Research Assistant | Kumari M. Leela, B.Sc. (Ag.) |
| —do— | Shri E. Velappan, B.Sc.(Ag.),M.Sc.(Ag.) |
| Research Assistant | Shri K.B.Abdul Khader, B.Sc.(Ag.) |
| —do— | Shri M. P. Somaiah, B.Sc. (Ag.) Hons. |
| **Farm** | |
| Farm Superintendent | Shri M. Vijayarajan, B.Sc. (Ag.) Hons. |
| Farm Assistant | Shri A. Manjunatha Shetty, B.Sc.(Ag.) |
| Nursery Assistant | Shri S· Jayasheela Hegde, B.Sc. (Ag ) |
| **Statistics** | |
| Assistant Statistician | Vacant |
| Computor | Shri K. Vijayakumar, B.Sc. |
| **Soil Chemistry** | |
| Soil Chemist | Dr. A. R. Mohapatra, B.Sc.(Ag.), M.Sc.(Ag.), Ph.D. |
| Senior Research Assistant | Shri N. Tirumaleshwar Bhat, B.Sc.(Ag.), M.Sc.(Ag.) |

**Plant Pathology**

| | |
|---|---|
| Plant Pathologist | Dr. K. K. Narayanan Nambiar, B.Sc.(Ag.),M.Sc.(Ag.),Ph.D. |
| Senior Research Assistant | Shri S. Edison, B.Sc.(Ag.),M.Sc.(Ag.) |

**Entomology**

| | |
|---|---|
| Entomologist | Vacant |
| Research Assistant | Shri S. N. Seshadri, B.Sc. (Ag.) |

**Plant Physiology**

| | |
|---|---|
| Plant Physiologist | Dr. Ram Bali Ram Yadava, B.Sc.(Ag.), M.Sc.(Ag.),Ph.D. |
| Research Assistant | Shri C. K. Mathai, B.Sc. (Ag.) |
| —do— | Shri K. Vellaichamy, B.Sc.(Ag.) |
| —do— | Shri B. Nagaraj, B.Sc.(Ag.) |
| —do— | Shri C. Devaraju, B.Sc.(Ag.) |

**Library**

| | |
|---|---|
| Librarian | Shri S. R. Raghavendra, M.Sc., Diploma in Library Science |

**Administration**

| | |
|---|---|
| Administrative Officer | Shri N.K. Srinivasa Murthy, B.Com. |
| Accounts Officer | Shri P. N. Ramadas, M.A.,S A.S.(DA) |
| Asst. Admn. Officer | Vacant |

**Regional Arecanut Research Station, Kannara**

| | |
|---|---|
| Research Officer | Shri A. K. Sadanandan, B.Sc.(Ag.), M.Sc.(Ag) |
| Research Assistant (Pathology) | Shri K. J. Antony, M.Sc. |
| Research Assistant(Agronomy) | Shri P.G. Rajendran, B.Sc.(Ag.), M.Sc (Ag.) |
| Farm Assistant | Shri E. I. Antony |

**Regional Arecanut Research Station, Pacha**

| | |
|---|---|
| Research Officer | Shri K. J. Abraham, B.Sc.(Ag.) |
| Senior Research Assistant (Botany) | Shri R. Balakrishnan Nair, B.Sc., M.Sc.(Ag.) |
| Research Assistant (Agronomy) | Vacant |
| Farm Assistant | Shri K. K. Krishnan Nambiar |

**Regional Arecanut Research Station, Hirehalli,**

| | |
|---|---|
| Research Officer | Shri M. Sannamarappa, B.Sc.(Ag.) |
| Research Asst. (Agronomy) | Shri N.Narayana Bhat, B.Sc.,B.Sc.(Ag.) |
| —do— (Pathology) | Shri S.N. Sampathkumar, B.Sc.(Ag.) |
| Farm Assistant | Shri T. Kempanna |

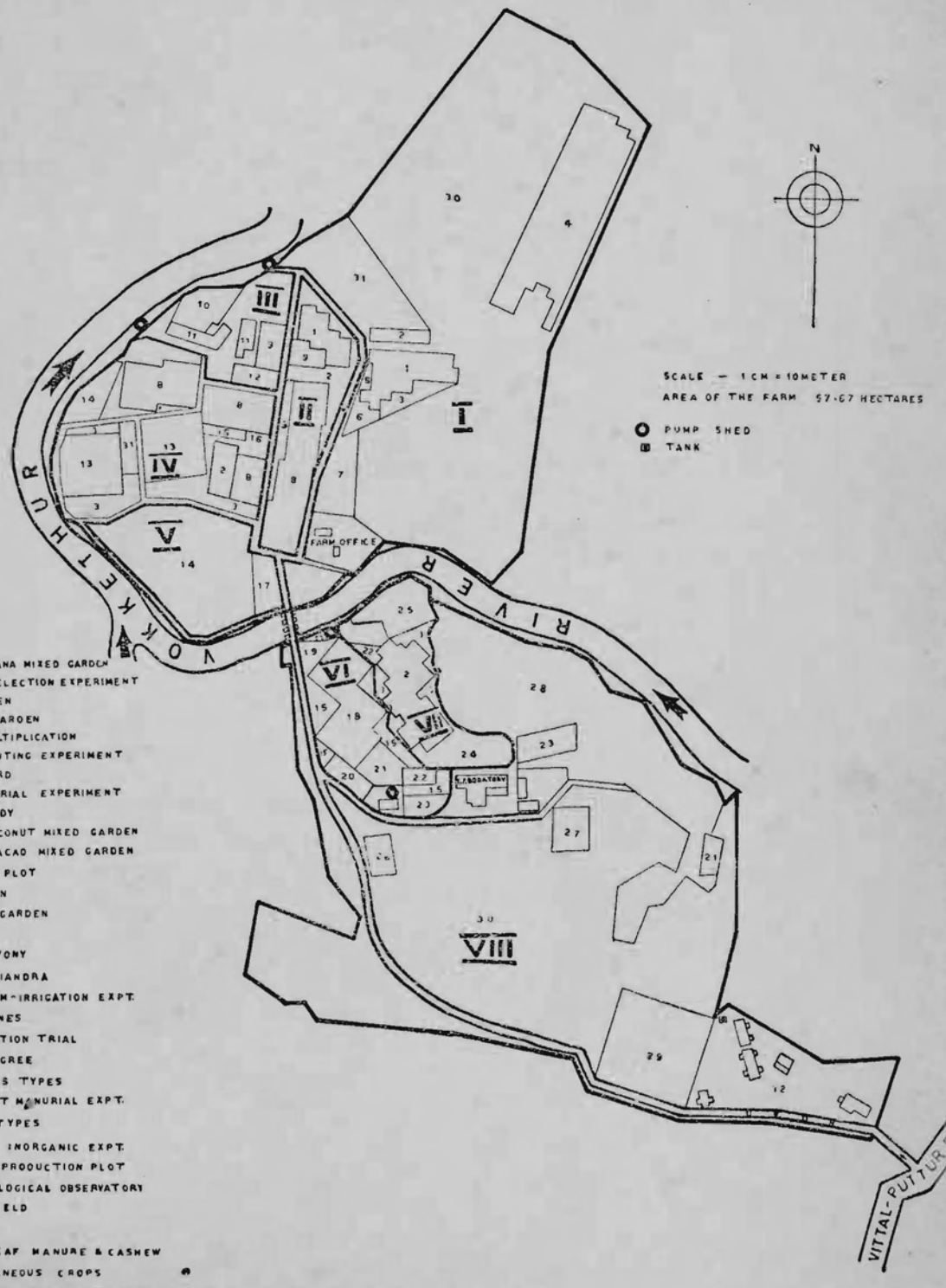
**Regional Arecanut Research Station, Mohitnagar**

| | |
|---|---|
| Research Officer | Vacant |
| Senior Research Asst.(Pathology) | Vacant |
| Research Asst.(Agronomy) | Shri Ram Keshwar Singh, B.Sc.(Ag.) |
| Farm Assistant | Shri Hari Lal, B.Sc.(Ag.) |

**Regional Arecanut Research Station, Kahikuchi**

| | |
|---|---|
| Research Officer | Vacant |
| Research Asst. (Pathology) | Shri Birendra Kumar Sarma, M.Sc. |
| Research Asst.(Agronomy) | Shri Gorachand Biswas, M.Sc.(Ag.) |
| Farm Assistant | Vacant |

# PLAN OF
# CENTRAL ARECANUT RESEARCH STATION, VITTAL




1. ARECA + BANANA MIXED GARDEN
2. SEEDNUT SELECTION EXPERIMENT
3. BULK GARDEN
4. COCONUT GARDEN
5. EXOTIC MULTIPLICATION
6. TRANSPLANTING EXPERIMENT
7. DRYING YARD
8. N P K MANURIAL EXPERIMENT
9. ROOT STUDY
10. ARECA + COCONUT MIXED GARDEN
11. ARECA + CACAO MIXED GARDEN
12. MUTATION PLOT
13. S.T. GARDEN
14. PROGENY GARDEN
15. HYBRIDS
16. POLYEMBRYONY
17. ARECA TRIANDRA
18. DEPTH-CUM-IRRIGATION EXPT.
19. INBRED LINES
20. MULTILOCATION TRIAL
21. MASS-PEDIGREE
22. INDIGENOUS TYPES
23. PERMANENT MANURIAL EXPT.
24. EXOTIC TYPES
25. ORGANIC INORGANIC EXPT.
26. MAXIMUM PRODUCTION PLOT
27. METEOROLOGICAL OBSERVATORY
28. PADDY FIELD
29. ORCHARD
30. GREEN LEAF MANURE & CASHEW
31. MISCELLANEOUS CROPS
32. RESIDENTIAL QUARTERS & GUEST HOUSE