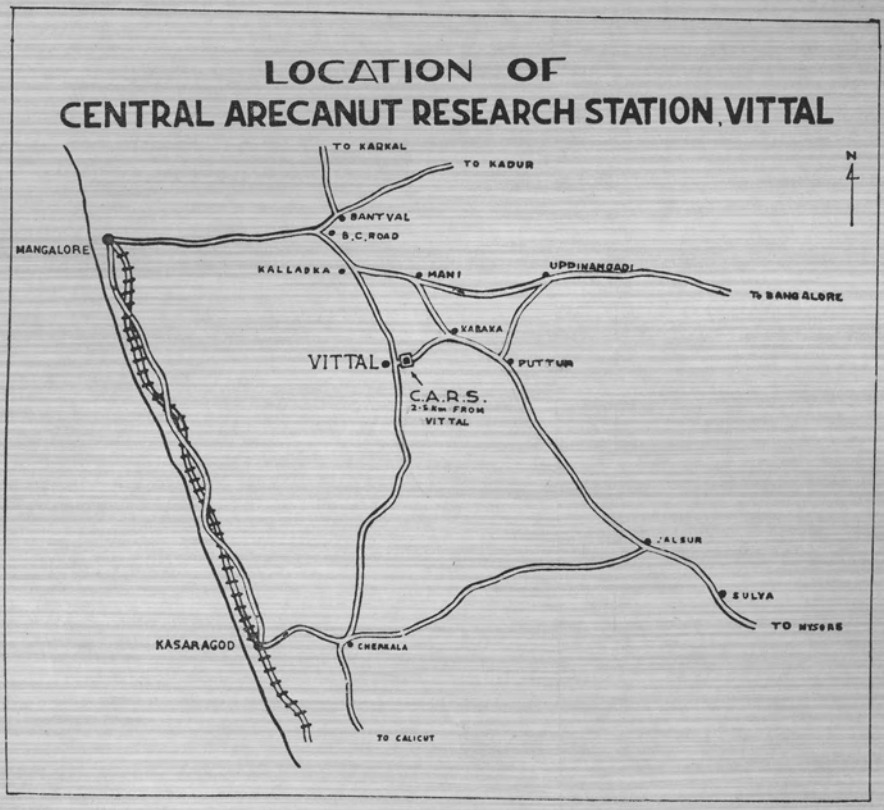
Annual Report of the Central and Regional Arecanut Research Stations

1968

Central Arecanut Research Station, Vittal,
Mysore State, India
1970



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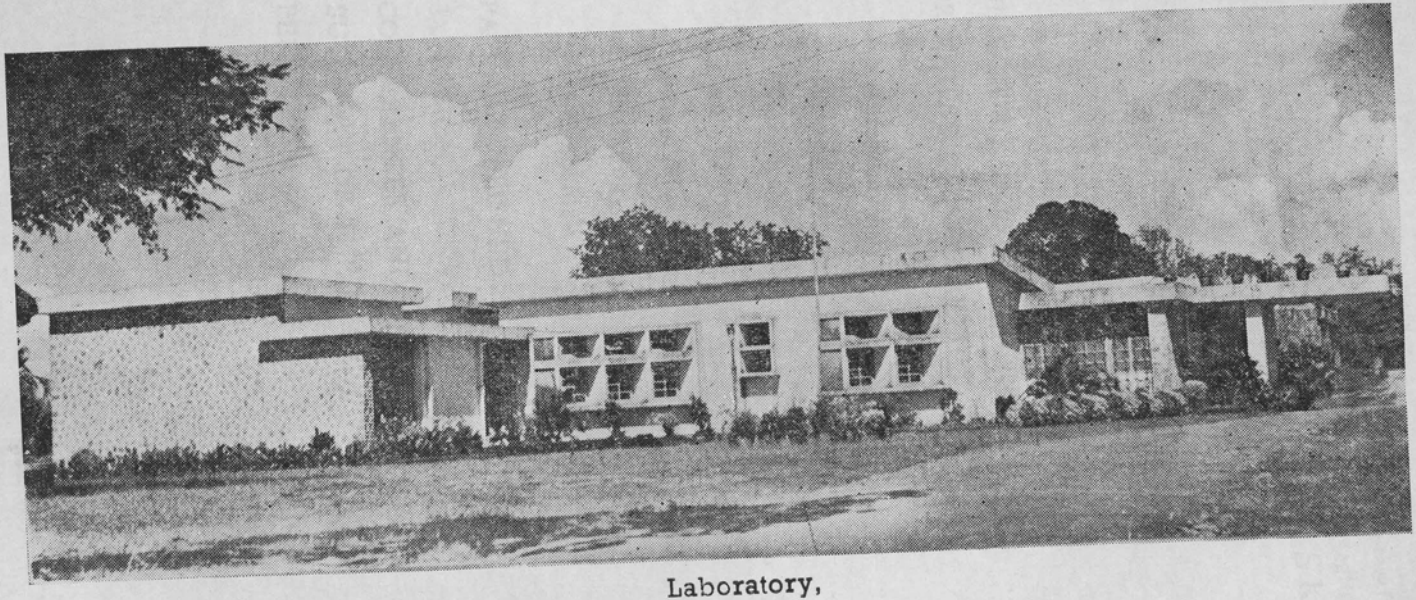

Laboratory,
Central Arecanut Research Station, Vittal.

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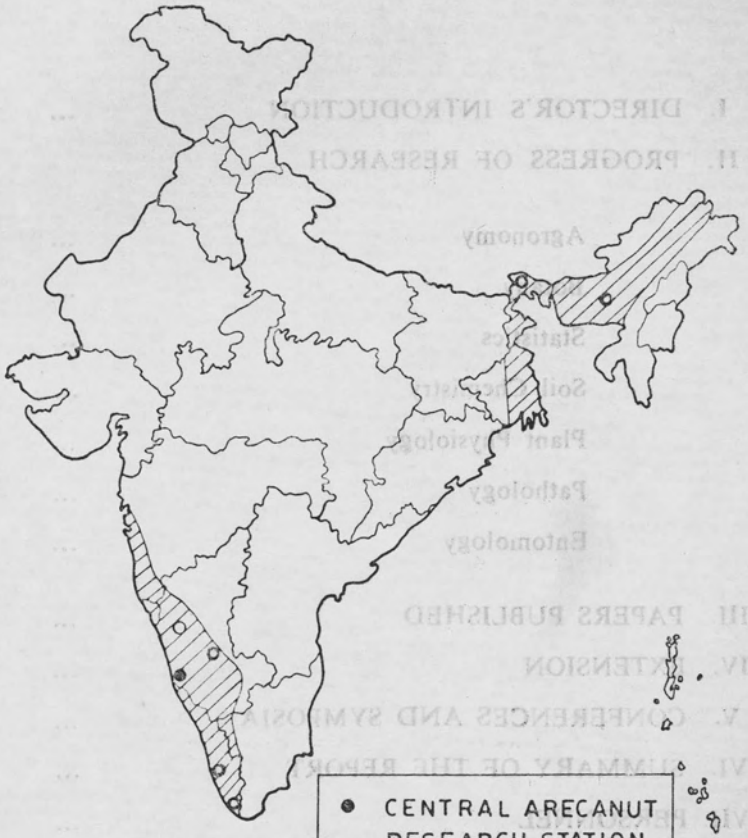


I. DIRECTOR'S INTRODUCTION

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 57.67 ha.

Besides the Central Station, there are five Regional Research Stations located at Kahikuchi, Mohitnagar, Hirehalli, Peechi and Palode.

The Station at Kahikuchi 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 20.18° 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.

The Station at Mohitnagar 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 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 Regional Station, Peechi 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 Regional Station, Palode is located at Palode Village in Nedumangad Taluk of Trivandrum District of Kerala State and is 36 km away from Trivandrum City. It lies at 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 11.77 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 centres of the research findings of Central Station for adoption in the region. The Stations are also to supply quality planting material 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.

ORGANISTIONAL 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 also. The Regional Stations also have each a small library for immediate reference.

DISTINGUISHED VISITORS

A large number of scientists from different organisations, officials of State Department of Agriculture, students from different academic and Agricultural Universities, Directors of various Research Institutes, Parliamentarians and progressive farmers from different localities visited the Central and Regional Stations during the year underr eport. The important visitors to Central Arecanut Research Station, Vittal, included Dr. B. P. Pal, Director-General, Dr. A. B. Joshi, Deputy Director-General (C. S.) and Shri K. P. A. Menon Secretary of Indian Council of Agricultural Research; Shri C. M. Poonacha, Union Minister for Railways; Shri B Vittaldas Shetty, Minister of State for Food and Civil Supplies, Government of Mysore; Shri M. C. Pothen, Chairman, Indian Arecanut Development Council; Dr. H. C. Govindu, Professor of Plant Pathology and Dr. C. S. Holton of University of Agricultural Sciences, Bangalore; Dr. A. Mariakulandai, Principal, Agricultural College, Madurai; Dr. M. L. Magoon, Director, Central Tuber Crops Research Institute, Trivandrum; Shri M. C. Nambiar, Director, Central Coconut Research Station, Kasaragod; Shri T. T. Paulose, Deputy Director, Regional Office (Arecanut and Spices Development), Calicut; Shri M. M. Krishna Marar, Director, Coconut Development Council, Ernakulam; Shri K. P. Padmanabhan Nambiar, Deputy Director, Central Coconut Research Station, Nileshwar; Shri M. A. Menon, Deputy Director, Regional Office, Coconut Development, Ernakulam; Shri V. K. Bhaskaran Nair, Director of Research, Rubber Board, Kottayam; Shri B. S. Varadarajan, Joint Director of Agriculture, Bangalore; Shri K. Anke Gowda, Deputy Director of Agriculture, Mangalore; Shri C. Kusumakara, Assistant Director of Agriculture, Puttur; Shri N. Raghavendra, Professor, Ayurveda Vidyalaya, Hubli; Mr. Stanley, USAID, University of Tenn.; Mr. Fever, Cadbury Brothers (Pr.) Ltd., England; Shri K. S. N. Adige, M. L. C., Mangalore; Mr. Sione Kulu, Coconut Replanting scheme, Tonga Is. and Dr. M. Puttarudhriah, Director of Instructions, University of Agricultural Sciences, Bangalore.

Among the visitors to Regional Arecanut Research Station, Peechi, mention may be made of Shri M. N. Govindan Nair, Minister for Agriculture, Kerala; Dr. M. S. Nair, Director of Agriculture, Kerala and Shri C. N. Menoky, District Collector, Trichur. Shri A. K. Sengupta, Joint Director of Agriculture, Jalpaiguri; Shri S. N. Chakraborty, Ex. Joint Director of Agriculture, Jalpaiguri; Shri T. T. Paulose, Deputy Director,

Arecanut & Spices Development, Calicut; and Dr. S. B. Lal, Director, Central Coconut Research Station, Kayamkulam visited Regional Arecanut Research Station, Mohitnagar during the period under report. Dr. S. B. Lal, Dr. B. R. Murthy and Dr. D. C. Mahanta, Director, Central Coconut Research Station, Kayamkulam, Coordinator, Indian Council of Agricultural Research, New Delhi and Professor and Head of Zoology Department, Cotton College, Gauhati, respectively and Shri D. D. Srivastava, Plant Protection Officer, Government of India, Gauhati, Shri D. Sarma, Marketing Intelligence Officer, Agricultural Marketing, Gauhati; Shri A. K. Sarma, Joint Director (I P), Department of Agriculture, Assam and Shri P. K. Saikai, Principal, Panchayat Raj Training Centre, Kahikuchi, visited Regional Arecanut Research Station, Kahikuchi.

IMPORTANT EVENTS OF THE YEAR

The fifth Farmers' Week Celebration organised from 24th to 26th January, 1968 was inagurated by Shri C. M. Poonacha, Hon'ble Union Minister for Railways and presided over by Shri B. Vittaldas Shetty, now Minister of State for Food & Civil Supplies, Mysore State. A very informative exhibition covering all aspects of arecanut crop as well as a number of allied crops and subjects had been organised during the occasion. Dr. A. B. Joshi, Deputy Director-General of the Indian Council of Agricultural Research also participated in the celebrations.

During the year considerable changes were effected in the technical programme of the Research Station as well as in its methods of execution. The problems were critically scrutinised and appropriate projects drawn up. The projects were assigned to different project leaders and associates for execution. While assigning the projects it was ensured that generally none of the scientists are project leaders for more than two or three projects and also associates in four or five. Depending upon the type of work in a project an inter-disciplinary participation had also been arranged in a number of projects. The method of writing reports on project-wise basis by each participant in the project was also standardised.

The July 1968 issue of Indian Farming was brought out with focus on Central Arecanut Research Station. A number of articles covering various aspects of the crop were published in this issue.

RESEARCH COLLABORATION AT NATIONAL LEVEL

One of the Research Assistants was trained in Agricultural Meteorology and crop weather observations at the Directorate of Agricultural Meteorology, Poona, for a period of two months. The All India Summer Institute of Genetics organised by the University of Kerala, Trivandrum

and the Summer Institute for Plant Pathologists and Plant Protection Officers arranged at the Indian Agricultural Research Institute, New Delhi, were attended by Senior Research Assistants in Botany and Plant Pathology respectively. Field facilities were provided for the Central Tuber Crops Research Institute, Trivandrum, for laying out extensive field experiments with tapioca and sweet potato varieties.

RESEARCH COLLABORATION AT INTERNATIONAL LEVEL

Progress was made in the rearing of a predator for the biological control of mites in collaboration with the Commonwealth Institute of Biological Control, Bangalore A number of specimens were got identified by the Commonwealth Entomological Institute, London.

In collaboration with Messrs Cadbury Brothers Limited, Bournville, England, one consignment of hybrid seeds involving six crosses of criollo variety of cacao was obtained.

FELLOWSHIP AND STUDENTSHIP

Two of the staff members joined for Post-graduate courses in Agronomy and Entomology. One of them was awarded fellowship by the Indian Council of Agricultural Research for the study. During the year two other staff members completed their post-graduate courses and rejoined duty.

RESEARCH ASSOCIATIONS

The Third Research Council Meeting of Central and Regional Arecanut Research Stations was held on 27th and 28th December, 1968 at the Central Station, Vittal. The Deputy Director, Regional Office (Arecanut and Spices Development), Calicut, the Research Officers from Regional Stations at Peechi, Palode, Hirehalli, and Kahikuchi, the Superintendent, Regional Arecanut Research Station, Thirthahalli (State), the Heads of Sections and research staff of Central Arecanut Research Station attended the meeting and took active part in the deliberations. Every project under the technical programme was discussed in detail and some of them reoriented. Under the aegis of the Study Circle six meetings were held in February, June, July, August, October and December. 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 a member of the Development Council for Arecanut and Spices, Calicut and Arecanut Sub-Committee of the Indian

Standards Institution, New Delhi. 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 on Pilot Sample Survey for correct estimation of area and production of arecanut.

In addition to normal activities of research, numerous enquiries that were being received by the Central and Regional Stations seeking advice on various problems connected with the crop such as cultivation practices, spacing and layouts 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., were suitably answered. Requests for spot inspections for selection of site and layout of gardens received were also attended to wherever feasible. The Central and Regional Stations were also centres of study tour.

EXTENSION

The Central Station participated in Agricultural Exhibitions, District Horticultural Show, etc., organised by different organisations. Farmers' Week was celebrated in which extension staff of the State Departments and large number of growers participated This was of very great educative value to the arecanut growers. A total of 67,610 quality seednuts and 10,957 quality seedlings were distributed during the year.

FINANCE

The sanctioned budget of Research Stations for the financial year 1968-'69 was Rs. 9.31 lakhs. The expenditure on major heads was of the following order.

1.	Pay and allowances of staff	Rs. 4,57,490.00
2.	Working expenses	Rs. 4,73,267 00
		Rs. 9,30,757 00

The revenue receipts of the Stations touched a figure of Rs. 1,71,425 against Rs 1,18,500 realised during the previous year.

II. PROGRESS OF RESEARCH

AGRONOMY

(K. Shama Bhat, K. Narasimha Murthy, M. Sannamarappa, A. K. Sadanandan and R. K. Bhattacharya)

SUMMARY OF SALIENT FINDINGS

Planting seedlings up to two years in age whether directly or after transplanting in the nursery beds does not affect their initial flowering whereas planting seedlings three or four-year old causes delay in flowering. Spacing given to palms in the main field has considerable influence on rate of leaf-fall, production of spadices and female flowers, flower-set and yield. Under the conditions prevailing at Vittal, the optimum spacing for the palm was found to be 2.7 m X 2.7 m. In another centre (Peechi) also the yield per plot was maximum where the spacing was 2.7 m X 2.7 m, though the same did not differ significantly than in plots where the spacing was 1.8 m X 1.8 m, 1.8 m X 2.7 m and 1.8 m X 3.6 m. The trees under similar experiment at Hirehalli and Kahikuchi were in the initial stages of flowering. In one of the centres irrigating the palms once in three days had given significantly more yield (number and wet weight) of nuts than no irrigation as well as under irrigation once in six and nine days. In the same centre planting seedlings at 90 cm depth had recorded significantly more yield than planting at 30 cm and 60 cm depths. In the experimental garden where the effect of growing banana as intercrop with the arecanut is being studied, more number of areca palms flowered for the first time during the year and no adverse effect of the intercrop was noticed hitherto on the performance of the main crop (arecanut). In another centre where other intercrops like elephant-foot-yam, colocasia, pineapple and banana were grown with arecanut, the intercrops did not have any adverse effect on the main crop of arecanut. In the mixed garden where arecanut and cacao are grown at 50:50 population basis, the latter yielded a mean of 21.8 pods per tree during the fourth year of growth. The flowering among the areca trees was also normal since 52.8 per cent of the trees under the mixed plot flowered as against 44.6 per cent in the pure plantation of same age. In the N P K manurial experiment palms receiving nitrogen at N_1 and N_2 levels (i. e., 50 and 100 g of N per tree) and green leaf at higher levels (i. e., at 6.8 and 13.6 kg per tree) yielded significantly

more than those under no nitrogen or green leaf, in one of the centres. In another centre the influence of potash on yield was significant and plots receiving K at 140 g per tree recorded higher yield than those receiving no potash. In Palode area where the palms are not normally irrigated, the influence of application of N P K with or without micro-nutrients but with irrigation continued to be significantly superior to the application of the same nutrients without irrigation. The yield in plots with irrigation and nutrients was nearly three times more than in plots with nutrients but without irrigation. There was no significant difference in the performance of palms receiving N P K either in organic or in-organic forms. The vertical penetration of arecanut roots in a garden with high water table was found to confine to a depth of 140 cm as against to a depth of 260 cm seen in deep well-drained soils.

(b) RESEARCHES IN HAND

A. 1. Determination of optimum age of transplanting seedlings-cum-sowing *in situ Vs.* transplanting of single, double and treble transplanted seedlings.

The age of seedlings used for the main field planting varies from tract to tract. In some places seednuts are directly sown *in situ* and in other areas seedlings raised in nurseries and retained there for varying durations are used for the planting. An observational trial to study the relative merits of the different practices was laid out at the Central Arecanut Research Station with the following eight treatments.

1 Directly sowing seednuts 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

The trial was commenced in 1961. Growth measurements of the palms recorded showed that the palms under treatments 4, 7, 5, and 8 (i e., those which had been transplanted when they were 3 or 4 years old) to be less vigorous than the palms under other treatments. Observations recorded on the flowering of the palms are given in Table 1.

TABLE 1

Production of spadices as related to age of planting

Treatment	Percentage of palms flowered	Mean number of spadices produced per tree (1967-1968)
1	100.00	4.6
2	100.00	3.5
3	100.00	4.8
4	80.00	2.7
5	30.00	0.9
6	100.00	4.1
7	60.00	1.8
8	20.00	0.4

From the above it is observed that only 20 to 30 per cent of the trees have flowered among those which had been transplanted when they were 4 years old whereas cent per cent of the trees have flowered among those which had been transplanted when they were two years old or less. The number of spadices produced per tree was also more in palms under treatments, 1, 2, 3 and 6.

A similar trial with six treatments was in progress at Kahikuchi since 1963-64. Observations made on the growth features of the palms revealed that the palms which had been planted in the field when young (18 or 30 months old) continue to be more vigorous than those which had been planted when they were 42 months old.

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

This experiment having six spacings viz , 1.8 m X 1.8 m, 2.7 m X 1.8 m, 3.6 m X 1.8 m, 2.7 m X 2.7 m, 3.6 m X 2.7 m and 3.6 m X 3.6 m as treatments, laid out on a randomised block design replicated six times was initiated in 1958 at Vittal. The trees commenced flowering in 962-63. Studies on the flowering aspects were continued to be made in the garden.

a) Leaf fall and inflorescence production: The number of leaves shed, spadices produced and percentage of spadices to leaves shed progressively increased with increase in spacing. Trees spaced at 1.8 m X 1.8 m had significantly less number (6.53) of leaves shed, spadices (3.65) produced and percentage of spadices to leaf-fall (55 96) per tree than others.

b) Spacing and number of female flowers produced and set: The number of female flowers produced and percentage of set were also found to show significant variation. Trees spaced at 3.6 m X 3.6 m and 2.7 m X 2.7 m had significantly more number of female flowers than trees spaced at 1.8 m X 1.8 m, 1.8 m X 2.7 m and 3.6 m X 1.8 m. The flower-set in plots 3.6 m X 3.6 m, 3.6 m X 2.7 m and 2.7 m X 2.7 m was significantly more than in plots having trees spaced at 2 7 m X 1.8 m and 1.8 m X 1.8 m.

c) Spacing and yield: The fifth crop of the garden was harvested during the period and the yield difference between the treatments was found to be significant. Trees spaced at 2.7 m X 2.7 m recorded significantly more number of fruits than in all other treatments except those spaced at 3.6 m X 2.7 m. But with regard to weight of fruits harvested, trees spaced at 2.7 m X 2.7 m recorded significantly more weight than all other treatments.

The mean data recorded on the above aspects are given in Table 2.

A Similar trial was also running in the Regional Stations at Peechi, Hirehalli and Kahikuchi having different agro-climatic conditions. At Peechi, where the trees were planted in 1960, the mean number of leaves shed, spadices produced per tree, percentage of spadices to leaf-fall and the mean flowers produced per tree increased with increase in spacing. Regarding yield, the total number and the weight of fruits harvested per plot were maximum in treatment 2.7 m X 2.7 m, though the same did not differ significantly from plots spaced at 1.8 m X 1.8 m, 1.8 m X 2.7 m and 1.8 m X 3.6 m. At Hirehalli where the trees were planted in 1961, the second crop harvested during the period did not reveal any significant difference between the different treatments. The trees have not yet reached the full bearing stage. At Kahikuchi where the planting was done in 1961-62 no significant difference was observed between different treatments with regard to the performance of individual trees in respect of spadices produced, female flowers and flower-set.

A. 3. Effect of different spacings and methods of layout on the incidence of sunscorch on arecanut palm

Arecanut palms are highly susceptible to sunscorch particularly in situations where the palms are exposed to southern and south-western sun. In order to find out whether the method of aligning the garden and spacing have any bearing with scorching, an observational trial was planted in 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. A count of the palms showing sunscorch symptoms made in 1967-68 showed that the percentage of palms affected by sunscorch was less in the plot spaced at 3.6 m X 3.6 m quincunx, north-south as compared to other methods.

TABLE 2

Determination of optimum spacing in the main field: Data on yield and other ancillary characters

Sl. No.	Treatments	Mean No. of nuts/plot (0.023 ha.)	Mean wet weight of nuts/plot (kg)	Mean No. of spadices/tree	Mean No. of female flowers per tree	Percentage of fruit-set
1	1.8 m X 1.8 m	3364.50	111.72	3.65	617.27	12.47
2	2.7 m X 1.8 m	4454.67	146.90	4 66	834.58	13.21
3	3.6 m X 1.8 m	4242.67	148.78	5.12	903.93	22.14
4	2.7 m X 2.7 m	5652.67	196.81	5.69	1385.79	28.59
5	3.6 m X 2.7 m	4590.83	155.39	6.23	1186.50	29.57
6	3 6 m X 3.6 m	3025.17	104.17	6.23	1437.83	29.79
S. E. per plot		1001.17	32.01	0.55	216.36	5.99
S E. per difference between two treatment means		578.05	18.48	0.32	152.97	4.23
Overall mean		4221.75	143.96	5.33	1060.98	22.63
C. V. (%)		23.71	22.23	10.32	20.39	26.47
C. D. (P = 0.05)		1190.78	38.07	0.66	325.98	9.01

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

The depth at which arecanut seedlings are planted in the main field and the intervals of irrigation vary considerably from tract to tract and with different soil conditions. This experiment was, therefore, initiated to determine the effect of depth of planting areca seedlings in the main field and the intervals of irrigations on yield under conditions prevailing in the different regions. At Peechi, 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 of planting (viz , 30 cm, 60 cm and 90 cm). The yield and related data collected during the year revealed significant differences between main as well as sub-treatments. Irrigating once in 3 days had given significantly more yield (number and wet weight) than no irrigation as well as plots under irrigation once in 6 and 9 days. Similarly planting at 90 cm depth had recorded significantly more yield than planting at 30 cm and 60 cm depths. Under uniform irrigation, the yield per plot increased with increase in depth of planting and planting at 90 cm depth had given significantly more yield than at other depths, 30 cm and 60 cm. Planting at 30 cm depth and irrigating once in 3 days had given lesser yield than planting at 90 cm depth and irrigating once in 9 days. The relevant data are given in Table 3.

At the Central Station the experiments were 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 made revealed that the difference in the height of plants alone is significant in respect of irrigation intervals. Plants irrigated once in 5 and 10 days were significantly taller than those under once in 20 days irrigation.

At Kahikuchi where 15, 30 and 45 cm depths have been adopted, seedlings planted at 45cm depth had significantly less number of nodes than the rest.

The above experiment was also initiated at Hirehalli in 1964, but further studies were kept in abeyance in view of the saline patch noticed in a portion of the experimental garden.

A. 6. Intercropping experiment

a) Banana: Banana is the most common food crop intercropped in arecanut gardens in all arecanut growing tracts. In order to assess the

TABLE 3

Intervals of irrigation and depth of planting: Yield data for Peechi Centre (1967-68)

Treatment	No. of nuts per tree				Wet wt. of nuts per tree (kg)			
	D_1	D_2	D_3	Mean	D_1	D_2	D_3	Mean
No irrigation	1.73	1.62	21.89	8.41	0.05	0.04	0.72	0.27
Irrigation once in 3 days	121.66	179.80	278.49	193.32	3.56	5.49	8.27	5.77
Irrigation once in 6 days	67.35	108.53	204.84	126.91	1.82	3.09	5.99	3.63
Irrigation once in 9 days	91.64	112.89	165.89	123.47	2.74	3.57	4.64	3.65
Mean	70.67	100.71	167 78	—	2.04	3.05	4.91	—

S. E. per plot	56.64	1.47
S. E per sub-plot	47.46	1.24
Overall mean	113.02	3.33
C. V. for main plot	50.12	44.14
C. V. for sub-plot	42.00	37.24
S. E. difference of 2 main plots	20.67	0.54
,, 2 sub-plots	15.00	0.39
S. E. for differences of 2 sub. at same level of mains	—	0.78
S. E. of diff. 2 mains means at same level of subs.	—	0.83
C. D. (P = 0.05) for main treatment	45.04	1.18
C. D. (P = 0.05) for two sub-treatments	30.60	0.79
C. D. for 2 sub. at same level of main	—	1.59
C. D. for 2 mains at same level of sub.	—	1.69

effect of growing banana as an intercrop in arecanut gardens as well as to find out the optimum number and stage at which the former can be raised with areca, an experiment on a 8 X 4 randomised block design with the following 8 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 certain 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 experiment was running in the second stage (i. e., the period covering 4th to 6th year). More number of palms flowered during the year and the percentage of trees flowered ranged from 37.5 to 68.8 and the mean number of spadices produced per tree ranged between 1.10 and 2.36 and the differences between treatments were not significant.

A similar experiment as above with only five treatments superimposed in a three-year old garden was running at Kahikuchi since 1963-64. The arecanut palms were in the early stages of flowering.

b) Other crops: In order to explore the possibility of growing inter and associate crops in arecanut gardens without detriment to the arecanut crop, trials with various crops were in progress at the Regional Station at Peechi. Earlier study had indicated that elephant-foot-yam

(Amorphophallus campanulatus) was the most profitable in crop. During 1967, the trial was relaid with two substitutes viz., pepper and ginger instead of colocasia *(Colocasia antiquorum)* and banana. These intercrops were found to have no significant effect on the yield of arecanut palms (during 1967-68). Regarding the performance of intercrops, yam was harvested and the yield worked out to 3730 kg per ha. Ginger has not come for harvest. The growth of pepper has been satisfactory but that of pineapple was not satisfactory.

A similar trial with intercrops of banana, pineapple, guinea grass *(Panicum maximum)*, betelvine and ginger was in progress at Kahikuchi. The effect of growing the above crops was found to be significant on the performance of the arecanut palm. Plots with guinea grass gave significantly more yield (number and weight of fruits) than all other treatments whose differences in yield was not significant.

The above trial with banana, pineapple, tapioca and betelvine as intercrops was initiated at Hirehalli during the year.

A. 7. Mixed cropping experiments

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., (i) arecanut and coconut as mixed crop and (ii) arecanut as pure crop, repeated twice 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 palms was satisfactory.

Similar trials as above were also in progress at Kahikuchi and Palode.

b) Arecanut and cacao: A mixed garden of arecanut and cacao (variety: Criollo) was planted at the Central Station in 1964 as an observational trial with (i) arecanut and cacao at 50:50, (ii) areca as pure crop and (iii) cacao as border crop in areca garden. The second crop of cacao was harvested during the year and the trees under treatment (i) had a mean yield of 21.8 pods per tree and those under treatment (iii) had a mean yield of 4.6 pods per tree. The arecanut palms have also commenced to flower and the percentage of palms flowered in the different treatment plots were 52.8, 44.6 and 37.5 respectively.

A. 8. Effect of different methods of intercultivation on the productivity of palms

A cultural experiment with four treatments and six replications was initiated at the Regional Station, Hirehalli in 1967. The treatments consist of (i) scything grass and weeds twice a year (December and June), (ii) digging with mammatty fork twice a year (December and June), (iii) digging with mammatty fork once a year in December followed by scything grass and weeds in June and (iv) scything grass and weeds twice a year as in treatment (i) and digging once in two years. The growth measurements of the palms were recorded. The data showed that palms under treatment (iii) have significantly more number of leaves than those under treatments (i) and (iv)

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 initiated in 1967 at the Regional Station, Peechi was continued. Observations on leaf-fall, production of spadices and yield were continued to be recorded.

An observation 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 and (iii) permanent cover cropping and manuring was continued. During the year each of the sub-treatment plots was superimposed with three sub-sub-treatments as follows:

i)	No cultivation no manuring	a) No cultivation, no manuring
		b) Cultivation alone
		c) Manuring alone
ii)	Clean cultivation and manuring	d) Clean cultivation and manuring once in two years.
		e) Clean cultivation and manuring once in six months.
		f) Clean cultivation and manuring once a year
iii)	Permanent cover cropping and manuring	g) Cover crop to be cut and spread plus manuring
		h) Cover crop to be cut and incorporated by digging plus manuring
		i) Permanent cover cropping plus manuring

Since sub-sub-treatments were superimposed only during the year, the data on flowering behaviour for the main and sub-treatments alone were statistically examined.

It was found that the number of spadices, number of nuts and wet weight of nuts per palm were significantly more in palms planted on the slopes without taking into account the contour than those planted on terraces made along the contour. The treatments 'planting on terraces made at site of planting' and 'planting on slopes without taking into account the contour', did not differ significantly for any of the characters examined. Among the sub-treatments, 'clean cultivation and manuring' was significantly better than 'no cultivation and manuring' in respect of yield and all other ancillary characters examined. It was also found that 'clean cultivation and manuring' differed significantly from the treatments 'permanent cover cropping and manuring' in respect of number of spadices, percentage of spadices to leaf-fall, number of nuts and wet weight of nuts. 'Permanent cover cropping and manuring' was significantly better than 'no cultivation and no manuring' only in respect of number of leaves shed, number of spadices and percentage of spadices to leaf-fall.

A. 9. N P K manurial experiment

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 replicate. The treatments consisted of 0, 25 and 50 kg of nitrogen (N); 0, 20 and 40 kg of phosphoric acid ($P_2 O_5$); 0, 35 and 70 kg of potash ($K_2 O$) and 0, 3400 and 6800 kg of green leaf (G) for 500 palms. Data on leaf-fall, production of spadices and yield (second harvest) of fruits were collected. It was observed that the main effects of N, P and green leaf (G) are significant in respect of leaf-fall and N and G in respect of production of spadices, percentage of spadices to leaf-fall and percentage of trees flowered. N_1 and N_2 had significantly more leaf-fall, number of spadices produced, percentage of spadices to leaf-fall and percentage of trees flowered than N_0 and there was no significant difference between N_1 and N_2. P_2 had significantly more leaf-fall than P_1 and P_0. G_2 and G_1 recorded significantly more leaf-fall, number of spadices and percentage of trees flowered than G_0. G_2 had significantly more percentage of spadices to leaf-fall than G_0. None of the interactions was significant. Regarding yield only the main effects of N and G were significant. N_1 and N_2 had significantly more number and weight of fruits than N_0, but there was no significant difference between N_1 and N_2.

Similarly G_2 and G_1 had recorded significantly more number and weight of fruits than G_0 with no significant difference between themselves.

Observations on similar lines were also made at Peechi where the trial was initiated in 1961. From the analysis of data gathered it was seen that there exists no significant difference in case of leaf-fall, spadices produced and percentage of spadices to leaf-fall for the main effects as well as for interactions. Regarding yield N_2 had significantly more number of nuts than N_0 , whereas K_2 had significantly more number and weight of fruits than K_0.

The palms under N P K manurial experiments planted at Hirehalli in 1962 are in the initial stage of flowering. The quinquennial observations on growth features (viz., height, girth, number of nodes, etc.) of the palms recorded did not show any significant difference due to treatments. A similar experiment laid out at Kahikuchi in 1962 was also in progress where the effect of N was significant, on inflorscence production and percentage of inflorescence to leaves shed. N_1 and N_2 have given significantly more inflorescences and percentage of spadices to leaf-fall than N_0 .

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 first dose of fertilizers during the year. The experiment has three levels of N (0, 50 and 100 kg per 500 palms), three levels of P_2O_5 (0, 20 and 40 kg per 500 palms) and three levels of K_2O (0, 70 and 140 kg per 500 palms) as treatments with lime at 1 kg per plant for the sub-plot treatment as against no lime.

The experiment laid out at Palode to determine the influence of application of macro and micronutrients with and without irrigation showed during the second 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. There was no significant difference in inflorescence production or yield between plots receiving micro nutrients and without micro nutrients. The mean yield per plot for different treatments is given in Table 4.

It will be observed from the above table that irrigation enhances yield almost three times.

TABLE 4

Yield data: Macro and micro nutrients with and without irrigation

	Treatments	No. of nuts.	Weight of nuts. (gm)
1.	No cultivation, no manuring	1.13	33.67
2.	N P K with irrigation	88.60	2344.56
3.	N P K without irrigation	25.91	665.11
4.	N P K + micro nutrients with irrigation	108.87	2839.89
5.	N P K + micro nutrients without irrigation	37.56	968.69
	S.E./plot	28.72	700.17
	Overall mean	18.16	442.77
	C. V. (%)	52.41	1370.38
	S. E. of treatment mean	54.80	51.09
	C. D. (P = 0.05)	38.50	938.67

Another experiment laid out at Palode to determine the effect of application of N P K with and without lime revealed (as in the previous year) no significant influence of lime over plots without lime. The garden was planted in 1961 and the treatments were superimposed from 1964 onwards.

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

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. 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

The experiment which aims at determining the advantage or otherwise of application of fertilizer in split doses was initiated during the year 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 K and N in two doses in September and January

A. 12. Harvesting trials

a) Season-wise variation in quantity of produce and (b) quality of produce as influenced by degree of maturity

Nuts from three maturity levels, 6, 7 and 8 months were harvested and two lots of 40 kg from each of the maturity level were processed. The processed produce awaits evaluation.

A. 13 Root studies of arecanut palms

Study on the distribution of root was extended to a garden in the low lying area of Central Station with palms aged 11 years and spaced at 2.6 m X 2.6 m. The lateral spread of roots was seen up to 2.75 m from the centre of the palm. Maximum concentration of 58.52 per cent of the roots was within 50 cm radius from the tree and 94.47 per cent was within 100 cm from the tree. The depth of vertical penetration was only up to 140 cm and maximum concentration of 76.1 per cent of the roots was within 50 cm layer from the surface. The second layer of 51 to 100 cm contained 20.32 per cent of all roots. The study has thus brought out the poor penetration of roots in low lying areas with high water table as compared to the penetration up to 2.6 meter in palms under well drained deep soil conditions (*vide* Annual Report 1965-66).

A. 14. Crop weather study

Weather data in respect of rainfall, temperature, humidity, etc., were recorded at the Central and Regional Stations. The data on rain fall and temperature are given in Table 5.

It can be seen that the premonsoon rains (April and May) during the year at Vittal was only 49.8 mm as against the average of 154.74 mm for the corresponding period for the last five years. Similarly there was no rainfall in December as against the normal of about 45.00 mm expected.

TABLE 5

Rain-fall and temperature data for the year 1968

Month	VITTAL										PEECHI								HIREHALLI							
					Temperature °C										Temperature °C								Temperature °C			
	No. of rainy days in 1968	Rain-fall mm. 1968	Average No. of rainy days for last 5 years	Mean rainfall for the last 5 years in mm	Highest maximum	Lowest maximum	Lowest minimum	Highest minimum	Average bright sunshine	Average humidity %	No of rainy days in 1968	Rainfall in mm 1968	Average No. of rainy days for last 5 years	Mean rainfall for the last 5 years in mm	Highest Maximum	Lowest maximum	Lowest minimum	Highest minimum	No. of rainy days in 1968	Rain fall in mm 1968	Average No. of rainy days for last 5 years	Mean rainfall for the last 5 years in mm	Highest maximum	Lowest maximum	Lowest minimum	Highest minimum
January	Nil	Nil	0.05	2.45	34.5	31.0	14.5	18.5	9.88	63	Nil	Nil	Nil	Nil	33.0	32.0	16.5	23.0	Nil	Nil	0 4	4.36	31.5	26.5	5.0	16.0
February	Nil	Nil	Nil	Nil	36.0	31.5	17.0	20.5	10.13	69	1	57.0	0.2	15.4	33.5	32.5	17.0	21.0	3	58.0	Nil	Nil	32.5	29.5	11.0	18.0
March	Nil	Nil	Nil	5.10	38.0	33.0	16.0	24.5	9.52	67	3	64.7	1.8	31.9	36.0	33.5	20.0	24.0	Nil	Nil	0.4	3.60	37.5	30.0	11.0	19.0
April	2	46.8	2.8	38.36	39.0	31.0	17.5	24.2	8.67	67	5	63.5	3.0	28.6	35.0	33.0	20.0	24.5	6	66.8	4.4	52.6	37.5	32.5	15.0	23.0
May	Nil	3.0	5.0	116.38	36.0	32.0	17.5	25.0	8.52	67	4	84.6	5.0	134.7	34.5	29.8	20.5	24.0	6	111.7	4.0	126.34	36.0	31.5	15.5	22.0
June	23	771.2	23.0	720.40	35.0	24.0	19.5	25.0	3.83	86	23	661.0	22.4	535.6	34.5	27.0	19.5	24.0	10	118.0	8.2	130.0	34.0	26.5	18.5	20.5
July	31	1883.0	28.2	1096.66	29.5	23.0	18 5	22.2	1.45	89	30	1603.4	23.3	717.4	31.0	25.0	19.5	21.5	13	136.2	12.6	215.94	29.0	24.0	18.0	20.0
August	21	582.7	25.4	750.20	31.0	25.0	20.0	22.6	7.21	81	21	608.0	20.0	433.3	31.5	27.5	20.0	22.0	9	70.1	12.8	193.14	31.0	26.5	17.0	19.5
September	21	341.9	13.4	199.92	32.5	27.0	19 0	22.5	5 05	86	15	280.6	12.2	203.1	31.5	27.0	20.0	22.0	13	327.0	9.4	193.10	31.0	26.0	17.0	19.0
October	9	156.6	8.8	157.44	35.0	26.0	19.0	22.2	8·12	74	6	128.2	11.8	313.4	31.0	30.0	20.0	21.0	8	157.5	8.0	192.76	30.5	27.5	12.5	19.0
November	4	54.4	3.8	67.50	24.5	31.0	15.3	22.5	8.81	65	2	14.0	5.2	113.9	31.0	30.5	19.5	21.5	4	99.4	4.4	135.26	30.0	20.5	9.0	18.0
December	Nil	Nil	2.4	44.66	35.0	31.0	12.6	22.8	9.45	67	Nil	Nil	2.6	40.5	33.0	29.5	15.0	21.5	2	7.1	1.8	15.90	30.5	23·0	6.0	18.0
Total	**111**	**3839.6**	**112.85**	**3199.07**							**110**	**3565.0**	**107.2**	**2567.8**					**74**	**1151.8**	**66.4**	**1263.00**				

Month	KAHIKUCHI								MOHITNAGAR								PALODE							
					Temperature °C								Temperature °C								Temperature °C			
	No. of rainy days in 1968	Rain-fall mm. 1968	Average No. of rainy days for last 5 years	Mean rainfall for the last 5 years(mm)	Highest maximum	Lowest maximum	Lowest minimum	Highest minimum	No. of rainy days in 1968	Rainfall in mm 1968	Average No. of rainy days for last 5 years	Mean rainfall for the last 5 years (mm)	Highest Maximum	Lowest maximum	Lowest minimum	Highest minimum	No. of rainy days in 1968	Rain fall in mm 1968	Average No. of rainy days for last 5 years	Mean rainfall for the last 5 years in(mm)	Highest maximum	Lowest maximum	Lowest minimum	Highest minimum
January	Nil	Nil	1.4	6.52	25.5	23.30	8.0	17.41	2	6.7	0.4	5.02	26.7	15.5	4.3	12.0	3	21.2	2.6	42.72	35.2	33.0	15.0	21.0
February	Nil	Nil	2.6	19.50	29.0	24.40	10.9	18.76	1	2.4	0 8	5.36	30.0	16.5	3.7	12.5	2	17.8	1.4	5.08	36.2	32.0	14.0	23.0
March	5	39.2	6.4	66.30	36.4	27.50	15.7	20.10	4	37.2	3.0	51.56	33.5	20.2	7.5	17.5	7	113.3	7.6	129.76	36.5	32.0	16.2	23.5
April	12	173.0	13.0	156.30	35.3	28.96	18.9	27.73	3	18.8	5.8	98.32	39.0	25.9	10.6	23.5	13	243.8	12.2	210.35	35.7	30.5	20.8	23.0
May	18	334.0	16.6	250.52	35 3	28.89	22.4	26.67	10	98.7	12.2	289.04	37.4	26.3	15.1	25.1	3	62.4	11.2	149.12	38.5	29.5	20.2	24.0
June	20	360.0	21.0	353.24	33.4	30.40	24.3	27.38	18	557.0	20 4	607.62	34.3	25.9	23.0	27.0	20	533.6	16.4	312.90	33.5	26.0	20.0	24.2
July	15	326.0	19.0	294.20	33.5	31.60	25.5	27.27	25	807.2	21.2	862.66	33.2	27.3	23.4	26.3	23	641.0	19.6	346.10	32.5	25.5	19.2	23.0
August	14	298.2	18.4	290.50	35.5	30.60	25.50	28.02	22	612.9	23.8	787.80	33.6	27.1	23.0	26.4	16	131.0	15.4	210.50	32.5	29.0	14.0	22.6
September	9	70.0	15.2	166.60	34.2	31.20	23.8	29.80	20	608.3	17.2	542.60	34.8	25.8	22.0	25.8	19	292.4	14.8	272.80	32.8	27.2	20.2	27.0
October	3	73.2	4.8	53.52	30.5	29.49	18.4	25.86	6	550.1	5.0	90.16	32.7	21.7	14.8	24 0	19	416.0	18.6	378.40	35.2	28.2	17.2	27.8
November	Nil	Nil	2.6	24.52	29.5	26.10	15.06	19.32	—	Nil	0.6	4.92	29.4	25.1	10.7	17.6	10	243.4	11.6	257.24	34.7	28.0	16.8	21.5
December	Nil	Nil	1.0	1.72	29.0	24.10	9.92	17.52	—	Nil	0.2	2.40	28.5	20.1	4 5	12 7	5	101.2	6.4	136.32	35.2	27.0	13.5	21.0
Total	**96**	**1672.6**	**122.9**	**1682.64**					**111**	**3208.3**	**110.6**	**3347.46**					**140**	**2817.1**	**137.8**	**2451.29**				

(a) RESEARCHES CONTEMPLATED

With the object of determining the standard labour requirements for various operations connected with the raising of the arecanut crop and economics of arecanut cultivation under different conditions it has been proposed to include a new project on the economics of arecanut cultivation.

Programme of work for 1969

Number and name of the Project	Venue of work
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
A. 2. Determination of optimum spacing in the mainfield	Vittal, Peechi, Hirehalli and Kahikuchi
A. 3. Effect of different methods of layout on the incidence of sun scorch on arecanut palms	Vittal
A. 4. Effect of different intervals of irrigation at different depths of planting arecanut	Hirehalli, Vittal, Peechi 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 a) Arecanut and banana b) Arecanut and other crops	Vittal, Kahikuchi, Peechi, Hirehalli, Mohitnagar and Palode
A. 7. Mixed cropping experiments a) Arecanut and coconut 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. 10. Effect of applying fertilizers to supply N P K in organic and inorganic forms on palm performance	Vittal

A. 11. Studies on placement and fractional application of fertilizers	Peechi
A. 12. Harvesting trials (a) season-wise variation in quality of produce and (b) quality of produce as influenced by degree of maturity	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
A. 15. Economics of areca cultivation	Vittal, Peechi, Palode, Hirehalli, Kahikuchi and Mohitnagar

BOTANY

(In-charge: K. V. Ahamed Bavappa)

SUMMARY OF SALIENT FINDINGS

Five promising introductions were isolated based on the cumulative yield of individual palms. Trials were laid out with these varieties in cultivators' fields. Crosses effected for studying xenia effect have shown that pollen has very little influence on the size, shape and quality of the kernel. Certain of the hybrids between indigenous and exotic types were found to show hybrid vigour. The interspecific cross involving Areca catechu *and* A. triandra *showed distinct reciprocal difference in respect of suckering. Comparison of growth characters at the time of planting in the case of seedlings of Mass-pedigree selection showed little variability for number of leaves which seems to be due to the selection pressure already applied in earlier stages. Studies on structure and development of nuts under high and low altitudes showed that the quality and germination percentage have shown gradual improvement as the altitude decreased. The technique of studying the endosperm cytology was standardised.*

(b) RESEARCHES IN HAND

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

a) Exotic types collection: Seventeen species and types introduced 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 type were assessed for their yield from 1963-64. The cumulative yield of the types isolated is given belowin Table 1 (Page 28).

The quality of *Chali* from these types was also assessed and found to be comparable with the local.

A large scale multilocation trial using inter-crossed material of the above promising types was laid out in five arecanut growing regions of Mysore and Kerala States, for studying the performance of the types under varying agroclimatic conditions.

TABLE 1

Yield of exotic introductions

Sl. No.	Name of the type	VTL. No.	Yield in Kg (ripe nuts)/year/palm
1	China	VTL. 3	9.51
2	Singapore	VTL. 17	9.26
3	Siagon (2)	VTL. 13	8.60
4	Saigon (1)	VTL. 12	8.54
5	Indonesia (6)	VTL. 11	8.25
6	Vittal		3.11

The germination experiment to assess the possibility of using variability in germination capacity as a descriptive characteristic was continued. Fifty nuts from each of the types Indonesia 4 and 6 (VTL. 9 and VTL. 11), Fiji (VTL. 1), British Solomon Islands 1, 2 and 3 [VTL. 18(a), 18(b) and 18(c)], Singapore (VTL. 17), Ceylon 1 and 2 (VTL. 5 and VTL. 15), Saigon 1, 2 and 3 (VTL. 12, VTL. 13 and VTL. 14), China (VTL. 3), *Areca triandra* (VTL. 7) and local have been sown.

The multiplication programme of the exotic introductions was in progress and seednuts, sprouts and seedlings were sent to the Regional Stations.

The introductions of 1964 consisted of one unspecified species of *Areca*, *Areca normanbyi* and ten types of *Areca catechu*. All of them have started flowering except the unspecified species. Yield and other growth measurements of individual palms are being studied.

Seven species and types of *Areca* viz., *Areca macrocalyx*, Bougain ville 1, 2 and 3 (*Areca* sp.), *Areca novohibernica*, *Areca langloisiana* and Port moresby (*Areca* sp.) introduced from New Ireland, New Guinea and Bahamas were planted during the year along with local on an 8 X 4 randomised block design with single tree plots.

b) *Indigenous types collection:* The first batch of indigenous collection consisting of 9 types from different tracts of the country was planted during 1964. Yield data of individual palms of each type are being gathered and a preliminary yield evaluation was carried out in respect of 8 types. Yield recorded is given in Table 2.

TABLE 2

Yield of indigenous types

Sl. No.	Name of the type	Yield in kg (ripe nuts)/year/palm
1	Thirthahalli	11.1
2	Mohitnagar	9.7
3	Assam	8.9
4	Hirehalli	8.4
5	Peechi	6.1
6	Chickmagalur	6.0
7	Mettupalayam	5.8
8	South Kanara (local)	4.2

The ripe fruits were dried and the quality of *Chali* tested. It was found that the quality in respect of all the varieties excepting that of Thirthahalli is comparable with that of local. *Chali* prepared from the Thirthahalli nuts showed shrinkage of kernels. During 1966, four more types were added to the existing collection.

The progenies of the dwarf palm (3 dwarfs and 1 tall) are maintained in good condition. Nuts obtained from one of them were sown last year and the seedlings are maintained in the primary nursery.

Certain crosses using the types Sweet areca, Thirthahalli and local and different pollen parents were undertaken to study the effect of pollen on the size, shape and quality of the kernel. The nuts were harvested and tested for the characters under study. No regular and distinct variation was observed among different crosses in comparison with the selfed and open pollinated nuts. This differential behaviour may probably be due to the polygenic system involved in the genetics of these characters.

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

'Prepotent' mother palms had been isolated based on the data available from a large number of progenies of 41 mother palms. In order to study the genetics of prepotency, seedlings of nine mother palms were planted during 1966, on a compact family block design with five replications. A total of 180 progenies are being studied in detail. Growth measurements for 1968 were analysed and the results showed significant difference between families for various characters Number of leaves, girth and height were

found to be maximum for the progeny of family of K. K. F. 23, while the maximum number of nodes were recorded by progeny of K. K. F. 9.

Progeny trials were also in progress at the Regional Stations. At Peechi, the study was made on 80 progenies of four mother palms. The data gathered in respect of growth and productive characters showed that the progeny of mother palm number 93 is superior to the rest. At Hirehalli the experiment was laid on an 8 X 4 randomised block design. The data collected showed that the mean number of spadices produced and the percentage of spadices to leaf fall vary widely between families, the maximum recorded by mother palm No. 2 being statistically significant.

B. 4. Production of inbred lines of distinct types

In order to evolve suitable inbred lines of arecanut, the programme of selfing was in progress in the types China, Saigon, Singapore, Indonesia and Ceylon and the seedlings raised are maintained in the secondary nursery. Sprouts (selfed) of *A. triandra*, Sreevardhan, Thirthahalli, China and local (prepotent palm) have been planted in the secondary nursery. Selfed progenies of mother palms KMJ. 13 and NGB. 293 along with open pollinated ones were planted in a 2 X 10 randomised block design with two palms per plot. Growth measurements recorded during the year when analysed statistically revealed that the two treatments do not differ significantly.

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

Nuts obtained from crosses involving China (VTL. 3), Sreevardhan and *A. triandra* were sown last year and the sprouts were transplanted to the secondary nursery.

Seedlings from crosses *A. triandra* X *A. catechu* and reciprocal crosses were planted in a 4 X 8 randomised block design during 1967. The growth measurements of this year were analysed and the results revealed that hybrids of *A. catechu* X *A. triandra* have significantly lesser girth than that of the *A. catechu* parent.

A fresh batch of interspecific hybrids involving *A. catechu* and *A. triandra* was planted this year in a 4 X 16 randomised block design with single tree plot The suckering habit of the *A. triandra* parent and the F1 progeny of the crosses between *A. catechu* and *A. triandra* was studied. The results are given in Table 3.

TABLE 3

Suckering in parents and F1

Year of planting	Details	*Areca triandra*	*A. triandra* X *A. catechu*	*A catechu* X *A. triandra*	*Areca catechu*
1967	No. of plants studied	8	7	8	8
	No. of plants suckered	2	6	–	–
	Total No. of suckers produced	3	11	–	–
1968	No. of plants studied	15	15	16	16
	No. of plants suckered	7	9	–	–
	Total No. of suckers produced	13	15	–	–

From the above it is seen that there is distinct reciprocal difference in suckering which may be due to cytoplasmic inheritance or interaction between cytoplasmic and nuclear genes.

Hybrids obtained from the crosses, Local X Indonesia 1 (VTL. 47), Local X Andaman (VTL. 45), Local X Indonesia 2 (VTL. 48) and Nicobar (VTL. 46) X Local and planted during 1965 were under study. The palms showed earliness in bearing, large sized inflorescence, large number of female flowers and heavier crown habits. Hybrid vigour expression of the hybrids is being studied critically.

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

This study was initiated for finding out how far selection of seednuts, seedlings and mother palms influences the germination and future performance of the progeny. The experiment was laid out with the following treatments:

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

5. Selected nuts from non-prepotent mother palms
6. Selected nuts from prepotent mother palms

Growth measurements showed no significant difference between the treatments for seedling vigour.

B. 7. Improvement by Mass-pedigree selection

The Mass-pedigree selection method reported earlier was modified to include a crossing programme on the principle of polycross technique. The selected 20 plants were pollinated interse with mixed pollen. All the nuts so obtained were harvested and sown in the nursery along with open pollinated nuts from the same palms and two controls.

Seedlings raised from 18 palms of the finally selected group, were screened for number of leaves and planted in the main field along with the control, during 1968 in a randomised block design with three replications and six palms per plot. Growth measurements at the time of planting showed wide variability between treatments for height and girth. Number of leaves did not show any significant variation, probably due to the selection pressure exerted at various stages of selections already done. The mean height of seedlings ranged from 81 cm to 108 cm.

Seedlings raised from seednuts supplied to the Regional Station at Mohitnagar for building up the genetic stock were in the secondary nursery.

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

Ripe arecanuts of high altitude are found to shrink, when they are dried for the preparation of *Chali*. The development of the kernel appears to be highly influenced by climatic factors especially by temperature. The present study is intended to find out the developmental aspects of the kernel in relation to the climatic factors prevailing at different altitudes which render them unsuitable for the preparation of *Chali*. Ripe nuts collected from these altitudes (800 m, 320 m, 300 m, and 220 m-control) were sown for studying their germination capacity on the statistical design. The data collected showed significant difference between treatments. The percentage of germination was the lowest (76%) for the nuts collected from 800 m as against 96% in the case of control. Drying trials showed that there is considerable shrinkage of chali in respect of nuts from higher elevations. These results are in conformity with the observations made earlier.

A systematic study on the prob'em was initiated during this year. A survey was conducted in South Kanara and Coorg Districts and five gardens were fixed at different altitudes from 300 m to 1200 m. Maximum-minimum thermometers were installed in all these gardens and daily observations are being taken to know the temperature variation of these places so as to study the kernel development in relation to the temperature variation. Samples of nuts from these gardens were collected and put for drying and germination trials.

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

Endosperm of tender nuts (about four months old) was fixed at 11.30 A. M. in acetic alcohol and later transferred to 70% alcohol. Squashes were prepared taking the lower portion of the fleshy tissue in 2% acetocarmine. Satisfactory number of dividing cells at different stages of division could be obtained. No regularity was noticed in the number of chromosomes in different cells. Most of the cells showed a chromosome number of 48 (3n) and in others the number was found to be higher than the expected number. Studies to understand the exact level of ploidy and behaviour of chromosomes during division with respect to different zones of the endosperm tissue are in progress.

B. 11. Studies on fruit setting and shedding

Earlier experiments had given encouraging results in fruit set when the pollination is assisted. Since the method was found uneconomic, the low setters alone were isolated and trials are being conducted with them.

B. 12. Inducing mutations in arecanut by

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

In order to increase the genetic variability seed arecanuts were treated with different mutagens. Seedlings obtained after irradiation of seednuts with thermal and pile neutrons were planted during 1963. The one plant under the treatment 1×10^{12} 3 hrs. 42 m. has continued to be poor in growth and has not flowered so far. A total of 200 seednuts were irradiated with gamma rays during 1965-66 and the seedlings planted at the Central Station and at the Regional Station, Palode. The plants are under study.

Sprouts of arecanut were treated with colchicine and seedlings were planted in the main field. The palms are being studied.

(c) RESEARCHES CONTEMPLATED

Hybridisation involving different exotic and indigenous types and species to exploit hybrid vigour and cytological studies of all the exotic introductions and hybrids will be taken up.

Programme of work for 1969

Number and name of the project		Venue of work
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, Polode 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. 4.	Production of inbred lines of distinct types	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. 8.	Floral initiation	Vittal
B. 9.	Structure and development of fruits in arecanut under high and low altitudes	Vittal
B. 10	Cytological and anatomical studies of types, species and hybrids of arecanut	Vittal
B. 11.	Studies on fruit setting and shedding	Vittal
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	Vittal and Palode

STATISTICS

(P. R. Ramachander)

SUMMARY OF SALIENT FINDINGS

Two samples of 10 kg each of green nuts with husk drawn from a given lot at random were found to be sufficient for determining the percentage of out-turn of 'Podi', *a trade variety of Mysore state. The yield components of palms under different yield groups were found to differ to varying degrees. The maximum variation was seen in case of percentage of set. The highest yield group had 50 per cent set as against 5 per cent in the lowest yield group. A new method of measuring the alternate bearing tendency has been worked out and it was seen that palms with this bearing tendency do not constitute a large proportion. Though the total number of rachis produced by a tree had a high heritability it was not possible to use it as a selection criterion due to its lack of correlation with yield. A selection index using 29 characters was found to increase the efficiency of mother palm selection five times. A simpler index using number of leaves and height of seedlings at the time of planting was found to be three times more efficient than straight selection.*

(a) RESEARCHES COMPLETED

S. 1. Refinement of experimental technique

Determination of sample size for estimating percentage of out-turn of Podi of a given lot (In collaboration with Regional Arecanut Research Station, Hirehalli).

For comparison of treatments in different experiments, the estimate of final produce from different plots is necessary. Sampling technique to work out the percentage of out-turn of *Chali* (ripe nuts dried and husked) as well as one of the important trade varieties of tender nuts, *Choor* of Kerala has already been worked out. During the period under report sampling technique was worked out for another important trade variety *Podi* from Mysore.

For this purpose 96 lots each weighing 10 kg (green weight with husk) were cured separately and percentage out-turn of *Podi* determined. By grouping randomly, samples of greater weight were obtained. The coefficient

of variation in each case and also the minimum number of samples of a particular size required to give the estimates falling within 5 per cent limit of the actual value 95 per cent of times were worked out. The results showed that two samples of 10 kg each will be optimum for the above purpose.

S. 2. Correlation, heritability and causation studies

(a) *Study of variation in yield components of palms with differing yields:* Yield in arecanut has been observed to be a highly variable character. Under uniformly cultivated conditions palms yielding below 50 nuts as well as those yielding above 600 nuts are found. In order to examine the variability of different yield components, 400 palms were grouped according to their yield and in each group the mean yield component worked out. The data relating to three such groups are given in Table 1.

TABLE 1

Variability in yield components in palms of different yield groups

	Number of nuts yielded		
	0—50	200—250	600 and above
1. Leaf fall/year	7.1	7.6	7.6
2. No. of inflorescences	4 0	5.7	7.1
3. No. of bunches harvested	0.9	3.2	5.1
4. Total number of female flowers	602.3	1122.9	1744.1
5. Percentage of nut set	5.0	29.1	49.4
6. Size of nut (gm)	41.4	36.0	33.4
7. Percentage of inflorescences to leaves shed	56.2	75.0	93.8
8. Percentage of bunches harvested to inflorescence	20.8	57.4	73.1
9. Percentage of nuts harvested to nuts set	52.3	79.1	81.8

From the above it is seen that there is considerable variation between the yield components of palms belonging to the different yield groups. The least variable is the number of leaves shed per year and the maximum variability is shown by percentage of nut set. The highest yielding group has approximately 10 times the percentage of set, three times the number of female flowers, double the percentage of inflorescences to leaves shed and about one and a half times the percentage of nuts harvested to nut set than those belonging to the lowest yield group.

b) Study of year-wise variation in yield: In all perennial crops, one of the important subjects of study is the yield variation of the same tree from year to year. On examination of the relevant literature it was seen that the existing methods to measure this were inadequate due to the fact that they did not take into consideration either the year-wise variation in yield due to environment or amount of reduction in yield. A new method for studying alternate bearing was, therefore, worked out.

For this purpose a palm is classified as low yielding when its yield is 20 per cent less than the garden mean for a particular year and high yielding when it yields more than 20 per cent of garden mean. The palms yielding in between were classified as medium yielders. A palm was classified as alternate bearer when there is a rhythmic sequence of ups and downs in classification scores year after year (eg., H L H L H L). The data pertaining to a plantaion in the early years of bearing of coastal Mysore and a middle aged plantation in *Malanad* parts of Mysore where distinct cultivars are grown are given in Table 2.

TABLE 2

Frequency of palms of different yield patterns

	% of occurrence	
	Coastal (Vittal)	*Malanad* (Thirthahalli)
1. Alternate	13.0	4.8
2. Regularly high	7.7	8.0
3. Regularly medium	0.3	–
4. Regularly low	23.8	17.6
5. Irregular	55.2	69.6

The more or less similar frequencies found indicate that (1) alternate bearers do not constitute a considerable majority, (2) the population contains about 8 per cent of palms which are always high yielding and about 20 per cent of palms which are always low yielding, (3) the characteristic yielding behaviour is exhibited even in the initial stages of bearing and (4) the yielding pattern is not different for the two distinct cultivars grown under different environments.

c) Heritability studies: Previous studies have revealed that yield in arecanut was mostly contributed by two mutually independent characters viz., number of female flowers and percentage of set. It was suspected that number of rachis in a bunch may be related to the percentage of set obtained. The correlation and heritability of total number of rachis per tree as well as mean number of rachis per bunch are given in Table 3.

TABLE 3

Relationship between number of rachis and yield components

	Total No. of rachis	No. of rachis per bunch
1. Heritability	0.68	0.04
2. Phenotypic correlation with percentage of set	0.11	0.06
3. Genotypic correlation with percentage of set	-0.77	-0.13
4. Phenotypic correlation with yield	0.39	—
5. Genotypic correlation with yield	-0.23	—

It can be seen that both the characters examined do not bear any relation with percentage of set. Since the total number of rachis produced had a high heritability its correlations with yield worked out indicate that this character cannot be used as a selection criterion due to its positive phenotypic and negative genotypic correlation.

S. 3. Discriminant functions and selection index

The heritability of yield being low, search was being continued to find out characters with high heritability and significant genotypic and phenotypic correlations with yield. The age at first bearing was found to be one such character. A selection index (using Fair Field Smith's method of discriminant functions) using 17 growth characters and 12 yield components was therefore worked out. The computation was done in the electronic computor installed at Institute of Agricultural Research Statistics, New Delhi. Since for practical application an index involving such a large number of characters cannot be used eight other indices involving lesser number of characters were also worked out. The genetic advance obtained for the different indices are given in Table 4.

It can be seen that the index using all the 29 characters is about five times more efficient than straight selection based on yield. The major contribution to this efficiency is by the 17 growth characters of which those at the time of planting contribute the maximum. An index based on two characters at the time of planting is about three times more efficient than straight selection.

The selection index based on three growth characters at the time of planting was worked out for all the 3000 plants and the best ten per cent among them was selected which was further screened for age at bearing and is being used for supply of seednuts from the Station.

TABLE 4

Genetic advance due to selection index formulated with different characters

Selection index	Characters	Genetic advance/k
I	17 growth characters and 12 yield components	284
II	17 growth characters	271
III	12 yield components	116
IV	3 growth characters at time of planting	201
V	No. of leaves and height at time of transplanting	190
VI	Growth characters after one year growth	96
VII	Growth characters after two years growth	126
VIII	Growth characters after six years growth	80
IX	No. of leaves at time of planting, girth at collar after one year growth and No. of nodes after two years growth	146
	Straight selection based only on yield	57

(b) RESEARCHES ON HAND

S. 2. Correlation, heritability and causation studies

Correlation between morphological characters of seedlings: Phenotypic and genotypic correlations between the morphological characters at the time of planting as well as the heritability of individual characters were worked out for seedlings of Vittal, Hirehalli and Peechi types. There were sharp differences between the phenotypic correlations obtained. Regarding girth at collar and height of seedlings, the heritability as well as genotypic correlations were more or less showing the same trend. While the heritability of number of leaves was high both at Peechi and Vittal, it was considerably low at Hirehalli. The work is being repeated with the data gathered from Palode, Kahikuchi and Mohitnagar.

(c) RESEARCHES CONTEMPLATED

Since no information is available on the factors governing the market price of the different varieties of arecanut it is proposed to take up a project on the marketing problems of arecanut.

Programme of work for 1969

Number and name of the Project	Venue of work
S. 1. Refinement of experimental technique	Vittal
S. 2. Correlation, heritability and causation studies a) Correlation between morphological characters of seedlings b) Correlation between morphological and other characters of the palm with yield c) Heritability studies	Vittal, Peechi and Hirehalli
S. 3. Discriminant functions and selection index	Vittal
S. 4. Marketing problems of arecanut	Vittal

WEATHER DATA FOR THE YEAR 1969

VITTAL

Month	No. of rainy days in 1969	Rainfall in mm 1969	Mean No. of rainy days for last 5 Yrs.	Mean rainfall for the last 5 Yrs. in mm	Temperature °C				Mean hrs. of bright sunshine	Mean humidity %
					Highest maximum	Lowest maximum	Lowest minimum	Highest minimum		
January	Nil	Nil	0.2	1.0	35.8	32.0	14.8	18.5	10.0	57.5
February	Nil	Nil	Nil	Nil	36.5	32.5	16.8	20.8	10.1	57.5
March	Nil	1.2	Nil	Nil	37.8	33.8	19.0	24.0	9.1	66.0
April	3	76.5	2.0	37.2	39.0	31.0	19.0	26.3	9.1	71.5
May	2	12.4	2.0	84.8	37.0	30.0	21.0	25.5	7.3	72.0
June	24	88.65	22.4	735.9	33.2	25.0	20.5	23.5	3.8	80.0
July	31	1402.8	28.2	1282.7	30.8	25.0	19.5	23.5	2.7	84.5
August	21	437.6	23.8	653.9	33.0	28.0	20.2	23.5	6.1	75.0
September	18	585.6	15.0	237.6	32.5	24.0	19.5	22.0	4.9	77.5
October	9	193.4	8.4	123.3	34.0	29.0	19.6	22.6	7.0	70.0
November	9	207.8	4.0	72.0	35.0	29.5	17.1	22.1	7.9	63.5
December	2	14.8	2.0	39.7	34.0	30.5	15.1	22.1	8.1	61.5
Total	**119**	**3816.75**	**108.0**	**3267.9**						

PEECHI

Month	No. of rainy days in 1969	Rainfall in mm 1969	Mean No. of rainy days for last 5 Yrs.	Mean rainfall for the last 5 Yrs. in mm	Temperature °C			
					Highest maximum	Lowest maximum	Lowest minimum	Highest minimum
January	Nil	Nil	Nil	Nil	32.0	31.5	15.0	21.5
February	Nil	Nil	0.2	11.40	33.5	32.5	16.0	20.5
March	Nil	Nil	1.0	33.06	36.0	33.5	19.0	23.0
April	4	37.0	4.0	41.30	35.5	33.5	20.5	24.5
May	12	174.0	5.0	139.48	35.5	31.0	20.0	24.0
June	25	642.3	23.2	576.24	32.0	25.5	18.0	22.0
July	28	1018.2	25.0	884.24	31.0	25.5	17.0	21.0
August	19	273.4	19.2	440.08	31.5	27.0	19.0	20.0
September	13	222.0	13.4	222.66	30.5	26 0	18.0	21.0
October	11	199.2	11.0	265.68	31.5	29.0	16.5	21.0
November	3	151.3	5.2	101.40	31.5	27.0	15.5	20.5
December	2	37.0	1.8	34.06	31.0	29.0	16.0	20.5
Total	**117**	**2754.4**	**109.8**	**2749.60**				

HIREHALLI

Month	No. of rainy days in 1969	Rainfall in mm 1969	Mean No. of rainy days for last 5 Yrs.	Mean rainfall for last 5 Yrs. in mm	Temperature °C			
					Highest maximum	Lowest maximum	Highest minimum	Lowest minimum
January	Nil	Nil	Nil	Nil	30.0	27.0	16.5	9.0
February	Nil	Nil	0.6	11.6	35.0	29.0	18.5	12.0
March	Nil	Nil	0.4	3.6	35.5	32.5	18.5	15.0
April	5	64.3	4.2	45.5	36.5	31.5	22.5	18.0
May	6	128.4	4.6	143.4	36.0	28.0	23.5	18.0
June	4	67.2	8.4	137.04	33.5	29.0	20.0	18.0
July	10	110.9	12.6	261.38	30.5	23.0	19.5	17.5
August	12	207.15	11.4	163.22	31.5	26.5	20.0	16.5
September	8	98.4	10.4	224.12	31.0	25.0	18.5	16.0
October	8	167.0	7.6	162.40	31.5	22.5	19.5	13.5
November	8	44.3	5.0	142.74	29.5	22.0	18.5	10.5
December	3	20.0	2.2	34.66	28.0	22.0	18.0	10.0
Total	**64**	**909.65**	**67.4**	**1284.64**				

MOHITNAGAR

Month	No. of rainy days in 1969	Rainfall in mm 1969	Mean No. of rainy days for last 5 Yrs.	Mean rainfall for the last 5 Yrs. in mm	Temperature °C				Mean humidity %
					Highest maximum	Lowest maximum	Lowest minimum	Highest minimum	
January	1	3.4	0.8	6.36	25.8	18.6	5-1	11.2	63.0
February	1	3.0	1.0	5.84	29.8	19.7	5.2	14.3	60.0
March	5	34.7	4.0	51.38	33.5	19.6	10.1	21.7	60.0
April	4	42.4	4.4	67.84	35.0	21.9	13.8	22.5	60.0
May	12	265.2	11.4	233.90	37.0	25.6	17.4	25.4	68.0
June	24	608.5	19.8	585.16	35.7	26.2	21.4	26.3	77.5
July	27	638.6	22.0	917.68	35.0	25.9	23.6	26.6	78.0
August	25	442.6	23.0	714.62	34.4	26.6	23 4	27.3	83.5
September	16	359.9	18.2	593.60	36.3	23.7	19.9	26.3	79.5
October	2	40.1	5.0	177.50	33.2	28.1	14.8	23.4	64.5
November	1	14.4	0.6	4.92	30.5	20.8	10.5	18.8	71.0
December	—	Nil	0.2	2.40	27.5	24.7	5.0	15.2	68.5
Total	**118**	**2452.8**	**110.4**	**3361.20**					

PALODE

Month	No. of rainy days in 1969	Rainfall in mm 1969	Mean No. of rainy days for last 5 Yrs.	Mean rainfall for the last 5 Yrs. in mm	Temperature °C			
					Highest maximum	Lowest maximum	Lowest minimum	Highest minimum
January	1	15.5	2.4	27.64	35.0	30.0	13.5	19.6
February	1	8.0	1.4	6.04	38.5	28.5	15.4	22.0
March	6	43.6	7.6	123.62	37.0	33.0	16.0	23.0
April	15	368.5	13.2	218.43	36.2	32.0	20.6	24.5
May	18	263.2	8.6	125.10	35.2	29.5	21.5	24.6
June	19	218.3	17.2	368.76	24.5	28.0	21.0	23.0
July	21	370.8	19.8	383.22	31.5	25.0	19.5	22.5
August	12	247.5	14.6	180.86	33.3	27.5	19.0	22.5
September	12	113.0	15.6	272.92	34.5	27.0	19.3	21.6
October	21	510.2	19.2	401.36	34.0	28.0	17.8	22.0
November	11	159.6	13.2	266.68	33.5	27.0	15.5	22.5
December	9	77.8	5.6	140.60	34.5	25.0	15.0	23.0
Total	**146**	**2414.0**	**138.4**	**2515.73**				

KAHIKUCHI

Month	No. of rainy days in 1959	Rainfall in mm 1969	Mean rainfall for the last 5 Yrs. in mm	Temperature °C				Mean humidity %
				Highest maximum	Lowest maximum	Lowest minimum	Highest minimum	
January	3	24.30	11.06	25.50	23.33	8.37	17.41	66.64
February	Nil	Nil	11.24	29.00	24.33	9.52	18.76	62.81
March	8	66.30	64.72	36.40	27.50	15.60	20.25	62.69
April	14	89.30	137.78	35.30	28.96	18.90	24.00	65.86
May	12	65.20	216.30	35.30	23.89	22.80	26.67	74.52
June	21	473.00	367.90	33.40	30.40	24.30	27.38	74.80
July	21	343.00	296.20	33.50	31.60	25.03	26.38	81.30
August	19	342.20	269.16	35.50	30.60	24.56	25.60	80.65
September	10	209.00	162.72	34.20	31.20	23.70	25.50	77.73
October	7	51.30	40.52	32.20	29.50	18.40	21.72	76.68
November	3	21.20	28.76	29.50	36.10	15.06	17.70	71.42
December	Nil	Nil	1.32	29.00	24.10	9.92	12.40	74.47
Total	**118**	**1684.80**	**1607.68**					

TABLE 1

Available P_2O_5 (ppm) in Soil Profile*

Sampling intervals in days	0 kg P_2O_5/ha					50 kg P_2O_5/ha					100 kg P_2O_5/ha					200 kg P_2O_5/ha				
	Depth of soil sampling in cm.					Depth of soil sampling in cm.					Depth of soil sampling in cm.					Depth of soil sampling in cm.				
	0—5	5—10	10—15	15—20	20—30	0—5	5+10	10—15	15—20	20—30	0—5	5—10	10—15	15—20	20—30	0—5	5—10	10—15	15—20	20—30
Initial**	5.24	5.74	4.78	3.38	2.80	5.04	5.86	4.50	2.38	2.70	4.94	4.94	3.94	2.22	2.60	5.48	5.48	4.50	3.32	2.90
1	5.24	5.20	3.76	2.44	2.78	111.44	25.64	11.06	5.54	3.98	154.14	78.68	33.32	12.02	4.86	240.28	127.82	36.98	21.98	9.38
3	5.92	6.14	4.30	3.86	2.56	80.52	21.68	12 66	7.12	3.84	132.84	69.74	30.92	12.24	5.84	176.90	108.90	35.64	45.54	12.60
5	4.48	3.96	3.48	2.82	2.78	59.42	17.74	9.78	5.98	3.42	106.32	51.56	24.76	12.12	4.80	137.62	100.12	32.42	20.36	12.82
10	5.40	4.80	3.22	2.42	2.44	39.58	16.24	7.42	4.80	3 06	80.48	45.20	15.08	10.38	4.34	130.06	84.54	41.20	19.64	10.46
15	5.66	6.60	4.32	2.50	2.70	34.00	16.36	5.60	3.84	3.42	71.58	33.68	11.02	8.68	3.74	117.94	54.40	26.98	16.44	9.14
20	7.04	5.32	4.88	2.96	3.08	24 92	12.72	5.22	3.16	2.58	67.36	31.40	10.38	7.98	4.42	109.40	44.56	19.50	14 76	8.12
25	6.20	6.60	4.46	3.04	3.68	24.90	11.94	4.76	3.04	2.84	50.72	25.10	9.54	8.34	4.58	93.92	37.48	16 40	12.98	8.46
30	6.20	6.90	5.62	3.48	3.24	22.50	9.46	5.16	3.10	2.96	40 86	16.52	9.36	7.44	3.88	88.62	28.54	16.96	12.44	7.10
40	6.34	5.76	4 54	2.78	2.88	17.40	9.00	5.08	2.74	3.06	32.64	15.34	9 48	6.02	3.78	67.40	25.68	14 64	10.88	7.60
50	6.20	6.08	3.98	2.56	2.60	16.04	6.78	4.14	2.62	2.70	23.48	13.52	7.74	5.08	3.96	61.10	24.48	13.62	9.20	5.72
60	6.02	6.20	3.86	2.78	2.20	12.64	5.24	3.76	2.02	2.38	17.98	11.00	5.98	3 94	3.20	52.14	17.78	10.70	7.26	3.00
120	6.00	6 20	4.00	2.00	2.20	10 80	5.00	3.76	2.30	2.30	12.49	8.00	3.98	3.90	3.00	22.90	10.20	8.70	5.29	3.40
180	5.78	5.50	4.00	2.10	2.18	7.50	5.50	3.98	2.40	2.70	9.15	6.15	3.90	4.10	2.90	12.58	9.15	5.00	4.30	3.10
360	5.41	5.60	3.70	2.40	2.20	6.10	5 00	4.00	3.00	2.50	9.15	7.00	4.10	4.10	3.00	10.10	7 98	5.40	4.58	3.40

* Mean of five replications.

** Before the application of superphosphate

From Table 2 it is seen that there is an initial increase in organic carbon content in all the treatments except cattle manure. Lowest organic carbon content was seen in the plots applied with *Gliricidia* while highest was in the case of forest leaf.

In order to find out the relative efficiency of different green manure crops in their green matter production and organic matter and nutrient addition capacities, an experiment on a 6 X 5 randomised block design was laid out with the following treatments:

(1) *Crotalaria*, (2) *Mimosa*, (3) *Calopogonium*, (4) *Stylosanthes*, (5) *Centrosema* and (6) Control. Initially the soil contained 0.7%, 0.067% and 32.6 ppm organic carbon, total nitrogen, and available nitrogen content respectively, whereas C:N ratio available was found to be 10.4. The chemical composition of the green manure crops is given in Table 3.

TABLE 3

Chemical composition of different green manure crops
(expressed as % on oven dry basis)

	Green matter produced kg/ha	Moisture	Ash	N	P_2O_5	K_2O
Crotalaria anagyroides	8069	84.1	4.67	2.88	0.18	0.64
Mimosa invisa	17000	80.2	3.71	2.89	0.21	0.26
Calopogonium muconoides	10759	88.0	6.45	1.81	0.33	1.66
Stylosanthes gracilis	13449	88.2	6.72	1.74	0.25	1.22
Centrosema pubescens	5380	84.3	8.32	2.32	0.41	1.92

From Table 3 it will be seen that even though *Centrosema pubescens* has the maximum values for nutrients the green matter produced is the least. Judging from the point of view of green matter production as well as nutrient status *Mimosa invisa* is the best.

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

Seasonal variation of nutrients in soil profile at 0—25, 25—50, 50—75 and 75—100 cm depths in fallow land and soil under arecanut plantation was studied. In order to study the influence of application of organic manures and inorganic fertilizers soil samples were collected both from the basin and from the centre of the arecanut trees. It was seen from the data that the pH values do not vary widely with the season in all the depths. Organic matter content was found to be

highest in fallow land in the month of November. No difference in organic carbon content was found between plots applied with inorganic fertilizers and organic manures separately. The available nitrogen (ammoniacal + nitrate) was found to be more in the months from March to September. No specific trend was observed in case of P_2O_5 availability. Available K_2O content was not seen to be affected with season except that the values were on lower side in the month of September. In general, the samples collected within the basin gave higher values for all the plant nutrients than those collected from the centre of the trees.

C. 7. Soil survey of the experimental farms

Experimental farms at Regional Arecanut Research Stations at Peechi, Palode, Hirehalli, Mohitnagar and Kahikuchi were surveyed and in all 29 profiles collected for laboratory studies. Soil maps on the basis of field data collected were prepared. It has been observed that the soils in general at Mohitnagar and Kahikuchi have hard and impervious layers below. At Hirehalli, high clay content in the soil was observed.

Programme of work for 1969

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. 4.	Standardisation of sampling technique for plant sample	Vittal
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

(M. V. Krishna Rao)

SUMMARY OF SALIENT FINDINGS

Data gathered from field experiments showed that the yellowing of foliage was less in the month of May as compared to August in all the centres. Even though there was reduction in yellowing due to imposition of treatments the results were not consistent. Palms under treatments K, L, C, F and B had in general less yellowing. In the case of kernel discolouration, treatments F, K, J and L were found to be effective in reducing the discolouration. Regarding yield, it was observed that treatments J, D and A had enhanced the yield of diseased palms up to 55 per cent as compared to diseased control. Analysis of soil samples collected from the experimental plots showed that soils are acidic in nature, medium in organic carbon and poor in nutrients.

(b) RESEARCHES ON HAND

PP. 1. Investigations on yellow leaf disease of arecanut

b) Field experiments with macro and micro-nutrients in growers fields
Field experiments involving application of macro and micro-nutrients laid out during the year 1965 and 1966 at four centres 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 owners' usual treatments

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

J—N P K + Manganese sulphate (68 g.) + Magnesium sulphate (68 g.) + 11 kg. cattle manure + Zinc sulphate 25 g.

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

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

M—Diseased control : receiving garden owners' usual treatments

Data gathered on yellowing of foliage, mean percentage of kernel discolouration, mean number of female flowers per bunch, percentage of fruit-set and yield were analysed statistically for each centre. The results are given below:

(i) *Yellowing of foliage:* Observation on yellowing was taken during May and August. The score for yellowing was less in May as compared to August in all the centres. At Punalur Unit, the treatments did not differ significantly. However, minimum yellowing was noticed in treatments K and L during August. On the other hand at Annamanada unit, significant difference for score for yellowing was observed during May only. Treatments D and E showed more yellowing than both control and healthy palms. During August, even though the overall score on yellowing was more as compared to May the treatment differences were not significant. Treatments C, F and B showed less yellowing than control. At Jayapura centre significant differences were observed among treatments during both May and August seasons. During May, treatment G had the least score for yellowing followed by J and I while in August treatments J, I and D in the descending order showed low scores for yellowing. No significant difference was obtained at Koothattukulam centre.

(ii) *Mean percentage of discoloured nuts:* The treatment differences were not significant at any of the centres. However, at Punalur and Koothattukulam units, the minimum percentage of kernel discolouration was noticed in treatment K followed by J and L. At Jayapura unit the nuts did not show discolouration in treatments D and F.

(iii) *Number of female flowers per bunch and percentage fruit-set:* Among the treatments no significant differences were found in respect of the above characters in all the centres.

(iv) *Yield:* At Annamanada unit, treatment J followed by B and D gave almost double the yield of treatment M (control) though the treatment differences were not significant. At Jayapura significant differences among

treatments were obtained. Treatments D and J recorded higher yields than treatment M. At Koothattukulam unit the treatments did not differ significantly. However, treatment A followed by L recorded the highest yield. At Punalur treatments B and J gave significantly more yield than control.

c) Chemical analysis of soil, plant tissues and nuts: Analysis of soil samples collected prior to the commencement of treatment application was continued. At Punalur the soil samples showed pH in the acidic range, the variation being 4.2 to 5.4. Organic carbon is medium to high. Available nitrogen varied from 117 ppm to 414 ppm in the first depth of 25 cm and 500 ppm to 134 ppm in the second depth 25 to 50 cm. At Jayapura, Annamanada and Koothattukulam centres available nitrogen and phosphorus were determined. Wide variability was found between replications.

(c) RESEARCHES CONTEMPLATED

Pot culture studies with different nutrients will be initiated.

Programme of work for 1969

Number and name of the Project	Venue of work
PP. 1. Yellow leaf disease of arecanut b) Investigations on physiological aspects i) survey for assessing the area affected by yellow leaf disease ii) Field experiments (with macro- and micro-nutrients) in growers' fields iii) Chemical analysis of soil and plant tissues and nuts iv) Pot cultural studies	Vittal, Koothattukulam, Annamanada, Punalur, Jayapura and Palode
PP. 2. Physiology of growth and development of areca palm	Vittal

PATHOLOGY

(T. S. S. Rawther and K. K. N. Nambiar)

SUMMARY OF SALIENT FINDINGS

Investigations on the fungal and pest infection of processed arecanuts were commenced towards the close of the year. The optimum sample size for ascertaining the percentage of nut infection of a given lot was found to be 10 samples of 30 nuts each. The percentage of infection of a lot on the 5th and 40th day after harvest did not differ considerably in the lots examined. Drying arecanut in the mechanical drier reduced infection of nuts to about 3 per cent. Fungi like Aspergillus sp., Penicillium sp., Rhizopus sp., *and* Fusarium sp., *were isolated from the infected kernel. Sap inoculation studies in the yellow leaf disease failed to transmit the disease. For the first time, yellow leaf disease was observed in various agronomic and botanic trials laid out at the Palode Research Station. At Regional Research Station, Kahikuchi, studies on crown rot showed that* Thielaviopsis sp. *was associated with the disease giving 33 per cent infection in the trials.*

(b) RESEARCHES ON HAND

P. 4. Investigations on yellow leaf disease of arecanut in Kerala

a) Pathological aspects: As in the previous year, monthly inoculation of sap from leaves of diseased arecanut was done on 125 healthy trees in the manurial-cum-irrigation experiment. Even though 10 palms of this experimental plot exhibited symptoms akin to yellow leaf disease none of the palms inoculated had contracted the disease.

b) Botanical aspects: Palms under exotic and indigenous types and species totalling 359 were under observation for the occurrence of disease symptoms. It was observed that 10 palms were showing symptoms akin to yellow leaf disease. Seedlings raised from irradiated seed materials failed to show any disease symptom.

c) Agronomic aspects: It has been suspected that the yellow leaf disease is associated with the neglected cultivation practices adopted in Kerala. Trials involving application of macro-and micro-nutrients with and without irrigation, planting on hill slopes adopting both the cultivator's

and improved practices and raising of arecanut mixed with other crops such as coconut, laid out in the earlier years were maintained with a view to finding out the effect of these factors on disease incidence. In the macro - and micro-nutrient experiment 10 palms out of a total of 375 palms showed symptoms similar to those of yellow leaf disease. The disease incidence did not show any relation with the treatments imposed. Stray incidence of disease was noticed in the other observation plot as well.

P. 6. Studies on crown rot disease in Assam

Serious damage to arecanut crop has been reported from Assam due to crown rot disease. The affected gardens were visited in 22 localities of 8 districts, viz., (U) K & J Hills, Cachar, Goalpura, Lakhimpur, Darrang, Sibsagar, Kamrup and Nowgong. Inoculation studies made with the fungi and bacteria isolated from diseased materials gave 33 per cent infection with *Thielaviopsis* sp. while there was no infection with bacteria.

P. 7. Fungal and pest infection of processed arecanuts

Processed nut is being damaged by fungi and insects which attack the produce during the course of processing as well as in storage. The market value of affected nut is considerably low because of its poor quality. No information is also available about the health hazards that are likely to occur due to chewing of the infected nuts.

At the instance of the Ministry of Health and Family Planning investigations were initiated to study the fungal infection of the *Chali* so as to evolve suitable methods to prevent such infection as well as to fix quality standards for the sale of the produce in the market.

The sampling technique was perfected. It was found that 10 samples of 30 nuts each drawn from a given lot of nuts harvested was sufficient for determining the percentage of infection in that lot. The harvested nuts which are cured for *Chali* preparation were sampled twice from the drying yard (compacted soil), the first one after 5 days of harvest and the second after 40 days of harvest. The samples drawn from the drying yard were cut into two halves and examined for fungal infection. The infected nuts were graded for the intensity of infection as 'mild', 'moderate' and 'severe'. The mean percentages of infection of lots during the 5th and 40th day after harvest are given in Table 1.

TABLE I

Mean percentage of infection of nuts in the drying yard

Type of infection	Mean percentage of infected nuts	
	5 days after harvest	40 days after harvest
Mild	12.58	16.75
Moderate	18.91	20.75
Severe	17.75	19.66
Total	49.24	57.16

The above data show that the percentages of infection on the 5th and 40th day do not differ considerably. It is, therefore, evident that the majority of infection takes place during the initial days of drying

Fungi such as *Aspergillus* sp., *Penicillium* sp , *Rhizopus* sp. and *Fusarium* sp. were frequently isolated from the infected kernel. The fungus *Cladosporium* sp. was isolated invariably from the exocarp of nuts and never from the kernel. Among the fungi attacking kernel *Aspergillus* sp. was predominant. The central white core is first attacked and after complete disintegration of these tissues the fungi pass on to surrounding tissues.

In another experiment, mechanical drier was used to dry the nuts soon after harvest. Six lots of 300 nuts each were dried in the drier. The temperature of the drier ranged between 60°C and 62°C. Analysis of nut infection after satisfactory drying showed that the infection was reduced to as low a level as 3.56 per cent. Only *Aspergillus* sp. and *Penicillium* sp. were observed in this case.

The above studies show that infection takes mainly from the drying yard and that quickening the process of drying and eliminating soil contact by using a mechanical drier reduce nut infection considerably. Further studies are in progress.

(c) RESEARCHES CONTEMPLATED

Laboratory studies on *Ganoderma lucidum* will be initiated. Survey for assessing crop losses due to *Koleroga* and *Anabe* will also be taken up.

Programme of work for 1969

Number and name of the project	Venue of work
P, 1. Investigations on *Koleroga (Phytophthora arecae)*	Vittal and Peechi
a) Trials on the control of *Koleroga* using low volume spray	
b) Studies on the retention of copper compounds sprayed on the fruits in the field	
c) Studies on the forecasting of the incidence of *Koleroga*	
P. 2. Investigation on *Band* disease	Vittal, Mohitnagar and Hirehalli
P. 3. Investigation on *Anabe*	Vittal, Hirehalli and Kahikuchi
P. 4. Yellow leaf disease of arecanut	Palode
a) Investigations on pathological aspects	
P. 5. Survey for assessing crop losses due to diseases	Vittal, Hirehalli, Kahikuchi and Peechi
a) *Koleroga*	
b) *Anabe*	
P. 6. Study of the crown rot disease in Assam	Kahikuchi and Vittal
P. 7. Fungal and pest infection of processed arecanuts	Vittal

ENTOMOLOGY

(B. C. Misra and S. N. Seshadri)

SUMMARY OF SALIENT FINDINGS

The life history of white mite (Paratetranychus indicus Hirst) *was worked out. The average period of incubation was found to be 79.2 hours and the average larval, protonymphal and deutonymphal periods are 26.6, 30.8 and 44.0 hours respectively. A female lays on an average 3-4 eggs per day and the average oviposition period is 10.1 days. The length of life of adult female is 9–18 days whereas males live for 7–10 days. Studies on other pests were in progress.*

(a) RESEARCHES COMPLETED

E. 1. Biological and chemical control of mites

As a prerequisite for taking up biological control, a detailed study of the biology of the white mite *(Paratetranychus indicus)* was taken up and completed. The mites were reared on floating bits of fresh arecanut leaf supported by two stubs of cotton on the cut ends of leaf bits. The following observations were made.

Life history

Mating: Both males and females become sexually mature on emergence from deutonymphs. The males wander about in search of quiescent deutonymph females. Pairing takes place immediately on the emergence of the female. Mating lasts for 1-2 minutes though the female allows more than once during its life time.

Pre-oviposition and oviposition periods: The pre-oviposition period varied from 17to29 hours with an average of 23.2 hours. The effective oviposition period ranged from 7 to 16 days with an average of 10.1 days among the 15 individuals under study (Table 1, page 55). The eggs are laid singly and they are on the undersurface of leaves mostly scattered. A female lays usually 3–4 eggs per day, the highest recorded number being 6 eggs in a day. The maximum number of eggs laid by a female during her life time was 51, the average being 3.2 eggs per day.

Post-oviposition period: The post-oviposition period varies from 12 to 22 hours with an average of 17.9 hours.

TABLE 1

Life period and oviposition by adult female of *Paratetranychus indicus* Hirst

Cage No.	Pre-oviposition period (in hrs.)	Maximum number of eggs laid per day	Minimum number of eggs laid per day	Average number of eggs laid per day	Post oviposition period (in hrs.)	Length of adult life (in days)	Eeffective oviposition period (in days)	Total No. of eggs laid per female
1	27.5	5	1	3.2	12	18.0	16	51
2	25.5	6	1	2.8	16	12.5	11	31
3	23.0	6	0	3.1	18	13·5	12	37
4	28.5	6	2	4.2	20	9.0	7	29
5	21.5	6	2	3.7	16	8.5	7	26
6	21.5	5	1	2.9	18	9 5	8	23
7	25.5	6	1	3.1	20	13.0	11	34
8	27.5	6	1	3.5	16	10.0	8	28
9	20.0	6	1	3.1	18	11.5	10	31
10	21.0	6	1	3.6	20	12.5	11	40
11	17.5	5	1	2.4	16	9.5	8	19
12	23.0	5	1	3.2	21	14.0	12	38
13	25.0	5	1	3.4	16	14.5	13	44
14	20.0	6	1	2.8	20	11.5	10	28
15	22.0	6	1	3.3	22	10.0	8	26
Average:	**23.2**			**3.21**	**17·9**	**11.8**	**10.1**	**32.3**

Egg: The egg is almost spherical, clear and wet when freshly laid, becoming opaque as incubation progresses. The incubation period varied from 72 to 95 hours with an average of 79.2 hours during the months of January-February.

Larva: The average learval period lasts for about one day. The larval period is followed by the first quiescent stage. The average active and quiescent periods of larva are 15.5 and 11.1 hours respectively (Table 2 page 57).

Nymphal stages: Protonymph: The average protonymphal period is from 1 to 1½ days. The active phase of the protonymph is followed by the second quiescent stage. The average active and quiescent periods of protonymphs are 17.5 and 13.3 hours respectively.

Deutonymph: The average deutonymphal period ranges from 1 to 2 days. After the third quiescent stage the adult emerges. The average active and quiescent periods of the deutonymph is 27.1 and 19.9 hours respectively.

Duration of immature stages: The time required for development from egg to adult varies from 6.5 to 9 days with an average of 7.5 days.

Adults and the length of Adult life: The female is oval, the body is dorsally slightly domed and flattened ventrally. The male is smaller, bright, pear shaped, the abdomen being much narrower at the rear and alomost tapering to a point. The female usually lives 9–18 days whereas male lives 7–10 days.

Habits and nature of injury: The mites are invariably found to attack the under surface of leaves of young arecanut palms. They spin a delicate web and the eggs are laid on or below the web. The damage is caused by the larval, nymphal and adult mites which suck the sap from the leaves. As a result, the affected portions lose their original green colour and develop yellow patches. These patches ultimately wither away. In case of severe attack, the young seedlings die.

Dispersal: The leaves touch one another in the nursery and the females can move laying eggs on many leaves and thus spread the infestation when the palms are young. Wind also serves as an agency for the dispersal of the mites.

(b) RESEARCHES ON HAND

E. 1. Biological and chemical control of mites

The work on biological control of mites which was initiated in the previous year was continued. The Commonwealth Institute of Biological Control, Bangalore is collaborating in this project.

TABLE 2

Duration of immature stages of *Paratetranychus indicus* Hirst,

Cage No.	Duration of stages in hours							
	Egg	Larva		Protonymph		Deutonymph		Total
		Active period	Quiescent period	Active period	Quiescent period	Active period	Quiescent period	
1	92	18	14	17	14	26	22	203
2	95	14	10	18	12	22	12	186
3	87	12	10	16	12	23	22.5	182.5
4	72	13	10	14	11	24	20.5	164.5
5	74.5	13	11.5	14.5	10	23	19.5	166
6	73.5	18	11	16	11	22	15	166.5
7	73	16	12	20	16	25	21	183
8	78	14	10	16	12	22.5	16	168.5
9	74.5	13	11.5	14.5	19	23	19	165.5
10	78	16	11	19.5	16	25	21	186.5
11	75.5	17	12	20	15	24	20	184.5
12	75	18	12	20	16	26	23.5	190.5
13	73	14	10	15	10	24	20	166
14	95	18	12	20	16	25	23	209
15	75	18	11	20	16	26	23	190
16	74.5	16	10	20	15	26	20	181.5
Average:	**79·2**	**15.5**	**11.1**	**17.5**	**13.3**	**24.1**	**19.9**	**181.8**

A new mite on arecanut fruits, distinctly different from the mites observed on arecanut leaves was noticed in May, 1968 at the Regional Arecanut Research Station, Peechi. These mites which harbour inside the inner whorl of calyx of nuts, cause severe shedding of tender nuts. A survey showed that 90 per cent of the palms are infested by the pest and they cause loss of fruits to the extent of 7.5 per cent. The mite is being indentified and control measures are being investigated.

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

Detailed studies were initiated on the biology of the inflorescence caterpillar. Laboratory trials to control this pest were also initiated. The studies are in progress.

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

The study on the biology of the pest was continued. From one of the batches the adult emerged was identified as *Xylotopeus gideon* by the Commonwealth Entomological Institute, London.

E. 4. Studies on the stem borer pest *(Xyleborus perforans)* of arecanut palms and mode of control

The intensity of damge due to the pest was reported to be severe in certain pockets near vittal. Oozing of a gummy exudation was a common symptom associated with the pest infestation. In severe cases the palms succumb to the attack. The possible role of castor plants (generally seen in the vicinity of arecanut gardens) as an alternate host is being examined.

E. 5. Binomics and control of spindle bug

Monthly counts of spindle bug (both adult and nymphs) were made at Regional Research Station, Peechi. It was observed that the maximum population of both adults and nymphs is present on arecanut plants during April.

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

The methodology adopted in other crops for similar studies was reviewed. A tentative programme was prepared.

(c) RESEARCHES CONTEMPLATED

Method of control of red ants and mite infesting the arecanut fruits are to be worked out. The insect associated with the tender nut fall is to be identified and its biology and control studied.

Programme of work for 1969

Number and name of the project	Venue of work
E. 1. Biologycal 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
E. 4. Study of the stem borer pest *Xyleborus perforans* of arecanut palms and mode of control	Vittal
E. 5. Binomics and control of spindle bug	Vittal, Peechi and Palode
E. 6. Survey for assessing crop losses due to pest a) Mites b) Spindle bug c) Inflorescence caterpillar d) Root-grub	Vittal, Palode, Peechi, Hirehalli and Mohitnagar

III. PAPERS PUBLISHED

During the period the following papers were published:

1 Agarwal, K. N., Bavappa, K. V. A. and Khosla, R. K. 1968
Study of size and shape of plots and blocks and optimum number of pre-experimental periods in arecanut. *Indian J. agric. Sci. 38*: 444-460

2 Bavappa, K. V. A. 1968.
A decade of research in arecanut. *Indian Fmg. 18* (4): 5-7

3 Bavappa, K. V. A. and Ramachander, P. R. 1968.
How to select mother palms. *ibid. 18* (4): 10, 13

4 Kalbande, A. R. 1968.
Proper manuring increases areca yield. *ibid. 18* (4): 11-13

5 Khader, K. B. A. and Antony, K. J. 1968.
Intercropping: a paying proposition for areca growers. *ibid. 18* (4): 14-15

6 Murthy, K. N. 1968.
Arecanut growing in North-East India. *ibid. 18* (4): 21, 23

7 Seshadri, S. N. 1968.
Occurrence of *Xyleborus perforans* Wollaston. (Scolytidae : Coleoptera) as a pest of arecanut and coconut crops. *Sci. & Cult. 34* (3): 132

8 Seshadri, S. N. and Rawther, T. S. S 1968.
Pests and diseases of arecanut. *ibid. 18* (4): 24-26

9 Shama Bhat, K. 1968.
For richer harvests watch individual areca palms. *ibid. 18* (4): 17-18

10 Shama Bhat, K. and Leela, M. 1968
Cacao and arecanut are good companions. *ibid. 18* (4): 19-20

11 Shama Bhat, K. and Leela, M. 1968.
Cultural requirements of arecanut. *ibid. 18* (4): 8-9

The following papers were accepted for publication:

1 Bavappa, K. V. A. and Ramachander, P. R.
Some immediate problems, possibilities and approaches in relation to genetic improvement of arecanut. *Indian J. Genet. Pl. Breeding*

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

3 Bhat, K. S. and Leela, M.
The effect of density of planting on the distribution of arecanut roots. *Trop. Agriculture*, Trin.

4 Seshadri, A. R.
Identical twins in arecanut. *Sci. & Cult.*

IV. EXTENSION

a) Results of immediate practical application

(1) Arecanut palms irrigated once in three days from December to May given a yield of one hundred and ninety three fruits per palm as against eight nuts per palm obtained from unirrigated (rainfed only) plots. Irrigation once in three days gave a net profit of Rs. 10,460/- per ha.

(2) Selection of seedlings based on a single selection index (number of leaves and height at the time of planting) is three times more efficient than straight selection for yield. For the index purpose the number of leaves of a seedling has to be multiplied by 40 and its height deducted from this value. Seedlings with higher index values should be selected.

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

(1) Of the many different types and species that are under regular yield trial five introductions have given yields ranging from 274 to 306 per cent over the local. Large scale trials in the cultivators' fields are under way with a view to studying their performance in the field prior to being released for large scale cultivation.

(2) *Chali* (whole dry ripe nuts) was found to be infected with fungus to varying degrees. Studies on this problem have indicated that the nuts contact the infection invariably from the drying yard which consists of only compact soil. Better flooring of of these yards has been found to bring down the infection. The drying process is being standardised.

(3) In the studies on floral initiation it is observed that one inflorescence is initiated in every leaf axil. However, every leaf fall is not accompained by production of an inflorescence. It has been observed in certain agronomic trials that production of inflorescences is highly influenced by the agronomic practices which the palms are subjected to. Determination of optimum conditions under which maximum production of inflorescences can be obtained is being done.

(4) Preliminary studies have indicated the distinct possibility of growing cacao and arecanut as a mixed plantation. Large scale trials are being programmed to work out the optimum cultivation practices for such a mixed crop husbandry.

c) Publicity activities

To give wide publicity to the various research findings, the Station participated in several exhibitions like District Horticultural Show at

Mangalore, Field Day and Horticultural Week at Horticultural Farm (Arecanut Development), Tirthahalli and Agricultural Exhibition organised by Emmakaje Panchayat in connection with the celebration of Gandhi Jayanthi.

The Fifth Farmers' Week, celebrated in January, 1968, was inaugurated by Shri C. M. Poonacha, Hon'ble Minister for Railways and presided over by Shri B. Vittaldas Shetty, now Minister of State for Food and Civil Supplies. Dr. A. B. Joshi, Deputy Director-General of the Indian Council of Agricultural Research, was also present. A very impressive exhibition in which the State Departments and a number of private firms participated was arranged in connection with the Farmers' Week celebration. Group discussions had been organised to enlighten the farmers about the activities of the Research Station.

Farmers' Week was also celebrated at the various Regional Arecanu Research Stations during the year under report. At the Regional Station, Peechi, the Farmers' Week was inaugurated by Shri M. N. Govindan Nair, Hon'ble Minister for Agriculture, Kerala, on 11th December, 1968 and presided over by Dr. M. S. Nair, Director of Agriculture, Kerala. At the Regional Station, Kahikuchi, along with the Farmers' Week, training in pests and diseases of arecanut was conducted from 26th to 28th August, 1968. Film on "Arecanut cultivation" was screened during the Farmers' Week at different stations.

Undergraduate and postgraduate students from a number of Agricultural and academic universities visited the Central and Regional Stations to acquaint themselves of the research work in progress. Besides, the Central Station attracted trainees from different Institutions and Departments of State Governments. They were given intensive training on all aspects of arecanut cultivation. A large number of enquiries seeking advice to solve various problems in arecanut cultivation were attended to promptly. Instances are quite numerous where progressive growers came to the Station to seek guidance from the research workers on various problems. The Station were also in touch with growers and trade interests throughout the country for identifying the problems in the field. The Arecanut Specialist and staff paid visits to the gardens for on-the-spot inspections wherever necessary.

V. CONFERENCES AND SYMPOSIA

The Third Research Council Meeting was held on 27th and 28th December, 1968 at the Central Station in which the Deputy Director, Regional Office, Calicut, the Research Officers from Regional Arecanut Research Stations, Palode, Peechi, Hirehalli and Kahikuchi and the Superintendent, Regional Arecanut Research Station, Tirthahalli and the Heads of Sections participated. The other research staff at Central Areanut Research Station, Vittal, also attended the deliberations by invitation. The technical programme was discussed in detail and the programme of work for 1969 drawn up. Under the aegis of the Study Circle six meetings were held in February, June, July, August, October and December during the year at Central Arecanut Research Station, Vittal, in which all the research staff participated.

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

1) Symposium on Accelerating Genetic Improvement of India's Plant Resources organised by the Indian Society of Genetics and Plant Breeding at new delhi, (2) Seminar on Coconut, Cashewnut, Arecanut and Spices at Goa, (3) Seminar on Production of Fruits and Cacao for Export at Bombay and (4) the Arecanut Development Council Meeting held at Madras, all organised by the Ministry of Food and Agriculture, and (5) Symposium on the living Resources of the Seas around India held at Ernakulam under the auspices of the Central Marine Fisheries Research Institute, Mandapam Camp. Papers on (1) Some immediate problems, possibilities and approaches in relation to genetic improvement of arecanut, (2) A decade of Research in Arecanut and (3) Cacao as part of mixed crop economy were presented by him in the above symposia or seminar.

VI. SUMMARY OF THE REPORT

Collection of exotic varieties and species of *Areca* and testing their performance under the existing field conditions at the Central as well as in all the five Regional Stations were continued. Trials were laid out in cultivators' fields with five promising introductions isolated based on the cumulative yield of palms. Certain of the hybrids between indigenous and exotic types were observed to show hybrid vigour. The interspecific hybids involving *Areca eatechu* and *A. triandra* showed distinct reciprocal difference in respect of suckering habit. Pollen was found to have little influence on the size, shape and quality of kernel. Comparison of growth characters of seedlings under Mass-pedigree selection programme at the time of planting revealed little variability for leaves. Studies on the structure and development of fruits in arecanut at high and low altitudes indicated a gradual improvement in nut quality as the altitude decreased. The technique for studying endosperm cytology was perfected. Studies on inducing mutation in arecanut either by irradiation or by chemical means were continued.

Planting seedlings up to two years in age whether directly or after transplanting in the nursery does not affect their initial flowering whereas planting three or four year old seedlings delayed flowering. Spacing given to palms exerted considerable influence on rate of leaf fall, production of spadices and female flowers, flower-set and yield. Under South Kanara conditions the optimum spacing for the palm was found to be 2.7 m x 2.7 m. At Regional Station, Peechi (Central Kerala) also, the highest yield was obtained from plots where 2.7 m x 2.7 m spacing was adopted though this yield was not very much different from yields obtained from certain other plots with different spacings. At Peechi palms receiving irrigation once in three days gave the highest yield. The lowest yield was recorded by palms raised under rainfed conditions. At Palode, the yield in plots with irrigation and manuring was nearly three times more than that from plots with manuring but without irrigation. At Peechi planting seedlings at 90 cm depth recorded considerably more yield them planting at 30 cm and 60 cm depths. In the studies with intercrops like banana, elephant-foot-yam, colocasia etc., no adverse effect of the intercrops was noticed on the performance of main crop. The flowering of areca was found to be not hampered in the mixed planting with cacao. The mean yield of cacao was 21.8 pods per tree. In the manurial experiments on arecanut positive response has been obtained for nitrogen, green leaf and potash. Application of N P K in either organic or inorganic form did not affect the yield.

A sampling technique was perfected for determining the percentage of out-turn of *Podi*, a trade variety of Mysore State. The yield components of palms under different yield groups were found to differ to varying degrees, the maximum variation being observed in the case of percentage of fruit-set. Palms with alternate bearing tendency did not constitute a large proportion The number of rachis produced by a tree does not have any correlation with the yield and hence cannot be used as a selection criterion in spite of its high heritability. A simple selection index using number of leaves and height at the time of planting is found to be three times more efficient than straight selection for yield.

Maximum availability of phosphorus was obtained after 24 hours of application of superphosphate and the availability decreased thereafter irrespective of levels and depths of application. Forest leaves applied to the soil increased the organic carbon status to the maximum while *Gliricidia* proved to be most ineffective. Of the different green manure crops tried, *Mimosa invisa* was the best as judged from the points of view of green matter production and nutrient status.

Studies on yellow leaf disease showed that the yellowing was less in the month of May than in August. Treatments involving application of Boron, Manganese and Magnesium with N P K were found to enhance the yield of diseased palms up to 55 per cent as compared to diseased control. The soils from disease-affected gardens were acidic in nature, medium in organic carbon and poor in nutrients. Sap inoculation studies consistently failed to transmit the disease. Investigations on the fungal infection of processed nuts showed that the percentage of infection on the fifth and fortieth day after harvest did not differ considerably and that majority of infetcion occurred during the first five days of drying itself. Drying arecanut in the mechanical drier reduced infection of nuts considerably. The infection of nuts was found to be mainly from the drying yard. Fungi like *Aspergillus* sp., *Penicillium* sp., *Rhizopus* sp. and *Fusarium* sp. were isolated from the infected kernel. Studies at Regional Station, Kahikuchi, showed that *Thielaviopsis paradoxa* was associated with crown rot of arecanut palms in Assam.

As a prelude to taking up biological control, the biology of white mite *(Paratetranychus indicus)* was studied in detail. A new mite on arecanut fruits, distinctly different from the leaf mites was observed to cause severe shedding of tendernuts at Regional Station, Peechi.

VII. PERSONNEL

Retirements, promotions and transfers

Shri V. L. Kurian, Office Assistant, retired from service on 7-8-1968.

Dr. K. K. N. Nambiar and Sarvashree B. C. Misra and M. V. Krishna Rao were appointed as Plant Pathologist, Entomologist and Plant Physiologist respectively during the year under report. Shri M. Vijayarajan was appointed as Research Officer, Regional Arecanut Research Station, Kannara, on *ad-hoc* basis with effect from 15-2-1968 to 7-8-1968. Shri A. K. Sadanandan took charge as Research Officer at Regional Arecanut Research Station, Kannara on 8-8-1968. Shri M. Sannamarappa, Research Officer, Regional Arecanut Research Station, Hirehalli, was appointed on regular basis with effect from 4th June, 1968. Shri R. K. Bhattacharya, Research Officer, Regional Arecanut Research Station, Mohitnagar, was reverted to his original post of Research Assistant (Agronomy), Regional Arecanut Research Station, Kahikuchi. Shri K. Narasimha Murthy joined duty as Research Officer at Regional Arecanut Research Station, Mohitnagar on 27-9-1968 on transfer from Regional Arecanut Research Station, Kahikuchi. Shri Ram Bali Ram Yadava, who was appointed as Research Officer at Regional Arecanut Research Station, Kahikuchi joined duty during the period. During the year under report Sarvashree S. Edison, Senior Research Assistant (Pathology) and M.P. Somaiah, Research Assistant (Agronomy) joined duty at Central Arecanut Research Station, Vittal. Shri S. Sadashivan Pillai was appointed as Research Assistant (Botany) on transfer from Regional Arecanut Research Station, Kannara, and shri M. S. Dravid was appointed as Senior Research Assistant (Chemistry) against the leave vacancy of Shri N. Thirumaleshwar Bhat. Sarvashree P. Rajendran and N. Narayana Bhat, Research Assistants in Agronomy and K. J. Antony and K. Vijayakumar Sukh, Research Assistants in Pathology joined their respective posts at the Regional Arecanut Research Stations at Kannara, Hirehalli and Mohitnagar.

Shri V. V. Subramanian, who was appointed as Accounts Officer relieved Shri V. N Dambal on 3-4-1968 and Shri N. K. Srinivasa Murthy who was promoted as Administrative Officer with effect from 16-4-1968 relieved Shri R. N. Juneja. The relieved Officers left the Research Station to take up their new assignments elsewhere.

Sarvashree C S. Abraham, Research Officer on *ad-hoc* basis, P.R.V. Subramania Iyer, Senior Research Assistant (Agronomy), P. Prasanna Kumar, Senior Research Assistant (Pathology), K. Annaji Rao, Research

Assistant (Botany), P. Pankajakshan Nair. Farm Assistant, K. Vijaya Kumar Sukh, Research Assistant (Pathology) and T. Mahabala Gowda, Farm Assistant were relieved on resignation during the year.

Kumari M. Leela, Senior Research Assistant (Agronomy) and Shri S. N. Seshadri, Research Assistant (Entomology), Central Arecanut Research Station, Vittal, 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	Vacant
Senior Research Assistant	Shri R. Sankaranarayana 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 —	Vacant
Research Assistant	Shri K. B. Abdul Khader, B. Sc. (Ag.)
— do —	Shri M. P. Somaiah, B. Sc. (Ag.) Hons.
Farm	
Farm Superintendent	Shri K. J. Abraham, B.Sc. (Ag.)
Farm Assistant	Shri A. Manjunatha Shetty, B.Sc. (Ag.)
Nursery Assistant	Shri S. Jayasheela Hegde, B.Sc. (Ag.)
Statistics	
Statistical Officer	Shri P. R. Ramachander, M.A., Diploma in Statistics (I. C. A. R.)
Computor	Shri K. Vijayakumar, B.Sc.
Soil Chemistry	
Soil Chemist	Dr. A. R. Kalbande, B.Sc. (Ag.), Assoc. I. A. R. I., Ph. D.
Senior Research Assistant	Shri N. Tirumaleshwar Bhat, B.Sc. (Ag.)
Plant Pathology	
Plant Pathologist	Dr. K. K. N. Nambiar, B Sc. (Ag.), M.Sc. (Ag.) Ph.D.
Senior Research Assistant	Shri S. Edison, B.Sc. (Ag.), M Sc. (Ag.)

Entomology	
Entomologist	Shri B.C. Misra, B.Sc. (Ag) M.Sc. (Ag.)
Research Assistant	Shri S.N. Seshadri, B.Sc. (Ag.)
Plant Physiology	
Plant Physiologist	Shri M.V. Krishna Rao, B.Sc. (Hons.), M.Sc.
Research Assistant (Agronomy)	Shri B. Nagaraj, B.Sc. (Ag.)
— do —	Shri C.K. Mathai, B.Sc. (Ag.)
— do —	Shri K. Vellaichamy, B.Sc. (Ag.)
Research Assistant (Chemistry)	Shri C. Devaraju, B.Sc. (Ag.)
Administration	
Administrative Officer	Shri N.K. Srinivasa Murthy, B.Com.
Assistant Administrative Officer	Vacant
Account Officer	Shri V.S. Subramanian, B.A. (Hons.). S.R.A.S.

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 M. Vijayarajan, B.Sc. (Ag.) Hons.

Regional Arecanut Research Station, Pacha

Research Officer	Shri T. S. S. Rawther, M.Sc
Senior Research Assistant (Botany)	Shri R. Balakrishna Nair, B.Sc.
Research Assistant (Agronomy)	Shri E. Velappan, B.Sc. (Ag.)
Farm Assistant	Vacant

Regional Arecanut Research Station, Hirehalli

Research Officer	Shri M. Sannamarappa, B.Sc. (Ag.)
Research Assistant (Agronomy)	Shri N. Narayana Bhat, B.Sc.,B.Sc.(Ag.)
Research Assistant (Pathology)	Shri M. Sampath Kumar, B.Sc. (Ag.)
Farm Assistant	Vacant

Regional Arecanut Research Station, Mohitnagar

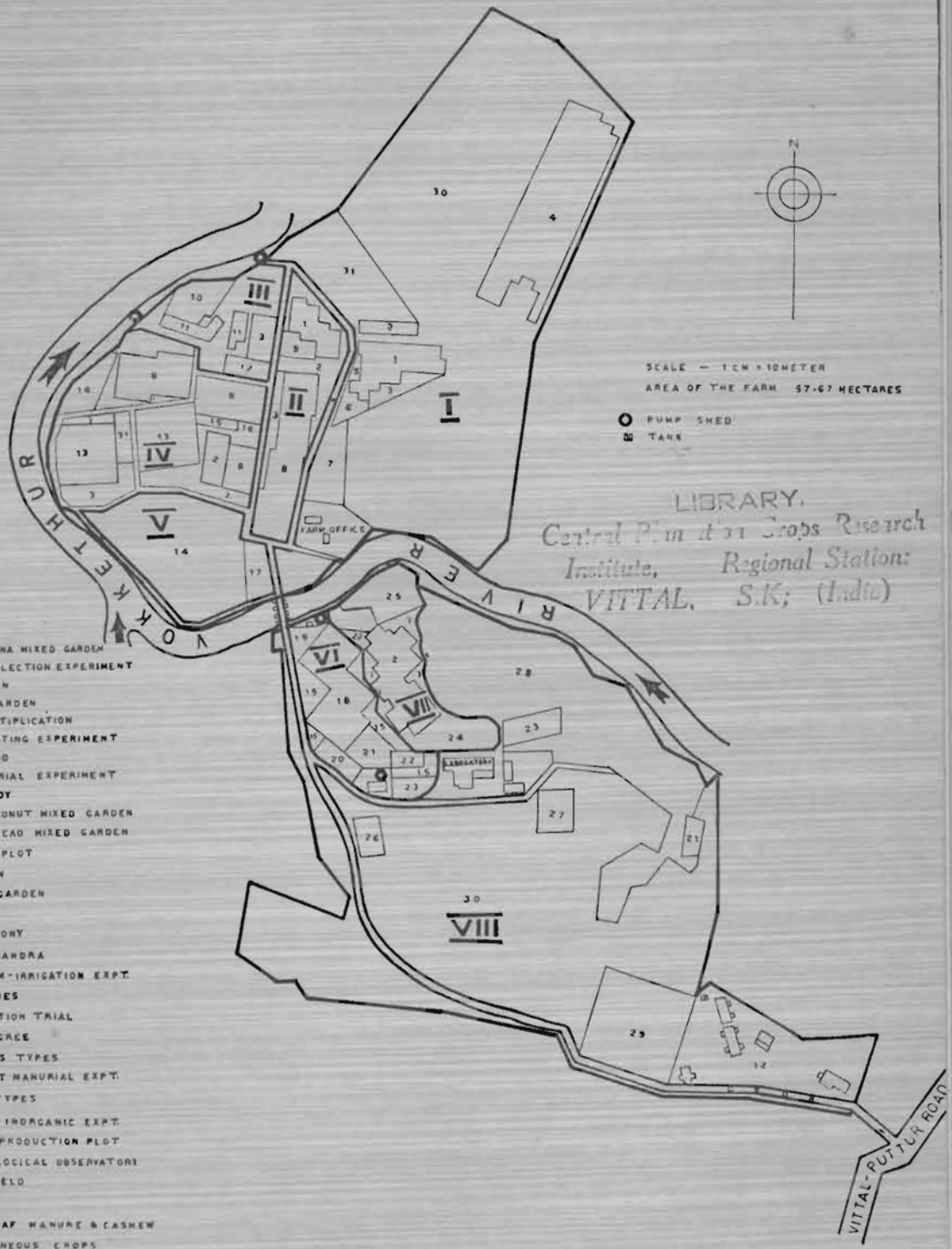
Research Officer	Shri K. Narasimha Murthy, B.Sc. (Ag), M.Sc. (Agri.)
Research Assistant (pathology)	Vacant
Research Assistant (Agronomy)	Shri Gorachand Biswas, M.Sc. (Ag.)
Farm Assistant	Shri Ram Keshwar Singh, B.Sc. (Ag.)

Regional Arecanut Research Station Kahikuchi

Research Officer	Shri Ram Bali Ram Yadava, B Sc (Ag.), M.Sc. (Ag.)
Research Assistant (Agronomy)	Shri R. K. Bhattacharya, B.Sc. (Ag.)
Rescarch Assistant (Pathology)	Shri Birendra Kumar Sarma, M.Sc.
Farm Assistant	Shri Harilal, B.Sc. (Ag.)

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