Annual Progress Report

OF

THE CENTRAL ARECANUT RESEARCH STATION,

VITTAL, MYSORE STATE

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For the period from

1—4—1959 to 31—3—1960.

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Annual Progress Report of the Central Arecanut Research Station, Vittal, South Kanara District, Mysore State for the Period from 1—4—1959 to 31—3—1960.

SECTION A – PART I

The Central Arecanut Research Station is located at Vittal Village, Buntwal Taluk, South Kanara District of Mysore State, twenty six miles towards North-East of the nearest Railway Station of Mangalore. The latitude and longitude of the Station are 12° 75″ N and 75°· 25″ E respectively and the altitude 500 feet above M. S. L. The soil is typically lateritic in nature and ranges from sandy loam to gravel.

The Research Station which was sanctioned up to 31-3-1966, started the work from 2-4-1956. The farm has got a total area of 65·86 acres. The Station was started with a view (i) to solve the local problems confronting arecanut industry (ii) to coordinate research work conducted at various Regional Research Station and (iii) to conduct fundamental research.

The area garden raised over an area of 5·50 acres for taking up progeny studies and conducting certain cultural experiments was manured and irrigated as per schedule. Quality seedlings numbering 34,736 were distributed among progressive growers. From 90,511 seednuts sown during last year, a total of 65,617 quality sprouts were transplanted in the secondary nursery. During the period under report 69,057 selected seednuts were sown for raising quality seedlings. Different green manure crops and green leaf manure crops were raised to augment the resources of green leaf supply of the Station. A total of 7,906 coconuts were harvested and the coconut trees were manured and their crowns cleaned. Coconut seedlings numbering 74 were planted at the station during the year. A new pump-shed was constructed and pump-set installed in the same. An irrigation channel over a length of 871 feet to lead water from this pumpset to blocks II, IV and V was constructed and cement plastered. The front roof of the farm shed was provided with an extension. A culvert connecting blocks II and III was constructed. An area of 62 cents was dug out and levelled in block IV. A temporary foot-bridge was constructed across the river Vokkethur.

The various investigations undertaken on the criteria for seednut selection and other factors that influence the production of quality seedlings revealed that, (a) the percentage of germination of seednuts gathered from

young palms were significantly less than those collected from middle aged and old palms, (b) there was no visible effect on the position of seednut in the bunch as well as in the order of bunches in respect of germination, (c) germination of 8 months old seednuts was significantly lower than nuts of higher maturity, (d) sowing the nuts and just covering or covering with 1" of soil was significantly better than deeper sowing, (e) seedlings planted at distances of 15"×15" and 18"×18" produced significantly better quality seedlings and spacing highly influenced root production, (f) storing the seednuts over 3 week after their harvest definitely reduced their viability and treating seednuts with Bordeaux mixture and Folidol gave high percentage of germination and less percentage of mortality under field conditions, (g) about 25% of the total nut in a bunch were light nuts which gave low germination percentage and produced poor seedlings and (h) application of Nitrogen at 75 lbs. and 150 lbs. per acre produced significantly more vigorous seedlings than no manuring. In the main field closer planting of 6'×6' had given a better stand for seedlings as compared to the rest. From the uniformity trial it was observed that a plot size with 20 to 24 plants gave low standard deviation both for nursery as well as for the main field experiments.

Experiments on study of the performance of the nuts having different floating habits, influence of the different position of seednuts cum depth of sowing seednuts, effect of different spacing cum efficacy of sowing unsprouted and sprouted seeds, standardisation of media for sprouting seednuts, effect of shade and no shade on seednut germination and seedling performance, Influence of post harvest treatment on seednut performance study of different green manure cum cover crops for arecanut garden, influence of manuring seedlings at different levels on their establishment, response of seedlings of varied vigour to different levels of manuring and investigation on different types of areca under rainfed and irrigated condition were laid out.

Out of the four seedlings introduced at the Station from Andaman, Nicobar and Indonesia, one of Andaman variety and two of Indonesian flowered at the age of seven. Twenty exotic species and types of Areca including the unclassified ones were collected from ten countries and maintained at the Station. The germination data of the sixty four ecotypes were gathered. Twenty five ecotypes marked out during the previous year were gathered from eight centres of Kerala and Mysore States and sown. In the studies on the influence of self, cross and open pollination of selected

palms on fruit-set, germination of seednuts and vigour of seedlings, self pollinated nuts gave the highest percentage of germination. Open pollination was found to give the highest fruit-set of 39.6%. Studies on the floral biology of Areca undertaken showed that the age of the palms namely young, middle and old gave no marked difference in flowering behaviour such as phase of male and feamale flowers. Extent of selfing taking place in arecanut was worked out. Preliminary trials on fruit setting and shedding with a few spray applications revealed that standard insecticide and fungicide mixture and IAA gave a low shedding of 18% and 26.9% respectively. The above trial was modified to include applications of harmones, fungicide, insecticide and manures, alone and in combination and laid out. Selfing was taken up for evolving inbred lines. Experiments were initiated with a view to reduce the time taken for germination of seed arecanut. Study on the dispersal of pollen of Areca through wind was taken up as a preliminary to the production of Elite seeds. A study on the segragation of characters was initiated to find out how far and to what extent the characters of the selected mother palms were retained by the projenies. Morphology of arecanut palm with reference to germination and root production, spread of roots and morphology of the stem and leaves were studied in detail. Root spread and number of main roots were more in the case of middle aged palm than young and old.

One garden at Kodapadavu was fixed up for Mahali experiment after surveying a number of tracts of high Mahali incidence. Gardens at Volamogru and Bolanthur were visited where incidence of premature nutfall, yellowing and wilting of crowns and attacks or spindle bug and mite noticed. Certain tracts in Sagar area (Mysore) and Kerala State were surveyed in connection with the yellowing of crowns prevalent in these regions. Yellowing of palms was also noticed at Kuthugodu–Chickmagalur. Incidence of budrot was noticed at Kanathur, Dewana, Puncha and Nileshwar.

In a trial against mites on seedlings Systox, Metasystox and Erysit were found to be effective in checking re-establishment of the pest. Intox '8' liquid applied to the soil at the rate of 8 oz. in 100 gallons of water was found to be effective in killing the white grubs feeding on areca roots. Microcop, Coppesan and Fytolan were quite promising in preliminary field trials against Mahali. Fungal infection and insect damage were commonly noticed on freshly fallen tendernuts of various stages of growth. Reduction in shedding of tendernuts and buttons was obtained by spraying I. A. A and a standard insecticide mixture to the bunches. In an experiment in the

rotting of husk by micro-organisms, nuts dipped in one per cent Bordeaux mixture and stored in baskets along with arecanuts husk treated with the same fungicide, remained in a fresh condition for a longer period. Fresh unopened flowers in selected bunches in a private garden were sprayed with different Copper oxychloride formulations with a view to find out incipient infection in arecanut. Mite speciments from this area were identified as *Paratetranychus* and *Raoiella sp.* by the Indian Agricultural Research Institute. A cockchafer beetle from a grub infested areca garden was named as *Lepidiota sp.* Leaf material and soil samples collected from Sagar area were sent to the Central Coconut Research Station, Kayamkulam and the Soil Chemist, Bangalore. Routine laboratory studies with the leafspot and other speciments were continued. Plants in the garden and nursery were protected against mite, yellow leafspot, scales, thrips and soft rot. Green manure plants were treated against Catterpiller attack and the seedlings in the laboratory against Spindle bug.

The Station participated in the World Agricultural Fair and put up exhibitions at various seminars and meetings. A Farmers' Week was celebrated at the Station which attracted large number of grower visitors and officials. Six officials deputed by the different intitutions were trained in all aspects of arecanut cultivation, for varying periods. Advice were given on all enquiries covering various problems of the crop. A total of 3,09,766 seednuts were procured from 2,226 mother palms and supplied to various centres. Ten research papers were written up.

PART II

1. Finance

Statement of Expenditure and Income

1 Total amount sanctioned :—

A	Non-recurring ...	Rs.	1,19,250
B	Recurring ...	Rs.	5,47,726
	Total ...	Rs.	6,66,976

			Non-recurring Rs. nP.	Recurring Rs. nP.
2	Total amount spent as on the last day of the year under report	A Since the inception of the Station upto 31-3-'59.	81,899 76	1,65,010 76
		B For the year under report (1959-'60)	60,356 30	82,705 90
		Total ...	1,42,256 06	2,47,716 66

3 Receipts realised:

		Rs. nP.
A	Since the inception of the Station upto 31-3-1959.	10,927 32
B	During the year under report (1959-'60)	9,551 53
	Total ..	20,478 85

2. Staff

Shri Ghouse Mohiyuddin, Agronomist was in charge of the Station from 1—4—1959 to 27—7—1959. He handed over charge to me and I continued to be in-charge of the Station during the rest of the period under report. Shri Thomas Mathew, Junior Research Assistant reported for duty on 8—4—1959 forenoon. Shri Shama Bhat, Farm Assistant entered on study leave with effect from 11—8—1959, and continued to be on leav- during the rest of the period under report. Shri B. Abdul Aziz, Clerke Typist of the Station was relieved on 22—8—1959 consequent on his appint- ment as Steno-Typist in the Secretariat of the Committee. Shri E. R. Narayanan reported for duty as Fieldman on 9—9—1959 and Shri S. Visweswara Raju as temporary Artist on contract basis for a period of three

months on 17—9—1959. Shri B. Prabhaker Rao, Fieldman was relieved of his duties with effect from 8—10—1959 consequent on his appointment in the Atomic Energy Commission. Shri K. J. Abraham reported for duty as Junior Research Assistant on 10—10—1959 forenoon. Shri N. Tirumaleshwar Bhat, Research Assistant (Agronomy) reported for duty on 4—11—1959. Shri N. Lokayya Naik, Store-Clerk joined duty on 21—12—1959. Five Field Attenders appointed for the Elite Seed Scheme joined their posts in January, 1960. Shri P. Muddappa Gowda, Agronomy Assistant, Regional Arecanut Research Station, Kyatsandra consequent on his transfer to this Station joined duty as Agronomy Assistant on 22-1-1960. Shri K. Thampi, Clerk-Typist reported for duty on 21—3—1960 forenoon. A statement of Staff as on 31—3—1960 is enclosed as Appendix I.

3. Weather conditions

In the absence of a full fledged observatory at the Research Station only rainfall could be recorded. The South West Monsoon became active early and heavy showers were recorded during the months of June and July. The North East Monsoon was of moderate intensity and continued upto the month of December 1959. The rainfall eventhough well distributed was unusually heavy. A total rainfall of 5,150.8 m.m. was received on 150 rainy days during the period under report as against 3,508.3 m.m. rainfall recorded on 120 rainy days during the corresponding period of last year. The month-wise distribution of rainfall recorded during the period is given below:

Month & Year	No. of rainy days	Rainfall in m.m.
1. April 1959 ...	6 ...	44.0
2. May 1959 ...	15 ...	213.2
3. June 1959 ...	25 ...	1,368.4
4. July 1959 ...	31 ...	1,787.0
5. August 1959 ...	27 ...	858.6
6. September 1959 ...	26 ...	603.9
7. October 1959 ...	12 ...	149.6
8. November 1959 ...	6 ...	78.9
9. December 1959 ...	1 ...	30.2
10. January 1960 ...	— ...	—
11. February 1960 ...	— ...	—
12. March 1960 ...	1 ...	17.0
Total ...	150 ...	5,150.8

4. Development of the Farm

(a) Areca garden: Block II (Area 5.50 acres)

All the plants in the garden which were planted during October 1957 with a view to take up progeny studies of the known parent palms and also to conduct certain main field experiments on green manures and on inter and associate crops in areca garden were given a spray with Wettable Sulphur against mite-attack during the months of May 1959 and February 1960. During the month of July 1959 the palms were sprayed with 1% Bordeaux mixture to prevent any fungal infection. The palms were manured with the following.

Green leaf	...	25 lb.	(per palms)
Compost or Farm Yard Manure	...	25 lb.	,,
Groundnut cake	...	½ lb.	,,
Supper phosphate	...	3.9 oz.	,,
Muriate of Potash	...	2.0 oz.	,,
Burnt earth	...	15 lb.	,,

The above manures were applied in the months of October–November in a single dose excepting burnt earth which was applied in March.

The garden was given a digging and weeding during the month of November 1959 and the clods were broken and levelled during January 1960. The exposed stems of the palms were wrapped with dry leaf-sheaths to prevent sun-scorching. The garden was regularly irrigated once in four days during the dry and hot months and the drainage was set right during the heavy monsoon. With a view to raise the level of the garden and also to cover up the exposed roots of the palms, application of fresh soil was taken up during the month of March 1960. Desuckering of banana clumps was attended to as and when found necessary. The morphological data of individual palms were recorded once during the year. The palms were coming up well.

(b) Areca Nurseries:

(i) *Nursery 1957—1959:* This was the third nursery of the Station and a total of 34,736 selected seedlings were distributed among progressive growers during the period under relevent details are given below:

Cost of raising 1½ year old areca seedling :

1.	Number of seednuts sown	47,283
2.	Number of seednuts germinated	42,543
3.	Number of good seedlings available for disposal at the end of 1½ years	34,309
4.	Percentage of quality seedlings over seednuts sown	73%

	ECONOMICS:	Rs.	nP.
1.	Cost of seednuts	2,400	15
2.	**Cultivation expenses**		
	(a) Preparatory cultivation including sowing seednuts	332	63
	(b) Transplanting to secondary nursery	167	52
	(c) Irrigation and drainage	231	09
	(d) Weeding, mulching, shading etc.	334	35
	(e) Plant Protection measures	83	71
	(f) Manures and manuring	627	38
	Total ...	4,176	83
3.	Receipts by sale of seedlings	5,846	59
4.	Cost of raising 1½ year old seedling	00	12
5.	Area covered	2.30 acres.	

(ii) *Nursery 1958—1960*: This was the fourth nursery of the Station. A total of 90,511 selected seednuts were procured from the pre-marked mother palms and were sown for sprouting. Out of this 76,970 seednuts germinated giving the germination percentage of 89.9. A total number of 65,617 quality sprouts were transplanted in the secondary nursery beds which were then mulched with green leaf. A shade crop of banana was planted. During the months of August and September the nursery beds were manured with a total of 5,000 lb. of Farm Yard Manure. The Western and Southern sides of the beds were sown with the seeds of *Crotalaria* to provide additional shade. The seedlings in the nursery were sprayed during November with a mixture of Bordeaux mixture and Folidol to preveut the spread of 'Yellow leaf spots.' During the months of December and January the seedlings were given four rounds of Wettable Sulphur spray against mite-attack. The nursery beds were regularly irrigated once in three days and weeded whenever found necessary. Artificial shade also was provided to the beds which were highly exposed.

(iii) *Nursery 1959—1961*: This was the fifth nursery of the Station. During the period under report, a total of 69,057 selected seednuts were procured from the premarked mother palms and were sown in the primary nursery for germination. The germination beds were watered twice daily and an artificial shade was provided to prevent sun-scorching. Germination was in progress.

(c) Miscellaneous crops:

Besides areca several miscellaneous crops were raised on the Station as subsidiary crops. Following were some of the important ones.

(i) Green manure crops:

Tephrosia purpurea (Kolinji) was raised as pure crop in an area of 1·25 acres and as 1:1 mixture crop of Kolinji and horsegram in an area of 2·15 acres in blocks IV and V respectively. The crops came up satisfactorily.

Crotalaria straiata seeds were sown in an area of 1·77 acres in Block 1. This crop was also raised as shade crop along the margins of the nursery beds in Block V A. A total of 140 lb. of seeds of the same were collected.

Sesbania speciosa was sown along the margins of experimental nursery beds in Block IV A, for providing shade. A total of 51 lb. of seeds were collected. The previous year's stock (balance) of 104 lb. of seeds were sold to the ryots at 25 nP. per lb.

(ii) Green leaf manure:

Gliricidia maculata: A total of 5,375 cuttings were planted along the Farm boundary and on hill-slopes with a view to supplement the green leaf supply of the Station.

(iii) Cashew:

Except ten trees, the usuructory right of all the rest of the trees were auctioned for Rs. 43—50nP. A total of 234½ lb. of quality seeds were obtained from the selected trees. Pits numbering 420 were dug on the hillock and were sown with cashew seeds.

(iv) Coconut:

Out of 235 coconut trees found in the Farm, six old trees died. During the year a total of 7,906 coconuts were harvested. The coconut

trees were manured with 50 lb. of green leaf, 12 lb. of wood ash and 2 lb. of Super phosphate and covered. The crowns of the trees were cleaned before manuring was done. The yield of coconut trees are given below for the past four years for comparison.

Sl. No.	Year	Yield of ripe nuts for the year
1	1955—'56	1,727 Numbers
2	1956—'57	3,545 Numbers
3	1957—'58	4,806 Numbers
4	1958—'59	6,924 Numbers
5	1959—'60	7,906 Numbers

Coconut seedlings: As many as 49 seedlings were replanted to fill up gaps in the pits planted last year. A total of 25 seedlings were planted during the month of September. All the seedlings were manured with 25 lb. of green leaf, 5 lb. of wood ash and 1 lb. of Super phosphate. The seedlings were pot watered regularly during dry and summer months.

Coconut nursery: A total of 238 seed coconuts were sown for raising seedlings and 224 quality seedlings were obtained.

(v) **Fruit plants**:

The different fruit plants such as graft mangoes, guava layers, sapota grafts, custard apple, bread-fruit etc. planted during the previous year were coming up well.

(vi) **Pine apple**:

During the month of August, 150 pineapple suckers were planted along the bund of block V. A.

(vii) **Mentha arvensis (Japanese mint)**:

Three hundred root-cuttings received from Mr. M. Krishna Chetty, Proprietor, Asoka Betelnut, Coimbatore were planted at the Station under three different coditions, (i) in 24 pots, two cuttigs in each with ordinary post-mixture (ii) under partial shade in the inter-spaces of arecanut garden in about 4 cents at a spacing of 2 feet in the row and 3 feet between rows, (iii) in open with the same spacing in about one cent. The cuttings planted in pots recorded 95% establishment whereas those in field and areca garden

recorded only 50% establishment. The cuttings were manured with Farm Yard Manure at the rate of 10 cart loads per acre.

(d) **Permanent improvements:**

Following items of work of permanent nature were taken up during the year under report.

1. (*a*) *Irrigation channel*: The work of the main irrigation channel leading water from the newly installed pump-set to Blocks II, IV and V was taken up during the month of October. An earthern embankment of 575 feet length with an average height of 2'—5" was put up and a cutting to a length of 325 feet with an average depth of 1'—10" was done. Over this, the irrigation channel was laid out with cut laterite stones in cement mortar to a length of 871 feet. The entire length of channel was plastered with cement mortar. The rain water drain intervening across the channel was provided with a culvert of R. C. pipe and the channel was led over this. The sides of the culvert was provided with a rough stone revetment lest the sides should collapse.

(*b*) A nine feet link between the storage tank in Block IV and the irrigation channel was constructrd with cut laterite stones in cement mortar and was plastered.

2 Prevention of flood water entry to the garden: A earthern embankment of 250' x 4' x 2' was put up on the river side near Block I to prevent the entry of flood-water during the heavy rains.

3. Roads, foot-paths and culverts: The main approach from the entrance to the Farm-shed was laid out and completed. A new foot-path between blocks IV and V was laid out and the sides of the bund towards block IV was strengthened by putting up grass sods. A culvert connecting Blocks II and III was constructed with cut laterite stones in cement mortar, and was plastered.

4. Pump-shed: A pump-shed of 12' x 10' was constructed on the Northern side of Block V near the river side and the pump-set installed.

5. Fencing: The Southern and Western sides of the Farm along the river side were fenced to a length of 1,500 feet with barbed-wire fixed on the *Casurina* posts.

6. Levelling: An area of 52 cents was levelled up in Block IV–A by digging out shurb-jungle.

7. Extension of roof to the Farm shed: The roof of the Farm shed was extended in front to a width of 6 feet.

8. Rivetment of river-side: Granite cut stones were being procured for the rivetment work along the Southern side of Block I for prevention of erosion.

(e) Miscellaneous:

1. Library: Fairly large number of important scientific books and journals numbering 74 and 15 respectively were added on to the library during the period.

2. Laboratory equipments: Certain laboratory equipments such as Stage micrometer, Terada Tension meter, Photographic accessories, Glasswares and Chemicals and Meteorological equipments such as dry and wet bulb, maximum-minimum thermometers, whirling phychrometer, soil thermometers, Windvane and Stevenson's screen were procured during the period.

3. World Agricultural Fair: Charts numbering 12 pertaining to the various aspects of arecanut crop such as pests and diseases control, seednut selection and raising quality seedlings lay out and maintenance of gardense, morphology of palms, types and species etc. were prepared and sent for the World Agricultural Fair along with a set of articles made out of arecanut stem and leaf sheath. Selected arecanut bunches and seedlings were also sent to the above exhibition.

4. Other Exhibitions: The Station put up an exhibition at the Regional Arecanut Research Station, Palode in connection with the Farmers' Week there, Arecanut growers' Seminar of Kerala held at Pazhanji and of Mysore held at Shimoga, Agricultural and Cattle Show held at Vittal and at the Regional Arecanut Research Station, Thirthahalli in connection with the Farmers' Week held there.

5 Farmers' Week: The Farmers' week at the Station was celebrated from 20th to 26th of November, 1959. Large number of progressive growers and officials participated in the discussion held on each day of the week. An exhibition convering all aspects of arecanut crop was specially put up for the occasion and a brochure on the activities of the Research Station was got printed and distributed to the visitors. Film shows on arecanut, other crops of interest and topics of educative value were arranged each day. The total of about 5,000 visitors visited the Station during the week and participated in the deliberations.

6. Training: The following officials deputed by different States and institutions were trained at this Station during the year on different aspects of arecanut cultivation.

Name of sponsoring authority	Designation of the trainees	No. of trainees	Period of training
1. Kerala State	Arecanut Development Assistants	two	10 days.
2. Madras State	Assistant Statistical Officer, Madras	One	3 days.
3. Andamans & Nicobar Administration	Arecanut Assistant	One	15 days.
4. Indian Central Arecanut Committee	Pathology Assistant and Agranomy Assistant (Regional Arecanut Research Station, Peechi)	Two	3 days.

7. Advisory work: During the period under report there were very large number of enquiries both from the officials from the State Agricultural Departments, and growers and estate owners on various aspects of arecanut cultivation as well as on the control measures of pests and diseases affecting arecanut.

Advice on selection of site, laying out plots, planting methods to be adopted, provision of shade, selection of planting material, manuring and intercultivation, irrigation and drainage and plant protection measures to be adopted for arecanut crop were given in detail. Large number of disease specimens affected with Koleroga, Anabe, Tendernut fall, Bud rot, Band, Nut splitting gummosis, Collar rot of seedlings, Leaf spot on seedlings, etc., were examined and suitable remedical measures suggested.

Specimens affected by various pests like mite, root grubs, spindle bug, stem borer etc. were examined and control measures for the pests given.

Field demonstration for control of Koleroga, mite and root grub were laid out in different private gardens. A number of gardens in various districts of Mysore and Kerala States were visited by the Staff of the Station and advice on specific problems of the growers given.

The arecanut growers who visited the Station in large numbers, individually as well as under the auspices of different N. E. S. Blocks were

all taken round the farm as well as to private gardens and the various items of research work in progress were explained to them.

8. *Procurement and supply of seed arecanuts* : From mother palms numbering 2,226, seednuts 3,09,766 were procured. Out of this, 69,057 nuts were sown for bulk nursery and 48,674 seednuts were utilised for various experiments. The balance of nuts were supplied to the following centres:

1.	Regional Arecanut Research Station,	Palode	45,375
2.	do.	Mohitnagar	10,500
3.	do.	Tumkur	2,500
4.	do.	Peechi	600
5.	do.	Assam	1,500
6.	Andra Pradesh nursery		40,400
7.	Certified village nurseries		90,000
8.	Others		1,160
		Total ...	1,92,035

9. *Visitors*: Following were some of the important personalities among the large number of official and non-officials who visited the Station during the period under report.

1 Dr. J. S. Patel, Agricultural Commissioner, Govt. of India.

2 Shri L. Venkataratnam, Horticultural Specialist, Directorate of Extension, Ministry of Food and Agriculture, Government of India.

3 Shri V. S. Rangacharlu, Fruit Specialist, Andhra Pradesh.

4 Shri S. P. Saha, Nursery Development Officer, Bihar.

5 Shri S. Narassappayya, B. A., B. L., M. L. C., President, South Kanara Agricultural Co-operative Marketing Society Ltd., Mangalore.

6 Shri K. S. N. Adiga, B. A., B. L., Advocate, Mangalore.

7 Shri B. Seshachar, Secretary, South Kanara Regulated Market Committee, Mangalore.

8 Shri B. S. Varadarajan, Secretary, Indian Central Arecanut Committee, Kozhikode.

9 Shri V. S. Govindarajan, Arecanut Technologist, Central Food Technological Research Institute, Mysore.

10 Shri P. P. Mathew, Manamel Plantation, Puduppadi.

SECTION B. — TECHNICAL PROGRAMME

PART I.

1. Approved Technical Programme for the Entire Period

BOTANY

I Breeding and Genetics of Areca

(1) Collection and maintenence of indigenous and exotic species and types of Areca.

(2) Detailed survey of arecanut gardens to assess genetic variation and select superior types.

(3) Floral biology of areca — flowering behaviours (rate, time and duration of flowering).

II Anatomical Studies

Structure and development of fruit in areca (to be taken up at the Central Coconut Research Station, Kasaragod).

III Physiological Studies

(1) Studies on fruit setting and shedding (to be taken up at the Central Coconut Research Station, Kasaragod).

(2) Salt resistance experiments with areca seedlings (to be taken up at the Central Coconut Research Station, Kasaragod).

(3) Physiological studies on germination of arecanuts (to be taken up at the Central Coconut Research Station, Kayamkulam).

(4) Investigations on different species of Areca under rainfed and irrigated conditions (at the Central Arecanut Research Station, Vittal and all the Regional Arecanut Research Stations).

(5) Pot culture experiment with N. P. K. only (at the Central Coconut Research Station, Kayamkulam).

AGRONOMY

IV A, Standardization of Nursery Practices

(1) **Criteria for seednut selection:**

(a) Effect of position of seednuts in the bunch on their size, germination and vigour of Seedlings.

(b) Influence of age of trees on their seednuts performance.

(c) To determine the frequency of seednuts having different floating habits, factors, influencing such habits and their relative merits.

(d) Studies on the performance of nuts gathered at different stages of maturity for seed purpose.

(e) Comparative merits of seednuts from different bunches of the same tree.

(2) **Sowing experiments :**

(a) Comparative study of different position of seednuts in sowing.

(b) Determination of optimum depth of sowing.

(c) Effect of different spacings on seednut performance.

(d) Standardization of media for sprauting seednuts.

(e) Effect of shade Vs. open on the seednuts germination and growth of seedlings with particular reference to sun-scorch and pest (mite) attack.

(f) Determination of the efficiency of sowing unsprouted Vs. sprouted seeds.

(g) Influence of post harvest treetments and period of sowing on seednut performance.

(h) Relative merits of single, double and treble transplanation of seedlings in the nursery.

(3) Storage trials on seednuts and viability studies.

(4) Standardization of the method of packing seedlings.

(5) Study of seednuts from different arecanut growing tracts for their viability, earliness in germination and vigour of seedlings.

(To be taken at the Central Arecanut Research Station, Vittal and Regional Arecanut Research Stations).

B. CULTURAL EXPERIMENS

(1) Determination of optimum spacing (to be done at Central Arecanut Research Station, Vittal).

(2) Effect of depth of trasplanting seedlings-cum-intervals of irrigation on growth and yield.

(3) Fffects of different methods of intercultivation on the productivity of the palms.

(4) Study of intercrops in arecanut gardens

(5) Comparative studies of different green manure-cum-cover crops for areca gardens.

} To be taken up at the Central Arecanut Research Station, Vittal and Regional Research Stations.

C. MANURIAL EXPERIMENTS

(1) Determination of optimum N. P. K. requirments of:

(a) Seedlings in the nursery for producing vigorous seedlings.

(b) Permanently transplanted seedlings in the garden for producing vigorous, early bearing and productive palms.

(2) Effect of time of application-cum-methods of manuring.

(3) Comparative effects of different doses of lime application over a basel dose of manure to bearing palms (to be taken up at the Central Arecanut Research Station, Vittal).

Chemical Studies:

V. (1) Detailed survey of soils of different arecanut growing tracts, collection of samples for chemical and machanical analysis

(2) Analysis of plant parts and soils for determination of uptake of N. P. K. by palms and exhaustion of soils

(3) Chemical analysis of irrigation water

} To be taken up at the Central Coconut Research Station. Kasaragod.

Investigation on diseases and pests

VI. (1) Survey of diseases for location of areas of high incidence of diseases and pests (to be carried out under the direction of Dr. K. P. V. Menon).

(2) Trial with proprietory fungicides and insecticides, to find effective control measures for all diseases and pests.

Crop weather study

VII. (1) To record meteriological data on rainfall, maximum and minimum temperature, humidity, soil temperature and moisture, sun-shine and wind velocity.

(2) Influence of seasonal and geographical factors on the time and nature of flowering and fruiting.

PART II

2. Detailed programme of work for the year 1959-'60

Item No. in the Technical Programme.	Name of the Experiments.	Year of commencement.	Year of conclusion.	Remarks
1	2	3	4	5
	BOTANY			
	I. Breeding and genetics of areca			
(1)	Collection and maintenance of indigenous and exotic species and types of areca	1958-59	To be continued for several years	
(2)	Detailed survey of arecanut gardens to assess genetic variation and select superior types	1958-59	do	
(3)	Floral biology of areca-flowering behaviour (Rate, time and duration of flowering).	1958-59	1960-61	

1	2	3	4	5
II	**Anatomical Studies**			
	Structure and development of fruit in areca	1959—60	—	
III	**Phisiological Studies**			
	Investigations on different species of areca under rain-fed and irrigated conditions	—	—	

AGRONOMY

A. Standardization of Nursery Practices

1. Criteria for seednuts selection

(a)	Effect of position of seed-nuts in the bunch on their size, germination and vigour of seedlings ...	1958—59	1960—61	
(b)	Influence of age of trees on their seednut performance	1959—60	1961—62	
(c)	To determine the frequency of seednuts having different floating habits factors influencing such habits and their relative merits ...	1959—60	1961—62	
(d)	Studies on the performance of nuts gathered at different stages of maturity for seed purposes ...	1959—60	1961—62	
(e)	Comparative merits of seed-nuts from different bunches of the same tree ...	1959—60	1961—62	

1	2	3	4	5
2.	**Sowing experiments**			
(a)	Comparative study of different positions of seednuts in sowing ...	1958—59	1960—61	
(b)	Determination of optimum depth of sowing ...	1959—60	1961—62	
(c)	Effect of different spacing on seedling performance...	1959—60	1961—62	
(d)	Standardization of media for sprouting seednuts ...	1959—60	1961—62	
(e)	Effect of shade Vs. open on the seednut germination and growth of seedlings with particular reference to sun-scorch and pests (mites) attack ...	1959—60	1961—62	
(f)	Determination of the efficacy of sowing unsprouted Vs. sprouted seeds. ...	1958—59	1960—61	
(g)	Influence of post harvest treatments and period of sowing on seednut performance. ...	1959—60	1961—62	
(h)	Relative merits of single, double and treble transplantation of seedlings in the nursery. ...	1959—60	1961—62	
3	Storage trial of seednuts and viability studies ...	1958—59	1960—61	
4	Standardisation of the method of packing seedlings...	1958—59	1961—62	

1	2	3	4	5
5	Study of seednuts from different arecanut growiug tracts for their viability, earliness in germination and vigour of seedlings ...	1959—60	1961—62	
	B. Cultural experiments			
(1)	Determination of optimum spacing ...	1958—59	To be continued for several years	
(2)	Fffect of depth of transplanting seedlings cum intervals of irrigation on growth and yield ...	1959—60	do	
(3)	Effect of different methods of intercultivation on the productivity of palms ...	1959—60	do	
(4)	Study of intercrops in arecanut gardens ...	1959—60	do	
(5)	Comparative studies of different green manure-cum-cover crops for areca gardens ...	1959—60	do	
(6)	Investigations on different types of areca under rainfed and irrigated conditions...	1959—60	do	
	C. Manurial experiments			
(1)	Determination of optimum N.P.K. requirements of:..			
(a)	Seedlings in the nursery for producing vigorous seedlings ...	1959—60	1961—62	

1	2	3	4	5
	(b) Permanently transplanted seedlings in the garden for producing vigorous, early bearing and productive palms ...	1959--60	For a number of years	
2	Effect of time of application-cum-method of manuring ...	1959—60	For a number of years	
3	Response of seedlings of varied vivgur to different levels of manuring. ...	1959 60	1961—62	
4	Influence of manuring the seedlings at different levels on their establishment in the main field ...	1959—60	1961—62	
5	Comparative effect of different doses of lime application over a basal dose of manure to bearing palms...	1959—60	For a number of years	

INVESTIGATION ON PESTS AND DISEASES

VI 2 Trial with Proprietory fungicides and Insecticides to Find Effective control Measures for all Diseases and pests

1	Environmental factors influencing the incidence of mites (pests on leaves) and the methods of control ...	1959—60	1961—62	
2	Trial with effective soil incecticides on the control of grubs (pest on roots) ...	1959—60	1961—62	
3	To find cheap and effective fungicides for Koleroga or Mahali ...	1959—60	1963—64	

1	2	3	4	5
4	To investigate causes and methods of control for button shedding and tender nut fall ..	1959—60	1961—62	
	CROP WEATHER STUDY			
VII (1)	To record meteorological data on rainfall, maximum and minimum temperature humidity, soil temperature and moisture, sunshine and wind velocity ...	1959—60	To be contd. till the Station exists	
2	Influence of seasonal and geographical factors on the time and nature of flowering and fruiting ...	1959—60		

PART III

3. Detailed Programme of work for the Year 1960—61

The above programme is enclosed as Appendix II

SECTION C. RESULTS

4. BOTANY

I. Breeding and Genetics of Areca:

(1) Collection and maintenence of indigenous and exotic species and types of Areca :

Out of the four seedlings introduced at the Station from Andamans, Nicobar and Indonesia earlier, three seedlings viz., one of Andamans and two of Indonesia flowered at the age of seven. All the plants were found to be similar to the local *Areca catechu* Linn. in their morphological features excepting in the case of Indonesia seedlings which had a shorter internodal distance of 3". The female flowers of one of the plants of Indonesian variety were found to be yellow in colour. The flowers of the Andaman variety were found to have a very strong aroma. The female flower

production in earlier inflorescences of Andaman variety was more than in local or Indonesian palms.

Over and above the seventeen varieties including the unclassified varieties received from foreign countries during previous year, three unclassified varietites were received from Aden, Singapore and British Solomon Islands.

The seedlings raised from the consignments received during the previous year were transplanted in the secondary nursery. All the species and types excepting *Areca triandra* got established quickly. *Areca triandra* was found to take longer time to get acclamatized to this region and the percentage of establishment was only 65.9 under the best of conditions against 100% establishment in the case of other species. Seedlings of the varieties from Saigon and Ceylon were found to be in general more vigorous than the rest. The leaves of "Rata Puwal" of Ceylon were found to be non-splitting. A comparative statement of germination and morphological characters of the seedling of these exotic varieties is furnished in Table I.

TABLE I.

(Morphological characters of seedlings of exotic species and types).

It was intended to use such of the species having desirable characters in various hybridization programmes after reclassifying them.

(2) Detailed survey of arecanut gardens to assess genetic variation and select superior types:

The study of the sixty four (64) ecotypes collected from fifteen centres of the States of Kerala, Mysore and Bombay was continued. The germination data gathered was statistically analysed. The mean percentage of germination as well as their distribution with reference to length and breadth of nuts are furnished in Table II.

TABLE II

(Distribution of Ecotypes and their percentage of germination).

From the table it would be seen that the seen seednuts from the Wynad tract of Kozhikode district gave low germination. This is in confirmity with the findings of the previous years. The sprouts were

TABLE I.

Morphological characters of seedlings of exotic species and types

Sl. No.	Country of distribution	Name of species	Year of introduction	Height ems.	No. of Leaves	Girth cms.	Remarks
1	Suva (Fiji)	*Areca catechu*	June 1958	68.7	5	10.2	
2	Mauritius	A. *triandra*	July 1958	21.0	2	2.7	High mortality of seedlings
3	Peking (China)	*Areca*	Sept. 1958	71.3	6	6.8	
4	Papua and New Guinea	a. A. *catechu* Linn	Sept. 1958	...	—	...	Not germinated
		b. Wild sp. of *Areca*	Nov. 1959	...	—	...	... ...
		c. *Areca* sp.	Nov. 1959	...	—	...	... ...
5	Ceylon	a. *Arecanut* var *Hamban*	Oct. 1958	63.4	5	6.1	
		b. *Arecanut* var *Ratapuwak*	Jan. 1959	62.0	4	7.4	Leaves non-splitting
6	Indonesia	a. *A. triandra* var bancana Scheff	Oct. 1958	24.3	2	2.9	High mortality of seedlings
		b. *A. triandra* Roxb. var	Oct. 1958	17.7	3	2.3	—do—

		c. *Areca macrocalyx* Zipp	Oct. 1958	...	—	...	Not germinated
		d. *Areca* species	Oct. 1958	57.5	5	6.6	
		e. *A. catechu* Linn	Oct. 1958	...	—	...	Not germinated
		f. *A. catechu* var. alba. Bl.	Oct. 1958	60.5	3	3.7	
7	Saigon	a. Cau Hon Day (Red)	Dec. 1958	80.5	6	8.2	Good growth
		b. Cau Hon Day (White)	Dec. 1958	86.4	6	7.7	Good growth
		c. Cau Vu Bo (White)	Dec. 1958	96.1	6	8.9	Good growth
8	Aden Protectorate	Unspecified	Feb. 1959	...	—	...	Not germinated
9	Singapore	Arecanuts	Mar. 1959	85.7	5	7.9	Sprouted in transit
10	Br. Solomon Is	Arecanuts	April 1959	32.0	3	3.4	
11	Local	Arecanuts	Dec. 1958	67.1	5	7.5	

TABLE II

Distribution of Ecotypes and their percentage of germination

Sl. No.	Length/Breadth range in cms.	TRACT														
		Palode	Edamon	Pengamukku	Kumaranellur	Kurmathur	Kottakkal	Waynad	Manjeri	Mani (S. Kanara)	Sringeri	Kallahalla (Thirthahalli)	Keladi (Sagar)	Sirsi (N. Kanara)	Dapoli (Ratnagiri)	Diviagar (Shrivardhan)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
1	2.5–3.4/												(1)*			
	2.5–2.9												100†			
2	2.5–3.4/									(7)		(5)		(4)		
	3.0–3.4									100		98		100		
3	2.5–3.4/													(2)		
	3.5–3.9													88		
4	2.5–3.4/															
	4.0–4.4															

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
5	3.5–4.4/										(1)	(1)	(2)			
	2.5–2.9										98	98	99			
6	3.5–4.4/										(2)	(2)		(5)		
	3.0–3.4										89	88		92		
7	3.5–4.4/									(2)		(3)		(1)	(4)	(3)
	3.5–3.9									95		49		95	96	98
8	3.5–4.4/									(8)			(3)	(3)		(1)
	4.0–4.4									96			96	85		98
9	4.5–5.4/							(2)			(3)	(7)				
	2.5–2.9							91			98	98				
10	4.5–5.4/	(1)	(1)					(3)	(1)		(4)	(4)			(2)	
	3.0–3.4	99	90					86	96		97	97			99	
11	4.5–5.4/		(2)	(1)	(3)	(1)	(3)		(3)	(1)		(6)			(1)	(2)
	3.5–3.9		96	97	96	94	97		91	95		98			97	97

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
12	4.5–5.4/			(2)	(2)		(2)			(5)						(4)
	4.0–4.4			92	96		99			94						92
13	5.5–6.4/															
	2.5–2.9															
14	5.5–6.4/	(2)	(3)					(1)	(4)	(3)						
	3.0–3.4	96	96					70	94	100						
15	5.8–6.4/	(3)	(4)	(3)	(4)	(2)	(4)			(4)					(3)	
	3.5–3.9	100	94	95	90	96	97			85					98	
16	5.6–6.4/			(4)	(1)		(1)		(2)	(6)						(5)
	4.0–4.4			98	92		95		94	96						95

*Ecotype
†Germination percentage

transplanted in the secondary nursery on the same experimental design after recording the morphological characters of the seedlings.

The following twentyfive (25) ecotypes marked out during the previous year were gathered from eight (8) centres of Kerala and Mysore States.

Ecotypes—(1959-1961)

Sl. No.	State	District	Tract	Number of types
1.	Kerala	Kozhikode	Manjeri	3
2.	-do-	-do-	Kottakkal	4
3.	-do-	Cannanore	Kurumathur	1
4.	Mysore	Shimoga	Kallahalla (Thirthahalli)	6
5.	-do-	-do-	Keladi (Sagar)	2
6.	-do-	South Kanara	Mani	5
7.	-do-	Chickmagalore	Birur	2
8.	-do-	-do-	Sringeri	2
Total	Two States	Five Districts	Eight tracts	25 ecotypes

The above types were sown on a 5 x 5 double lattice design with two replications. Thirty seednuts of each type were sown under each replication. Germination counts were being maintained. A few nuts from each type were sun-dried for "Chali" for finding out comparative merits.

3) **Floral Biology of Areca**:

(i) Flowering behaviour (Rate, time and duration of flowering): The above studies were continued during this yer also and it was observed that (a) a majority of the male flowers open between 6 A. M. and 10 A. M. and (b) the female flowers open between 2 A.M. and 10 A.M. Anthesis was found to start at 6 A. M. These observations confirmed the previous years findings. Further, it was found that the age of the palms viz., young, middle and old gave no marked difference in flowering behaviour such as phase of male and female flowers.

With a view to study the extent of selfing taking place in arecanut, all the twelve inflorescences were bagged with kora cloth bags and it was

observed that excepting in the case of two palms where there was overlapping of the male and female phase there was no fruit-set. The female flowers start shedding from 7th day of opening and get completely shed within a period of 16 to 22 days. In the case of 16% of palms where there was overlapping of the phases, there was fruitset ranging from 3.5 to 5·0% It is therefore evident that even though cross pollination was the rule in arecanut, selfing of flowers to a very small extent of 0·8% of the total number of nuts produced could take place. The extent of selfing taking place by the overlapping of the male and female phase of the two bunches of the same palm however remained to be worked out.

(*ii*) *Influence of self, cross and open pollination of selected palms on fruitset, germination of seednuts and vigour of seedlings*: This experiment which was taken up during the previous year with a view to find out how far treatments such as (i) self pollination, (ii) cross pollination with a palm of a distant garden and (iii) cross pollination with a palm of the same garden compare with open pollination in regard to fruitset etc. was continued. The hybrid seednuts collected from the above crosses and sown on a randomized replicated design during the previous year gave the following germination.

No.	Treatments	Percentage of germination
(i)	Self pollination	82·0
(ii)	Cross pollination with a palm of a distant garden	81·0
(iii)	Cross pollination with a palm of the same garden	82·0
(iv)	Open pollination	79·8

The above data indicated that self pollinated nuts gave the highest percentage of germination. Prior to planting the sprouts, relevent morphological characters were noted.

The hybridization was repeated during the year with the same treatments. The percentage of fruitset under different treatments is given below:

S. No.	Treatments	Percentage of fruit-set
(i)	Self pollination	26.4
(ii)	Cross pollination with a palm of a distant garden	17·4
(iii)	Cross pollination with a palm of the same garden	36·4
(iv)	Open pollination	39·6

Open pollination gave the highest fruit-set and cross pollination with a palm of a distant garden gave the least fruit-set. The above observations were in confirmity with the previous years findings.

A total of 2,672 (two thousand six hundred and seventy two) nuts under the above crosses were gathered and sown at the Station during the period under report.

III Physiological Studies:

(*1*) *Studies on fruit setting and shedding*: Preliminary trials taken up during 1959 with a few spray applications to control shedding of buttons and tendernuts gave the following results.

No.	Treatment	Concentration	Method of application	No. of application	Percentage of drops
1	2, 4–D	20 ppm	Spray	7	59.0
2	IAA	20 ppm	Spray	7	26.9
3	Standard insecticide and fungicide mixture	Per gallon: Shell-copper 13.5 gms. + Endrex 7.5 cc. + Tenac adhesive 4.5 c. c.	Spray	7	18.0
4	2, 4–D + IAA	20 ppm each	Spray	7	82.3
5	"Chogaru" (Arecanut extract)	4%	Spray	7	84.7

6	Urea	0.5%	Spray	7	84.2
7	Control (No treatment)	...	...	...	73.5

Spray applications with standard insecticide and fungicide mixture and IAA alone, gave a low shedding of 18% and 26.9% respectively. Examination of shed buttons showed fungal growth at the stigmatic portion. It was in interesting to note that during the year, most of the fallen nuts were found to be attacked by an insect at the calyx portion of the tendernuts.

The experiment was modified to include the applications of harmones, fungicide, insecticide and manures, alone and in combinations and laid out on a randomized replicated design with the following sixteen treatments in collaboration with Agronomy and Pathology sections.

S. No.	Treatments	Dose and other details
1	IAA	20 ppm
2	2, 4–D	20 ppm
3	Endrex	One ounce in 5 gallons of water
4	Coppesan	1 lb. per 20 gallons of water (0.5%)
5	Urea	0.5% or 1 lb. in 20 gallons of water
6	2, 4–D + Coconut water ...	20 ppm. fortified in coconut water
7	Moderate N.P.K. (40 lb. N., 50 lb. P_2O_5 75 lb. K_2O per acre.) ...	Per palm in two split doses: (i) Calcium ammonium nitrate 226 gms. (ii) Super phosphate 200 gms. (iii) Muriate of potash 114 gms.
8	Moderate N. (40 lb. N per acre.)	Per palm in two split doses: Calcium ammonium nitrate 226 gms.
9	Moderate P. (50 lb. of P_2O_5 per acre)	Per palm in two split doses: Super phosphate 200 gms.
10	Moderate K. (75 lb. of K_2O per acre)	Per palm in two split doses: Muriate of potash 114 gms.

11	Heavy N.P.K. (100 lb. of N. 80 lb. of P_2O_5 150 lb. of K_2O	Per palm in two split doses: Calcium ammonium nitrate 452 gms. Super phosphate 400 gms. Muriate of potash 228 gms.
12	Heavy NPK (100 lb., 80 lb. 150 lb. per acre) + 2, 4–D (20 ppm).	Manure applied per palm in two split doses spray with 2, 4–D (20 ppm).
13	Heavy N.P.K: (100 lb. 80 lb. 150 lb. per acre) + 2, 4–D (20 ppm) fortified in coconut water	Manure applied per palm in two split doses spray with 2, 4–D (20 ppm) fortified in coconut water
14	Heavy N.P.K. (100 lb. 80 lb. 150 lb. per acre) + I A A (20 ppm)	Manure applied as above spray with IAA (20 ppm.)
15	Metasystox (spray) ...	1 lb in 100 gallons of water
16	Control	No treatments

The spray applications were to be taken up once in every fortnight. The freshly fallen buttons and tendernuts were to be collected once in a week for examination.

(3) **Physiological studies on germination of arecanuts:**

In an experiment conducted at the Station with three treatments consisting of husking, half–husking and unhusking, it was observed that completely husked nuts took lesser number of days for germination. It was thought worth trying some of the growth promoting harmones in combination with these mecanical treatments for further reducing the duration for germination. The treatments consisted of completely husked and half–husked nuts treated with IAA, IPA., NAA and 2,4—D for 15 minutes and 30 minutes. The nuts at the rate of twenty five per treatment were sown in specially prepared rectangular pits filled with fine sand on a 5 x 5 double lattice design with two replications. The rate of germination and the time at which the first leaf emerges out would be recorded.

OTHER STUDIES

(1) **Study of Hybrid vigour and its utilisation: Production of Inbred Lines:**

Since arecanut is a cross fertilized crop, the existing palms are highly heterozygons in their genetis constitution. In order to take up hybridization programme, it is highly necessary that a pure line is built up by inbreding. For this purpose, twelve middle aged palms with desirable characters were marked out in a private garden and four thousand and seventy nine female flowers self polinated under controlled conditions.

(2) **Elite Seed Study: Production of Elite Seeds:**

In order to find out to what extent Areca pollen travels through the agency of wind, microslides smeared with Mayer's Egg Albumen were exposed by means of Aeroscopes (pollen traps) at uniform height of 35 feet and at two furlongs distances from an isolated private garden at Muda Village, B. C. Road. Slides inside the Aeroscopes were put up in all the four directions over a distance of one mile radius alround the garden. The slides were collected from the Aeroscopes at an intervals of 12 hours to begin with and pollen catch recorded. The direction of wind was also noted as indicated by a Windvane fixed at the centre of the garden. This study was initiated as a preliminary to the production of elite seeds.

(3) **Preliminary studies in the segregation of charactors:**

The study was initiated to determine how far and to what extent the characters like number of bunches and leaves, nut set, internodal distance, girth of the palm, size, colour and weight of the nuts and yield were being retained by the projenies. The seedlings raised and planted at the Station in Block II were being studied for the above characters. The mother palm and seedling character would be compared and the extent to which the characters were transmitted to the projenies would be worked out.

(4) **Study of the Morphology of Arecanut palm:**

The general morphology of Arecanut palm was studied in detail and the information gathered on the same are given below:

(a) *Germination and root production:* The study on the process of germination revealed that the embryo which was conical in shape measuring on an average 0.52 mm. x 0.40 mm. was buried in the endosperm at the clayx end of the nut and developed along two directions. The upper half

carried the primordia of the shoot and the root and grew up wards into a creamy white fleshy circular disc similar to a button head while the lower half simultaneously developed into a haustorium or the 'sucker' which represented the only cotyledon. The top of this fleshy body was wavy with two projections one of which grew into a thick beaklike projection enclosing the plumule and the other which got shifted to one side during the growth of the plumule, emerged out as the first root. This took place in about 30 days after sowing. The root at this stage was about 0.6 cm. in length. The beaklike projection split opened and the small shoot which emerged out was visible above the husk in another 20 days. During this period two more roots were produced from the same region where from the first root is produced. The top of the small shoot again split opened producing a similar shoot as the first from which emerged the first leaf in about 90 days after sowing. There were five roots at about this stage, the later forming roots emerging from the points opposite to the emergence of the first root. The first root at this stage measured about 24 cms. The rootlets of various sizes were also formed. The sequence of root production, length of the first root and size of the cotyledon for the first 90 days of sowing of nuts is given in table below:

TABLE III

Germination and root production

No. of days After sowing	SIZE OF THE COTYLEDON		No. of roots	Length of the first root in cm.
	Length in mm.	Breadth in mm.		
10	...	...	...	...
20	0.51	0.43	...	...
30	1.12	0.78	1	0.67
40	1.75	0.95	2	2.40
50	2.18	1.10	3	5.10
60	2.27	1.15	3	9.20
70	2.30	1.14	4	13.72
80	2.28	1.16	5	18.81
90	2.31	1.18	5	23.50

From the above, it would be seen that the cotyledon grew almost to its full size by about 50 days after sowing i. e. the time at which the sprout was visible outside the husk.

(b) *Spread of roots*: With a view to find out the number of roots present in the bole, palms of different age groups were dug out and their bole examined, and the same was found to be about 165 in a tree aged about 10 years, about 385 in a tree aged about 35 years and about 78 in a tree aged about 60 years. In old trees the earlier formed roots were found to decay. The main roots measure 195.9 cms. in length on an average, the maximum length recorded being 230 cms. They were fairly uniform in thickness and was 13.4 mm. in diameter on an average. The main roots produced much less of branch roots and rootlets. Normally roots were not formed very much above the bole region even when buried in the ground.

In order to study the vertical and lateral spread of roots, the roots in a vertical column of one foot width to a depth of 4 feet were studied from a distance of 5 feet away from the palm in all the four quadrants. The data gathered is given in the table below:

TABLE IV

Number of roots per sq. foot at varying depths below ground level for varying distences from the palm

Depth in feet from ground level	Distance from the palm.				
	1'	2	3'	4'	5'
1	29.50	10.00	2.00	2.25	2.25
2	57.75	11.25	3.00	2.25	2.50
3	17.75	6.50	0.50	0.50	0.75
4	1.50	0.75	0.50	0.75	0.50

From the above table it was seen that the maximum root concentration was within the first two feet depth from the ground level within a radious of two feet from the palm.

(c) *The stem*: In the case of young palms (about 10 years) the girth was found to vary from 38.1 cm, to 60.3 cm. with a mean of 49.6 cm. The mean girth of a middle aged palm (35 years) at the bottom, middle and

top portions of the stem was 41.0 cm., 34.0 cm. and 30.0 cm. respectively. The average number of leaves shed per year was 6.4, but in the case of young vigorous palms it went upto 8 or 9. The internodal distance at 10th internode of young palms were found to vary from 13.9 cm. to 34.3 cm, with a mean of 24.3 cm. Thereafter, there was a gradual reduction in the rate of growth as the age advanced. The mean internodal distance at the bottom, middle and top portions of the stem of a middle aged palm was 10.5 cm., 6.8 cm., and 1.7 cm. respectively. The average length of the stem was found to be 17.6 meters. Palms attaining a height of 30 meters were also not uncommon.

(d) *The leaf*: A one year old seedling was found to have normally 4 to 5 leaves, two year 6 to 7 and three year 7 to 8. In adult trees, the number of open leaves on the crown was found to range between seven and twelve with a mean of 9.6. In the arrangement of leaves on the crown, the 6th leaf stood over the first with a genetic spiral of two circles and the eleventh leaf over the 6th with a similar spiral. Thus, there were five rows of leaves ("Orthostichies") placed at 2/5 distance of the circle, giving a phyllotaxy of five ranked or 'Pentastichous' with an angular divergence of 144°. The longivity of the leaf after its emergence was about two years. The leaf sheath measured on an average 54 cms. in length and 15 cms. in breadth. The average length of the leaf was found to be 1.65 meters. The mean total of leaflets situated on either side of the leaf was 70. The leaflets that were near the base measure on an average 62.5 cms. in length and 7.0 cms. in breadth. These near the apex were 30.0 cms. in length and 5.8 cms. in breadth whereas in the centre they were 68.0 cms. in length and 7.0 cms. in breadth.

(5) *Verification of country of origin*: The twenty samples of cured arecanuts received from the Arecanut Technologist along with the four unspecified samples whose country of origin had to be determined were analysed based on the morphological features of the nuts viz , length, breadth, weight, shape, colour, volume, hardness, endosperm character, taste and embryo. Mycroscopic examination of sections of kernel did not reveal much difference in their anatomy.

AGRONOMY

IV A Standardisation of Nursery Practices

1. Criteria for seednut selection :

(a) *Effect of age of trees, order of bunches and position of seednut in the bunch on seednut performance* : This combined experiment (items a, b and c) which was laid out during the year 1958 — 59 in order to study the effect of (i) age of mother palms viz. young, middle and old (ii) order of bunches viz. first, second and third, and (iii) position of seednut in the bunch viz. top, middle and bottom on seednut performance was continued during the year. A 3^3 factorial confounded design in 9 plot blocks replicated twice had been adopted with thirty nuts sown under each treatment Germination counts of the nuts were recorded regularly. After completion of the germination of the nuts, twenty sprouts in each treatment were transplanted in the secondary nursery for further observations. The mean figures of number of days taken for starting germination and number of days taken to complete germination were worked out. The mean data is furnished below in Table V.

TABLE No. V

Mean number of days taken to start and complete germination

S. No.	Details of treatment (Main effects).	Mean No. of days taken to start geramination	Mean No. of days taken to complete germination after commencement
1	Young palm (a_0) ...	59.0 ...	43.1
2	Middle aged palm (a_1) ...	58.2 ...	32.9
3	Old palm (a_2) ...	54.4 ...	40.3
4	First bunch (b_0) ...	70.0 ...	35.0
5	Second bunch (b_1) ...	54.8 ...	36.2
6	Third bunch (b_2) ...	46.4 ...	45.1
7	Top portion of the bunch (p_0) ...	56.8 ...	37.1
8	Middle portion of the bunch (p_1) ...	56.7 ...	39.2
9	Bottom portion of the bunch (p_2) ...	57.7 ...	40.0

From the above, it might be seen that there was not much difference in the number of days taken to start as well as to complete germination when the nuts were gathered from different portions of the same bunch. Nuts from middle aged palms completed germination quickly.

The germination data gathered was statistically analysed and the results are tabulated below in Tables VI and VII.

TABLE No. VI

Mean germination percentage of seednuts in respect of main effects

S. No.	Main effect	Mean germination percentage	Significant or not	C. D.	Conclusion
1	Young palm (a_0)	89.27			
2	Middle aged palm (a_1)	99.03	Yes.		
3	Old palm (a_2)	95·93	P = 0.01	4.09	$a_0a_1a_2$
4	First bunch (b_0)	94.96	...	...	...
5	Second bunch (b_1)	95.01	No	...	...
6	Third bunch (b_2)	94.27	P = 0.05	...	...
7	Top portion of bunch (p_0)	94.27	...	...	...
8	Middle portion of the bunch (p_1)	94.27	No	...	...
9	Bottom portion of the bunch (p_2)	95.70	P = 0.05	...	...
10	General mean	94.74	...	...	...
11	Percentage of standard error to general mean	6.19	...	...	...
12	Standard error of the experiment	5.87	...	...	...

TABLE VII

Analysis of varience

	Source of variation		Sum of squares	D. F.	Mean square	Varience ratio
1	Blocks		88.416	5	17.683	0.513
2	Main effects of a.		895.558	2	447.779	12.991*
3	do b.		6.086	2	3.043	0.088
4	do p.		24.558	2	12.276	0.356
5	First order interaction	AB	324.062	4	81.015	2.350
6	do	BP	80.036	4	20.009	0.580
7	do	AP	35.196	4	8.799	0.255
8	Second order interaction replication	I.	51.927	2	25.963	0.753
	do	II.	218.895	2	109.447	3.175
	Y. Component		20.985	2	10.492	0.304
	Z. Component		21.902	2	10.951	0.318
9	Error		723.851	21	34.469	
	Total ...		2,491.474	52		

*Significant at 1% level.

It could be seen that the percentage of germination of seednut collected from different age groups alone was significant. Though the performance of nuts collected from middle aged and old palms were not significantly different, nuts of young palms were decidedly inferior to nuts collected from other two age groups. There was no visible effect on the position of seednut in the bunch and order of bunches in respect of germination.

The experiment was repeated on the same design with four replications for confirmation. The germination of the nuts were in progress.

(c) *To determine the frequency of seednuts having different floating habits, factors influencing such habits and their relative merits.* Seed arecanut when allowed to float in water show different floating habits such as vertical slanting and horizontal. The growers usually select vertically

floating nuts. This experiment was laid out to find out the influence of such floating habits on seednut performance. The experiment was laid out on a 3 x 8 randomised replicated design with three treatments viz. (1) vertically floating nuts (2) slanting nuts (3) horizontal nuts. Thirty nuts were sown under each treatment. The germination counts which were being recorded from the 30th day of sowing were in progress.

(d) *Studies on the performance of nuts gathered at different stages of maturity for seed purposes.* A randomized replicated trial with 5 replications and 6 treatments consisting of 8, 8½, 9, 9½, 10 and 10½ months old seednuts laid out during the previous year was continued in order to study the performance of these nuts from the point of view of seed quality Thirty seednuts were sown under each treatment. The germination data gathered was statistically analysed and the results are presented below in Tables VIII and IX.

TABLE VIII

Mean figures of germination percentage and time taken to start and complete germination.

S. No.	Maturity of nuts	Germination percentage	No. of days taken to start germination	No. of days taken to complete germination
1	8 months old nuts	26.74	63.0	23.0
2	8½ months old nuts	77.32	62.0	87.6
3	9 months old nuts	77.32	62.0	36.0
4	9½ months old nuts	83.96	59.6	44.8
5	10 months old nuts	85.96	56.6	48.4
6	10½ months old nuts	93.14	50 8	67.2
7	Significant or not	Yes.	...	...
8	Critical difference P>0.01	21.57	....	...
9	General mean	74.05	...	...
10	Percentage of standard error to general mean	21.93	...	...
11	Standard error of experiments	16.24	...	...

TABLE IX

Analysis of varience

S. No.	Source of variation	Sum of squares	D. F.	Mean square	F.
1	Block	6360.502	4	1590.125	6.024*
2	Treatment	14367.890	5	2873.578	10.886*
3	Error	4751.602	18	263.978	...
	Total ...	25,479.994	27		

*Significant at 1% level.

Conclusion : 1 2 3 4 5 6

Statistical analysis revealed that the germination percentage of eight months old seednuts was significantly lower than the other treatments. There was no significant difference in the germination of seednuts collected from 8½ months, 9 months, 9½ months, 10 months and 10½ months old seednuts. The time taken for commencement of germination was more in case of immature nuts than the matured nuts. Since the percentage of error to the general mean in the experiment tended to be large it was proposed to repeat the experiment with more number of nuts per treatment.

After completion of germination the sprouts were transplanted in the secondary nursery on a 4 x 4 latin square design. The first two treatments were deleted in the secondary nursery due to non-availability of sufficient number of sprouts.

The experiment could not be repeated during the year since the nuts earmarked for the purpose were severely attacked by Koleroga in spite of timely spraying.

(*e*) *Comparative merits of seednuts from different bunches of the same tree*: This experiment was laid out in order to investigate the comparative merits of seednuts gathered from different bunches of the same tree including the fourth bunch from the point of view of germination and quality of seedlings. The experiment was laid out on a 4 x 4 latin square design with four treatments consisting of seednuts collected from first, second, third and fourth bunches of the same tree. Fifty seednuts were sown in each

treatment. Germination counts of the nuts were recorded regularly and the data statistically analysed. After completion of the germination the sprouts were transplanted in the secondary nursery for further observations. The mean figures of germination percentage, number of days taken to start germination and the number of days taken to complete germination of the nuts are presented below in Tables X and XI.

TABLE X

Mean figures of germination percentage

S. No.	Bunches	Germination percentage	No. of days taken to start germination	No. of days taken to complete germination
1	Fist bunch	97·50	62·00	40·0
2	Second bunch	94·65	47·00	47·0
3	Third bunch	96·67	43·75	39·0
4	Fourth bunch	94·67	37·50	27·5

TABLE XI

Analysis of varience

Source of variation	Sum of squares	D. F.	Mean square	F.
Rows	81·5	3	27·2	2·1
Columns	24·5	3	8·2	0·6
Treatments	11·5	3	3·8	0·3
Error	51·5	4	12·9	—
Total	169·0	13		

The analysis of germination percentage showed that there was no significant difference in the effects of seednut collected from different bunches of the same tree.

The experiment was repeated on a 4 x 8 randomised block design for confirmation.

(f) Other Studies

(*i*) *Experiment to correlate the weight of seednuts with their germination and vigour of seedlings*: This experiment which was first laid out during 1956—57 in a randomised replicated design with three treatments consisting of seednuts weighing (1) 31 grams to 35 grams (2) 36 gms. to 40 gms.

and (3) 41 gms. to 45 gms. was continued during the year. The germination counts (1959—60) were recorded and the same analysed statistically. The results are given below in Tables XII and XIII.

TABLE XII

Germination

	Treatments weight of seeds	Average per cent of germination	No. of days taken to start germination	No. of days taken to complete germination
1	31—35 gms.	94.96	47.00	77.00
2	36—40 gms.	96.22	47.00	77.50
3	41—45 gms.	97.12	46.50	80.25

TABLE XIII

Analysis of varience

Source of variation	Sum of squares	D. F.	Mean sum of squares	F.
Block	192.96	7	27.57	4.65†
Treatment	14.14	2	7.07	1.19
Error	77.05	13	5.93	...
Total ...	284.15	22		

†Significant at 5% level.

From the above, it might be seen that the treatments do not vary significantly. However percentage of germination was more towards higher seed weight group. The same experiment conducted at the Station during the previous year had given significant difference in germination of the nuts.

The study was extended to find out the variation in the weight of nuts existing in the same bunch. For this bunches having uniform size were harvested and weight of individual nut in each bunch recorded. Depending upon the weight, the nuts of each bunch were graded into groups having difference of 5 grams in weight between each group. The frequency distribution of the nuts in each bunch recorded for two groups of bunches having different fruit sizes is given below in Table XIV (a) and (b).

TABLE XIV (a)

(Size of nut 5 7 c. m. × 3.9 c. m.)

Bunch No.	Below 20 gms.	Between 21-25 gms.	Between 26-30 gms.	Between 31-35 gms.	Between 36-40 gms.	Between 41-45 gms.	Between 46-50 gms.	Above 50 gms.	Total No. of nuts
1	..	..	3	32	69	42	2	..	148
2	...	2	9	27	32	25	1	..	96
3	..	..	1	29	72	46	6	..	154
4	3	..	12	38	47	26	2	..	128
5	..	2	10	23	86	83	20	4	225
Total	3	4	35	149	306	222	31	4	754
%	0.40	0.53	4.64	19.77	40.58	29.44	4.11	0.53	100

TABLE XIV (b)

(Size of nut 5 6 c. m × 3.8 c. m.)

Bunch No.	Below 20 gms.	Between 21-25 gms.	Between 26-30 gms.	Between 31-35 gms.	Between 36-40 gms.	Between 41-45 gms.	Between 46-50 gms	Above 50 gms.	Total No of nuts
1	8	12	24	48	46	12	..	..	150
2	4	7	40	80	63	16	..	..	210
3	1	1	15	75	68	10	..	..	170
4	9	12	24	123	104	55	2	..	329
Total	22	32	103	326	281	93	2	..	859
%	2.56	3.72	11.92	37.95	32.71	10.84	0.23	—	100

From the above, it would be seen that about 25% of the total nuts were light nuts. The experiment was repeated during the year for confirmation.

2. Sowing experiments

(*a*) *Comparative study of different positions of seednuts in sowing*: This experiment which was repeated was laid out in order to find out the

ideal position of sowing the seednuts so as to get high germination percentage and vigorous seedlings. A Randomised replicated trial with the following 4 treatments and 8 replications was taken up. The four treatments were vertical, slanting, horizontal and topsyturvy.

Twenty five seednuts in each treatment were sown and germination counts were recorded at four days interval starting from 40 days after sowing. The data were statistically analysed and the results are given below in Tables XV and XVI.

TABLE XV

Mean percentage of germination and number of days taken to start and complete germination

Treatments (Position of sowing)	Percent of germination	No. of days taken to start germination	No. of days taken to complete germination
1. Vertical	94·50	54·0	87·0
2. Slanting	97·50	55·0	85·5
3. Horizontal	92·50	59.0	98·5
4. Topsyturvy	91·00	78 0	121·0
5. Significant or not	Yes		
6. Critical difference	4·10	—	—

TABLE XVI

Analysis of Varience

Source of variation	D. F.	Sum of squares	Mean sum of squares	F.
Blocks	7	155·500	22·216	1·429
Treatments	3	189·500	63·167	4·062†
Error	21	326·500	15·548	—
Total	31	671·500	—	—

† Significant at 5% level

Conclusion: $\overline{2\ 1}\ \ \overline{3\ 4}$

From the above, it might seen that the treatment differ significantly. Sowing nuts slanting had given the maximum germination which was on a par with vertically sown nuts. During the previous year vertically sown nuts had given the maximum germination and was significantly better than slanting. The experiment was repeated for confirmation.

The morphological data of the seedlings (height, number of leaves and girth) planted in the 1958-59 nursery were recorded and statistically analysed. Results of analysis are given below in Tables XVII, XVIII, XIX and XX:

TABLE XVII

Morphological data of seedlings (1958-59)

Position of sowing	Mean girth in cm.	Mean height in cm.	Mean No. of leaves.
1 Vertical	2.22	62.05	4.36
2 Slanting	2.11	62.42	4.50
3 Horizontal	2.21	67.42	4.34
4 Topsyturvy	1.92	64.80	4.86
5 Significant or not	No	No	No

TABLE XVIII

Analysis of varience (Girth)

Source of variation	D. F.	Sum of squares	Mean squares	F
Block	7	3.1216	0.4459	7.91*
Treatment	3	0.4768	0.1589	2.82
Error	21	1.1852	0.0564	...
Total	31	4.7836	...	...

* Significant at 5% level.

TABLE XIX

Analysis of variance (height)

Source of variation	D. F.	Sum of squares	Mean squares	F.
Block	7	3176.52	453.99	6.8*
Treatment	3	148.08	49.36	0.7
Error	21	1405.95	66.95	...
Total	31	4730.55	...	...

*Significant at 5% level

TABLE XX

Analysis of variance (number of leaves)

Source of variation	D. F.	Sum of squares	Mean squares	F.
Block	7	14.72	2.10	10.0†
Treatments	3	1.39	0.46	2.2
Error	21	4.41	0.21	—
Total	31	20.52	...	...

†Significant at 5% level.

From the above, no significant difference was observed in the measurements of girth, hight or number of leaves on seedlings raised under the four methods of sowing.

(b) (i) *Determination of optimum depth of sowing*. This experiment which was taken up during its second year for confirmation was laid out on a 5 x 5 latin square design to find out the optimum depth of sowing seed arecanuts for sprouting. The treatments consisted of sowing nuts at depths of 0", 1", 2", 3" and 4".

Germination counts were regularly recorded with an interval of 4 days starting from 40 days after sowing, and the data statistically analysed. The results are given below in Tables XXI and XXII.

TABLE XXI

Percentage of germination

S. No.	Treatment (Depth of sowing).	Mean per cent of germination	No. of days taken to start germination	No. of days taken to complete germination
1	0″	99.2	38.0	73.2
2	1″	96.0	49.2	88.4
3	2″	86.4	58.0	101.2
4	3″	86.4	68.4	111.6
5	4″	72.8	73.2	120.4

TABLE XXII

Analysis of Variance

Source of variation	Sum of squares	D. F.	Mean squares	Variance ratio
Rows	277.76	4	69.44	1.38
Colomns	655.36	4	163.84	3.26
Treatments	2127.36	4	531.84	10.58*
Error	602.88	12	50.24	
Total ..	3663.36	24	...	...

*Significant at 1% level.

Critical difference: 9.77

Conclusion: 1 2 3 4 5

From the above, it was observed that the treatments differ significantly. Sowing seednuts at depths of 0″ and 1″ did not give different effects on germination. However sowing nuts at depths of 2″ and below gave significantly lower germination than sowing at 0″. It was also seen that as the depth of sowing increased the number of days taken to start and complete germination also got increased. These observations were in conformity with last years findings.

(ii) *Study of different position of seednuts cum depth of sowing.* The two experiments on position of seednuts in sowing and depth of sowing seednuts were combined and laid out on a randomised block design with 16 treatments (4 positions and 4 depths) as suggested by the Statistical Adviser. The depth of 4″ was deleted since it was observed in the previous two experiments that it was decidedly inferior. The germination of seednuts sown in this experiment was in progress.

(c) *Effect of different spacing on seedling performance*: This experiment which was laid out during 1958-'59 in order to find out the ifluennce of spacing on the growth of seedlings in the nursery on a 5 x 5 latin square design was continued during the year. The five different spacings consisted of (i) 6″ x 6″, (ii) 9″ x 9″, (iii) 12″ x 12″, (iv) 15″ x 15″ and (v) 18″ x 18″. The morphological data viz. height, number of leaves and diameter at the collar of the seedlings were recorded after one year growth in the nursery. The same was statistically analysed. The results are presented below in Tables XXIII and XXIV.

TABLE XXIII

Morphological data of seedlings one year after planting

S. No.	Distance of planting	Mean height in cm.	Mean diameter in cm.	Mean No. of leaves
1	6″ x 6″	118.502	1.88	4.35
2	9″ x 9″	107.462	2.13	4.87
3	12″ x 12″	99.562	2.36	4.81
4	15″ x 15″	95.506	2.88	4.93
5	18″ x 18″	92.384	3.05	5.32
6	Significant or not	No.	Yes.	Yes.
7	Critical difference	—	0.39	0.28
8	General mean	106.680	2.46	4.86
9	Percentage of standard error to general mean	12.900	4.10	11.40
10	Standard error of the experiment	13.277	0.28	0.20

TABLE XXIV

Analysis of variance

S. No.	Source of variation	D. F.	HEIGHT			NO. OF LEAVES			DIAMETER		
			Sum of square	Mean square	F.	Sum of square	Mean square	F.	Sum of square	Mean square	F.
1	2	3	4	5	6	7	8	9	10	11	12
1	Rows	4	1177.7	294.4	1.7	0.20	0.05	1.25	0.31	0.08	1.00
2	Columns	4	4773.3	1193.3	*6.8	1.35	0.34	*8.50	0.58	0.15	1.88
3	Treatment	4	2202.0	550.5	3.1	2.39	0.60	*15.00	4.91	1.23	*15.38
4	Error	12	2116.0	176.3	...	0.42	0.40	...	0.92	0.08	...
	Total	24	10269.0	...	...	4.36	...	...	6.72	...	...

*Significant at 1% level.

Conclusion:

Number of leaves: 1 2 3 4 5

Diameter: 1 2 3 4 5

The analysis revealed that the treatment differences were significant for diameter and number of leaves. Seedlings planted at a distance of 15" x 15" and 18" x 18" had significantly better diameter than the seedlings planted under other treatments. The number of leaves produced were also significantly more in 18 inches spacing than the rest.

Root studies were made in order to assess the effect of spacing on root development. Observations were recorded on root system of three plants selected at random in each of the treatment in one column. The number of roots, their individual length, working depth and weight and weight of shoot were recorded in addition to lateral and vertical spread of roots. The results are summarised in Table XXV.

TABLE XXV

Spacing and root development (Mean data)

S. No.	Distance of planting	No. of roots	Extent Vertical	Extent Lateral	Maximum length	Combined length	Working depth	Total weight of roots	Total weight of shoot
1	6″ x 6″	13.33	52.67 cms.	40.33 cms.	51.67 cms.	348 67 cms.	31.33 cms.	62.00 gms.	212.33 gms.
2	9″ x 9″	15.00	55.00 cms.	68.00 cms.	60.00 cms.	438.67 cms.	32.00 cms.	69.67 gms.	203.67 gms.
3	12″ x 12″	15.67	65.00 cms.	70.67 cms.	69.00 cms.	423.67 cms.	35.00 cms.	87.67 gms.	221.33 gms.
4	15″ x 15″	19,67	69.67 cms.	95.55 cms.	89.00 cms.	776.67 cms.	36.67 cms.	218.00 gms.	463.33 gms.
5	18″ x 18″	24.33	75.00 cms.	80.67 cms.	86.00 cms.	769.33 cms.	34.00 cms.	183.67 gms.	412.00 gms.

From the above table it could be seen that spacing highly influences root production. Excepting for working depth which was more or less constant for all spacings there was progressive increase in all the characters studied with increasing spacing from 6″ to 15″. Quality seedlings produced from different spacings were also assessed. For this, morphological data of individual plants for the entire population was surveyed consistent with the general mean of diameter at the collar and the number of leaves produced. The percentage turn over of quality seedlings in each treatment was found to be 9, 25, 45, 62 and 68 respectively. It was therefore clear that the percentage of quality seedlings produced was more when seedlings were planted wider apart.

The experiment was repeated on similar lines for confirmation.

(*d*) *Standardisation of media for sprouting seednuts:* An experiment was laid out in a 5 x 6 randomised block design in order to find out the best media for sprouting seed arecanuts. The treatments consisted of (1) sowing nuts in soil media (2) sowing nuts in sand media (3) nuts arranged in country basket with straw mulch (4) tying nuts in straw bundles (5) heaping the nuts under shade. One hundred nuts in each treatment were sown. The germination was in progress.

(*e*) *Effect of shade Vs. open on seednut germination and growth of seedlings with particular reference to sun-scorch and pest (mite) attack.* Arecanut being a very delicate plant required shade for its proper growth. It was observed that mortality of seedlings was very high when they were raised in open sun. Too much shade apart from being costly, made the plants grow lanky. Attack of pests like mites also was more when seedlings were exposed to sun. This expiriment was therefore laid out on a 3 x 8 randomised replicated design in order to find out the extent to which shade was to be provided for raising seedlings. It consisted of the following three treatments (1) Open (complete exposure) (2) Partial shade and (3) Complete shade

The experiment was under progress.

(*f*) *Effect of different spacing cum efficacy of sowing unsprouted and sprouted seeds on seedling performance*: This experiment which was designed in a 8 x 4 randomised replicated design in order to find out the optimum spacing to be given to seedlings in the nursery when sprouted and unsprouted seeds was sown and their interaction on seedlings performance was sown with unsprouted nuts during the year. The germination of nuts was in progress.

(*g*) *Influence of post harvest treatment and period of sowing on seednut performance.* Seed arecanuts prior to their sowing was subjected to different treatments with a view to increase their germination and produce larger number of quality seedlings. This experiment was designed in order to find out the influence of these treatments on germination and quality of seedlings and was laid out in a 12 x 4 randomised replicated design with the following different treatments.

1 Harvesting and immediate sowing.
2 Treating with cowdung slurry and immediate sowing.
3 Treating with cowdung slurry, air drying for 3 days and immediate sowing.

4 Treating nuts with cowdung slurry, air drying for 6 days and sowing.

5 Treating nuts with cowdung slurry, air drying for 9 days and sowing.

6 Sun drying nuts for 2 days and sowing.

7 Sun drying nuts for 4 days and sowing.

8 Sun drying nuts for 6 days and sowing.

9 Air drying nuts for 3 days and sowing.

10 Air drying nuts for 6 days and sowing.

11 Air drying nuts for 9 days and sowing.

12 Soaking nuts in water for 3 days and sowing.

Thirty nuts were sown per treatment and the germination of the nuts was in progress.

3. Storage trial of seednuts and viability studies:

This experiment was designed in order to find out a suitable method of storing arecanuts without loss of viability. Observations on the morphological characters of the seedlings transplanted during the previous year on a 4 x 6 x 2 split plot design were recorded and data statistically analysed. The analysis of variance is given in Table XXVI.

TABLE XXVI.

(The analysis of variance)

It could be seen from the above table that neither the main treatments nor sub-treatments were significant. However the interaction was significant in the case of measurment on the number of leaves.

The experiment which was modified and laid out on a 4 x 7 x 4 split plot design during the same year was continued. The germination data gathered were got analysed and it revealed that the main treatments gave significantly different performance in germination. The critical difference

for means of main treatments was 1.52. The average germination percentage for the four periods of sowing were as follows:

Sowing after 1 week 95.36%

Sowing after 2 weeks 96.28%

Sowing after 3 weeks 95.00%

Sowing after 4 weeks 92.64%

Sowing within first three weeks gave best results. The analysis of variance is given in Table XXVII below:

TABLE XXVII

Analysis of variance

Source of variation	Sum of squares	D. F.	Mean square	F.
Replications	53.000	3	17.667	1.60
Main treatment	201.858	3	67.286	6.10*
Error (a)	99.285	9	11.032	..
Sub-treatment	84.929	6	14.155	1.32
Interactions	179.642	18	9.980	0.93
Error (b)	769.715	72	10.690	..
Total	1,388.429	111	..	..

* Significant 1% level.

Means, standard error and critical difference

Standard Error of Experiment	3.27
General Mean	94.82
Percentage of standard error to general mean ...	3.45
Critical difference for means of main treatment ...	1.61

TABLE XXVI

The analysis of variance

Source of variation	D. F.	Girth			No. of leaves			Height		
		Sum of squares	Mean sum of squares	F	sum of squares	Mean sum of squares	F	Sum of squares	Mean sum of squares	F
1	2	3	4	5	6	7	8	9	10	11
Replication	1	0.015	0.015	0.146	1.003	1.003	9.552	1649.5	1649.5	9.97*
Main treatments	3	0.829	0.276	2.680	0.038	0.013	0.124	1505.2	501.7	3.03
Error (a)	3	0.310	0.103	...	0.316	0.105	...	496.1	165.4	...
Sub-treatments	5	0.565	0.113	1.165	0.411	0.082	1.390	757.7	151.5	0.62
Interaction	15	1.632	0.109	1.124	3.315	0.221	3.746*	3137.9	209.2	0.85
Error (b)	18	1·743	0.097	...	1.058	0.059	...	4413.6	245.2	...
Total	45	5.094	...	...	6.141	...	...	11959.9	...	...

*Significant at 5% level.

However the germination percentage recorded by the different sub-treatments is given below:

Sub-treatments		Percentage of germination
1. Control—heaping nuts in shade	...	94.80
2. Untreated seednuts packed in double gunnies treated with 1% Bordeaux mixture	....	96.00
3. Seednuts treated with 1% Bordeaux mixture and packed in double gunnies treated with 1% Bordeaux mixture	...	95.25
4. Seednuts treated with Folidol 2.c.c. per gallon and packed in double gunnies treated with 1% Bordeaux mixture	...	94.75
5. Seednuts treated with 0.1% Mercuric Chloride solution and packed in double gunnies treated with 1% Bordeaux mixture	...	95.38
6. Seednuts treated with Folidol 2 c. c. per gallon + 1% Bordeaux mixture and packed in double gunnies treated with 1% Bordeaux mixture	...	93.00
7. Seednuts packed with saw dust in double gunnies treated with 1% Bordeaux mixture	...	94.50

The experiment was further modified and laid out on a 12 x 4 randomised replicated design with the following treatments in collaboration with the Arecanut Technologist.

Treatments:

1. Control untreated nuts packed in untreated double gunnies sown 15 days after storage.
2. Same as item 1 sown after 30 days storage.

3. Nuts treated with 1% Bordeaux mixture and packed in doube gunnies treated with 1% Bordeaux mixture and sown 15 days after storage.

4. Same as item 3 above sown 30 days after storage.

5. Wax coated nuts packed in double gunny bags treated with 1% Bordeaux mixture sown 15 days after storage.

6 Same as item 5 above sown 30 days after storage.

7. Wax coated nuts packed in baskets with cushioning material sown 15 days after storage.

8. Same as item 7 above sown 30 days after storage.

9. Nuts treated with 1% Bordeaux mixture and packed in baskets with cushionning material sown 15 days after storage.

10. Same as item 9 above sown 30 days after storage.

11 Untreated nuts packed in baskets with cushioning material sown 15 days after storage.

12 Same as item 11 above sown 30 days after storage.

The germination of the nut was in progress.

Information on the seed arecanuts numbering 1,500 in each treated as per the above 7 treatments and despatched to Arecanut Nursery Assistant at Baruva for further study, was gathered and same is furnished in Table XXVIII.

From the table it might be seen that seednuts treated with Bordeaux mixture and Folidol (Treatments 3 and 4) gave high percentage of germination and lesser percentage of mortality. This was in conformity with the results obtained at the Research Station during the previous year's trial. About 25 nuts in each of 20 lots received from Arecanut Technologist after storage studies were sown for testing their viability.

B. Cultural Experiments

(*1*) *Determination of optimum spacing in the main field*: This experiment designed on a randomised replicated lay out with 6 treatments (6′ x 6′, 6′ x 9′, 6′ x 12′, 9′ x 9′, 9′ x 12′ and 12′ x 12′) and 6 replications in order to find out the optimum spacing to be adopted while planting areca seedlings in the main field was planted in October 1958

During April 1959 the experimental plot was given a gereral weeding and all plants were applied with Calcium Ammonium Nitrate at the rate of 2 oz. per plant. Drainage channels were formed all round the plots as well as in between every 2 rows of palms. The Shade crop of Sesbania raised gave an estimated acre yield of 10,500 lbs. green matter. Each plant was applied with 11 lbs. of the same. The plants were sprayed with .025% microcop and bases drenched with 0.1% Ceresan wet. The manuring of plants in the plot was started in September. The silt deposited at the bases of the plants were removed and each plant manured with 20 lbs. of green leaf. During October, Urea at the rate 1/10 lb. per plant was applied. Application of Cattle Manure was taken up during December 1959 at the rate of 20 lbs. per plant. In addition, Muriate of Potash at the rate of 57 gms. per plant was also applied. During November the inter-space in the garden was dug and shade crop of Sesbania was sown on the Western and Southern sides of plants. Irrigation channels were formed during November–December and irrigations were there after regularly given at inter-vals of 4 days. Stems of all exposed plants were protected from sun-scorch by providing artificial shade. Mite and thrips attack was controlled by spraying wettable sulphur and folidol.

The few gaps that occured due to the mortality of a few plants were gap-filled with seedlings of the same mother palm that had been reserved for the purpose. The growth measurements viz. height of the plant, girth at the collar, number of leaves, leaf spread and length of the second leaf (next to last leaf) of all the plants in the plot were recorded during December 1959. The data collected in respect of number of leaves, girth and height are given in Table XXIX.

TABLE XXVIII

Germination and mortality data of seednuts supplied to Arecanut Nursery Assistant, Baruva, Andhra State

Origin of Seednut: South Kanara. Date of receipt: 5--1—1959. Date of sowing: 6—1—1959.

S. No.	Name of treatment	No. of nuts sown	No. of nuts germinated	Percent of germination	No. of sprouts died	Percent of mortality	Present population
1.	Control	1500	823	55	131	16	692
2.	Double gunney treated with 1% Bordeaux mixture and untreated seednuts.	1500	731	49	112	15	619
3.	Double gunney treated with 1% Bordeaux mixture and seednut treated with 1% Bordeaux mixture	1500	1110	74	80	7	1030
4.	Seednuts treated with Folidol 2 c. c. per gallon + gunny with 1% Bordeaux mixture.	1500	1098	73	94	9	1004
5.	Seednuts treated with 0·1% Mercuric chloride + double gunny with 1% Bordeaux mixture.	1500	688	46	72	10	616
6.	Seednut treated with Folidol 2 c. c. per gallon + 1% Bordeaux mixture + double gunny with 1% Bordeaux mixture.	1500	839	56	82	10	757
7.	Seednuts packed with saw dust + gunney treated with 1% Bordeaux mixture.	1500	572	38	102	18	470

TABLE XXIX

Mean morphological data of

Treatment	Girth at collar in c. m.						Height	
Replication	6′ x 6′ 1	9′ x 6′ 2	12′ x 6′ 3	9′ x 9′ 4	12′ x 9′ 5	12′ x 12′ 6	1	2
I	8·21	6·62	7·81	6·28	8·42	6·32	222·63	182·51
II	7·09	6·44	5·34	6·22	5·18	5·44	191·80	196·30
III	3·03	3·26	2·96	3·37	3·18	3·39	97·25	107·76
IV	7·22	6·68	5·49	6·66	4·67	5·40	178·02	174·80
V	7·40	7·16	8·23	6·33	6·45	6·06	196·89	183·30
VI	7·95	7·09	7·44	6·82	7·54	5·53	189·04	184·09
Total	40·90	37·25	37·27	35·68	35·44	32·14	1075·63	1028·77
General mean for the treatment	6·82	6·20	6·21	5·95	5·90	5·36	179·27	171·46

seedlings of S. T. Garden 1959-60

in c. m.				No. of leaves					
3	4	5	6	1	2	3	4	5	6
197·40	199·71	212·57	184·60	5·29	4·67	5·18	4·81	5·57	5·30
162·86	189·71	155·42	167·80	5·09	5·33	5·05	5·33	4·07	5·10
100·59	112·24	114·00	117·50	4·61	4·36	4·77	4·67	4·71	4·60
160·95	166·43	146·36	154·40	5·54	5·09	4·68	5·62	4·43	5·00
203·77	172·43	164·43	159·00	5·06	5·18	5·23	5·05	4·85	5·00
165·86	158·09	114·21	148·00	5·42	5·24	5·64	5·29	5·57	4·80
991·43	998·57	906·99	931·30	31·01	29·87	30·55	30·77	29·20	29·80
165·21	166·43	151·17	155·22	5·17	4·98	5·09	5·13	4·87	4·97

From the above table it may be seen that the seedlings in 6′ x 6′ spacing got good stand as compared to the rest.

(5) *Comparative study of different green manure-cum-cver crops for areca garden.* With a view to find out a suitable green manure cum cover crop for arecanut gardens the following eleven different green manures were sown along the borders of the nursery beds for priliminary observations and multiplication.

1 *Crotalaria usermoensis*
2 *Tephrosia candida*
3 *Tephrosia purpurea*
4 *Leucana glauca*
5 *Centrosema pubescenes*
6 *Crotalaria anagyroides*
7 *Phaseolus laxthyroides*
8 *Tephrosia noctiflora*
9 *Calapagonium mucanoides*
10 *Sesbania speciosa*
11 *Crotalaria striata*

Crotalaria anagyroides and *Tephrosia candida* were found to come up well. The seeds from all the varieties were gathered for field trial.

(6) *Investigations on different types of areca under rainfed and irrigated conditions.* This experiment was taken up in order to investigate whether any of the types or species that were known to come up under low moisture condition could be grown as purely rainfed crop or with limited irrigations. The 500 seednuts received each from Regional Arecanut Research Station, Palode, Peechi, Tumkur and Central Arecanut Research Station, Vittal were sown in primary nursery for germination.

The germination was in progress.

(7) *Other Studies.*

Uniformity trial:- (a) *Collection of yield data of palms* : The collection of yield data as well as morphological characters of the 570 palms of uniform age of about eight years cultivated under identical conditions, marked out in a private garden during the previous year with a view to analyse the yield data and such other characters for finding out the optimum number of trees for experimental purposes was continued during

the period. The yield data (number of nuts and weight of nut in Kilograms) of the palms for one year were tabulated and got statistically analysed at the Institute of Agricultural Research Statistics. The results of analysis are given in Tables XXX, XXXI, XXXII, and XXXIII.

TABLE XXX

Coefficient of variation of different plot sizes arranged according to different plot shapes

Plot size (1 unit= 1 tree)	Plot shape	4 plot block		8 plot block	
		C. V.	Av. C. V.	C. V.	Av. C. V.
1		96	96	97	97
2	2 trees in a row	67	70	68	70
	2 trees in a col	72	—	72	—
3	3 trees in a col	56	56	58	58
4	4 trees in a col	51	50	52	50
5	2 trees in 2 rows	42	—	44	—
	4 trees in a row	55	—	54	—
	2 trees in 2 cols	51	—	52	—
6	6 trees in a col	40	40	43	48
	3 trees in 2 cols	40	—	54	—
8	8 trees in a row	41	36	39	34
	2 tress in 4 rows	35	—	33	—
	4 trees in 2 rows	28	—	28	—
	4 trees in 2 cols	39	—	37	—
12	6 trees in 2 cols	33	31	—	27
	12 trees in a col	36	—	—	—
	2 trees in 6 rows	24	—	27	—
16	8 trees in 2 rows	20	22	—	—
	4 trees in 4 rows	22	—	—	—
	2 trees in 8 rows	25	—	—	—
24	4 trees in 6 rows	15	20	—	—
	2 trees in 12 rows	26	—	—	—

TABLE XXXI

Minimum number of trees per treatment required for 5% S. E. with and without guards for 4 plot blocks

Net plot size	Estimated C. V. (without guards)	Observed C. V. with single guards	Gross plot size with single guards	No. of trees	
				with out guards	with single guards
1	99	79	4	392	1568
2	70	59	6	392	1176
3	57	50	8	390	1010
4	50	49	10	400	1000
6	41	45	14	408	862
8	35	24	15	392	735
12	29	—	—	408	—
16	25	—	—	400	—
24	20	—	—	384	—
50	14	—	—	400	—

TABLE XXXII

Minimum number of trees per treatment required for 5% S. E. with and without guards for 8 plot blocks

Net plot size	Estimated C. V. (without guards)	Observed C. V. with single guards	Cross plot size with single guards	No. of trees	
				without guards	with single guards
1	100	83	4	400	1600
2	71	65	6	404	1212
3	58	57	8	405	1080
4	50	54	9	400	900
6	41	46	14	408	952
8	36	—	15	416	780
12	29	—	—	408	—
16	25	—	—	400	—
24	21	—	—	432	—
50	15	—	—	450	—

TABLE XXXIII

Coefficient of variation and block efficiency for plots and blocks of different sizes and shapes

4 plot Block			8 plot Block		
Block shape	C. V.	Block Efficiency	Block Shape	C. V.	Block Efficiency
		Plot of 1 tree			
4 units in a col	95	1.04	4 units in 2 cols	95	1.04
4 units in a row	93	1.08	2 units in 4 rows	97	1.00
2 units in 2 cols	95	1.04	4 units in 2 rows	99	0.96
2 units in 2 rows	100	0.94			
		Plot of 2 trees in a row			
4 units in a row	64	1.10	1 unit in 8 rows	67	1.00
1 unit in 4 rows	67	1.00	2 units in 4 rows	68	0.96
2 units in 2 rows	70	0.92	4 units in 2 rows	68	0.96
		Plots of 3 trees in a column			
2 units in 2 cols	53	1.19	2 units in 4 cols	56	1.08
1 unit in 4 cols	59	0.96	1 unit in 8 cols	59	0.96
		Plots of 4 trees arranged as 2 trees in 2 rows			
1 unit in 4 rows	41	1.14	2 units in 4 rows	44	1.00
2 units in 2 rows	43	1.04			
1 unit in 4 cols	43	1.04			
		Plots of 6 trees arranged as 3 trees in 2 columns			
4 units in a col	35	1.44	2 units in 4 cols	54	0.61
2 units in 2 cols	40	1.10			
1 unit in 4 cols	45	0.86			
		Plots of 8 trees arranged as 4 trees in 2 rows			
1 unit in 4 rows	29	1.00	2 units in 4 rows	28	1.06
2 units in 2 rows	28	1.06			
		Plots of 12 trees arranged as 3 trees in 4 columns			
4 units in 1 col	21	1.54	4 units in 2 cols	27	0.92
4 units in a row	28	0.86			

Plots of 16 trees arranged as 8 trees in 2 rows		
1 unit in 4 rows	20	1.21
Plots of 24 trees arranged as 4 trees in 6 rows		
2 units in 2 rows	15	0.76

From the above it would be seen that increase of plote size gave marked reduction in the coefficient of variation. The variation was observed to be almost entirly non-positional. The shape of plots and blocks did not materially effect the coefficient of variation. All the plot sizes without guards gave roughly the same minimum number of trees required for estimating the treatment mean with a given level of accuracy. Blocks were observed to have poor efficiency.

(b) *Nursery:—Plot size for nursery experiments*: In order to deter, mine the optimum number of plants required for nursery experiments-morphological features (Height, number of leaves, diameter at collar, length of leaf, number of roots and length of roots) of one hundred seedlings raised from nuts of a single bunch of a mother palm with a border row all round were measured. The mean, standard deviation and standard deviation of mean were then calculated taking different number of plants from 1 to 40 as units. The data are given in table XXXIV.

From the table it would be seen that there was reduction in standard deviation of the mean as progress was made from 1 to 24 tree plots and by increasing size of plots above 24 the reduction of the standard deviation with the number of extra plants required was small. It therefore appeared that 24 seedling plots would be the optimum for nursery experiment.

C. MANURIAL EXPERIMENTS

1. (a) *Determination of optimum N. P. K. requirement of seedlings in the nursery*. The stored food material available in the kernel of arecanut was rather limited and it could not be excepted to sustain the seedlings for long. The secondary nursery where seedlings were to grow over one year would therefore to be manured. This experiment was designed to find out the optimum quantities of N. P. K. that were to be applied to get a good growth for the seedlings. The experiment was laid out duridg the previous year on a 3^3 confounded factorial design with three levels of Nitrogen (0 lb., 75 lbs. and 150 lbs. per acre), three levels of Phosphoric acid (0 lb., 25 lbs. and 50 lbs. per acre) and three levels of Potash (0 lb., 75 lbs. and 150 lbs.

TABLE XXXIV

Plot size and standard deviation of mean etc. in respect of six morphological characters of seedlings

Sample Size	Height (cm.)			No. of leaves			Length of leaves (cm.)			Diameter of collar (cm.)			No. of roots			Length of roots (cm.)		
	Mean	St. Dn.	St. Dn. of Mean	Mean	St diviation	St. Dn. of Mean	Mean	St. Dn.	St Dn of Mean	Mean	St. Dn.	St. Dn. of Mean	Mean	St. Dn.	St. Dn of Mean	Mean	St. Dn	St. Dn. of Mean
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
4	45·25	6·72	3·36	3·25	0·13	0·22	21·25	0·44	0·22	1·00	0·07	0·04	7·25	0·44	0·22	20·00	3·00	1·50
8	45·00	6·04	2·14	3·25	0·43	0·15	20·75	1·30	0·46	0·96	0·09	0·03	7·50	0·71	0·25	19·50	3·74	1·32
12	47·25	4·67	1·35	3·33	0·17	0·14	21·92	1·50	0·43	0·97	0·09	0·03	7·25	0·01	0·29	20·90	2·70	0·78
16	44·06	4·33	1·08	3·12	0·33	0·08	21·44	1·66	0·41	1·02	0·10	0·02	7·19	0·89	0·22	20·81	5·09	1·27
20	45·10	5·20	1·16	3·05	0·22	0·05	21·25	1·79	0·40	0·97	0·06	0·01	7·40	1·11	0·25	19·10	2·38	0·53
24	47·46	3·95	0·84	3·21	0·41	0·08	21·96	1·57	0·32	0·96	0·10	0·02	7·21	0·87	0·18	19·87	5·37	1·10
32	46·50	4·42	0·78	3·19	0·39	0·07	21·41	1·77	0·28	0·97	0·10	0·02	7·19	1·36	0·24	19·47	2·48	0·44
40	46·10	5·57	0·88	3·05	0·38	0·06	21·50	1·53	0·29	0·97	0·09	0·01	7·92	1·29	0·20	20·62	3·45	0·55

per acre). Nitrogen was applied in the from of groundnut cake and Urea in equal proportions, Phosphoric acid as Super phosphate and potash as Burnt earth and Muriate of potash in equal proportions. The manures were applied in two equal split doses i.e., three months and six months after planting.

The morphological data viz. number of leaves, height in cms. and girth of seedlings at the collar region in cms. were recorded and statistically analysed. The results of analysis is furnished in Tables XXXV and XXXVI.

TABLE XXXV

Averages and critical differences

		No. of leaves	Height in cm.	Diameter in cm.
1	Average per plot	5.07	105.29	2.78
2	Critical difference to test mens of different levels of nitrogen (Factor a) ...	0.12	6.54	0.21
3	Average values (a_0) no nitrogen ...	4.95	96.28	2.51
	(a_1) 75 lbs. Nitrogen per acre ...	5.14	108.23	2.92
	(a_2) 150 lbs. nitrogen per acre ...	5.14	111.35	2.91

TABLE XXXVI

Analysis of variance

S. No.	Source of variation	D.F.	No. of leaves			Height			Diameter		
			Sum of squares	Mean sum of squares	F	Sum of squares	Mean sum of squares	F	Sum of squares	Mean sum of squares	F
1	2	3	4	5	6	7	8	9	10	11	12
1	Blocks	11	0·90	0·082	1·367	25300·94	2300·085	11·936*	10·03	0·912	4·493*
2	Main effect of A	2	0·87	0·435	7·250	4555·49	2277·745	11·820	1·05	2·025	9·975*
3	Main effect of B	2	0·33	0·165	2·750	987·02	493·510	2·561	0·35	0·175	0·862
4	Main effect of C	2	0·16	0·080	1·333	789·66	394·830	2·049	0·44	0·220	1·084
5	1st order interaction A B	4	0.02	0.005	0.083	1709.69	427.423	2.218	1.75	0.438	2.158
6	–do– B C	4	0.24	0.060	1.000	944.51	236.128	1.225	0.91	0.228	1.123
7	–do– A C	4	0.26	0.065	1.083	1153.27	288.318	1.496	0.38	0.095	0.468
8	2nd order interaction										
	Replication 1	2	0.05	0.025	0.417	194.91	97.455	0.506	0.06	0.030	0.148
	Replication 2	2	0.16	0.080	1.333	505.50	252.750	1.312 §	0.20	0.100	0.493
	Replication 3	2	0.03	0.015	0.250	1705.77	852.885	4.426 §	0.05	0.025	0.123
	Replication 4	2	0.03	0.015	0.250	125.72	62.860	0.326	0.23	0.115	0.567
9	Error	70	4.22	0.060	...	13489.10	192.701	...	14.21	0.203	...
	Total	107	7.27	..	..	51461.58	..	..	32.66	..	..

* Significant at 1% level.

§ Significant at 5% level.

The experiment revealed that only the main effects of Nitrogen were significant in respect of observations on (a) number of leaves (b) height in centimeters and (c) diameter in centimeters of seedlings. Neither the main effects of P. K. nor the interactions were significant.

It was also seen that the difference between the measurements in set of seedlings receiving 75 lb. of nitrogen per acre and 150 lbs. of nitrogen per acre were not significant. However application of nitrogen gave a significant deviation in number of leaves etc. from no application of nitrogen. Hence 75 lbs. of nitrogen per acre might be taken as economic dose of nitrogen as revealed by the experiment.

This experiment has been repeated for confirmation.

(3) *Response of seedlings of varied vigour to different levels of manuring*: This experiment was taken up in order to study the growth behaviour of seedlings of varied vigour to different levels of manuring.

A 6 x 4 randomised replicated design was adopted with the following treatments.

1 Vigorous seedlings with no manuring
2 Vigorous seedlings with moderate manuring (75 lb. Nitrogen, 25 lbs. P_2O_5 and 75 lbs. K_2O)
3 Vigorous seedlings with heavy manuring (150 lb. Nitrogen, 50 lb. P_2O_5 and 150 lbs. K_2O)
4 Poor seedlings with no manuring.
5 Poor seedlings with moderate manuring (As in treatment 2)
6 Poor seedlings with heavy manuring (as in treatment 3)

The sprouts were graded into two groups (1) vigorous and (2) poor. Manuring was given in two equal split does one after three months and second after six months of transplanting. Nitrogen was applied in the form of groundnut cake and Urea in equal proportions, Phosphoric acid as Super phosphate and Potash as Burnt earth and Muriate of potash.

This experiment was modified during 1960 – 61 as "Response of early, medium and late germinated seedlings of varied vigour to different levels of manuring" as it was observed from some other experiment that seedlings germinated late were invariably poor. Six bunches from six trees with 200 nuts each were sown. The germination was in progress.

(4) *Influence of manuring seedlings at different levels on their establishment*: Arecanut seedlings in the nursery were found to respond well to

manuring. From an experiment on the manurial requirment of seedlings in the nursery it was observed that manuring with 75 lb. and 150 lb. Nitrogen had significantly increased the growth of seedlings. There we re certain reports to the effect that seedlings of some of the perennial crops raised in heavy fertility area when transplanted gave low percentage of establishment. As such a 3 x 8 randomised replicated experiment was designed with a view to find out the influence of manuring the arecanut seedlings at different levels on their establishment in the main field. The treatments consisted of transplanting seedlings raised (a) without manuring (b) with moderate manuring (75 lb. Nitrogen, 25 lb. P_2O_5, 75 lb. K_2O per acre) and (c) with heavy manuring (150 lb. Nitrogen, 50 lb. K_2O and 150 lb. P_2O_5 per acre).

The seedlings were transplanted in the month of June and the observations on their establishment etc. were continued for a period of one year. But for a slight change in the colour of the foliage in the case of heavily manured seedlings from dark green to pale green all the seedlings were quite healthy and got themselves established. It therefore appeared that manuring did not affect the establishment of seedlings.

Investigation on Pests and Diseases

VI (2) *Trial with proprietory fungicides and insecticides to find effective control measures for all diseases and pests*:

1 *Enviromental factors influencing the incidence of mites and the methods of control*: This experiment was laid out in the farm nursery on a 10 x 4 randomized replicated design. The following chemicals were used.

	Chemical	Dose
1	Systox	8 oz./ 100 gallons.
2	Folidol	5 oz./ 100 ,,
3	Ekatin	16 oz./ 100 ,,
4	Metasystox	16 oz./ 100 ,,
5	Wettable Sulphur BPM	16 oz./ 10 ,,
6	Erysit	16 oz./ 100 ,,
7	Ultra Sulphur	16 oz./ 60 ,,
8	Basudin	16 oz./ 80 ,,
9	Aramite	16 oz./ 100 ,,

The various chemicals were applied to the plants after recording the pre-treatment count of mites. Counts were recorded after 48 hours and later at intervals of one week. The treatments were repeated after one month. Unsprayed checks were left in each replication for comparison. The results of observations are given in table XXXVII.

TABLE XXXVII

Number of plants infested in each bed

Sl. No.	Treatment	R. I		R. II		R. III		R. IV	
		A	B	A	B	A	B	A	B
1	Systox	46	4	7	—	47	—	12	—
2	Folidol	18	4	24	14	55	12	38	8
3	Ekatin	31	—	40	37	65	16	15	12
4	Metasystox	20	—	21	2	48	—	25	—
5	Wettable Sulphur	58	—	12	1	56	2	50	—
6	Erysit	22	—	53	—	48	—	13	3
7	Ultra Sulphur	11	1	26	5	29	6	30	2
8	Basudin	30	1	16	48	52	6	44	18
9	Aramite	16	4	22	2	35	—	53	8
10	Control	27	7	19	30	13	—	30	25

Note: A. Before application of treatments.
B. After application of treatments (One month later).

From the above it might be seen that Systox, Metasystox and Erysit were quite effective in controlling the mites.

The experiment was modified to include Chlorocide, Chlorocide + Folidol, Metasystox, Wettable Sulphur and Erysit along with a control. Chlorocide was claimed to have action on egg mass and freshly hatched larvae.

(2) *Trial with effective soil insecticides on the control of grubs (pest on root)* This experiment laid out as an observation trial at a garden in Paivalike (Kasaragod Taluk) in order to find out an effective control measure against the white grubs which damage the root system of arecanut, was continued during the year. A randomised trial with the following eight chemicals, was laid out. Recommended doses of the chemicals were applied

as broadcast, since it had been observed that in the case of basal application to the palms the pests were found moving towards untreated zones. A thorough digging in the plots was given before the various chemicals applied.

1. Aldrex — 30 EC Solution.
2. Aldrex — 5% dust.
3. Intox '8' liquid.
4. Intox '8' Dust.
5. Lead Arsenate.
6. D. D. T. 50% Wettable.
7. Folidol liquid.
8. Folidol dust.

The pre-treatment and post-treatment counts of grubs in the soil as well as the effect of the treatments on the trees were recorded and the same were given in the Tables XXXVIII and XXXIX.

TABLE XXXVIII

Before application of pesticides

Sl. No.	Treatment	Average No. of grubs	Conditon of the crown and inflorescence.
1	Aldrex liquid	10	Reduction in the number of leaves, their yellowing, poor nut set.
2	Folidol liquid	12	do
3	Folidol dust	15	do
4	Lead Arsenate	12	do
5	DDT 50%	15	do
6	Intox '8' dust	14	do
7	Aldrex dust	12	do
8	Indox '8' liquid	20	do
9	Control	15—20	do

TABLE XXXIX

After application of Pesticides

Sl. No.	Treatment	Average No. of grubs	Condition of crown and inflorescence
1	Aldrex liquid	5	Slight improvement
2	Folidol liquid	7	Not satisfactory
3	Folidol dust	8	Slight improvement
4	Lead Arsenate	8	Not satisfactory
5	DDT 50%	7	Slight improvement
6	Intox '8' dust	6	Slight improvement
7	Aldrex dust	5	Not very satisfactory
8	Intox '8' liquid	1	Good improvement—Good nutset
9	Control	10—15	Poor

From the above tables, it would be seen that Intox '8' liquid applied at the rate of 8 oz. in 100 gallons of water was quite effective. The excavation studies in the beginning of the experiment revealed the presence of beetles at a depth of 1 to 1½ feet and those at the end of the experiment indicated the presence of a large number of freshly hatched larvae in the untreated portions of the garden.

(3) *To find cheap and effective fungicides for Koleroga*: This experiment was laid out in a private garden at Kodi where the incidence of Mahali was high every year. Five palms selected at random were sprayed by each chemical. The results were compared with the performance of one percent Boardeaux mixture. Three sprayings were given at intervals of 30–40 days and during the last spray, "Sovaspray" which was noticed to be phytotoxic, was eliminated. Daily nut fall was recorded and freshly shed nuts were examined for the incidence of *Mahali* and the results were given in Table XL.

TABLE XL

Number of fallen nuts due to *Koleroga*

Sl. No.	Treatment	Dose	No. of fallen nuts per treatment, per tree					Total
			1	2	3	4	5	
1	Sovaspray	1 part to 20 parts of water	...	49	3	...	4	56
2	Shell-Copper	3 lb. per 100 gallons	...	5	5	...	....	10
3	Dithane Z. 78	1½ lb. per 100 gallons	...	150	....	...	4	154
4	Flit-406	1 lb. per 50 gallons	...	...	12	...	...	12
5	Bordeaux mixture	1 per cent	1	1	1	...	...	3
6	Blitox	1 lb. per 50 gallons	...	7	5	4	...	16
7	Fytolan	1 lb. per 40 gallons	...	...	3	...	...	3
8	Microcop	1 lb. per 40 gallons	...	...	...	...	...	...
9	Coppesan	1 lb. per 20 gallons	...	...	...	...	...	...
10	No treatment (Control)	..	29	29	5	32	16	111

From the above, it might be seen that Microcop, Coppesan and Fytolan treatments were quite promising. The experiment was repeated for confirmation of the results on hand.

(4) *To investigate causes and methods of control for button-shedding and tendernut fall*: This experiment was laid out with certain hormones, fungicides and insecticides applied as spray on arecanut bunches in order to find out a control measure for the shedding of buttons and tender nuts during the previous year in collaboration with Botany.

From these studies, it was found that the standard insecticide-fungicide mixture containing Shell Copper, Endrex and IAA 20 ppm. application reduced shedding of buttons and tendernuts. An examination of the fallen buttons revealed fungal infection at their tips. *Gloeosporium* was chiefly noticed. Mycelium was also noticed on some stigmatic surfaces. Insect injuries causing brownish patches and cracks were noticed particularly at the bases of tender nuts of different ages.

The experiment was modified to include certain manurial treatments over and above the existing ones, and proposed to be laid out in collaboration with the Botany and Agronomy Divisions on a 6 x 4 randomized replicated design in a private garden at Badanaje.

(5) *Other Studies.*

(a) *Band Disease Survey*: In the main garden on the farm 25 plants showing 'band' symptoms were marked out in order to try certain micro-nutrients and also for certain observations on the insects noticed on the plants.

(b) *A study of the husk rotting organisms*: A 6 x 4 randomised replicated trial was set up in the laboratary, to study the effect of the organisms on the husk of arecanut in storage. The following were the treatments.

	Treatment	Mode of storage
1	Untreated nuts	Untreated double gunnies
2	Nuts treated with one per cent Bordeaux mixture	Double gunnies treated with one per cent Bordeaux mixture
3	Nuts dipped in wax emulsion	Double gunnies treated with one per cent Bordeaux mixture
4	Nuts dipped in wax emulsion	Stored in untreated cushionning material (arecanut husk)
5	Nuts dipped in one per cent Bordeaux mixture	Stored in baskets with cushionning material both treated with one percent Bordeaux mixture
6	Untreated nuts	Stored in baskets with cushionning material untreated

For each treatment, 100 nuts were put. Small samples of nuts were examined at weekly intervals for the presence of micro-organisms. The condition of the nuts and the various micro-organisms noticed were also recorded. Kernels were placed in moist chambers from time to time to study the infecting factors inside. Nuts coated with wax emulsion and stored in double gunnies treated with one percent Bordeaux mixture rotted more rapidly than nuts under any other treatment. Nuts under treatment 4 were sound after one week after which rotting slowly started. Rotting was minimum in nuts under treatment 5. The nuts were in a fresh and sound condition upto 3 weeks.

The following were the important organisms noticed. Thielaviopsis, Gloeosporium, Penicillium, Fusarium, Diplodia, Mucor, Mites, Maggots, Bacteria.

(c) *Seed Treatment Experiment*: Some of the nursery diseases like yellow spot, wilt etc. recorded in recent years were doubted to be seed borne. Hence to see whether they could be checked by pre-treatment of seeds with protectants, a 6 x 4 randomised replicated trial was laid out in the Farm Nursery with 200 nuts per treatment. The following were the chemicals and dosages used:

Chemical		Doses
Mercuric chloride	...	1 : 1000 solution
Ceresan wet	...	0·1% solution
Flit 406	...	2 lb. per 50 gallons
Dithane Z 78	...	1½ lb. per 100 gallons
Cuprous-Oxide (50% Cu)	...	5 lb. per 100 gallons

The nuts were dipped in the solutions for periods ranging from 2 to 5 minutes dried in the shade and were sown. Germination counts and observations were recorded from time to time in the beds. Germination was in progress.

(*d*) *Trials in the incipient infection in arecanut*: It was a common observation that fresh arecanuts in storage were showing infection from some type of fungi, which could not be controlled by usual chemical methods. The infection was thought to have set in the nut at a very early stage of its development. A field trial was laid out in a private garden with the following four treatments.

Treatment			Dose
Coppesan	...	...	1 lb. in 20 gallons
Microcop	...	...	1 lb. in 40 gallons
Blitox	...	...	1 lb. in 30 gallons
Control	...	...	No treatment

Fresh unopened female flowers in selected bunches were sprayed with the chemicals. The treatments were being repeated at weekly intervals till the nut stage. Further observations were underway.

(*e*) *Sending samples for examination and naming*: Specimens of red and white mite sent to Indian Agricultural Research Institute (Entomology Division) were identified respectively as *Raoiella indica* and *Paratetranychus sp.* Samples of leafspot fungus and collar-rot of seedlings were also sent for naming. Soil samples from healthy and diseased gardens in the Sagar area were sent to the Assistant Soil Chemist and the Agricultural Chemist, Bangalore for analysis. Leaf material collected from diseased and disease free palms from the same area were sent to the Central Coconut Research Station, Kayamkulam for analysis and advice. A specimen of areca stem infested by a borer was also sent to Indian Agricultural Research Institute for identification.

(f) Laboratory work: Routine laboratory studies with the leafspot were continued. From the leaves collected from Sagar area *Gloeosporium* was obtained. From the roots of the specimens *Fusarium* and *Pythum* were isolated.

Good mycelial growth was obtained form *Phytophthora* from *Koleroga* nuts planted on an agar medium made by using a mud sample which was claimed to have fungicidal properties against the disease.

A beetle collected from a grub infested garden in Paivalike village was named as *Lepidiota* species. Many budrot specimens from the surrounding area as well as from Kasaragod revealed the presence of *Phytophthora.*

Various specimens of gummosis, borer attack, wilt, root and collar rot and specimens from Sagar area were examined.

(g) *Plant Protection work on the Farm*: Bulk and experimental seedlings and plants in the spacing garden were repeatedly sprayed with Wettable sulphur against mite, with Microcop solution and one per cent Bordeaux mixture against Yellow spot on leaves, with Folidol against scales and thrips and also with 'Paramar' 50 against thrips.

A couple of treatments with 1% Bordeaux mixture + Folidol liquid were also done to the experimental and bulk nurseries against a heavy attack of leaf spot.

Plants in the main garden were repeatedly sprayed with Wettable sulphur against red mite. A few pits and also the experimental beds in the varietal collection plot were drenched with a 0.1% solution of Ceresan wet against soft rot. Hybrids were given a combination spray of one percent

Bordeaux mixture + Folidol. A few garden plants were treated with Dieldrex against insect damage.

Heavily mite infested leaves in the bulk nurseries were cut and burnt occasionally. A few green manure plants were treated with *Endrex* against catter-pillar attack.

Intox '8' dust was applied in the Agronomic nurseries against white ants. Seedlings kept in the laboratory for experimental purposes were treated with D. D. T. solution against mealy bugs.

(h) *Survey of diseases for locating areas of high incidence of diseases and pests*: A garden at Volamogru near Puttur which had been neglected for sometime was visited. Shedding of tendernuts and buttons, and attacks of spindle bug and mite were noticed.

A number of tracts were surveyed with a view to fix up zones where incidence of *Mahali* was noticed every year for taking up an experiment in the control of the diseases. One garden was finally fixed up at Kodapadavu, a zone where *Mahali* was in prevalence year after year.

A report of the prevalence of a new disease was received from Sagar area.

Symptoms: Drying up of leaves from tips backwards, wilting of crown, rotting and drying up of roots, reduction in yield and gradual death of palms. The exact cause of the disease was not clear. A few gardens at Madsur, Lingadahalli, Yellare and Ambaragodlu were visited. In addition to the new disease, incidence of leafspot and mite attack were also noticed on planted seedlings in some gardens. The gardens were revisited in December 1959, along with a visiting team of specialists from the Indian Agricultural Research Institute. The team also conducted a survey of the Yellow leaf disease affected areas, of the Kerala State along with me.

A garden at Bolanthur where some planted seedlings were rotting and palms were exhibiting yellowing and wilting symptoms was visited. It was observed that the substratum in the garden was very hard and the water table very high.

At Kanathur, a garden where a high incidence of fungal budrot was reported was visited. Incidence of similar budrot was also noticed at Dewana, Punacha and Nileshwar.

A diseased garden at Kuthugodu was visited. Two types of yellowing of crowns which resulted in the reduction in yield and death of a few palms were noticed.

During the year, the incidence of *Koleroga* was quite severe and even many of the garden which had not been reported to be attacked by the disease for the past so many years were attcked. The fungus was found to attack the buds of the palms too causing budrot in severe cases of infection. The loss in yield due to *Koleroga* as reported by the growers themselves was about 15 to 20 percent in addition to the loss of a large number of palms due to budrot.

The seedlings in almost all the areas were found to be infected with leaf spot and softrot of collar due to bacterial infection causing their death.

SECTION D. — PUBLICATIONS

The following research papers and articles of general interest were written and sent for publication.

Articles published:

1.	Bavappa, K. V. A.	"Field Experimentation in Arecanut—Part I"—Coconut Research Workers' Conference and Arecanut Journal, Vol X. No. 3, 1959
2.	Bavappa, K. V. A. and Murthy, K. N.	"Occurrence of Chlorophyll deficiency in Arecanut"—Arecanut Journal Vol. X. No. 2, 1959
3.	Bavappa, K. V. A. and Murthy, K. N.	"Potentialities in Arecanut Stem and Leaves"—Arecanut Journal Vol. X. No. 2, 1959.
4.	Murthy, K. N. and Bavappa, K. V. A.	"In Malnad, arecanut growing is an expert's job"—Indian Farming, January 1960.

Articles in press:

1.	Bavappa, K. V. A. and Murthy, K. N.	"Morphology of Arecanut palm—Root"
2.	Nagaraja Rao, K. S.	"Plant Protection Practices in Arecanut."
3.	Murthy, K. N. and Bavappa, K. V. A.	"Morphology of Arecanut palm—Shoot"
4.	Murthy, K. N. and Bavappa, K. V. A.	"Species and Ecotypes of Arecanut"
5.	Murthy, K. N. and Bavappa, K. V. A.	"Breeding in Arecanut"
6.	Murthy, K. N. and Bavappa, K. V. A.	"Floral Biology of Arecanut"

Sd/-
(K. V. AHAMED BAVAPPA)
Agronomist.

Vittal,
14—10—1960.

APPENDIX I

Staff of the Central Arecanut Research Station, Vittal, South Kanara District, Mysore State as on 31—3—1960.

S. No.	Name & Qualifications	Designation
1	Shri K. V. Ahamed Bavappa, B. Sc. (Ag)	Agronomist
(a)	**Research Staff:**	
1	Shri K. Narasimha Murthy, B. Sc. (Ag.)	Botanical Asst.
2	Shri K. S. Nagaraja Rao, M. Sc.	Pathological Asst.
3	Shri P. Muddappa Gowda, B. Sc. (Ag.), D. H.	Agronomy Asst.
4	Shri N. Tirumaleswara Bhat, B. Sc. (Ag.)	Agronomy Asst.
5	Shri Thomas Mathew, B. Sc. (Ag.) Hons.	Junior Res. Asst.
6	Shri K. J. Abraham, B. Sc. (Ag.)	Junior Res. Asst.
7	Shri K. K. Krishnan Nambiar.	Fieldman.
8	Shri. P. T. Sreedharan Nair	Fieldman.
9	Shri K. Kunhiramapanicker.	Fieldman.
10	Shri E. R. Narayanan	Fieldman.
(b)	**Ministerial Staff:**	
1	Shri K. Raghava Rao.	Head-Clerk-Cum-Accountant
2	Kumari H. Shreemanthini Bai.	Junior Clerk.
3	Shri N. Lokayya Naik.	Store-Clerk.
4	Shri K. Thampi	Clerk-Typist

APPENDIX II

Detailed Programme of Work for the Year 1960 61

Item No. in the Technical Programme	Name of the experiments	Year of commence-ment	Year of conclusion	Remarks.
1	2	3	4	5
I.	**Breeding and Genetics of Areca**			
(1)	Collection and maintenance of indigenous and exotic species and types of areca	1958–59	To be continued for several years	The collection was being made through Bureau of Plant Introduction
(2)	Detailed survey of arecanut gardens to assess genetic variation and select superior types	1958-59	–do–	
(3)	Floral biology on areca flowering behaviour (Rate, time and duration of flowering	1958–59	1960–61	The experiment was being conducted in growers' gardens
(a)	Study on the range of variation in flowering from tree to tree in the same garden	...	...	...
(b)	Study on the monthwise variation in flowering	...	...	...

1	2	3	4	5
(c)	The frequency destribution of number of palms flowering per week during all the weeks of flowering period is to be obtained in the garden. The phenomenon of early flowering etc. has to be correlated with the production of nuts	...	...	...
(d)	Floral initiation	..	..	To study the development of spathe, spadix, relationship between spadix and leaf production, the effect of age and season of opening and production, spadices, abortion of spadices.
(e)	Study of pollen	...	...	Morphology of pollen, viability in storage.
(4)	Hybridization and selection:			
(a)	Standardization of crossing technique.	..	..	Aims at evolving improved techniques.
(b)	Study of hybrid vigour and its utilization:			
(i)	Production of inbred line.	..	..	To build up inbred line for exploiting hybrid vigour.
(ii)	Hybridization between distinct ecotypes.			For exploiting hybrid vigour.

1	2	3	4	5
	(iii) Preliminary studies in the seggregation of characters			To calculate how far and to what extent the mother palm characters were transmitted to the progenies.
(5)	Production of Elite Seeds	1959–60	..	To study the dispersal of pollen of areca by wind and then to take up production of elite seeds
II	**Anatomical Studies**			
	Structure and development of fruit in areca	1959–60	..	The experiment would be taken up together with other items on cytogenetics.
III	**Physiological Studies**			
(1)	Studies on fruit-setting and shedding	..	1959–60	To investigate the causes of shedding of buttons and tender nuts in arecanut and methods of control.
(3)	Germination of arecanut	...	...	To reduce the time taken for germination (Pot culture).
(4)	Investigations on different species of areca under rainfed and irrigated conditions	...	...	The work would be taken up soon after the different species of areca were collected.

1	2	3	4	5
IV. A.	**Standardisation of Nursery Practices**			
	1. Criteria for seednut selection:			
(a, b, e)	Study of the effect of age of trees, order of bunches and position of seednuts in the bunch on the seednut performance	1959–60	1961–62	The experiment was combined on a confounded design as sugested by the Statistical Adviser.
(c)	To determine the frequency of seednuts having different floating habits, factors influencing such habits and their relative merits	1959–60	1961–62	...
(d)	Studies on the performance of nuts gathered at different stages of maturity for seed purposes	1959–60	1961–62	...
	2. Sowing experiments			
(a, b)	Study of different position of seednuts-cum depth of sowing	1959–60	1961–62	...
(c, f)	Effect of different spacing-cum-efficacy of sowing unsprouted and sprouted seeds on seedling performance	1959–60	1961–62	...
(d)	Standardization of media for sprouting seednuts	1959–60	1961–62	...

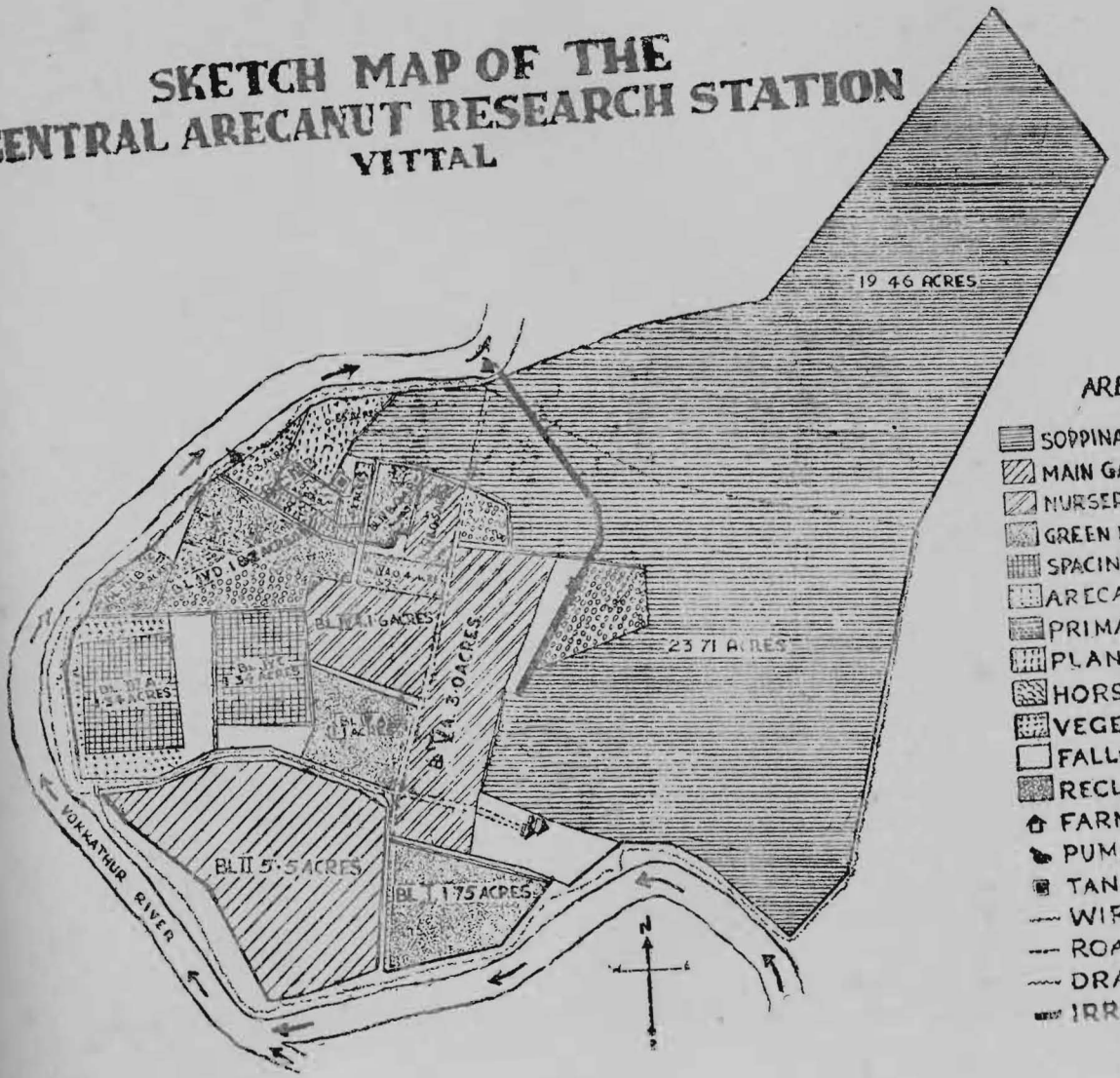
1	2	3	4	5
(e)	Effect of shade Vs. open on the seednut germination and growth of seedlings with perticular reference to sun-scorch and pests (mites) attack.	1959-60	1961-62	...
(g)	Influence of post-harvest treatments and period of sowing on seednut performance	1959-60	1961-62	...
(h)	Determination of optimum age of transplanting seedlings-cum-sowing in-situ Vs. transplanting of single, double and treble transplantations in the nursery	...	...	Observation plot.
3.	Storage trial of seednus and viability studies	1958-59	1960-61	....
4.	Standardisation of the method of packing seedlings.	1960-61	1962-63	...
5.	Study of seednut from different arecanut growing tracts for their viability, earliness in germination and vigour of seedlings.	1959-60	1961-62	To be combined with ecotype study.
IV. B.	**Cultural Experiments.**			
(1)	Determination of optimum spacing	1958-59	To be continued for several years	...
(2)	Effect of depth of transplanting seedlings-cum intervals of irrigation on growth and yield	1960-61	do	Would be taken up subject to the availability of land under acquisition.

1	2	3	4	5
(3)	Effect of different methods of intercultivation on the productivity of palms	1960-61	do	do
(4)	Study of intercrops in arecanut gardens	1960-61	do	...
(5)	Comparative studies of different green manure-cum-cover crops for areca gardens	1960-61	do	...
(6)	Investigations of different types of areca under rainfed and irrigated conditions.	1959-60	To be continued for several years	
(7)	Uniformity trial - Collection of yield data of palms.	1959-60	do	
IV C	**Manurial experiments**			
(1)	Determination of optimum N. P. K. requirements of:			
(b)	Permanently transplanted seedlings in the garden for producing vigorous, early bearing and productive palms.	1960-61	For a number of years	Subject to availability of land under acquisiton.
(2)	Simple manurial trials on areeanut in Ryots' gardens	1960-61	do	
VI 2.	Trial with proprietory fungicidies and insecticides to find effective control measures for all diseases and pests.			

1	2	3	4	5
(1)	Control of mites on arecanut including study on the influence of application of insecticides to the base of seedlings on mite nutrition.	1959-60	1961-62	Being taken up on young seedlings at Central Arecanut Research Station and on grown up palms in growers' gardens.
(2)	Trial on effective soil insecticide in the control of grubs (Pests on Roots).	1959-60	1961-62	Being taken up in the bearing gardens.
(3)	To find cheap and effective fungicides for 'Koleroga' or 'Mahali'.	1959-60	1963-64	
(4)	To investigate causes and methods of control for button shedding and tender-nut fall.	1959-60		
(5)	Trial against yellow leaf spot of arecanut.	1960-61	1962-63	Isolation, inoculation, etc. of the organism and macro and micro nutrient studies.
(6)	Trial with micro-nutrients against Band and a study of the association of insects with the disease.	1960-61		Survey will be undertaken in the first instance.
(7)	Study of collar-rot of seedlings and influence of soil micro- organisms.	1960-61	1962-63	

1	2	3	4	5
(8)	Studies in the control of sun-scorching of stem.	1960–61	1962–63	
(9)	A study of husk-rotting organisms	1960–61	1962–63	
VII	**Crop Weather Study**			
(1)	To record meteorological data on rainfall, maximum and minimum temperature, humidity, soil temperature and moisture, sunshine and wind velocity.	1959–60	To be continued till the Station exists.	
(2)	Influence of seasonal and geographical factors on the time and nature of flowering and fruiting.	1959–60		

SKETCH MAP OF THE CENTRAL ARECANUT RESEARCH STATION VITTAL



AREA OF THE FARM 65.86 ACRES

- SOPPINABETTA
- MAIN GARDEN 1957
- NURSERY 1959-60
- GREEN MANURE CROPS
- SPACING EXPERIMENT GARDEN 1958
- ARECANUT GARDEN 1959
- PRIMARY NURSERY
- PLANTAIN
- HORSE GRAM
- VEGETABLES
- FALLOW
- RECLAIMED AREA
- FARM SHEDS
- PUMP SHEDS
- TANKS
- WIRE FENCE
- ROADS
- DRAINS
- IRRIGATION CHANNEL