

RESEARCH PROJECT

1. Institute Code No. : No. AG.H. 3.19. Bot.PB.1.09.
2. ICAR Code No. :
3. Name and address of the research institute/centre : College of Horticulture, Vellanikkara P.O., Trichur Dist., Kerala.
4. Title of the project : Pollination studies, including assisted pollination in cashew.
5. Name and designation of the principal investigator : V.K. Damodaran, Professor of Horticulture.
6. Name(s) and designation of the associates :
 1. K.K. Vidyadharan, Associate Professor.
 2. P.K. Valsalakumari, Jr. Instr.
 3. N.K. Parameswaran.
7. Location of the research project : College of Horticulture.
8. Objectives:

To find out the extent of crop loss in cashew due to lack of pollination and the possibility of increasing the fruit-set by different methods of assisted pollination.
9. Practical utility:

It has been reported that only about 6% of the perfect flowers are carried to maturity and lack of pollination is one of the reasons for low fruit-set. If pollination and fruit-set could be increased by assisted pollination yield would also be increased.
10. Technical programme:
 1. To find out the extent of fruit-set and yield of nut under natural conditions.
 2. To find out the percentage of flowers not setting fruits due to lack of pollination.
 3. To find out the percentage of fruit-set in hand pollinated conditions.
 4. Storage studies on pollen grains without diluants and with diluants.
 5. Fruit set with assisted pollination
 - a) Dusting the panicles with diluted pollen grains, talc, skim milk powder.
 - b) Spraying of panicles with coconut water containing pollen, sugar solution and Neera.
 6. Germination of pollen grains in artificial media of the above samples.

Contd.....2/-

- 11. Date of start : 1--12--1978.
- 12. Date of completion : 1--7--1979.
- 13. Estimated cost : Rs. 750/-
- 14. Facilities required : Facilities available in the College of Horticulture will be sufficient.

Signature of Sd/- PRINCIPAL INVESTIGATOR. HEAD OF DIVISION

DIRECTOR OF RESEARCH

FRC IX - Approved.

RESEARCH PROJECT - 1978.

Faculty of : AGRICULTURE Department of : BOTANY

1. Name of Research Station : Cashew Research Station,
Anakkayam.
2. Project No. : AG.H. 3.13. Bot.PB. 2.05.
3. Title of the project : Varietal testing of superior
cashew types in coastal sandy
areas.
4. Name(s) and designation of
 - (a) Project Leader : P.G. VEERARAGHAVAN,
Associate Professor.
 - (b) Associate : M.G. VASAVAN,
Assistant Professor.

5. Objectives:

At present the superior cashew types identified in this research station are tested at 3 centres only viz. Anakkayam, Vellanikkara and Thiruvazhumkunnu where the soil types are mainly lateritic.

As cashew is also largely grown in the coastal belt of the State, testing of the superior selections under coastal sandy soil conditions will add more information on their performance under such agro-climatic conditions.

6. Practical utility:

Suitable types can be recommended for growing in coastal areas on the basis of the study.

7. A short review of literature:

No previous studies have been undertaken in Kerala or India. No published literature is also available on the studies conducted in any other cashew growing countrig.

8. Technical programme:

An observational trial will be laid out with the following 10 superior types identified at this station.

BLA-139-1, BLA.273-1, BLA.39-4, NDR.2-1, NLR.2-1.
K.22-1, K.19-1, H.3.17, H.3-13, H.4-7.

No. of plants per type : 4 clonal progenies (airlayers)

Replication : 2

Spacing : 8 m x 8 m

Contd.....2/-

Note:- The replication may be restricted to one if adequate land is not available in the cultivators' fields.

9. Date of start : 1978.
10. Likely date of completion : 1988.
11. Additional facilities required : NIL
12. Approximate cost : Rs. 5,000/-
13. Signature of

Sd/-
PROJECT LEADER. HEAD OF DEPARTMENT. DIRECTOR OF RESEARCH.

FRC IX - Approved, with the modification that two plant plots with four replications may be used instead of four plant plots with two replications.

P R O F O R M A

KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE

DEPARTMENT OF HORTICULTURE (POMOLOGY)
COLLEGE OF HORTICULTURE
VELLANIKKARA, TRICHUR.

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE

(For approval of University)

No. AG.H. 3.19. Bot.PB. 2.06.

1. Name of Candidate : LAKSHMY DEVI, P.K.
2. Date of admission and admission number : 10-10-1979
79-12-03.
3. Name and designation of Chairman of Advisory Committee : Prof. V.K. Damodaran, Head, Dept. of Pomology, College of Horticulture, Vellanikkara.
4. Topic of research for thesis : Variability in the F1 population of Cashew (Anacardium - occidentale, L)
5. Objective of Research:

The objective of the study is to find out the variation in the qualitative as well as the quantitative characters of the F1 progenies of selected crosses with a view to identifying superior hybrids in cashew.

6. Brief review of previous work done:

Hybridisation between selected types was started at the Cashew Research Station, Anakkayam in 1963. The F1 progenies of 4 parental combinations were evaluated and some superior hybrids have been evolved. Damodaran (1977) has reported the variations in the F1 populations in the earliest set of F1 hybrids, and a few superior hybrids have been identified. Similar works are in progress in the CRS at Vridhachalam, (in Tamil Nadu) Vengurla (in Maharashtra) Bapatla (in Andhra Pradesh) and Ullal (in Karnataka).

During the year 1973, crosses were made between 5 parents, selected for the following characters.

1. Large nut size - K-30-1
2. High sex ratio - H-3-13
3. High setting percentage Brazil - 9-1
4. Large no. of nuts per panicle - ALGD-1-1
5. Early and short flowering phase - BLA-139-1

Contd.....2/-

114 F1 progenies derived from the above crosses were planted at Main campus at Vellanikkara of the Kerala Agricultural University in 1973 and these are to be evaluated for their economic characters. It is proposed to study the important economic characters of these progenies for identifying superior genotypes for further testing and multiplication.

7. Scientific and practical importance of the research:

The study is expected to make it possible to identify the superior types among the hybrid progenies which may be further multiplied by vegetative means.

8. Technical programme in brief:

The following aspects will be studied.

- I. (1) Growth of trees represented by its height, girth of the trunk and mean spread.
- (2) Branching in representative samples.
- (3) Percentage of flowered and non-flowered shoots in samples.
- (4) Percentage of perfect flowers on sample basis.
- II. Floral characters
 - (1) Season and duration of flowering.
 - (2) Proportion of flowered and non-flowered shoots.
 - (3) Percentage of fruit set.
 - (4) Percentage of fruit drop.
 - (5) No. of nuts harvested on sample basis as well as whole tree basis.
- III. Apple characters
 - (1) Colour, size, shape of apple.
 - (2) Weight of apple.
 - (3) Percentage of juice.
 - (4) Total sugars.
 - (5) Sugar-acid ratio.
 - (6) Tanin content.
 - (7) TSS.
- IV. Nut characters
 - (1) Size
 - (2) Shape
 - (3) Weight of 100 nuts

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(4) Percentage of Kernal

9. Estimate	:	Expenses on spraying, cost of chemical and labour charges:
		Rs. 5,000
Fellowship	:	Rs. 3,600

Total		Rs. 8,600
		=====
10. Receipts	:	Nil
11. Location of research	:	Vellanikkara.

Vellanikkara,
Date: 5-3-1980.

Sd/-
Signature of candidate.

Sd/-
Signature of Chairman of
Advisory Committee.

Sd/-
Signature of Dean.

COLLEGE OF HORTICULTURE
VELLANIKKARA

RESEARCH PROJECT PROPOSED

1. Institution code No. : No. AG.H. 3.19. Che. 1.01.
2. ICAR Code No. :
3. Name and address of the Research Institute : College of Horticulture,
Vellanikkara.
4. Title of the project :
Title of the problem : Foliar diagnosis in cashew.
5. Name and designation of principal investigator : Vilasa Chandran, T.,
Junior Instructor.
6. Name and designation of Associates : 1. Dr. M. Aravindakshan,
Professor of Horticulture
(Pomology).
2. Gopikumar, K. Jr. Instructor.
7. Location : All India Co-ordinated Cashew
Improvement Project, Vellanikkara.
8. Objectives:
To standardise the leaf for foliar diagnosis in
Cashew.
Practical utility:
In planning fertilizer programmes in cashew, leaf
analysis may serve as a guide.
- c. Review of work done:
In mango and guava similar line of work has been
undertaken. Research data are not available for
cashew.
9. Technical programme:
Samples will be collected from terminal shoots
of various ages around the periphery of the tree.
25 shoots will be selected from one tree as each
of 3 replications. Samples consisting of 2 leaves
will be collected at bimonthly intervals (ie leaf
ages ranged from 2-12 months). For the study of
the effect of leaf position, 25 shoots from
fruiting and 25 shoots from non-shooting terminals
will be tagged in each replication. When shoots
mature, two leaves will be sampled from each
shoot from 3 positions viz., base, middle and
terminal leaves. All the samples collected will
be analysed for N,P,K,Ca,Mg and S.
10. Date of start : January 1979.
11. Likely date of completion: January 1980.
12. Estimated man months : 12
13. Facilities required : 1. Facilities for sample colle-
ction from the All India Co-ordinated
Cashew Improvement Project.
2. Laboratory facilities at the
College of Horticulture.
14. Financing organization : Kerala Agricultural University.
15. Approximate cost : Rs. 800/- Sd/-
Principal Investigator.

FRC IX - Approved.

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE

Programme of Research for Master's Degree
(For approval of the University)

COLLEGE OF HORTICULTURE, VELLANIKKARA.

No. AG.H. 3.19. Ent. 1.02.

1. Name of the candidate : K.M. Thomas.
2. Date of admission & No. : 16--10--1978 : 78-11-61
3. Name and Designation of : Dr C.C.Abraham, Prof. of Entomo-
Chairman, Advisory logy, College of Horticulture.
Committee
4. Topic for Research for thesis:

"Relative susceptibility of Cashew types to infestation
by Helopeltis antonii Sign. (Hemiptern : Miridae)
(Part of the new KAU Project)

5. Objective of Research:

- a. To screen different accessions of Cashew for resi-
stance to Helopeltis antonii
- b. To study the influence of plant canopy architecture
and chemical composition of the shoots and floral
branches on the relative susceptibility of the
accessions.

6. Brief review of the previous work done on the topic:

Studies conducted at the CPCRI, Kasaragode did not
reveal differences among the accessions with regard to
susceptibility to Helopeltis (GB Pillai, 1979 Personal
Communication). Significant differences were detected
among the accessions maintained at the Cashew Research
Station, Madakkathara and the tree No. 665 showed
relative resistance. The tree No. K-10-2-12-18 was
found to be highly susceptible (Ambika and Abraham,
1979).

7. Scientific and/or practical importance of the research:

Helopeltis is the major pest of cashew causing 30-70%
loss in yield. Identification of source of resistance
and vegetative propagation of such types is the best
strategy against the pest. Information on the basis
of resistance will be helpful in future breeding
programmes. The present studies will be helpful to
identify resistance genotypes and to understand the
basis/resistance.

/of

8. Technical programme:

1. The seedling progenies of accessions and hybrids
of cashew will be rated for their field suscepti-
bility on the basis of flush damage and panicle
damage intensities by scoring on a 0-5 scale.

Contd.....2/-

2. Representative trees belonging to resistant, moderately resistant, susceptible and highly susceptible groups will be selected and their relative susceptibility will be confirmed by releasing five fifth instar nymphs of the test insect in polythene cages on shoots and panicles and recording their survival and the damage intensities.
3. The influence of plant canopy architecture, light intensities within the plant canopy and chemical composition of the shoots and floral branches will be ascertained by correlation analysis. The chemical composition will be studied with reference to the percentage of sap nitrogen, soluble sugars and tannins.

9. Estimate of expenditure and receipts if any:

Expenditure:

(a) Fellowship @ Rs. 500/- trimester	Rs. 3,000/-
(b) Contingencies	Rs. 5,000/-
	<u>Rs. 8,000/-</u>
Total	Rs. 8,000/-
	=====

Receipts : Nil

10. Location of Research : Cashew Research Station,
Madakkathara.

(Signature of the Candidate)

Signature of the Chairman,
Advisory Committee.

Signature of the Assoc. Dean.

Vellanikkara,
16-3-1979.

FRC IX.

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE

DEPARTMENT OF AGRIL. ENTOMOLOGY, COLLEGE OF HORTICULTURE
VELLANIKKARA.PROGRAMME OF RESEARCH FOR MASTER'S DEGREE

No. AG.H. 3.19. Ent. 1.03.

1. Name of the candidate : B. BALASUBRAHMANYAM.
2. Date of Admission and admission No. : 10--10--1979.
79-11-38.
3. Name and designation of : P.J. Joy, Assistant Professor.
Chairman of Advisory
Committee
4. Topic of Research for Thesis: The pest complex infesting
cashew inflorescence.
5. Object of Research:

To identify the various pests affecting cashew inflorescence and to study the nature of infestations and seasonal fluctuations.

6. Brief ~~xxx~~ review of previous work done on the topic:

About 30% yield reduction is reported in cashew by the attack of the Tea mosquito bug Helopeltis antonii (Anon 1966) Remamony and Abraham (1977) observed Pachypeltis maesarum in company with H. antonii attaching cashew. Rhynchothrips raoensis has been reported by Abraham (1958) attacking cashew inflorescence.

In addition to these, the cashew inflorescence is attacked by the blossom webber Lamida monoculalis, the hairy caterpillar Euproctis scintillans, the chafer beetle popillia complanata, the caterpillar Pingasa ruginari, the mealy bug Ferrisia virgata, the aphid Toxoptera odinae and the flatids, Flata sp (Pillai et al 1976) Detailed information on the phenology and nature of infestation of these pests is not now available.

7. Scientific and/or practical importance of the Research:

There is a substantial yield reduction in cashew due to the attack of various pests infesting the inflorescence. For the effective control of the different pests, their seasonal history and nature of damage are of great value.

8. Technical programme:

a) Periodical survey of the major cashew growing tracts

Contd.....2/-

from Sept. to Feb. for studying the different species of pests affecting inflorescence.

- b) The biology of newly observed pests will be studied.
- c) The nature of damage inflicted by the various inflorescence pests will be studied.
- d) Phenological studies of the pest complex by conducting field surveys at periodic intervals in selected localities.

9. Estimate of expenditure and receipts if any:

a) Fellowship @ Rs. 600/- per trimester	Rs. 3600/-
b) Contingencies and labour charges for surveying work	Rs. 3000/-

	Rs. 6600/-
	=====

Receipts : NIL

10. Location of research : Department of Entomology,
College of Horticulture,
Vellanikkara.

Sd/-
Signature of the candidate.

Sd/-
Signature of the Chairman
(Advisory Committee)

Sd/-
Signature of the Assoc. Dean.

Place: Vellanikkara.
Date : 22--2--1980.

RESEARCH PROFORMA

1. Institute Code No. : AG.H. 3. 19.Proc.Tech. 1.01
2. ICAR Code No. :
3. Name and address of the Research Institute/Centre : College of Horticulture, Vellanikkara P.O., Mannuthy, Trichur.
4. Title of the project : Studies on the optimum maturity and chemical composition of cashew apple for the preparation of different unfermented products.
5. Title of the problem :
6. Name and designation of the Principal Investigator : P.K. Valsalakumari, Jr. Instructor.
7. Name(s) and designation(s) of the associate(s) : 1. Sri. T. Vilasachandran, Junior Instructor.
2. Sri. V.K. Damodaran, Prof. of Horticulture.
3. Smt. N.K. Vimalakumari, Asst. Professor.
8. Location of the research project : College of Horticulture, Vellanikkara.
9. Objectives:
To find out the optimum maturity and chemical composition of cashew apple for the preparation of various unfermented products.
10. Practical utility : The optimum maturity stage of cashew apples for the preparation of different products has not been studied so far. The apples need not be retained on the tree after the maturity of the nuts, if they can be economically utilised before falling on the ground.
11. Technical programme
- Study of the biochemical changes associated with ripening of cashew apple.
 - Preparation of different unfermented products from cashew apple harvested on alternate days from the time of maturity of the nuts and also from ripe, fallen down apples.
 - Study of the quality of the products prepared from apples at different stages of maturity by organoleptic evaluation and by analysing the T.S.S., total sugars, reducing sugars, acidity and ascorbic acid contents.
 - Working out the economics of harvesting cashew apple and preparing the products before they fall on the ~~xxxx~~ ground.
12. Date of starting : January, 1979.
13. Date of completion : June, 1979.
14. Estimated cost : Rs. 1,000/-
15. Facilities required : Facilities in the College of Horticulture will be sufficient.
16. If organised by our organisation ~~xxxx~~ other than the institute : Organised by the College.
- Signature of Sd/- HEAD OF DIVISION.
PRINCIPAL INVESTIGATOR. DIRECTOR OF RESEARCH.
- FRC X. DIRECTOR OF RESEARCH.

COLLEGE OF HORTICULTURE
VELLANIKKARA
RESEARCH PROJECT PROPOSED

1. Institution Code No. : NO. AG.H. 3.19. Proc.Tech. 1.02.
2. ICAR Code No. :
3. Name and address of the Research Institute : College of Horticulture,
Vellanikkara.
4. Title of the project :
Title of the problem : Studies on the preparation of
fermented beverages and pectin
from Cashew apple.
5. Name and designation of principal investigator : T. Vilasachandran, Jr. Instructor.
6. Name and designation of Associates : 1. Valsala Kumari, P.K.,
Junior Instructor.
2. Sri. V.K. Damodaran, Prof.
of Horticulture (K.A.D.P.).
7. Location : College of Horticulture,
Vellanikkara.
8. a. Objectives:
 1. To find the suitability of yellow, red and mixed coloured apples for the preparation of fermented beverages.
 2. To evaluate the apples of high yielding varieties for the preparation of the fermented beverage.
 3. To fix up the optimum inoculum of yeast for the preparation of alcoholic beverage.
 4. Storage studies of the fermented beverage.
 5. To study the possibility of commercial extraction of pectin.

b. Practical utility:

Cashew apple is practically wasted at present in our State and its effective utilization will be an asset to national economy.

The present study may be helpful to recommend the apple quality and optimum yeast inoculum for better recovery and quality of fermented beverage from cashew apple.

Cashew apple pectin if found to be of better quality can be recommended for commercial exploitation.

Contd.....2/-

C. Review of work done.

Cruess (1958) had recommended the yeast starter equal to 10 per cent of juice for the preparation of fermented alcoholic beverages from fruits in general.

Sandhi (1952) observed that cashew apple residue is a good source of pectin (8.2 to 11.2%) and so can be utilised for the recovery of low methoxyl pectin.

9. Technical Programme

Fermented beverage will be prepared from yellow, red and mixed coloured apples and also from cashew apples of high yielding types. Product quality will be assessed.

Yeast starter of Sacchromyces ellipsoides and Sulphur dioxide will be utilised in varying doses for the preparation of alcoholic beverage.

The product prepared will be stored at room temperature and cold storage and the quality will be assessed at weekly intervals for a period of one year.

Efficacy of various methods for extracting pectin from cashew apple will be studied. Quality and quantity of pectin extracted will be studied.

10. Date of start : December 1978.
11. Likely date of completion: May 1981.
12. Estimated man months : 18
13. Facilities required : 1. Facilities for collecting apple from All India Co-Ordinated Cashew Improvement Project.
2. Laboratory facilities, College of Horticulture.
14. Financing organization : Kerala Agricultural University.
15. Approximate cost : Rs. 1,000/-

Sd/-
Principal Investigator.

FRC IX - Approved.

COLLEGE OF HORTICULTURE, VELLANIKKARA.

(Research Project Proposed)

1. Institution Code No. : No. AG.H. 3.19. Proc.Tech. 1.03.
2. ICAR Code No.
3. Name and address of the : College of Horticulture,
Research Institute Vellanikkara.
4. a. Title of the project :
Title of the problem : Post harvest studies of Cashew
apple.
5. Name and designation of : Vilasa Chandran, T.,
principal investigator Junior Instructor.
6. Name and designation of : Dr M. Aravindakshan, Prof. of
Associates Horticulture (Pomology).
7. Location : College of Horticulture,
Vellanikkara.

8. a. Objectives:

1. To study the storage life and quality of cashew apple under different storage conditions.
2. To develop a preservation technique for cashew apple juice.
3. To study the influence of mixing lime juice and pineapple juice with cashew apple juice on its quality and storage behaviour.
4. To study the post harvest pathology of cashew apple.
5. To evolve a cheaper and more efficient method other than CFTRI methods for the successful removal of acrid and astringent principles of cashew apple.

6. Practical utility:

The storage life of cashew apple and cashew apple juice is very poor. If an efficient storage technique for cashew apple and an effective preservation method for its juice can be developed, it will be of economic value as far as cashew apple utilisation is concerned.

Tracing out the organism for the sudden spoilage of cashew apple will be of much value with regard to its storage, transport and utilisation.

The C.F.T.R.I. methods for removing the acrid and astringent principles are found to adversely affect the nutritive value of cashew/ Removing the acrid and astringent principles with the minimum loss of its nutritive quality will be an asset to cashew apple utilisation.

/apple.

Contd.....2/-

c. Review of work-done:

Singh and Mathur (1953) reported that storage life of cashew apple from the date of picking was approximately 5 days at 82-95°F and 5 weeks at a storage temperature of 32-35°F. They also observed a marked influence of storage temperature on the quality of cashew ~~apple~~ apple.

Patwardhan (1970) suggested that cashew apple and its juice can be preserved for 2-3 weeks by steeping in water containing 0.25% citric acid and 400 ppm SO₃ or 800 ppm of benzoic acid.

Patwardhan (1970) stated that Candida krusei is responsible for the fermentation and sudden spoilage of cashew apple and its juice.

Technical programme:

Cashew apples categorised under yellow, red and mixed colours will be utilised for the study.

Fruits will be stored at room temperature and cold storage. Quality will be assessed at 3 day intervals. Effect of various treatments, viz., dipping the apples in Sodium chloride, boiling the fruits and sun drying for varying times on the storage behaviour of fruits will be studied.

Cashew apple juice will be preserved both in open storage and cold storage. Influence of varying concentrations of citric acid, SO₂ and combinations of these two on the preservation of cashew apple juice will be studied. Effect of boiling the fruit and collecting the juice in earthen pots painted with lime also will be noted.

Lime juice, pineapple juice and cashew apple juice will be mixed at varying proportions. The influence of this mixing on the quality and storage behaviour of cashew apple will be studied.

Apple will be dipped in different concentrations of kanji water tamarind solution brine solution and calcium ~~hydroxide~~ hydroxide solution and the fruit quality will be assessed.

10. Date of start : January 1979.
11. Likely date of completion : 1981.
12. Estimated man months : 9
13. Facilities required : i. To collect apples from the All India Co-ordinated Cashew Improvement Project, Vellanikkara.
ii. Laboratory facilities, College of Horticulture.
14. Financing organization : Kerala Agricultural University.
15. Approximate cost : Rs. 1,000/-

Sd/-

Principal Investigator.

FRC IX - Approved.

RESEARCH PROJECT

1. Institute Code No. : No. AG.H. 3.19. Proc.Tech. 1.04.
2. ICAR Code No. :
3. Name and address of the : College of Horticulture,
Research Institute/
Centre : Vellanikkara.
4. Title of the Project : Research on Cashew.
Title of the problem : Clarification of cashew apple
juice.
5. Name and designation of : Augustin, A., Asst. Professor
the Principal Investigator in Bio Chemistry.
6. Name and designation of : Prof. V.K. Damodaran, Professor
Associates of Horticulture.
7. Location : College of Horticulture.
8. a. Objectives : To find a method of removing
the astringency of the cashew
apple juice.

b. Practical utility:

With the increased production of cashewnut envisaged in our planting programmes, the production of cashew apple also has increased considerably. The huge quantity of apple is practically wasted at present without considering the nutritive value. The only drawback is the astringent and acrid principles. It is very essential to remove the same without destroying the quality of the juice so that it can be converted as soft drink.

Previous work:

Steaming of cashew fruit (Jain et. al. 1954) is an efficient method of removing astringent and acrid principles. But it is badly effecting the quality of the juice. Treatment of the fruit for 4-5 minutes in boiling solution of common salt (2%) or H₂SO₄ (0.2 N) gave almost same result as steaming. Addition of gelatin (0.25 to 0.4%) pectin (0.35%) or lime juice (25%) resulted in the precipitation of undesirable substances which were removed by straining or centrifugation. The Department of Industries, Madras has suggested (Curr. Sci, 1934-35, 3, 627) to treat the juice with slaked lime which precipitates the undesirable constituents. After filtration through cloth and addition of a little acetic acid, the filtrate is having almost same the quality as after steaming.

9. Technical Programme:-

- a) Study of the effect of Ca (OH)₂ in addition to gelatin and lime juice for clarification.

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-2-

- b) Study of the keeping quality by adding chemicals like sodium benzoate and Pot. meta bisulphite.
- c) Study of the effect of carbonation and the keeping quality of soft drink prepared from the clarified juice.

Observations to be recorded

1. The quantity of $\text{Ca}(\text{OH})_2$, gelatin and lime juice required for clarification.
 2. Quality assay of carbonated juice at intervals of one month for a period of six months.
 3. Comparative study of sodium benzoate and pct. meta-bisulphite as preservatives for the clarified juice.
 4. The nutrient status of clarified juice and soft drink.
10. Date of start : January 1979.
 11. Likely date of completion : 1980.
 12. Estimated man months : 4 man months.
 13. Facilities required : Staff and laboratory as per the approved programme under KADP.
 14. Financing organization : KADP Research and Training.
 15. Approximate cost : Rs. 3,000/-

Signature of

Sd/-

FRC XI.

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE

DEPARTMENT OF AGRONOMY

1. Name and address of the Research Centre : Coconut Research Sub-Station, Balaramapuram.
2. Project No. : AG. 4(a). 10. Agron. 1.05.
3. Title of the Project : Varietal-cum-fertilizer studies on pepper grown as an intercrop in coconut gardens using coconut palm as standards.
4. Name and designation of
 - a) Project leader : Dr K.M. Sukumaran, Asso. Professor.
 - b) Associates : 1. S. Sasikumaran, Asst. Professor.
2. K.S. Remamony, Asst. Professor.

5. Objective:

1. To screen out the most suitable variety for intercropping in coconut gardens.
2. To work out the suitable fertilizer schedule for Pepper grown as intercrop in coconut gardens.

6. Practical utility:

Pepper can be grown as an intercrop in coconut gardens using coconut trees themselves as standards. Information regarding the variety of pepper, suitable under coconut plantation is not available. The performance of the hybrid variety Panniyur I is reported as not quite promising under the shade of coconut. The manurial requirement of pepper as an intercrop in coconut has also not been well studied. Information with respect to the variety suitable for growing under the shade of coconut palms, as well as the manurial requirement for the intercropped vine, would help in raising an economical intercrop of pepper in coconut gardens which could augment the income of the coconut farmer in a substantial way.

7. Short review of literature.

Published reports on the pepper varieties adapted for the shade of coconut gardens and on the proper manurial schedules for pepper intercropped with coconut palms are practically unavailable.

8. Technical programme:Treatments

1. Panniyur I with N.P.K. @ 100:40:140 gms/vine/year.
2. -do- @ 70:40:140 + 50 gm magnesium oxide/vine/year.

Contd.....2/-

-2-

3. Karimunda with NPK @ 100:40:140 gms/vine/year.
4. -do- @ 70:40:140 + 50 gm. magnesium oxide/vine/year.
5. Cheriya kaniyakadan with NPK @ 100:40:140 gms/vine/year.
6. -do- @ 70:40:140 + 50 gm. magnesium oxide/vine/year.
7. Kottanadan with NPK @ 100:40:140 gms/vine/year.
8. -do- @ 70:40:140 + 50 gm. magnesium oxide/vine/year.
9. Narayakodi with NPK @ 100:40:140 gms/vine/year.
10. -do- @ 70:40:140 + 50 gm magnesium oxide/vine/year.

Design : Randomised Block Design.

Plot size : 5 coconut palms spaced 6.5 m x 6.5 m will form a plot.

The rooted cuttings will be planted one metre away from the base of the coconut palms. The fertilizers will be applied in two equal split doses, one during May-June and the other during September-October. NPK @ 0.5; 0.32 and 1.20 kg/palm/year will be applied to the coconut palms.

During the first year of planting $\frac{1}{3}$ quantity of the fertilizer will be applied during June and during the second and third years $\frac{2}{3}$ and full quantities of fertilizers will be given from 4th year.

Observations to be recorded.

1. Height of vine for the first 5 years.
2. Internodal length.
3. No. of leaves per sq. metre.
4. Leaf area.
5. Date of first flowering.
6. No. of spikes per unit area.
7. No. of bisexual flower per spiket.
8. No. of fully developed berries per spiket.
9. Fruit setting percentage.
10. Weight of 1000 berries.
11. Drying percentage of berries.
12. Total berry yield per vine.

9. Date of starting : 1979 June.

Contd.....3/-

-3-

10. Likely date of completion : 1989.
11. Facilities required :
12. Approximate cost : Rs. 10,000/-
13. Signature of

Sd/-

PROJECT LEADER. HEAD OF DEPARTMENT. DIRECTOR OF RESEARCH.

FRC IX - Approved. Lime or dolomite at 1 kg./palm may be applied to the Coconut palms along with the usual NPK treatments. Only the coconut variety West Coast. Tall should be used for training the Pepper vines.

PROFORMA FOR RESEARCH PROJECT PROPOSAL

KERALA AGRICULTURAL UNIVERSITY

RESEARCH PROJECT

Faculty of Agriculture Department of Agronomy

1. Name of Research Centre : Pepper Research Station,
Panniyur.
2. Project No. : To be allotted.
No. AG. 4(a).11. Agron. 1.06.
3. Title of Project : Fertilizer trial on local
varieties of pepper in culti-
vators' fields.
4. Name and designation
- a) Project Leader : Asst. Professor (Agronomy).
- b) Associates : Asst. Professor (Chemistry).

5. Objective:-

To find out the manurial requirements and to formulate an economic fertilizer dose for the local varieties of pepper.

6. Practical utility:-

So far fertilizer application for pepper has not been accepted as a regular systematic practice by pepper cultivators of the State. Lack of information on the manurial requirement of local varieties is one of the reasons for this slackness on the part of the farmers. Manurial trials on the hybrid variety of pepper, Panniyur-1 is in progress at this station. But, so far, no such trials have been initiated on the other local popular varieties of pepper. Sufficient number of plants of local varieties are not available at this station to take up such a trial. The matter ~~xxxx~~ was discussed with Vice Chancellor, Kerala Agricultural University while he visited this station in Jan. 1977. The Vice Chancellor has suggested that the trial may be taken up in cultivators' fields near about this station. This project is drawn up according to the above suggestion. If the trial is taken up in an yielding garden of a willing cultivator, it should be possible to get the results within three or four years. Formulation of an economic manurial schedule or fertilizer doses is quite essential for drawing up an improvement programme for any crop.

7. short review of literature:-

Experimental data on nutrient requirements of local varieties of pepper is not available at present. However, Pillay and Sasikumaran (1976) has reported that one hectare of Panniyur-1 pepper plants (1200) Nos. annually removes about 34 kg. N, 3.5 kg. of P_2O_5 and 32 kg. K_2O from the soil (Arec. & Spices Bul. 8 (i))

Contd.....2/-

13-14), Raj (1972 and 1973) has reported the organic and inorganic fertiliser requirements of pepper in Sarawak. No data on this aspect is available in respect of Kerala Soils and Pepper varieties, which justifies the conduct of this experiment.

8. Technical Programme:-

A field experiment using incremental doses of the three major nutrients will be conducted, in cultivators' field near about the Pepper Research Station, Panniyur. The gardens selected will have sufficient number of plants of the local popular varieties (Arakulam Munda and Karimunda). The plants should be of uniform age and growth as far as possible and should be in good yielding stage. The details of the experiment are as follows -

Design : 3^3 x 2 Factorial confounded design totally confounding N, P and K.

Treatments

1. Nitrogen : 50, 100 and 150 g N per plant per year.
2. Phosphorus: 25, 50 and 75 g P_2O_5 per plant per year.
3. Potassium : 100, 150 and 200 g K_2O per plant per year.

Altogether there will be twenty seven treatment combinations.

Replications : Two
 Plot size : 6 to 12 plants according to availability.
 Variety : Plot-1-Karimunda.
 Plot-2-Arakulam Munda.

All the plants will be given a uniform application of 10 kg. green leaves or cattle manure. All the cultural and management practices will be uniform to the plants.

The No. of spikes, total yield, 1000 berry weight and volume and drying percentage will be observed and recorded.

9. Date of start : June, 1977.
10. Likely date of completion : 1980.
11. Additional facilities required : Nil
12. Approximate cost : Rs. 2,000/-

Sd/-

Project Leader. Head of Department. Director of Research.

FRC IX - Approved.

P R O F O R M A
 KERALA AGRICULTURAL UNIVERSITY
 FACULTY OF AGRICULTURE
 DEPARTMENT OF HORTICULTURE
 COLLEGE OF HORTICULTURE
 VELLANIKKARA TRICHUR

Programme of Research for Masters Degree

(for approval of University)

No. AG.H. 4(a).19. Bot. 2.04.

1. Name of candidate : Rema Menon
2. Date of admission & admission number : 16-10-1978.
78-12-03.
3. Name and designation of Chairman of Advisory Committee : Dr P.C. Sivaraman Nair, Assoc. Dean, College of Horticulture, Vellanikkara.
4. Topic of Research for Thesis : Growth, flowering, floral biology and spike shedding in pepper : Piper nigrum L.
5. Objectives of the Research:
 1. To study the pattern of growth and flowering in pepper.
 2. To study the floral biology.
 3. To study the spike shedding in pepper.
6. Brief review of the work done:

The growth pattern of pepper is not known, although from experience it can be seen that the plants put forth new flushes in May-June after the receipt of 7.5 to 10 cm of rain. Along with the new flushes spikes are also produced alternatively on leaf axils opposite to the leaves. No work has been done on the nature and time of flush development and the extend of spike production. It is also not known whether spikes are produced in all the leaf axils. The growth study become more important at present when pepper is being trained on coconut under irrigated conditions. Such irrigation is likely to affect the flushes and also the flowering. Therefore the present study is proposed to investigate the flushing habit of pepper under rainfed conditions.

Though the floral biology of pepper has been studied to a certain extent for the hybridisation programme at the Pepper Research Station, Panniyur, no detailed study has been conducted and published. The research reports from Pepper Research Station, Taliparamba clearly indicated that the pollination in pepper is through rain water which also is in accordance with the

Contd.....2/-

common belief and experience of the cultivators. It is quite often possible to forecast the extent of crop production during a particular year by the nature and distribution of rainfall during the period of ~~xxxx~~ flushing. But contrary to this it has been reported recently that water has no connection in fruit set in pepper. This aspect has to be investigated further to obtain conclusive results.

Spike shedding is a serious problem in pepper. Though several physiological and nutritional causes and moisture stress are the reasons attributed, the exact reason or reasons are not known. The present study, therefore, is intended to study the extent of shedding and the period of shedding so that timely action can be taken to reduce the loss.

7. Scientific/Practical importance of the work:

The study of growth pattern is quite important for regulating manuring and flowering. Similarly floral biology and detailed pollen studies will help to take proper action to increase the fruit set. The spike shedding studies is quite important to reduce the shedding and to increase the yield.

8. Technical programme:

The varieties proposed for the study are Panniyur-1 and Karimunda. Twelve plants under each will be selected and the growth, flowering and fruitset will be studied.

The following data will be collected:

1. The number of flushes and extension in shoot growth for a period of 1 year.
2. Period of spike initiation.
3. Period of receptivity.
4. Structure and viability of pollen.
5. Nature of pollination.
6. Number of flowers produced.
7. Number of flowers set.
8. Number of spikes dropped at different interval.
9. Moisture status of the soil at periodic interval.
10. Climate characters such as rainfall, temperature (Maximum and minimum) and humidity.

9. a) Estimated Expenditure : Rs. 1,500/-
 b) Receipts : Nil
10. Location of Research : College of Horticulture.

Sd/-

Signature of the candidate.

Sd/-

Signature of the Chairman of
 Advisory Committee.

Sd/-

Signature of the Dean.

KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE

Dept. of Soil Science & Agricultural Chemistry.

- No. AG.H. 4(a).19. Che. 1.03.
1. Name of candidate : SUSHAMA, P.K.
 2. Date of Admission & Admission No. : 10--10--1979.
79-11-30
 3. Name & Designation of Chairman of Advisory Committee : Dr A.I. Jose, Assoc. Professor of Soil Science & Agrl. Chemistry.
 4. Topic of research for thesis : Foliar diagnosis, yield and quality of pepper in relation to N, P and K.
 5. Objectives of research :
 - a. To develop foliar diagnostic technique in pepper with a view to predicting yield in relation to N, P and K.
 - b. To study the yield and quality of pepper in response to graded doses of N, P & K.
 6. Brief review of previous work done on the topic:

Nutrient exhaust studies on major and secondary plant nutrients in pepper have been carried out by Pillay & Sasikumaran (1977). According to their estimate, one hect. of pepper yielding an average of 1 kg dry pepper/vine requires 340 kg nitrogen, 5.50 kg P₂O₅ and 32.0 kg K₂O for the production of berries alone. Based on this observation, a manurial schedule of 100 kg N, 40 g P₂O₅ and 100 g K₂O/vine has been recommended.

7. Scientific and/or practical importance of the Research:
 - a. Standardization of tissue for foliar diagnosis in relation to N, P and K.
 - b. Prediction of yield based on foliar diagnostic technique.
 - c. Study of the pattern of uptake of N, P and K and the optimum dose of these nutrient elements for maximum and economic yield.
 - d. Study of quality of black pepper as affected by different levels of N, P and K.
8. Technical programme (Give outline)

Leaf samples will be collected from experimental plants from a standing fertilizer trial available at the Pepper Research Station, Panniyoor.

Contd.....2/-

Details of the experiment are:-

Design: 3^3 factorial experiment in randomised block design with NP^2K^2 totally confounded.

Levels of Nitrogen:

no - 50 kg/ha.
 n_1 - 100 kg/ha.
 n_2 - 150 kg/ha.

Levels of phosphorus:

p_0 - 50 kg/ha.
 p_1 - 100 kg/ha.
 p_2 - 150 kg/ha.

Levels of potassium

k_0 - 50 kg/ha.
 k_1 - 100 kg/ha.
 k_2 - 150 kg/ha.

Total number of treatment combinations : 27

Replications	:	2
Plants/plot	:	5
Spacing	:	2 m x 3.5 m
Variety	:	Panniyoor-1

In order to standardise the tissue for foliar diagnosis, leaf samples will be drawn from selected plants under each treatment during different periods and from different positions, numbering the leaves available on selected shoots.

After the standardization of the sampling time and leaf positions, it will be possible to correlate the levels of nutrients in the index leaf with that of yield and the levels of nutrient supplied. Regression equations will be established for the prediction of yield based on nutrient level of the index leaf.

The pattern of uptake of N, P and K will also be examined by chemical analysis of plant materials collected periodically. This will help in indicating the appropriate time at which there will be maximum uptake of nutrients. This can be made use of in determining the time of application of fertilizers. The optimum dose of N, P and K for maximum and economic yields can be worked out from the response of plants to the graded doses of N, P and K.

Contd.....3/-

The possible changes in the quality of pepper especially the yield of oleoresin will be studied by analysing the berries from the experimental plants, collected at different stages of maturity.

9. Estimate of expenditure and Receipts if any:

1. Expenditure:

a. Fellowship @ Rs. 600/trimester = Rs. 3,600/-

b. Contingencies:-

Sampling charges = Rs. 2,000/-

Transportation cost & other expenses = Rs. 500/-

Total = Rs. 6,100/-

2. Receipts : Nil

10. Location of Research: : College of Horticulture, Vellanikkara. (Samples will be collected from the standing NPK Trial on Panniyoor-1 at the Pepper Research Station, Panniyoor.)
(If out side College Campus)

Sd/-

Signature of the candidate.

Sd/-

Signature of the Chairman
(Advisory Committee)

Sd/-

Signature of the Assoc. Dean.

7. Scientific/practical importance of the research:

By standardising the deficiency symptoms manifested by different nutrients we can easily predict the requirement of the plant without going for sophisticated chemical analysis. Also by finding the critical level of each nutrient, an accurate fertilizer recommendation can be evolved.

8. Technical programme: 1) Investigations on nutrient deficiency symptoms

The cuttings of hybrid variety, Panniyur-1, will be grown in potting mixture for six months. Fertilizers will be applied as per the package of practices recommendations. After six months when the plants have achieved sufficient vegetative growth, they will be transplanted to acid washed sand medium in pots (for developing deficiency of major nutrients, polythene pots will be used and that for minor nutrients, porcelain pots will be used). The plants will be grown in the sand medium under rain and dust proof pandal, till they become deficient in the respective nutrient which is not applied. The deficiency symptoms manifested by the plant at that stage will be colour photographed. Three plants will be removed at random from each treatment at an interval of one month starting from two months after the application of treatments and they will be analysed for the nutrient in question. The details of the experiment are as follows:-

Design	- C R D
Variety	- Panniyur - 1
No. of treatments	- 12
No. of plants per treatment	- 40 (10 as observational)

Treatments

1. Control (nutrient solution containing all the nutrient elements - Hewitt solution)

Control minus N, P, K, Ca, Mg, S, Mn, Zn, Cl, Fe and Cu.

2. Investigations to find out the critical level of major nutrients

The experiment will be conducted on the existing five year old pepper plants (var. Panniyur-1) at the Pepper Research Station, Panniyur. The existing plants will be grouped into various yield groups based on the previous years yield data.

Contd.....3/-

P R O F O R M A

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE

Department of Horticulture. College of Horticulture.
Vellanikkara, Trichur.

PROGRAMME OF RESEARCH FOR DOCTORATE DEGREE

(For approval of University)

1. Name of candidate : Nybe, E.V. No. AG.H. 4(a).19. Che. 3.01.
2. Date of admission and admission No. : 10-10-1979.
79-22-01.
3. Name and designation of : Dr P.C. Sivaraman Nair,
Chairman of Advisory Assoc. Dean, College of Horti-
Committee culture.
4. Topic of research for thesis : Investigations on the nutri-
tion of black pepper (Piper
nigrum L.)
5. Objectives of the research:
1. To develop nutrient deficiency symptoms in black pepper under pot culture.
 2. To find out the critical levels of major nutrients in respect of yield under field conditions.
6. Brief review of previous work:

Very little work has been done on the nutritional aspect of pepper. Though systematic work was initiated in Sarawak early in 1959 (Reports of the Agrl. Dept. Sarawak, 1961), no concrete results are available.

De Waard (1969) was the first researcher to conduct studies on nutritional deficiencies and foliar diagnosis in pepper. He conducted a pot ext. in Sarawak to study the deficiency symptoms of NPK, Ca and Mg, the concentrations of nutrients associated with actual and incipient deficiencies, the influence of nutrients on the chemical concentration in leaves etc. From the pot culture, it was observed that - deficiency symptoms are characteristic for the element in question and correspond with significantly low leaf concentrations.

So far ~~the~~ such work has been initiated in India. De. Waard conducted studies with reference to macro nutrients only. But micronutrients also play an important role in perennial crops like pepper. Therefore it is proposed to conduct an investigation on the deficiency symptoms of all the nutrients and the critical levels of major nutrients.

Contd.....2/-

Sampling will commence with the flowering from May-June. Prior to flowering one sample will also be taken to assess the nutrient exhaustion with the advancement of berry development. Sampling will be continued until harvest. The frequency of sampling is once in two months. De Waard's standard leaf will be the plant part to be sampled.

Analysis:- Chemical analysis of the leaf samples will be done for all the nutrients (both macro and micro) and the relationship between the leaf concentrations of these nutrients and yield will be worked out in order to find out the critical levels.

9. a. Estimated expenditure:

Cultivation expenses (excluding the cost of plastic buckets and perceline pots)	Rs. 20,000
Laboratory chemicals	Rs. 10,000
Photographs	Rs. 2,000
Total	----- Rs. 32,000 =====

9. b. Receipts : NIL

10. Location: College of Horticulture, Vellanikkara and Pepper Research Station, Panniyur.

Sd/-
Signature of candidate.

Sd/-
Signature of the Dean.

KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE

Programme of Research for Master's Degree

DEPARTMENT OF PLANT PATHOLOGY : COLLEGE OF HORTICULTURE,
VELLANIKKARA.

No. AG.H. 4(a).19. Path. 2.07.

1. Name of the candidate : VILASINI, T.N.
2. Date of admission & No. 16--10--1978 : 78-11-65
3. Name and Designation of the Chairman, Advisory Committee : Dr Abi Cheeran, Assoc. Professor of Plant Pathology.
4. Whether the Project is approved by the University : Yes (A part of approved Res. programme)
5. ~~Exx~~ Institute Code No. : 5(a) 15-8-4.
6. Topics of the Research for thesis:

"Quick wilt disease of Pepper-II The techniques for screening pepper varieties against quick wilt disease caused by Phytophthora palmivora (Butler) Butler.
7. Objective of the Research:

To find out a rapid and perfect technique to screen large number of pepper varieties (both open pollinated and hybrid seedlings) against the quick-wilt organism of pepper.
8. Brief review of previous work done on the topic: (give reference to the important publications/thesis)
 1. Turner (1973) has made an attempt to screen the pepper varieties available at Sarawak against Phytophthora by using zoospore suspension of the pathogen.
 2. Lee (1973) reported that the pathogen Phytophthora palmivora is capable of producing some toxic metabolite in vivo and in vitro and the advantage of this phenomenon can be utilised for screening the pepper varieties against the pathogen by using culture-filtrate containing toxic metabolites.
9. Scientific and/or practical importance of the research:

The study will help to find out an easy, rapid and perfect method of screening large number of hybrid and open pollinated seedlings of Pepper against the pathogen Phytophthora palmivora.
10. Technical programme:
 1. One year old rooted cuttings of pepper will be ~~xxxxx~~ inoculated by the conventional methods and

Contd.....2/-

development of the disease will be recorded and studied.

2. Dipping the rooted cuttings of pepper plant in the standardised zoospore suspension and the development of necrotic lesions of the root and symptom expression of the plant will be recorded and studied.
3. Dipping the rooted cuttings in the partially purified culture filtrate which contain the toxic metabolite and are free from propagules of the pathogen/~~xxx~~ the necrotic lesions developed on the roots and the conductive tissues of the host.
4. Dipping the cut ends of the branches of pepper seedlings in the partially purified culture filtrate and absorbing the necrotic lesions on the different tissues of the plant.
5. A comparative efficacy of the different methods will be evaluated and the best method will be selected for utilisation in the practical screening programme.

11. Estimate of expenditure : Rs. 7,000/-

12. Location of research if outside the College Campus:

Plant Pathology Department, College of Horticulture, Vellanikkara and Pepper Research Scheme, Kerala Agricultural University, Main Campus, Vellanikkara.

Signature of the student.

Assoc. Professor, Plant Pathology.

Assoc. Dean.

College of Horticulture,
Vellanikkara,
Dated, 1--3--1979.

FRC IX

P R O F O R M A
 KERALA AGRICULTURAL UNIVERSITY
 FACULTY OF AGRICULTURE
DEPARTMENT OF HORTICULTURE-PLN. CROPS
 COLLEGE OF HORTICULTURE
 VELLANIKKARA - TRICHUR

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE

(For approval of University)

- No. AG.H. 4(a).19. Path. 3.02.
1. Name of candidate : GEETHA, C.K.
 2. Date of admission & admission number : 10--10--1979.
79-12-01.
 3. Name and designation of Chairman Advisory Committee : Dr P.C. Sivaraman Nair, Associate Dean, College of Horticulture, Vellanikkara.
 4. Topic of research for thesis : Investigations on spike shedding in pepper, Piper nigrum L.
 5. Objective of the research:

1. To find out the extent of spike shedding in different cultivars.
2. To find out the physiological causes responsible for the shedding.
3. To find out whether external application of growth regulators can reduce or eliminate the spike shedding.
4. To find out whether major nutrient imbalance has any bearing on spike shedding.

6. Brief review of the previous work done on the topic:

Spike shedding may be due to one or more of the following factors:-

1. Genetic
2. Physiological
3. Effect of macro and microclimate and
4. Moisture stress during the period of development

Studies conducted by Pillai et al (1977) have shown that there is difference in spike shedding among the varieties which indicates that the genetical factors are involved. Pillai et al. (1977) have found that planofix has influence in increasing the berry size but not in the reduction in spike shedding. No other detailed study has been taken up on this important aspect. Therefore the present ~~xxxx~~ study is intended to throw light on the factors that are responsible for spike shedding and also to verify whether some of

Contd.....2/-

the plant growth regulators which are found to be useful in reducing fruit drop will have any influence in spike shedding in pepper.

7. Scientific and/or practical important of the research:

Spike shedding is found to the extent of 11-75% in certain varieties in certain seasons. If we can reduce the spike shedding it can go a long way in increasing the yield of pepper.

8. Technical programme in brief:

- (1) The extent of spike shedding in the following cultivars will be studied for one season starting from flowering till harvest to study the differences in spike shedding among the cultivars.

Cultivars:

1. Panniyur-1
2. Karimunda
3. Kottanadan

(2) Physiological factors:

The following observations will be made to find out the physiological causes of spike shedding.

1. Qualitative analysis of the different amino-acids present from spike shedding till harvest at monthly intervals.

2. Qualitative analysis of the auxin level will be made by paper chromatographic method during the above period.

3. The major nutritional status (N,P,K and Ca.) of the shoots will be ascertained from flowering till harvest at monthly intervals.

(3) The anatomical changes:

The anatomical changes taking place just before and after the formation of abscission layer will be studied by taking sections at intervals.

(4) Moisture stress studies:

The moisture level in the plot will be studied by periodical sampling and finding out the moisture level of the soil in three depths: 5 cm, 10cm and 15 cm.

(5) Studies using plant growth regulators:

The following plant growth regulators and proprietary preparations will be utilized for the study.

1. IAA - 3 concentrations, 50,100,150 ppm.

- 2. 2,4-D - 5,10 and 15 ppm.
 - 3. NAA - 50,100 and 150 ppm.
 - 4. Planofix - 50,100 and 150 ppm.
 - 5. Vardhak - 50,100 and 150 ppm.
 - 6. Zinc - 0.5% (as zinc sulphate)
 - 7. Control - water spray
- Cultivar - Panniyur - 1.

Design - RBD

No. of treatments - 17

No. of replications - 3

No. of plants/treatment/replication - 4

No. of experimental plants - 204

(6) Climatic factors:

Temperature, humidity and rainfall will be recorded during the entire period.

Except on item (1) for all other studies Panniyur - I will be utilized.

9. Estimate of expenditure and receipt if any :

A. Cultivation expenses	-	Rs. 1000
Chemicals	-	Rs. 3000

Total	-	Rs. 4000
		=====

B. Receipt - NIL

10. Location of the experiment : Instructional Farm, Vellanikkara.

Vellanikkara,
Date: 29-2-1980.

Sd/-
Signature of the candidate.

Sd/-
Signature of the Chairman
Advisory Committee.

Sd/-
Signature of the Assoc. Dean.

FACULTY OF AGRICULTURE

DEPARTMENT OF PLANT PATHOLOGY - COLLEGE OF AGRICULTURE,
VELLAYANI.Programme of Research for the Ph.D.
(For approval of the University)

- No. AG. 4(a).18. Path. 6.01.
1. Name of candidate : M. ABRAHAM
 2. Date of admission & Admission No. : 19--10--1978.
78-21-08.
 3. Name and designation of Chairman : Dr James Mathew, Asst. Professor of Plant Pathology.
 4. Topic of Research for thesis : "Bacterial leaf spot of pepper, (Piper nigrum L.) incited by Xanthomonas betlicola Patel et al."
 5. Objectives of Research:

Pepper (Piper nigrum L.) popularly known as "King of Spices", is an important foreign exchange earning crop of our country. Out of the 30,000 tonnes of Black Pepper produced annually in India, Kerala alone accounts for nearly 25,000 tonnes. During the past one decade, diseases have been causing considerable damage to the crop in our state. A new bacterial leaf spot disease of pepper was reported for the first time by James Mathew et al. (1977) from Trivandrum District of Kerala. Further observations revealed its occurrence~~xxx~~ in other important pepper growing tracts of the State, viz. Nedumangad, Kottarakkara, Punalur, Muvattupuzha, Neriya Mangalam, Sulthanbatterly and Ambalavayl. Even though the disease is at present seen in an endemic pattern, it is possible that under the high rainfall conditions prevailing in most pepper growing parts of Kerala and continuous growing of pepper, the disease may flare-up in an epiphytotic proportion and can pose a serious threat to the pepper cultivation in our State. No detailed investigation on this disease has been carried out so far. Hence, it is proposed to conduct detailed studies on this disease aiming at the evolution of efficient and economic control measures.

6. Brief review of previous work on the topic:

The disease was first recorded by James Mathew et al. (1977) from Trivandrum District of Kerala. No other work has been done on this disease.

7. Scientific and practical importance of Research:

The information from the investigation will be helpful in understanding the various aspects of the disease and its causative bacterium and will be help-

Contd.....2/-

ful in formulating suitable control measures against the disease.

8. Technical programme:

- (a) Characterisation of the pathogen and collection of isolates from different pepper growing areas of the State.
- (b) Pathogenic variability in the casual bacterium of the disease.
- (c) Symptomatology of the disease both under natural and artificially inoculated conditions.
- (d) Screening of pepper cultivars for the source of resistance.
- (e) Survival of the bacterium in the diseased plant material and soil.
- (f) Toxicogenicity of the bacterium and its role in the symptom expression.
- (g) Host range of the pathogen.
- (h) Chemical control in vitro and in vivo using antibiotics.

9. Estimates of expenditure : Rs. 8,000/-

10. Location of Research : College of Agriculture, Vellayani and the Pepper Research Stations at Vellanikkara and Panniyoor.

Vellayani,
19-4-1979.

Signature of the Candidate.

Signature of Chairman Advisory
Committee.

FRC IX.

RESEARCH PROJECT

181

Faculty of Agriculture : Department of Botany.

1. Name of Research Centre : Cardamom Research Station, Pampadumpara.
2. Project No. : AG. 4(b).17. Bot. 1.03.
3. Title of project : Studies on the pollen morphology and pollen viability in 3 varieties of Cardamom viz., Malabar, Mysore and Vazhuka.
4. Name and designation of
 - (a) Project Leader : T.S. Rajendran, Instructor.
 - (b) Associate : Jacob John, Junior Instructor.
5. Objective:

Comparative study of morphology and viability of pollen of the three different varieties to see whether any significant difference exists among these varieties in the above respects.

6. Practical utility:

The close association between applied polynology and plant taxonomy has been emphasised by various workers. As a general rule, they serve best in distinguishing between and showing relationships among the various groups of plants. Moreover pollen viability is a factor contributing to fertilization, fruit set and yield. Hence an understanding of the above will be helpful in breeding varieties for higher yield.

7. Short review of literature:

Wodehouse (1928), cited by Erdtman (1952) states that the forms of pollen grains ~~xxx~~ are as useful as any other characteristic in the classification of plants. A great deal of work has been done on the morphology and viability of pollen grain of temperate region fruit trees in the U.S.A., U.S.S.R., U.K. etc. But with regard to tropical and sub tropical plants information on this aspect is meagre. Adam (1916) found the best germination of pollen in apple is in 1.5-10% cane sugar solution. Schumuther (1935) discovered that boron as borate was a stimulant to pollen germination.

8. Technical programme:

Pollen viability

- a) Standardising a media in which pollen grains of cardamom flowers show maximum germination percentage.
- b) Finding out the time of maximum pollen viability.

Contd.....2/-

- c) Observing and counting under the microscope pollen grains of the three varieties collected at the same time and put into the same media for germination.
- d) Working out percentage of germination.
- e) Statistical analysis.

Morphology.

- a) Collecting pollen grains soon after anther dehiscence.
- b) Observing under the microscope.
- c) Statistical analysis of the data.

9. Observations : Pollen viability.
 No. of viable and non-viable
~~xxxx~~ pollens in a number of
 microscopic fields.

Herphology.

1. Size of pollen grains.
2. Colour of pollen grains.
3. Shape of pollen grain.

10. Date of starting : July 1977.
11. Additional facilities required : Nil
12. Approximate cost : Rs. 50/-
13. Signature of :
- a) Project leader :
 - b) Head of Department :
 - c) Director of Research :

FRC IX - Approved.

RESEARCH PROJECT

- Faculty of Agriculture : Department of Botany.
1. Name of Research Centre : Cardamom Research Station, Pampadumpara.
 2. Project No. : AG. 4(b).17. Hort. 1.01.
 3. Title of project : Effect of plant growth regulators on flowering and fruit set in ~~XXXX~~ cardamom.
 4. Name and designation of the project leader : T.S. Rajendran, Instructor.
Associate : Jose Mathew, Junior Instructor.
 5. Objective : To study the effect of spraying plant growth regulators on flowering and fruit set in cardamom.
 6. Practical utility : The flowering period of cardamom is spread throughout the year. If the time span can be reduced by spraying growth regulators harvesting charges can be considerably reduced. Moreover growth regulator may increase the percentage of fruit-set and so the yield can be enhanced.
 7. Short review of literature:

Many workers have reported that the application of planofix has reduced ball shedding in Cotton (Bhat, 1972, Sahsrabudh, 1974, Sankaran and Balasubramanian 1975). Gill (1975) reports that planofix spraying on cotton plants increased the yield of cotton. Sivasubramanian and Rajamoni (1972) and Chandramony and Mary K. George, (1976) found that spraying with planofix increased yield in chillies. Planofix application has also been found to increase fruitset in cashew (Murthy et al S. Sasikumaran and P.K. Venugopalan Nambiar, 1977).

8. Technical programme:

Two sprayings with three different doses of 5 plant growth regulators, namely Ethrel, Planofix, Acemone, Microcil and Microfix at an interval of 20 days. Spraying will be done on the basal portion of the pseudostem and completely over the panicles, to the point of run off.

9. Observations

Pre-treatment:

1. No. of fruits present at the time of commencement of experiment.

Contd.....2/-

2. No. of panicles present.
3. No. of flowers present.

Post treatment observation:

1. No. of flowers produced (to be recorded daily).
 2. Total number of panicles (weekly).
 3. Total number of capsules produced.
 4. Percentage of fruit set.
 5. Total weight of capsules and weight of unit number of capsules.
 6. Variation any in the period of maturity of capsules.
 7. Average No. of seeds per capsules.
 8. Percentage of germination of seeds.
10. Date of commencement : 1978.
 11. Additional facilities required : Nil
 12. Approximate cost : Rs. 1,000/-
 13. Signature of
 - a) Project leader :
 - b) Head of Department :
 - c) Director of Research:

FRC IX - Approved. In the technical programme the names of the active ingredients should also be given (if known) as well as the concentration. The environmental conditions should be uniform.

KERALA AGRICULTURAL UNIVERSITY
Faculty of Agriculture
Department of Plant Pathology
College of Agriculture

PROGRAMME OF RESEARCH FOR THE Ph.D. PROGRAMME IN
PLANT PATHOLOGY

(For approval of the University)

No. AG. 4(c,d).18. Path. 3.01.

1. Name of the candidate : P. KARUNAKARAN.
2. Date of admission and Admission No. : 29--10--1974
74-21-25.
3. Name and Designation of Chairman, Advisory Committee : Dr M. Chandrasekharan Nair, Associate Professor of Plant Pathology.
4. Topics of research for thesis : Etiology and Control of the Diseases of Major tree Spices of Kerala.
5. Objectives of research:

The cultivation of tree spices viz. Clove (Eugenia caryophyllata Thumb.), Nutmeg (Myristica fragrans Houtt.) and Cinnamon (Cinnamomum zeylonicum Breyn) are on the increase in Kerala where the conditions are ideal for their cultivation. But the main constraint confronted by the farmers is the outbreak of a number of diseases, the etiology and epidemiology of which are poorly understood rendering the control measures adopted often ineffective. Hence, it is proposed to take up a detailed study on the diseases affecting these crops in Kerala.

The programme includes extensive survey of the different areas of the State for recording the incidence of the various diseases on the tree spices, assessing the intensity of attack and losses due to various diseases, identifying the pathogens and studying them in detail, assaying the efficacy of fungicides in the laboratory and testing them under field conditions so as to recommend proper control measures.

6. Brief review of previous work done on the topics:

No attempt was made in India or abroad to study the various diseases affecting tree spices, except for a few records of diseases. The earliest known record in India on the occurrence of a disease was that of fruit fall in Nutmeg resulting in heavy loss Ramakrishnan and Damodaran, 1954). Menon and Rema Devi (1967) reported on the incidence of a leaf spot of Nutmeg caused by Collectotrichum. Nair et al. (1978) recorded a shot hole disease of Nutmeg caused by Collectotrichum gloeosporioides. Philip et al. (1973) reported a seedling wilt of Nutmeg caused by Fusarium sp.

Contd.....2/-

Jose and Pailey (1966) reported on the incidence of leaf spot disease on clove caused by a species of Gloeosporium.

Muthappa (1965) reported that Cinnamon leaves are known to be infected by Exosporium cinnamomi, Resenscheldiella cinnamomi (Muthappa, 1967) and Uraecium nothopegiae on stem shoots and leaves (Ramakrishnan, 1966).

Outside India Nutman and Roberts (1971) made a detailed study on a decline disease of clove and they have elucidated the cause of this "sudden death" to infection by Valsa eugeniae and Endothia eugeniae.

No attempt was made so far to undertake organised surveys on the occurrence of diseases on tree spices in Kerala and to study them in detail and hence the present studies.

7. Scientific and/or practical importance of research:

No systematic efforts have been made so far in the State to study the diseases affecting tree spices. The information gathered from the present studies will reveal the prevalence of various diseases on tree spices in different parts of the State, the losses due to these diseases and their etiology and also the epidemiology. These will help to devise suitable economic schedule of operations to be followed by the growers of the spice crops for the control of various diseases, which will help in a long way to save the valuable products of the spice crops from destruction by diseases.

8. Technical programme:

1. Collection of various disease specimen of major tree spices viz., Clove, Nutmeg and Cinnamon.

2. Isolation and pure culture of the causal organism of the various diseases.

3. Studies on the etiology of the various diseases.

4. One major disease each on clove, nutmeg and cinnamon will be studied in detail on the following aspects.

A. Nutritional requirements of the Pathogen.

B. Studies on the physiology of parasitism.

(a) Mode of entry - direct or indirect, factors influencing entry.

(b) Histopathology of colonisation of the host by the pathogen.

(c) Mechanism of infection and disease development - role of enzymes, toxins etc.

Contd.....3/-

C. Physiological alterations brought about by interaction on host metabolism - changes in photosynthetic pigments, carbohydrates, nitrogen fractions and mineral metabolism.

D. In vitro and in vivo studies on the control by fungicides, antibiotics and other chemicals.

9. Approximate cost : Rs. 10,000/-
10. Location of Research : College of Agriculture,
Vellayani.

Sd/-
SIGNATURE OF CANDIDATE.

Vellayani,
15-11-1978.

Sd/-
Signature of Chairman,
Advisory Committee.

FRC VIII.

KERALA AGRICULTURAL UNIVERSITY

Research Project

1. Name of Research Centre : Horticultural Research Station, Ambalavayal.
No. AG. 4(e).12. Path. 2.01.
2. Project No. : To be assigned (new project).
3. Title of project : Studies on the Symptomatology, etiology and control of the new bacterial disease of ginger in Wynad.
4. Name(s) and designation of
 - a) Project Leader : G. Indrasenan, Asst. Professor (Plant Pathology).
 - b) Associates : 1. Dr James Mathew, Asst. Professor (P.P.), College of Agriculture, Vellayani.
2. V. Sreekumar, Jr. Instructor, Horticultural Research Station, Ambalavayal.
5. Objective:

This disease of bacterial origin is a new report on ginger. The disease in its wake has caused considerable damage to the standing crop of this station and nearby areas. Effective control measures could not be adopted for want of information about the disease. The objective of the experiment is to study the symptomatology, etiology and control of the disease.

6. Practical Utility:

Ginger is one of the important spice crops of Kerala cultivated in an area of 11671 ha. with a production of 28,840 tons of dry ginger annually. This is one of the dollar earning crops of great economic significance. The recent outbreak of a disease of bacterial origin can be a factor limiting its production.

The disease can cause considerable damage to the crop and its rate of spread is quite alarming. Extensive area is brought under this crop in the nearby areas by cultivators - because of the lucrative income from this crop. If the disease is allowed to spread, it may result in 60-70% loss in yield and sometimes the entire crop would be wiped out under favourable conditions resulting in total loss to the cultivators. In the advanced stage of infection, it is very difficult to distinguish symptoms of this disease from those of soft-rot caused by the Pythium spp. The results of the proposed studies will enable to understand the Symptomatology of the disease and the etiology of the Pathogen. Information on other aspects are highly essential for

Contd.....2/-

evolving suitable measures of control of this disease. By adopting proper control measures it will be possible to check, the disease and save the crop.

7. Short review of literature:

Pordesimo and Raymundo (1963) reported the bacterial rot of ginger from Philippines. Hayward A.C. Moffett. M.L Pegg K.G. (1967) reported bacterial wilt of ginger in Queensland. Pegg. M.G., Mofett. M.L. (1971) studied the host range of giner strain of Pseudomonas solanacearum in Queensland. Quinon, V.L. Aragaki, M and Ishii.M, (1963) reported the wilt caused by Pseudomonas on ginger from Hawaii. (Plant Disease Reporter 47:710-713) The same workers (1964) studied the Pathogenicity and serological relationships of three strains of Pseudomonas solanacearum in Hawaii (Phytopathology 41 : 1096-99). Orian, G (1953) reported the same disease from Mauritius (Report of Department of Agriculture Mauritius P.P 37-40) From India an unspecified rot in ginger was reported suspected to be of bacterial origin (Anon. 1974 - Annual Report 1973 CPCRI Kasaragod PP. 149-151).

8. Technical Programme:

Detailed studies will be undertaken on Symptomatology, etiology and control of the disease.

1. Symptomatology

- (a) Symptous under field conditions
- (b) Symptous produced by artificial inoculation
- (c) Effect of inoculation at different growth stages of the host.
- (d) Effect of inoculation with different isolates of Pathogen.

2. Etiology: Isolation, Pathogenicity and identification of the bacterial Pathogen will be undertaken.

- (a) Isolation of Pathogen
- (b) Determination of its Pathogenicity
- (c) Characters of the Pathogen and its identification

3. Survival:

- (a) Isolation of Pathogen from infected soil at different periods.
- (b) Planting of healthy seed material in infected soil at different periods.
- (c) Isolation of Pathogen from infected rhizome at different periods.
- (d) Planting of infected rhizome in sterilized soil at different periods."

- (e) Isolation of Pathogen from infected crop debris at different periods.
- (f) Planting of healthy rhizome in sterilized soil mixed with infected crop debris.

4. Control:

- (a) Screening of germplasm collection and wild species of ginger to locate the source of resistance.
- (b) Chemical: (i) The following antibiotics will be tested in vitro and the most effective one selected. Agromycin, Terramycin, Chloramphenicol, Amphotericin, Streptomycin, Plantomycin and streptomycin.
 - (ii) Treating the infected seed and isolation of Pathogen at different intervals.
 - (iii) Sowing treated seed material (infected) to note the incidence of disease.
 - (iv) Healthy seed material to be treated and sown in infected soil to study the incidence of the disease.
 - (v) Effect of soil drench and foliar spray of plants to note the incidence.
 - (vi) Effect of soil amendments and ameliorants on the incidence of disease.

The details of lay out of the various experiments will be finalised after discussions with the Professor of Statistics and Plant Pathology.

- 9. Date of start : April 1979.
- 10. Likely date of complete : February 1981.
- 11. Additional facilities : The facilities available at the College of Agriculture, Vellayani and Horticultural Research Station, Ambalavayal will be utilized.
- 12. Approximate cost : Rs. 5,000/- towards cost of chemicals and T.A. for scientists.
- 13. Signature of

Sd/-
Project Leader. Head of Department. Director of Research.

FRC IX - Approved.

PROFORMA FOR RESEARCH PROJECT PROPOSAL
KERALA AGRICULTURAL UNIVERSITY, VELLANIKKARA.

191

- Faculty of Agriculture Department of Plant Pathology
No. AG. 4(e).18. Path. 3.01.
1. Name of student : MARYKUTTY SAMUEL
 2. Date of Admission : 16--10--1978.
Admission Number : 78-11-36.
 3. Name and Designation of : Dr James Mathew, Assistant
Chairman, Advisory Professor, Plant Pathology.
Committee
 4. Name and address of : College of Agriculture,
Research Institute/ Vellayani.
Centre
 5. Title of the Project : Etiology of bacterial wilt of
ginger incited by Pseudomonas
solanacearum E.F. Smith and its
control.
 6. Objective:

The bacterial wilt disease of ginger is of recent occurrence in India causing very serious crop losses in the ginger-growing tracts of Kerala. Practically no information is available on this disease in our country. The results of the present investigations on the pathogen, disease, and its control will be useful in formulating suitable control measures against the disease.

7. Practical utility:

Ginger (Zingiber officinale Rosc) is a crop of great economic significance to India and especially to Kerala, being a foreign exchange earning produce. Kerala State alone accounts for more than 25447 tonnes of dry ginger production annually from 10350 ha. of ginger crop.

As in the case of other crops, ginger is also prone to a number of plant diseases. Recently during the monsoon months of 1978, a new bacterial disease was seen in epiphytotic proportions in the Ambalavayal and Sultanbattery areas of Calicut district and Adiparamba area of Trivandrum district. The disease assumed very serious and alarming proportions in certain fields resulting in partial to total crop losses. Preliminary investigations on this malady revealed that the disease is the bacterial wilt of ginger caused by Pseudomonas solanacearum E.F. Smith, reported from other parts of the world.

In view of the potential crop losses the disease is liable to cause to ginger cultivation in our State,

Contd.....2/-

the following lines of study are ~~now~~ proposed to be undertaken with a view to understanding more about the pathogen and disease and also to formulate effective control measures against this disease.

8. Short review of literature:

Ishii, M. and Aragaki, M. (1963) reported ginger wilt caused by Pseudomonas solanacearum E.F. Smith from Hawaii, for the first time. Jamil, M. (1965) has reported Pseudomonas solanacearum from Malaya on ginger. Hayward et al (1967) reported that this disease has been found to occur in Queensland. Chew (1969) reported that bacterial wilt has been recognised as the greatest problem in ginger production in peat soils in Malaysia. Zehr E.I. (1969) reported its occurrence from Phillipines.

9. Technical Programme:

(1) Symptomatology:

The symptoms of the disease under natural and artificially inoculated conditions will be studied in detail.

(2) Characterization of the pathogen:

The pathogen causing ginger wilt will be characterized using routine bacteriological procedures and its identity established.

(3) Survival of the Pathogen:

Role of infected seed rhizomes, crop residues and soil in the survival of the pathogen from season to season will be studied.

(4) Control of the disease by chemicals:

Screening of antibiotics and chemicals will be done to identify an effective chemical for the control of the disease.

(5) Role of nematodes:

Association of root knot nematode, if any, in the disease will be studied.

(6) Toxin studies:

Toxigenicity of the bacterium and the role of such toxins in symptom expression will be studied.

10. Estimate of expenditure

and receipts if any : Rs. 2,500/-

11. Location of research if any

outside the College Campus : ...

Vellayani,
8th March, 1979.

Sd/-
Signature of candidate.

Sd/-
Signature of Chairman
(Advisory Committee).

Sd/-
Signature of Head of Department.

FRC VIII.

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE

Programme of Research for Master's Degree

DEPARTMENT OF PLANT PATHOLOGY : COLLEGE OF HORTICULTURE,
VELLANIKKARA.
No. AG.H. 4(e).19. Path. 4.01.

1. Name of the Candidate : PREMANATHAN THATTANKANDY.
2. Date of Admission and admission number : 16--10--1978.
78-11-63.
3. Name & Designation of the Chairman of Advisory Committee: Dr C.K. Peethambaran, Assistant Professor of Plant Pathology.
4. Whether the project is approved by the University : Submitted for approval.
5. Institute Code No. :
6. Topics of the Research for thesis. : Studies on the Phyllosticta Leaf spot of ginger.
7. Objective of the Research:
 - a. To study the infection pattern of the pathogen.
 - b. To study the atmospheric conditions favourable for the disease development.
 - c. Screening of germplasm of ginger against the disease.
 - d. Fungicidal control of the disease - Laboratory and field studies.
8. Brief review of previous work done on the topic:

Phyllosticta zingiberi causal organism of the leaf spot disease of ginger was first reported in India by Ramakrishnan (1942) from Godavari and Malabar Districts of the erstwhile Madras State. The same disease was reported by Sohi et al (1964) from Himachal Pradesh and by Shukla and Haware (1973) from Madhya Pradesh.

Physiological studies of Phyllosticta zingiberi were conducted only by a very few workers. Ramakrishnan (1942) observed that the optimum pH for the growth of the fungus on Richard's agar lies between 4.3 and 5.8. Sadasivan and Subramanian (1955) studied the vitamin requirement of the fungus along with 26 other isolates of fungi.

According to Ramakrishnan (1942) the disease could be controlled by one or two applications of Bordeaux mixture. Chanliongco (1966) got good control by using Zerlate, Vancid Z-45 or Dithane M.42. Spraying with 0.2% Dithane 278 six times at fortnightly intervals

Contd.....2/-

gave good control of the fungus. Similarly Flit 406 (0.3%) Dithane M.22 (0.2%) or Bordeaux Mixture also were effective in checking the disease (Sohi. 1975).

9. Scientific and/or practical importance of the research:

The important disease of ginger was considered to be the soft rot caused by Pythium spp even though the leaf spot disease caused by Phyllosticta zingiberi was known to occur in Kerala. But until recent years it was considered to be a minor disease. Now this disease has almost the same status of the soft rot disease. No field trial or detailed Laboratory studies against this fungal pathogen has been carried out in Kerala ~~xxx~~ and hence an effective recommendation for the control of the disease is not available. Similarly the source of primary infection conditions necessary for infection and varieties resistant against this pathogen are not clearly understood so far. The present study will throw light on these lines.

10. Technical programme:

1. Source of primary infection and the incidence of the disease in field on one variety of giner will be studied.
2. Study of the secondary infection and spread of the disease.
3. Meteorological factors such as rainfall, humidity and atmospheric temperature will be recorded and correlated with the incidence and spread of the disease.
4. Fungicidal treatment for the control of the disease will be conducted in the field, as well as laboratory, in RBD with 6 fungicides replicated 4 items.
5. Estimation of crop damage.
6. Screening of different cultivars of ginger by score card method to find out the resistant variety.

11. Estimate of expenditure and receipts if any:

Contingent expenditure : Rs. 5,000/-

12. Location of the research (if outside the College Campus)

Inside the College Campus.

Signature of the student.

Assistant Professor.

Head of the Department.

Associate Dean.

Vellanikkara,
Dated 16--3--1979.

RESEARCH PROJECT

1. Institute Code No. : No. AG.H. 4(e).19. Proc.Tech. 1.01.
2. ICAR Code No. :
3. Name and address of the : College of Horticulture,
Research Institute/
Centre Vellanikkara.
4. Title of the project : Research on spices - Ginger.
5. Title of the problem : Storage trial on ginger.
6. Name and designation of : G. Sreekandan Nair,
the principal investigator Assistant Professor.
7. Name and designation of
the Associates :
8. Location : College of Horticulture.
9. Objectives : To find out a suitable storage
method for seed ginger rhizomes.

10. Technical programme:

Design - split plot. Replications 3

Major Treatments - varieties - 5

Minor Treatment - 6

1. Keeping in wooden boxes.
2. Heaping in a layer of sand + Covering with sand.
3. Heaping in a layer of saw dust + Covering with sawdust.
4. Heaping in pits + Covering with wooden planks.
5. Keeping in gunny bags on platforms.
6. Keeping in Polythene bags.

(5 kg. of seed rhizome treated in Agallol 3 0.25% will be utilized for one minor treatment. The condition of seed will be studied after storage and the cost benefit ratio will be worked out.

b. Practical utility:

The present study will help to find out a suitable method of storing seed ginger Rhizome.

c. Review of literature:

Studies have been undertaken at the Horticultural Research Station, Ambalavayal and CFTRI Mysore. It showed that keeping a portion of crop in the field

Contd.....2/-

under heavy mulch till the planting season, keeping in pits under anaerobic conditions and treating the seeds with fungicides + growth inhibitors and storing in Polythene bags at specific temperatures and RH are good. But the farmers are reluctant to follow the above methods due to various reasons. Further the cost of storing large quantities of rhizomes by the above methods is also very high. Hence the present study is to find out a more suitable method of storage which will suit the farmer, by way of easiness and less cost.

11. Likely date of start : December 1978.
12. Likely date of completion : June 1980.
13. Estimated man month : 1 month.
14. Facilities required : Available facilities at the College will be made use of. The seed material from the varietal trial can be used for the trial.
15. Financing organization : Kerala Agricultural University.
16. Approximate cost : Rs. 1,000/- per year.
17. Signature of the project leader :

Sd/-
(G. SREEKANDAN NAIR).

FRC IX - Approved.

1. Institute Code No. :
2. Name and address of the Research Institute/Centre : College of Horticulture, Vellanikkara.
3. a. Title of the project : Research on spices - Turmeric
b. Title of the problem : Effect of different planting materials on growth, yield and quality of turmeric.
4. Name and designation of the principal investigator : Joseph Philip, Jr. Assistant Professor (Hort.).
5. Name(s) and address of Associate(s) : Dr P.C. Sivaraman Nair, Associate Dean, College of Horticulture, Vellanikkara.
6. Location : Instructional Farm, Vellanikkara.
7. Review of work done:

Desai (1939) found that mother rhizomes gave upto 50 per cent increased yield over fingers in certain years, while in certain other years the differences in yields between mother and finger rhizomes were not significant. At the Turmeric Research Station, Gudayagiri (Orissa, 1954-55) it was found that the whole mother rhizomes gave higher yields than the same cut longitudinally into halves, but it was recommended that cut-halves could be used to solve the problem of seed scarcity without incurring sizeable loss in yield. Studies made at the Turmeric Research Station, Pedupalem (1960) have shown that mother rhizomes when planted as whole or split halves gave rise to more vigorous sprouts than when fingers are planted. In our state not much work seems to have been done to select the best planting material and to find out its effect on growth and quality of turmeric.

8. (a) Objectives:

- (1) To find out the most suitable planting material in turmeric for getting maximum yield per unit area.
- (2) To compare the effects of planting material on growth and quality of turmeric.

(b) Practical utility:

Recommendation of most suitable planting material in turmeric will help to increase the production and productivity of turmeric with better quality in our State.

9. Technical Programme : Lay out - Randomised Block Design
No. of replications - 5

Contd.....2/-

Plot size : 3 x 1 x 0.25 m
Spacing : 25 x 25 cm
No. of treatments : 3
Tr. 1 - Whole mother rhizomes
Tr. 2 - Mother rhizomes cut longitudinally into halves.
Tr. 3 - Primary fingers.

Two types of turmeric will be used for the trial. Twenty plants in each plot will be selected at random for recording the observations on the following growth characters.

- a) Height of plant
- b) Number of leaves per plot and per tiller
- c) Number of tillers per plant
- d) Length, breadth, and leaf area of leaves
- e) Petiole length

The observations on the above growth characters will be recorded during the months of October and November. The yield of green turmeric per plot cutting percentage and quality of turmeric in terms of oleoresin and curcumin will be recorded after the harvest of the crop on attaining full maturity.

10. Date of start : 1979.
11. Likely date of completion : 1981.
12. Estimated man months : 24
13. Facilities required : The available facilities at the College of Horticulture will be utilized.
14. Financing organization : Kerala Agricultural University.
15. Approximate cost : Rs. 3,000/- per year.
16. Signature of

Sd/-
PROJECT LEADER.

FACULTY OF AGRICULTURE

Instructional FarmRESEARCH PROJECT

1. Research Centre : Instructional Farm, College of Agriculture, Vellayani.
2. Project No. : No. AG. 4(f)-18. Bot. 3.02.
3. Title of the project : Varietal trial and maturity studies on turmeric (Curcuma longa L.)
4. Name and designation of the Principal Investigator : B.K. Jayachandran, Junior Assistant Professor.
5. Name and designation of the Associates : 1. M. Meera Bai, Junior Asst. Professor, Instructional Farm.
2. K. Pushpangadah, Associate Professor, Instructional Farm.
6. Objectives
 - i. to find turmeric varieties giving higher yield of fresh rhizomes.
 - ii. to find out the curing percentage of different turmeric varieties.
 - iii. to determine the curcumin content of different varieties.
 - iv. to determine the precise degree of maturity at which maximum curing percentage is obtained.
 - v. to find out the correct maturity stage at which maximum recovery of curcumin is available.
7. Brief review of the previous work on the topic:

In the germplasm collection at the Horticultural Research Station, Ambalavayal varieties Sugandam, G.L.Puram-II, Duggirala & Kodur gave more than 40 tons/hectare. At College of Horticulture, Mannuthy detailed evaluation on yield and quality of turmeric is in progress (K.A.U. annual report 1976-77). Andhra Pradesh stands first in Turmeric cultivation in the country and most popular varieties are Duggirala, Tukurpet Kasthuri Pasupu, Chaya Pasupu and Armoor. Recently promising clones C.L.L. 370, C.L.L. 325 and C.L.L. 326 are gaining popularity at Andhra Pradesh (Indian, Arecanut, Spices and Cocoa Journal II(2):31-32)

Contd.....2/-

8. Practical Utility:

Systematic evaluation of turmeric varieties in respect of yield and quality has not been carried out in this region and so experiment will help to identify suitable varieties giving higher yield with better quality.

9. Technical programme:

The layout of the experiment is in a simple Randomized Block Design with 12 treatments (varieties as treatments) replicated thrice. Another replication is required for periodical uprooting of rhizomes in order to carry out maturity studies. The following observations are to be recorded.

- i. germination percentage
- ii. Yield of fresh rhizomes at full maturity
- iii. Curing percentage
- iv. Curcumin content of different varieties at full maturity
- v. Periodical uprooting of turmeric rhizomes of the selected varieties at various maturity stages and determination of curing percentage, curcumin content etc.

Varieties (Treatments)

- | | | |
|-------------------------|-------------------------|---------------------|
| 1. G.L. Puram II | 2. Vontimiths | 3. Duggirala |
| 4. Kuchipudi | 5. Amirthapani Kothapet | |
| 6. Mannuthy Local (V 5) | 7. Nandyal type | |
| 8. Kodur type | 9. Amalapuram | 10. Kasthuri Thanak |
| 11. G.L. Puram I | 12. Armoor | |

10. Date of starting : April 1979.
11. Date of completion : June 1980.
12. Estimated man months : 60
13. Facilities required : Existing facilities in the Instructional Farm can be utilized for field experiments. The Chemical analysis can be conducted utilising the facilities available at Regional Research Laboratory, Trivandum.
14. If financed by an organization other than the Institute :
15. Approximate cost : Rs. 6,000/-
16. Signature of the Principal Investigator.

P R O F O R M A

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KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE
DEPARTMENT OF HORTICULTURE
COLLEGE OF HORTICULTURE
VELLANIKKARA

Programme of Research for Masters Degree.
(for approval of University)

No. AG.H. 4(f).19. Bot. 4.01.

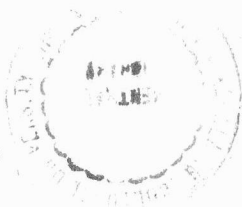
1. Name of candidate : HANZHA GEORGE.
2. Date of admission and admission number : 16--10--'78
78-12-05
3. Name and designation of the Chairman of Advisory Committee : Dr P.C. Sivaraman Nair,
Assoc. Dean, College of Horticulture, Vellanikkara.
4. Topic of Research for thesis : "Variability in the open-pollinated progenies of turmeric *Curcuma aromatica* Salisb".
5. Objectives of the Research:
 1. To exploit the genetical variability in turmeric for selecting superior types.
 2. To evolve selection criteria based on the morphological characters and yield.
6. Brief review of the previous work:

The scheme for research on turmeric was first implemented in 1944 at Gudayagiri in Orissa State under the auspices of the ICAR. The main object was to determine the optimum cultural and manurial requirements of the crop grown under local conditions, to test variety in respect of quality and yield and to evolve high yielding and disease resistant types of turmeric by selection, hybridization and by induction of polyploidy. Research was carried out to study the percentage of germination of turmeric seeds with different pre-sowing treatments and also to induce polyploidy by colchicine treatments in the germinating seeds and sprouts.

Although studies on the morphology and anthesis of the turmeric flower were undertaken, efforts to evolve a suitable technique for controlled pollination had not met with success. Thus the breeding aspect of the crop through hybridisation still remains to be studied. A rich collection of germplasm material has been built up as a result of the research work already carried out in the country and since the

Contd.....2/-

800883



KERALA AGRICULTURAL UNIVERSITY
 FACULTY OF AGRICULTURE
 DEPARTMENT OF SOIL SCIENCE & AGRIL. CHEMISTRY
 COLLEGE OF HORTICULTURE, VELLANIKKARA.

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE
 (For approval of University)

- AG.H. 4(f).19. Che. 1.01.
1. Name of Candidate : SAIFUDEEN, N.
 2. Date of Admission and Admission No. : 16--10--1978.
78-11-56.
 3. Name and Designation of Chairman of Advisory Committee : Dr A.I. Jose, Assoc. Professor of Soil Science and Agril. Chemistry, College of Horticulture, Vellanikkara.
 4. Topic of Research for thesis : Foliar diagnosis, yield and quality of Turmeric in relation to nitrogen, phosphorus and potassium.

5. Objective of Research:

- a. To develop foliar diagnosis technique in turmeric with a view to predicting nutrient deficiencies and yield in relation to nitrogen, phosphorus and potassium.
- b. To study the response of turmeric (in terms of yield and quality) to graded doses of nitrogen, phosphorus and potassium.

6. Brief review of previous work done on the topic:

Johnson (1978) reported that the group of 5th to 12th leaves appeared to be the best suited for foliar diagnosis of N, P and K in ginger. The period between 90th to 120th day after planting was recommended as the optimum for the detection and amendment of the nutrient status of the crop.

The uptake of nitrogen, phosphorus and potassium in leaf and pseudostem progressively increased upto 180th day and then decreased while their uptake in rhizomes steadily increased till harvest. The graded doses of N, P and K and their interaction failed to influence the percentage of oleoresin content of ginger.

Studies on foliar diagnosis of turmeric have not yet been reported.

7. Scientific and/or practical importance of the research:

Contd.....2/-

- a. Prediction of yield and nutrient deficiencies based on tissue tests.
- b. Determination of the optimum level of nitrogen, phosphorus and potassium for turmeric.
- c. Quality evaluation of turmeric in relation to nitrogen, phosphorus and potassium applied.

8. Technical programme:
(Give outline)

A field experiment on turmeric with three levels of nitrogen, phosphorus and potassium in a confounded factorial randomised block design will be conducted at Vellanikkara Campus.

The details of the experiments are:-

- Levels of Nitrogen : 15, 30 and 45 kg/ha
- Levels of Phosphorus: 15, 30 and 45 kg P₂O₅/ha
- Levels of Potassium : 30, 60 and 90 kg K₂O/ha
- Total No. of treatments : 27
- Replication : 4
- Design : 3³ factorials in Randomised block design NP²K² totally confounded)
- No. of blocks : 12
- Plot size (Beds) : 3 x 1.2 M
- Spacing : 15 x 30 cm
- No. of plants per plot : 80 (60)

The practices of cultivation recommended in the "Package of Practices-1978" will be followed, except for the fertiliser treatments. Nitrogen will be applied in the form of urea, phosphorus as super-phosphate and potassium as muriate of potash. Tissue samples collected periodically from selected plant parts during the period of plant growth will be analysed for chemical constituents with a view to standardising the tissue for foliar diagnosis and to study the uptake of nutrients, optimum dose and quality aspects. Growth characters and yield will also be recorded.

9. Estimate of expenditure and receipts if any:

Expenditure:

a. Fellowship @ Rs. 500/trimester	= Rs. 3,000/-
b. Contingencies and cost of cultivation	= Rs. 6,000/-
Total	= Rs. 9,000/-
	=====

Contd.....3/-

Receipts.

a. Yield (rhizome)

Rs. 2,000/-

10. Location of Research (If outside the College Campus) : Instructional Farm,
Vellanikkara Campus,
College of Horticulture,
Vellanikkara.
(Inside the College Campus)

Place: Vellanikkara.

Date : 14--3--1979.

Sd/-
Signature of Candidate.

Sd/-
Signature of Chairman
(Advisory Committee)

Sd/-
Signature of Assoc. Dean.

FRC VIII.

KERALA AGRICULTURAL UNIVERSITY
DEPARTMENT OF HORTICULTURE
COLLEGE OF AGRICULTURE
VELLAYANI

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PROGRAMME OF RESEARCH WORK FOR MASTER'S DEGREE
(FOR APPROVAL OF THE UNIVERSITY)

No. AG. 4(f).18. Hort. 1.01.

1. Name of candidate : SABINA GEORGE THEKKAYAM
2. Date of admission : 14-10-1978.
Admission number : 78-12-01
3. Name and designation of Chairman, Advisory Committee : Sri. K. Srinivasan, Professor of Horticulture, College of Agriculture, Vellayani.
4. Topic of research for thesis : Effect of growth regulators on growth yield and quality of turmeric (Curcuma longa Linn)
5. Objectives of research:
 - i. To study the effect of three growth regulators, kinetin, cycocel and maleic hydrazide on the growth, yield and quality of ~~xxx~~ turmeric.
 - ii. To study the inter-relationships between the different yield components with respect to their contributions to total yield under the influence of growth regulators.
 - iii. To find the most efficient growth regulator and its best concentration for improving yield and quality.
 - iv. To study the economics of production with and without the application of growth regulators.

6. Brief review of previous work done:

No systematic research work has yet been undertaken to ascertain the effect of growth regulators in turmeric except for certain studies on the agronomical and botanical aspects of the crop.

7. Practical significane of research:

The present experiment proposes to undertake a study on the relationships between the yield contributing factors and their relative contributions to the final yield and quality of turmeric rhizomes, under the influence of growth regulators. This study also aims to unravel the possibilities of boosting the production of quality rhizomes of turmeric at reduced cost with the help of the growth regulating chemicals.

Contd.....2/-

8. Technical programme

- 1. Design of the experiment : Randomised Block Design
- 2. Number of replications : 4
- 3. Total number of treatments: 11 (3 growth regulators at 3 levels + water spray + control)

<u>Treatment</u>	<u>Symbol</u>	<u>Concentration</u>
1. Kinetin	T ₁	75 ppm
2. Kinetin	T ₂	100 ppm
3. Kinetin	T ₃	125 ppm
4. CCC	T ₄	1000 ppm
5. CCC	T ₅	1500 ppm
6. CCC	T ₆	2000 ppm
7. MH.	T ₇	25 ppm
8. MH.	T ₈	50 ppm
9. MH.	T ₉	75 ppm
10. Water spray	T ₁₀	
11. Absolute control	T ₁₁	

- 4. Total No. of plots : 11 x 4 = 44
- 5. Spacing : 15 x 30 cms
- 6. Turmeric type : Armoor

9. Observations to be recorded

PRE HARVEST STUDIES

- 1. Germination percentage
- 2. Height of the plant
- 3. Number of tillers per plant
- 4. Number of leaves per tiller
- 5. Number of leaves per plant
- 6. Leaf area per plant
- 7. Shoot/rhizome ratio (fresh wt.)
- 8. Shoot/rhizome (dry)
- 9. Number of rhizomes
 - a) No. of primary fingers
 - b) No. of secondary fingers
- 10. Length and girth of fingers formed
- 11. Incidence of rhizome rot

Contd.....3/-

12. Incidence of leaf spot infection

POST HARVEST STUDIES

1. Number and length of roots per plant
2. Number of primary and secondary fingers
3. Number of nodes per finger and length, breadth and inter nodal length of primary and secondary fingers
4. Yield of rhizomes
5. Harvest index
6. Recovery of dry Turmeric
7. Chemical analysis
8. a) Moisture content
b) Curcumin content
c) Essential oil content
d) Starch content
e) Crude fibre content

Estimate of expenditure : Rs. 7,000/-

Location of research : College of Agriculture, Vellayani Campus.

Facilities available : Facilities available at the department of Horticulture, College of Agriculture will be utilized.

Sd/-

Signature of the candidate.

Sd/-

Head of the Department.

Approved.

FRC VIII - Approved. Fertilizers should be applied as per the package of practices. The stages and frequency of application of growth regulators should be indicated.

No. AG. 5(a).14. Agron. 2.02.

1. Institution Code No. :
2. ICAR Code No. :
3. Name and address of the Research Institute/Centre : Banana Research Station, Kannara.
4. Title of the Project : Research on fruits (Banana).
5. Title of the problems : Effect of different ratios and levels of NPK on the growth, yield and quality of banana.
6. Name and designation of principal investigator : I.P. Sreedharan Nambiar, Asst. Professor (Agronomy).
7. Name and designation of Associates : Junior ~~xxxx~~ Instructor (Agronomy)
8. Location : Banana Research Station, Kannara.

9. a) Objectives:

To find out the optimum levels and ratios of fertilizer requirement for Nendran banana.

b) Practical utility:

To give a fertilizer recommendation to Nendran banana under the agro-climatic condition of Kerala.

10. Technical programme:

- | | | |
|---|---|------------------|
| Lay out | : | R.B.D. |
| Replication | : | 3 |
| Treatment | : | 10 ($3^2 + 1$) |
| N. 150, 200, 250 g/plant | | |
| K. 300, 400, 500 g/plant | | |
| P. Uniform dose of 150 g/plant | | |
| + Extra dose of phosphorus at 50 g/plant over the uniform dose of 150 g/plant | | |
| Variety | : | Nendran |
11. Date of start : 1978-79.
 12. Likely date of completion : 1980-81.
 13. Estimated man months : 36
 14. Facilities required : Existing facilities will be utilised.
 15. Financing organisation : Kerala Agricultural University.
 16. Approximate cost : Rs. 4000/- per year.

Sd/- Signature of Project Leader. Sd/- Head of Institute. Director of Research.

P R O F O R M A
 KERALA AGRICULTURAL UNIVERSITY
 FACULTY OF AGRICULTURE
 DEPARTMENT OF HORTICULTURE
 (Pomology)

COLLEGE OF HORTICULTURE, VELLANIKKARA, TRICHUR.

PROGRAMME OF RESEARCH FOR MASTERS DEGREE
 (For approval of the University)

1. Name of candidate : AG. 5(a).19. Agron. 2.03.
 VALSAMMA MATHEW
2. Date of admission and admission number : 16--10--1978.
 78-12-09.
3. Name and designation of Chairman of Advisory Committee : Dr M. Aravindakshan, Professor of Horticulture (Pomology), College of Horticulture, Vellanikkara.
4. Topic of Research for Thesis : Nitrogen nutrition in rainfed banana c.v. Palayankodan.
5. Objective of Research:
1. To find out the effect of different levels of 'N' on growth, yield and quality of fruits.
 2. To find out nutrient uptake at different phases of growth.
6. Brief review of previous work done in the topic (give reference to important publications or thesis)

Banana is one of the most depleting crops. Even inherently fertile soils get depleted of fertility within a few years of cropping.

Simmonds (1966) reported that a stable cultivation at a satisfactory level of productivity can only be attained by adequate supply of fertilizers. Hence to exploit the maximum yield potential of banana varieties adequate supply of nutrients is necessary. Reports regarding nutritional requirement studies in banana are numerous (Faweett 1926; Wood 1939; Croucher & Mitchel, 1940; Borel 1952; Bhan and Majumdar, 1959; Joseph 1969, Vadivelu 1978; Pillai et al 1977). In addition to this nutritional requirement studies for different varieties of banana are in progress at Banana Research Station, Kannara, Tamil Nadu Agricultural University, Coimbatore; BRS Yawal Maharashtra; IIHR, Bangalore and under All India Co-ordinated Fruit Improvement Project financed by ICAR. But so far no systematic work has been done to study the response of nutrients under rainfed conditions in banana which represents 80% of the total

Contd.....2/-

area of banana in Kerala. Hence this project has been taken up.

7. Scientific and/or practical importance of the research:

The fertilizer recommendations for rainfed bananas are empirical at present. The studies will help to fix the optimum dose of N for 'Palayankodan' variety of banana under rainfed conditions.

8. Technical programme in brief:

Lay out - RBD
Variety - Palayankodan
Treatments - 5

N-0, 100, 200, 400 gm/plant
P-200 gm/plant
K-400 gm/plant

Basal application - 15 kg FYM & 2.5 kg green leaf
No. of replications - 5
Plants/gross plot - 35
Plants/net plot - 9+3 (sampling)
Spacing - 2.13 x 2.13 M
No. of border rows - 1 per plot

Time of application : 1st dose - 3 months after planting
of fertilizers (with the onset of first showers)
2nd dose - 5 months after planting

Method of application:

FYM and green leaves will be applied as basal application and N, P and K fertilizers will be applied in two split doses as given above.

Observations to be taken:

A. Morphological characters:

1. Height of the pseudo stem
2. Girth of pseudostem
3. Total leaf area
4. Total number of leaves
5. Phylachron
6. Sucker production
7. Days for shooting
8. Days taken from shooting to harvest

B. Bunch characters

1. Length of the bunch
2. Length of the finger
3. Girth of the finger
4. No. of hands
5. No. of fingers
6. Weight of finger
7. Weight of bunch
8. Weight of hands
9. Number of fingers/hand

C. Fruit characters : Fruit weight, pulp weight, peel weight pulp/peel ratio.

Contd.....3/-

-3-

- Fruit quality : 1. Total soluble solids
 2. Acidity
 3. Sugar acid ratio
 4. Ascorbic acid, Total sugars,
 Reducing sugars and non reducing
 sugars

Nutrient uptake studies:

The nutrient uptake studies will be carried out at 3 different phases of plant growth.

- i. Maximum vegetative phase
 - ii. Shooting phase and
 - iii. Cutting stage
- Different parts of plants will be analysed.

Nutrient status of planting material and that of soils before planting and after harvest will also be carried out. The nutrient status of FYM will also be analysed.

9. Estimate including fellowship	Rs. 5,000 - Cost of cultivation
	3,000 - Fellowship

	8,000
	=====
10. Receipts	7,500

Location of Research

- College of Horticulture,
 Kerala Agricultural University.

Sd/-

Signature of the candidate.

Sd/-

Signature of the Chairman of
 the Advisory Committee.

Vellanikkara,
 19--2--1979.

Sd/-

Signature of Dean.

FRC VIII

RESEARCH PROJECT

213

1. Institute Code No. : No. AG. 5(a).14. Agron. 5.02.
2. ICAR Code No. :
3. Name and address of Research Institute/
Centre : Banana Research Station,
Kannara.
4. Title of the Project : Research on Fruits (Banana)
Title of the Problem : Population density trial
(Adaptive) in banana under
rainfed condition.
5. Name and designation of principal investigator : I.P. Sreedharan Nambiar.
6. Name(s) and designation of Associates : Valsamma Mathew, Jr. Instructor.
7. Location : University Main Campus,
Vellanikkara.
8. a) Objectives : To compare the results of
research conducted with irri-
gated banana (var. Robusta)
and to assess their merits and
demerits.
- b) Practical utility : To study the efficacy of adopt-
ing a close spacing for rainfed
banana to get maximum yield
per unit area.
9. Technical programme :
- Lay out : Observational
- Variety : 2 (Poovan and Palayankodan)
- Treatments : 3 (spacing)
1. 1.5 M x 1.5 M (4900 plants/ha)
2. 2.13 M x 2.13 (2150 plants/ha)
3. Twin planting
1.5 M x 2.13 M x 2.13 M
(2150 plants/ha)
10. Date of start : 1978-79.
11. Likely date of comple-
tion : 1980-81.
12. Estimated man months : 36
13. Facilities required : Existing facilities will be
utilised.
14. Financing organization : Kerala Agricultural University
15. Approximate cost : Rs. 1000/- first year
Rs. 500/- second year
Rs. 500/- third year

Sd/- Sd/-
Project Leader. Head of Institute. Director of Research.

FRC XI.

RESEARCH PROJECT

214

1. Institute Code No. : No. AG. 5(a).14. Agron. 10.02.
2. ICAR Code No. :
3. Name and address of Research Institute/Centre : Banana Research Station, Kannara.
4. Title of the Project : Effect of crop rotation on the growth and yield of Banana.
5. Name and designation of principal investigator : I.P. Sreedharan Nambiar.
6. Name and designation of Associates : Junior Instructor (Agronomy)
7. Location : Banana Research Station, Kannara.
8. a) Objectives : To find out the best crop combination for economic yield.

b) Practical utility:

By raising a continuous crop of Banana, the yield is seen declining. Moreover the weed infestation is also severe. So a change in the cropping pattern with suitable crop combinations which may result in good returns by minimising the costs of production has to be found out.

9. Technical programme:-

Lay out : 4 x 5 R.B.D.
Treatments : 4

3 years rotation

- | | | |
|--------------|-----------|--------------|
| 1. Banana | Tapioca | Banana |
| 2. Banana | Banana | Tapioca |
| 3. Banana + | Tapioca + | Banana + |
| Green manure | Groundnut | Green manure |
| 4. Banana | Paddy + | Tapioca |
| | Pulses | |

10. Date of start : 1978-79.
11. Likely date of completion : 1980-81.
12. Estimated man months : 36
13. Facilities required : Existing facilities will be utilized.
14. Financing organization : Kerala Agricultural University.
Rs. 3000/- (first year)
Rs. 1000/- (second year)
Rs. 2500/- (third year)

Sd/-
Signature of
Project Leader.

Sd/-
Head of Institute. Director of Research.

P R O F O R M A

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KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE
DEPARTMENT OF HORTICULTURE
COLLEGE OF HORTICULTURE, VELLANIKKARA, TRICHUR.

PROGRAMME OF RESEARCH FOR DOCTORATE DEGREE
(for approval of the University)

1. Name of Candidate : AG. 5(a). 19. Bot. 1.02.
P.K. Valsalakumari.
2. Date of admission and : 10--10--1979.
admission No. 79-22-02.
3. Name and designation of : Dr P.C. Sivaraman Nair,
the Chairman of the Assoc. Dean, College of
Advisory Committee Horticulture.
4. Topic of research for : Cyto-taxonomical studies of
thesis banana cultivars.
5. Objective of research : To study the cytotaxonomical
aspects of banana cultivars
and classify them into different
groups.
6. Brief review of the previous
work done:

Several opinions exist among the taxonomists about the classification of the cultivated banana. Saggot (1882) divided the genus Musa into 3 sections, Giant bananas, bananas with fleshy fruits (often edible) and ornamental bananas. Baker (1893) based on morphological characters divided the genus Musa into 3 subgenera - Physocaulis, Eumusa and Rhodochlamys. Primarily based on Chromosome number the family Musaceae was divided into two sections - Ensete ($2n = 18$) and Musa ($2n = 22$) by Cheesman in 1947. The genus Musa was subdivided into 4 sections - Australimusa and Callimusa with basic chromosome number 10 and Eumusa and Rhodochlamys with basic chromosome number 11. The cultivated parthenocarpic varieties of banana are included under the section Eumusa. According to Simmonds and Shepherd (1955) the edible bananas in the section Eumusa can be considered as hybrids of Musa acuminata and Musa balbisiana, the two wild species. Simmonds suggested the use of Musa sp. for all cultivated bananas. To indicate the relative contribution of the two parents Musa acuminata and Musa balbisiana towards any character Simmonds and Shepherd (1955) suggested a scoring method. They chalked out 15 characters which differ diagnostically in the two species. According to this method, the bananas are classified into diploids, triploids and tetraploids.

Contd.....2/-

The Section Eumusa which contains most of the edible bananas has the somatic chromosome number $2n = 22$ and 33 (Simmonds and Dodds, 1949; Weston 1946) Chakravorthy (1951) observed that in triploid varieties the respective Karyotype is variable even within the same individual and explained it as due to spontaneous rearrangement of chromosomes.

7. Scientific and/or practical importance of the research:

The classification of banana cultivars of Kerala has not been done so far. The taxonomic scoring method of Simmonds and Shepherd is adopted in grouping a particular clone. However, the morphological criteria for classification cannot be truly indicative of the ploidy level of genomic constitution. Cheesman's classification is primarily based on chromosome number. With the basis of Cheesman, Simmonds and Shepherds' work the present study aims at more investigations on the cytological and taxonomical aspects of banana cultivars in Kerala and classifying them into different groups. Moreover this will throw light on the quantitative and qualitative characters of different cultivars which are of much economic importance.

8. Technical Programme in brief:

The morphological and cytological characters of about 144 cultivars will be studied. The following procedures will be adopted.

Grouping of varieties into clusters by the D2 analysis.

Scoring by morphological characters and classifying the cultivars.

Cytological studies of the different groups.

Observations to be taken quantitative characters

1. Height of the plant
2. Girth of the plant
3. No. of leaves
4. Leaf area
5. Length of D leaf
6. Breadth of D leaf
7. Length of petiole
8. Weight of bunch
9. Length of bunch
10. Length of pedicel
11. Number of fingers/bunch
12. Weight of finger
13. No. of hands/bunch
14. Length of finger
15. Girth of finger
16. TSS
17. Sugar content
18. Keeping quality

Contd.....3/-

Qualitative characters

1. Pseudostem colour
2. Petiolar canal
3. Peduncle
4. Pedicel
5. Ovule
6. Bract shoulder
7. Bract curling
8. Bract shape
9. Bract apex
10. Bract colour
11. Colour fading
12. Bract scars
13. Free tapal of male flower
14. Male flower colour
15. Stigma colour

Cytological Studies

Karyotypic studies using Squash preparations of root tip.

Statistical design

Lattice design

No. of varieties	:	144
No. of plants per plot	:	4
No. of replication	:	2

9. Estimate of expenditure and receipts, if any:

Expenditure : Rs. 4000/-

Receipts : Rs. 8000/-

10. Location of Research : Instructional Farm and College of Horticulture, Vellanikkara.

Sd/-

Signature of candidate.

Sd/-

Signature of Chairman of Advisory Committee.

Sd/-

Signature of Assoc. Dean.

RESEARCH PROJECT

Faculty of Agriculture Department of Botany

Name of the Research Centre : Banana Research Station, Kannara.
No. AG. 5(a).14. Bot. 5.03.

Project No. : To be assigned

Title of the Project : Studies on moisture stress
tolerance in Banan Var. Nendran.

Name and designation of

(a) Project Leader : Dr N. Krishnan Nair,
Assistant Professor.

(b) Associate

Objective:- To test the clones which showed some
drought tolerance in maximum moisture
stress condition.Work done so far:

The plant which received 5, 10, 15 and 20 litres of water per day under the drip irrigation trial conducted during the year 1977-78 at Banana Research Station, Kannara showed some abnormalities in its growth during the flower initiation stage. But a few plants showed some tolerance for this moisture stress and the present trial is proposed to study whether we can isolate a clone having some drought tolerance.

Practical utility : To isolate a Nendran clone
having drought tolerance for
dry banana cultivation in Kerala.

Technical Programme:

A preliminary study on the performance of selected suckers from treatments of 5 and 10 liters of water per day from drip irrigation trial.

Date of start : 1978.

Likely date of completion : 1980.

Duration : 2 years.

Additional facilities : Nil

Approximate cost : Rs. 1,500/- per year.

Sd/- Sd/-
Signature of Project Head of Dept. Director of Research.
Leader.

FRC X - Approved.

KERALA AGRICULTURAL UNIVERSITY
 FACULTY OF AGRICULTURE - DEPARTMENT OF HORTICULTURE
 COLLEGE OF HORTICULTURE, VELLANIKKARA

PROGRAMME OF RESEARCH FOR DOCTORATE DEGREE
 (for approval of University)

- No. AG. 5(a).19. Bot. 5.03x 4
1. Name of the candidate : Rajeevan, P.K.
 2. Date of admission & Admission No. : 10--10--1979.
79-22-05.
 3. Name and designation of the Chairman of advisory committee : Dr N. Mohanakumaran, Professor and Head, Department of Plantation Crops & Spices, College of Horticulture.
 4. Topic of research for thesis : Intra clonal variations and nutritional studies in banana cv. Palayankodan.
 5. Objectives of research:
 - a) Study of intra-clonal variation:
 - i) To assess the differences in growth and development of the sub-clones in 'Palayankodan'.
 - ii) To study the variation in yield and quality in the clone 'Palayankodan'.
 - iii) Selection of high yielding short duration type in the clone 'Palayankodan' with disease resistance and good fruit qualities.
 - b) Nutritional aspects of the rainfed banana cv. Palayankodan in relation to yield and quality.
 - i) Distribution pattern of NPK in the plant at different developmental stages.
 - ii) Standardisation of split application of inorganic fertilizers with respect to growth, fruit development, yield and quality.
 - iii) Translocation pattern of nutrients on mattocking and the effect of mattocking on the ratoon crop.
 6. Brief review of previous work done:

With regard to the leaf development in bananas there is very little information available. A study conducted on the unfurling of leaves in banana showed that normally 4 days were needed in summer as against 14 or more days in winter (Summerbille, 1944). Leaf production in banana in relation to flower initiation has not been investigated in detail. Champion (1961) found that 23-43 laminate leaves appeared before flowering. Summeville (1944) held that plants established from sword suckers produced about 45-60 leaves. Simmonds (1966) opined that if

Contd.....2/-

the number of scale leaves produced are also taken into consideration, a figure of 60-70 leaves is about right. However, no observations have been made on the life of leaf lamina in the tropics.

As regards the nutrition of banana, several trials were conducted. Summerville (1944) concluded that potentiality for vegetative growth and fruit production was determined during the first three months of life of a shoot; thereafter, mineral supply was not very important. On the other hand, Walmsley and Twyford (1969) were of the opinion that fertilizer applied from 2 to 3 months after planting until flower initiation would be most effectively utilised. This aspect needs further confirmation, particularly since many cultivators apply fertilizers even after completion of the female phase and derive benefits in the form of increased size of fingers.

7. Scientific and/or practical importance of the research:

- a) The trial aims at describing the intra-clonal variation in banana cv. 'Palayankodan'.
- b) Isolation of a high yielding, short duration, disease resistant sub-clone of 'Palayankodan' would be possible.
- c) Information on the nutrient uptake will help formulate suitable fertilizer recommendations for rainfed bananas in Kerala.
- d) Studies on the split application of fertilizers will be more informative to formulate fertilizer schedules.

8. Technical programme:

- a) Survey and collection of sub-clones of 'Palayankodan' from different parts of Kerala.
- b) To study the interclonal variations, suckers collected from various parts of the State will be planted and they will be raised as per the package or practices recommended by the Kerala Agricultural University. Growth and developmental studies will be undertaken at monthly intervals on these plants.

The list of observations to be made has been included in item (9).

- c) One high yielding sub-clone with good horticultural qualities will be isolated from the different types collected.
- d) A detailed study on the following aspects will be undertaken with one sub-clone.

- i) Translocation pattern of nutrients from mother plant to suckers during the course of development and after harvest (on mattocking). Radio tracer techniques will be employed for this study.
- ii) Best time and optimum quantity of application of the recommended dose.

Planting season : Nov.-Dec.
 Design : RBD
 Treatments : 15
 Replications : 3
 Spacing : 2.13m²
 Plot size : 4 plants/plot

*

Treatments

Grades of fertilizer application

Treatments	Month from planting			
	2	4	6	8
T ₁	$\frac{1}{2}$	$\frac{1}{2}$	0	0
T ₂	$\frac{1}{2}$	0	$\frac{1}{2}$	0
T ₃	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{4}$	0
T ₄	$\frac{1}{2}$	0	$\frac{1}{4}$	$\frac{1}{4}$
T ₅	$\frac{1}{2}$	$\frac{1}{4}$	0	$\frac{1}{4}$
T ₆	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$
T ₇	$\frac{1}{4}$	$\frac{1}{2}$	0	$\frac{1}{4}$
T ₈	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{4}$	0
T ₉	$\frac{1}{4}$	0	$\frac{1}{2}$	$\frac{1}{4}$
T ₁₀	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{2}$	0
T ₁₁	$\frac{1}{4}$	$\frac{3}{4}$	0	0
T ₁₂	$\frac{1}{4}$	0	$\frac{3}{4}$	0
T ₁₃	$\frac{3}{4}$	$\frac{1}{4}$	0	0
T ₁₄	$\frac{3}{4}$	0	$\frac{1}{4}$	0
T ₁₅	$\frac{3}{4}$	0	0	$\frac{1}{4}$

*All other treatments and operations, including application of FYM, will be as per the recommendation of Kerala Agricultural University.

- iii) Distribution pattern of nutrients in the different parts of the plant at different stages of growth. Plants will be raised separately following the recommended package of practices. At various developmental stages, sample plants will be uprooted and analysed for NPK, Ca and Mg.

Contd.....4/-

Stages of uprooting

- A. Five months after planting
(Flower initiation stage)
- B. At shooting.
- C. At the completion of female phase.
- D. At harvest.

9. Observations:

a) Growth and developmental aspects:

- i) Height of plants
- ii) Thickness of pseudostem
- iii) Number of leaves
- iv) Life of leaves
- v) Leaf area
- vi) Stomatal density
- vii) Photosynthesis
- viii) Respiration
- ix) Days to shooting
- x) Duration of female phase
- xi) Days to harvest
- xii) Time taken for ripening
- xiii) Detailed fruit characters (length of pedicel, edible portion and apex, girth, curvature, angularity, colour of skin when mature and when ripe, thickness and texture of skin, colour, texture and sweetness of pulp, pulp/skin ratio etc.)

b) Yield/yield attributes.

- i) Number of fingers/hand
- ii) Weight of fingers/hand
- iii) Number of hands/bunch
- iv) Weight of hands/bunch
- v) Weight of bunches

c) Analytical aspects.

~~xxxxxxx~~

- i) Analysis for N,P,K,Ca and Mg.
- ii) Estimation of T.S.S., Vit. C and carbohydrates

d) Economics will be worked out wherever necessary.

10. Estimate of expenditure and receipts, if any:

Expenses

A. Survey and collection	Rs.	2,000.00
B. Cultivation	Rs.	7,000.00
C. Analysis	Rs.	3,000.00
D. Fellowship @ Rs. 900/tri-	Rs.	<u>3,100.00</u>
mester	Total	Rs. 19,100.00
		=====

Contd.....5/-

Receipts (excluding the bunches and suckers used for sampling)

A. From bunches	Rs. 2,500.00
B. From suckers	Rs. 500.00

Total	Rs. 3,000.00
	=====

11. Location of research : 1. Instructional Farm, Mannuthy.
2. College of Horticulture, Vellanikkara.

Sd/-
Signature of candidate.

Sd/-
Signature of Chairman,
Advisory Committee.

Sd/-
Signature of Assoc. Dean.

Signature of the Dean,
Post-graduate studies.

FRC XII.

KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE
DEPARTMENT OF AGRICULTURAL CHEMISTRY

225

PROGRAMME OF RESEARCH FOR Ph.D. COURSE

- No. AG. 5(a).18. Che. 1.01.
1. Name of the Candidate : G. Santhakumari.
 2. Date of admission and Register No. : 16--10--1978.
78-21-03.
 3. Name and designation of the Chairman, Advisory Committee : Dr R.S. Aiyer, Professor and Head of Soil Science and Agric. Chemistry.
 4. Topic of Research for Thesis : Efficiency of applied nutrients in banana (cultivar Nendran) under conditions of liming, split application and in presence of Nitrification inhibitors.

5. Objectives:-

1. Increasing the efficiency of N & K to Nendran Banana by liming.
2. To find out the uptake pattern of the two major nutrients, N & K as well as Ca and Mg, with growth to fix the peak periods of utilization.
3. Splitting of N & K according to peak periods of utilisation with a view to minimising the fertilizer use. Nitrification inhibitors will also be evaluated.

6. A brief review of previous work done in the topic.

Simmonds (1966) recommends adequate fertilization of the banana plant for ~~maxim~~ maximising yields. Though reports on the nutritional requirement of the banana plant in general, are numerous critical studies on the nutritional requirements of the cultivar Nendran are not available except for the work of Pillai et al (1977). This study, though it has enabled us to obtain the optimum and economic doses for cultivar Nendran, no attempt has been made to work out the peak periods of utilization of various nutrients.

At present there is an ongoing experiment on split applications of N & K to Banana (cultivar Nendran) at the Banana Research Station, Kannara. However this study has attempted to split the N & K doses without reducing the dosage to compensate for the increased number of splits. Further at present the application of N & K fertilizers is discontinued by the 5th month. Thus there is a research gap to be

is

filled up which proposed in the present study.

Contd.....2/-

7. Scientific and/or practical importance of the research.

The study proposed will enable to evolve a package of practices for N & K and lime in terms of doses and split application based on the utilization of the nutrients. The experiments are designed to ensure the maximum productivity with minimum fertiliser input.

8. Technical Programme:

The technical programme envisages two field experiments. The first field experiment is meant to get an insight on the pattern of nutrient uptake at different sages of growth under conditions of liming and without liming. The experiment will also give results on the usefulness of liming under Kerala conditions.

The second experiment, which will also be simultaneously laid out has a main thrust on split application of N & K and use of nitrification inhibitors. The splits suggested synchronise with definite physiological stages of growth viz., 5th leaf stage, 8th leaf stage, 15th leaf stage, (ie) flower initiation stage and flowering stage.

First experiment

Design - $3^2 \times 2$ factorial if RBD

Treatments

Combination of 3 levels of N & K, liming and without liming.

N - 150, 225, 300 g N/plant
K - 300, 450, 600 gK₂O/plant

Amendment (Lime)

1. Without any soil amendment
 2. Dolomite equivalent to 1 kg Cao/plant.
- (This will be finally fixed after determining lime requirement of the fields at Kannara)

Treatments

No - 150 gN/plant	K ₀ -300 g K ₂ O/plant
N ₁ - 225 g/ ..	K ₁ -450 ..
N ₂ - 300 g/ ..	K ₂ -600 ..
A ₀ - Without amendment.	
A ₁ - with amendment.	

P - 150 g/plant uniformly in all treatments as basal dose.

Treatment combinations : $3 \times 3 \times 2 = 18$

Contd.....3/-

Replications - 3 (one replication is for chemical analysis)
 No. of plants/plot : 16 Total No. of splots - 54
 Net plants/plot : 4 Duration - 1 year
 Spacing : 2 M x 2 M
 Plot size : 6 x 6 M

Second experiment

Design : RBD
 Replications : 3
 No. of plants/plot : 16
 Net plants/plot : 4
 No. of treatment : 14
 Total No. of plots : 42

Treatments

1. N & K Full dose 5 splits including flower emergence.
2. N & K 70%
3. N & K Full dose 4 splits ~~xxxx~~ including flower emergence.
4. N & K 70% 4 splits including flower emergence.
5. N & K Full dose 4 splits upto flower uninitiation.
6. N & K 70%
7. N & K Full dose 3 splits upto flower emergence.
8. N & K 70%
9. N & K 70% + Inhibitor 3 splits ..
10. N & K Full dose 3 splits upto flower initiation.
11. N & K 70%
12. N & K 70% + inhibitor 3 splits ..
13. N & K 2 splits Full dose.
14. N & K 2 splits full dose and inhibitor.

The full dose of N & K will be on the basis of the present package of practices. The various splits will be at definite physiological stages of crop growth. They are shown below:-

Percentage of N & K fertilizer apportioned for each split application.

	Basal	5th leaf	8th leaf	15th leaf (Flower ini- tiation)	Flower emer- gence
5 split	30%	10%	40	10	10
4 .. a.	40%	--	40	10	10
b.	40%	10	40	10	--
3 splits					
a.	40	--	50	10	--
b.	40	--	50	--	10
2 splits	50	--	50	--	--

Contd.....4/-

Observations to be recorded

1. Physico-chemical properties of soil before and after each experiment.
2. Plant growth and yield attributes.
3. Uptake of nutrients N,P,K Ca & Mg at various stages of growth, viz., 5th, 8th and 15th leaf stages and at the flowering and harvest stages.

For this purpose a separate analysis of the following plant parts and the yield of each such plant part will be carried out.

1. Rhizome
2. Leaf sheath
3. Leaf lamina
4. Leaf petiole
5. Flower
6. Fingers
7. The stem of the inflorescence

4. Final yield will be recorded.
5. Quality of produce will also be studied.

15. Date of start : Sept. - Oct. 1979.
16. Date of completion : Sept. - Oct. 1981.
17. Approximate cost : Rs. 8,000/-
18. Anticipated receipt : 1408 bunch each having an average of 8 kg (ie) 11264 kg @ 1.30/kg = 14643.20

Receipt:-

Location of research : Field experiments at Banana Research Station, Kannara.

Laboratory studies:-

College of Agriculture, Vellayani.
College of Horticulture, Vellanikkara.

Signature of the Candidate: Sd/-

Signature of Chairman,
Advisory Committee. Sd/-

Signature of Head of the Dept. Sd/-

Signature of the Dean. Sd/-

FRC X.

P R O F O R M A

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE - DEPARTMENT OF HORTICULTURE
(Pomology)

COLLEGE OF HORTICULTURE, VELLANIKKARA

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE

(For the approval of University)

- No. AG. 5(a).19. Proc.Tech. 1.01.
1. Name of candidate : Aravindakshan, K.
 2. Date of admission and admission Number : 16--10--'78.
78-12-04.
 3. Name and designation of the Chairman of Advisory Committee : Sri. S. Balakrishnan, Professor of Horticulture, (K.A.D.P.), College of Horticulture, Vellanikkara.
 4. Topic of Research for thesis : Effect of pre and post harvest treatments on storage and quality of banana var. Nendran.
 5. Objectives of study:

The major objectives of study are

1. To fix up the optimum maturity at harvest for Nendran based on physiological and biochemical studies.
 2. To study the effect of pre harvest applications of growth regulators on shelf life and quality of banana.
 3. To find out the effect of fungicidal treatments for controlling anthracnose disease.
 4. To find out the effect of different storage methods on the shelf life and quality of bananas.
6. Brief review of the previous work done:

Very scanty information is available about the post-harvest quality studies ~~xxx~~ of banana var. Nendran, which is a commercial banana variety of Kerala.

Madamba, Baes and Mendoza (1977) observed that in the case of Lacatan var. the biochemical changes undergone by the fruits during ripening was influenced by the maturity of fruits at harvest. Their results show that harvesting between full and full three quarters maturity increased eating quality of the fruits while the earlier harvests prolonged the shelf life.

Tomi et al (1970) have reported that pre-harvest sprays of 2,4-D at 10 ppm had a favourable effect on prolonging shelf life.

Contd.....2/-

Based on a comparative study of fungicidal treatments, Burden (1969) has reported that Benlate at 100 ppm and above provide effective control over anthracnose disease (C.O. glomeralla cingulata) of banana.

Subarban (1978) has reported that Benomyl at 600 ppm as post harvest dips could control the anthracnose disease to a great extent.

7. Scientific and/or practical importance of Research:

The present study is undertaken with an objective to standardize the optimum stage of harvest based on biochemical studies, effect of growth regulators on quality of fruits and to find out best storage method from commercial point of view.

8. Technical programme:

I. Uniform fingers will be harvested from the bunches of same chronological age, growing under identical environmental conditions receiving uniform cultural treatments, at different stages of its growth and maturity (at 10 days intervals after shooting).

Samples from each bunch will be analysed separately. The following fruit characters will be studied.

1. Morphological

- 1.1. Length 1.2. Girth 1.3. Volume
1.4. Pulp weight 1.5. Peel weight
1.6. Pulp Peel ratio

2. Physiological

- 2.1. Respiration.

3. Biochemical

- 3.1. Sugars (Reducing and non-reducing)
3.2. Total soluble salts.
3.3. Starch
3.4. Titrable acidity
3.5. Moisture
3.6. Dry matter content
3.7. Ascorbic acid content
3.8. Nitrogen
3.9. Chlorophyll 3.10. Phenols

The data will be utilised to study the physiological and biochemical changes undergone by the fruit during different stages of its growth.

II. In order to study the effect of growth regulators on post harvest behaviour and quality of fruits,

Contd.....3/-

3 different concentrations will be sprayed (as whole bunch sprays) as detailed below.

Growth regulators concentration stages of application -

- 1. NAA 50,100 & 200 ppm 45 days
- 2. 2,4-D 25,50 & 75 % & 60 "
- 3. Ethrel 100,250 & 500 "
- 4. Control Water spray

The treated bunches will be harvested at 3 different stages of maturity viz. 70th, 80th and 90th day after shooting and will be stored at room temperature so as to study their storage life and quality aspects as shown below.

1. Morphological characters

- 1.1. Bunch weight
- 1.2. Fruit weight
- 1.3. Peel weight
- 1.4. Pulp weight
- 1.5. Length
- 1.6. Volume

2. Biochemical studies

- 2.1. Titratable acids.
- 2.2. Sugars (reducing and non reducing)
- 2.3. Ascorbic acid content

The influence of growth regulators on the quality of fruits will be assessed.

III. To study the effect of fungicidal treatments, the following treatments will be tried.

<u>Fungicides</u>	<u>Concentrations</u>
1. Benlate	200-400 ppm
2. Anthrocol	0.1% - 0.2%
3. Thiride 75% W	0.1% - 0.2%

The treated bunches will be harvested at full maturity and will be stored under 3 different storage conditions.

Methods of storage

- 1. Polythene bag + Potassium permanganate.
- 2. Open storage.
- 3. Smoke house ripening and storing under open conditions.

The incidence of anthrocnose disease as well as the quality aspects of fruits will be studied.

- 9. Estimate (including fellow-ship) : Cost of cultivation, Cost of Chemicals etc. Rs. 8,500/-
- 10. Receipts : Rs. 1,000/-
- 11. Location of Research : College of Horticulture, Vellanikkara & Banana and Pineapple Research Station, Kannara.

Vellanikkara,
Date: 15-3-'79.

Signature of Candidate: Sd/-
Signature of Chairman: Sd/-
Signature of Dean (P.G.) Sd/-

RESEARCH PROJECTS

232

1. Institute Code No. : No. AG.H. 5(b).19. Bot.PB. 1.01.
2. Name and address of Research Institute : College of Horticulture, Vellanikkara.
3. a. Title of the project : Research on Acid lime
b. Title of the problem : Performance evaluation of cross protected acid lime.
4. Name and designation of Principal Investigator : Jose Philip, Junior Instructor (Hort.)
5. Name and designation of Associate : Dr M. Aravindakshan, Professor of Pomology.
6. Location : College of Horticulture, Vellanikkara.

7. Review of work done:

The pilot cum demonstration trials on acid lime (Citrus aurantifolia) pre-immunized with mild strain of tristeza virus conducted at I.I.H.R., Bangalore have proved to be a potential approach for protecting the crop against the invasion of severe strains under normal orchard conditions. Not much work has been done in our State with regard to the adaptability of Acid-lime seedlings.

8. a. Objectives:

- i. To find out the suitability of growing Acid lime in the plains of Kerala.
- ii. To study the growth, flowering and yield.
- iii. To find out its suitability of growing in open and as well as in partial shaded conditions.

b. Practical utility:

If Acid lime is found suitable for growing in plains in Kerala especially under partial shade conditions it can be recommended as one of the fruit crops in the homesteads of Kerala.

9. Technical Programme:-

Cross-protected Acid lime seedlings will be grown under open and shade conditions. After finding out the adaptability further trials on cultural and manual aspects will be taken up. Observations on growth, vigour, flowering, fruit set and fruit quality will be studied.

10. Date of start : 1978
11. Likely date of completion: 5 years.
12. Estimated man months : 60
13. Facilities required : The available facilities in the College of Horticulture will be utilised.
14. Approximate cost : Rs. 5,000/-
15. Signature of:

Sd/-

PROJECT LEADER.

RESEARCH PROJECT

233

1. Institute Code No. : No. AG.H. 5(c).19. Hort. 1.01.
2. ICAR Code No. :
3. Name and address of the Research Institute : College of Horticulture.
4. a) Title of the project : Research on Jack
Title of the problem : Effect of different plant growth regulators on rooting and subsequent performance of air layers in Jack.
5. Name and designation of principal investigator : Gopikumar, K.,
Junior Instructor.
6. Name and designation of Associate : Dr M. Aravindakshan, Professor
and Head, Dept. of Pomology,
College of Horticulture.
7. Location : College of Horticulture.
8. a) Objectives : To find out the suitable plant growth regulator and the optimum concentration for the rooting and subsequent performance of layers in Jack.

Practical utility:-

Even though air laying is found to be successful in Jack, the number of roots produced was found to be very low. If chemicals can produce good percentage of healthy roots in the layers, it will be highly advantageous to use such chemicals for large scale propagation in Jack by air layering.

Brief review of previous work:

Rao (1965) noticed that in Jack, growth regulating chemicals such as IBA, NAA and IAA were effective to induce rooting of layers. Application of seradix over the cut surface of shoot has been found to give a success of 72 percent. But no work seems to have been done on this aspect in Kerala.

9. Technical programme:

- | | | |
|-------------------------------|---|---|
| Design | : | R.B.D. |
| Growth regulators to be tried | : | IBA, IAA, NAA and Seradix. |
| Concentration | : | 250 ppm, 500 ppm, 750 ppm,
1000 ppm, 5000 ppm. |
| Treatments | : | 20 (Each treatment comprises
of 5 layers) |

Contd.....2/-

Replications: 5 (Five)

All the treatments will be tried on the rooting of layers at monthly intervals for a period of one year. The performance of layers in the main field will also be studied for a period of two years.

10. Date of start : 1978-79.
11. Likely date of completion: 1981-'82.
12. Estimated mon months : 36
13. Facilities required : Existing facilities will be utilised.
14. Financing organisation : Kerala Agricultural University.
15. Approximate cost : Rs. 8,000/-

Sd/-
PRINCIPAL INVESTIGATOR.

FRC X.

235

KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE
COLLEGE OF HORTICULTURE
VELLANIKKARA

PROGRAMME OF RESEARCH WORK (DEPT. OF ENTOMOLOGY)

1. Name of the candidate : No. AG.H. 5(d).19. Ent. 1.01.
: B. Narasimha Murthy.
2. Date of Admission and : 10--10--1979.
Admission No. : 79-11-37.
3. Name and designation of : Dr C.C. Abraham, Professor
Chairman of Advisory : of Entomology.
Committee
4. Topic of Research for : Susceptibility of mango
thesis : (Mangifera indica Lin)
varieties to infestation by
Idiocerine species (Idioceri-
nae: Jassidae: Homoptera) of
hoppers.

5. Objectives of the Research:

1. To identify mango varieties that are resistant to infestation by Idiocerine species of hoppers.
2. To study the mechanism of resistance.

6. Brief review of previous work done on the topic:

Idiocerine hoppers (Amritodus atkinsoni Leth) Idioscopus clipealis (Leth) and I. niveosparsus (Leth) are the most serious pests of mango throughout the country, causing inflorescence blight and premature fruit drop. The yield losses due to pest infestation ranges from 25 to 60%. The predominant species in South India is Idioscopus niveosparsus (Leth) (Rao 1930). Most of the work done in India on mango hoppers is on the chemical control and very little work has been done on the varietal resistance and the mechanism of the resistance (Wadhi and Batra, 1964) Serrane and Palo (1933) have indicated that all varieties of mango are apparently attacked with equal severity in the philippines.

7. Scientific or practical importance of the research work:

The studies will be helpful to identify promising mango varieties which are resistant to hopper infestation. The vegetative propagation of such varieties will help to increase and stabilize fruit production considerably.

8. Technical Programme:

1. Fluctuations in the field populations of different

Contd.....2/-

species of hoppers on randomly selected vegetative shoots and floral branches of different varieties will be recorded at fortnightly intervals from Oct. to February.

2. Relative susceptibility of the varieties will be ascertained by confining pairs of the dominant species on freshly emerged floral branches. The percentage damage to buds and flowers and the F₁ progeny production on different varieties will be recorded.

3. The chemical composition of the shoot and floral branches will be studied with reference to the percentage of sap nitrogen, total carbohydrates and soluble sugars. The influence of the chemical constituents on the extent of damage will be ascertained by correlation studies.

9. Estimation of expenditure and receipt if any:-

1. Chemicals	Rs. 500/-
2. Field cages for insect rearing	Rs. 600/-
3. M.Sc. Lab. requirement	Rs. 250/-
4. Labour charges	Rs. 550/-
5. Unforeseen expenditure	Rs. 300/-
6. Fellowship at Rs. 600/- per trimester for 6 trimesters	Rs. 3600/-

Total	Rs. 5700/-
	=====

Receipts : NIL

10. Location of research : Parts of Trichur and Palghat districts.

Sd/-
(B. NARASINHA MURTHY).

Sd/-
(Dr. C.C. Abraham,
Professor of Entomology &
Chairman)

Sd/-
Associate Dean.

Vellanikkara,
22--2--1980.

COLLEGE OF HORTICULTURE
VELLANIKKARA

237

Research Project Proposed

1. Institution Code No. : No. AG.H. 5(d).19. Hort. 5.01.
2. ICAR Code No. :
3. Name and address of the Research Institute : College of Horticulture,
Vellanikkara.
4. a. Title of the project :
Title of the problem : Quality evaluation of promising mango varieties under Kerala conditions.
5. Name and designation of Principal Investigator : Vilasa Chandran, T.,
Junior Instructor.
6. Name and designation of Associates : Dr M. Aravindkshan, Professor
of Horticulture (Pomology).
7. Location : Mango orchard, Mannuthy.
8. a. Objectives : 1. To assess the physio-chemical qualities of promising mango varieties under Kerala condition.
2. To correlate the quality with rainfall temperature and humidity.
- b. Practical utility : There is a general belief that the quality of mango will be poor under humid conditions. No systematic work has been done to evaluate the quality of mango varieties grown in Kerala (tropical humid zone). The study will be help to evaluate the quality of mango in relation to climatic factors.
- c. Review of work done : No systematic work has been done in this respect under Kerala conditions.
9. Technical programme : Varieties available at the mango orchard, Mannuthy, will be utilised for the study.
Fruit qualities like T.S.S., acidity, sugar and vitamin C will be evaluated.
10. Date of start : January 1979.

Contd.....2/-

11. Likely date of completion: 1981.
12. Estimated man months : 36
13. Facilities required : For the collection of fruits and Laboratory analysis.
14. Financing organisation : Kerala Agricultural University.
15. Approximate cost : Rs. 2,000/-

Sd/-

Principal Investigator.

FRC X.

KERALA AGRICULTURAL UNIVERSITY
 FACULTY OF AGRICULTURE
 DEPARTMENT OF HORTICULTURE - PROC. TECH.
 COLLEGE OF HORTICULTURE
 PROGRAMME OF RESEARCH FOR MASTER'S DEGREE

No. AG.H. 5(d).19. Hort. 6.01.

1. Name of candidate : JESSY. M. KURIAKOSE
2. Date of admission and Admission No. : 10--10--1979.
79-12-04.
3. Name and designation of Chairman of Advisory Committee : P. Sethumadhavan, Professor & Head, Department of Proc. Technology.
4. Topic of Research for Thesis : Maturity and Post-harvest studies in Mango.

5. Objectives of the Research:

1. To study the physical changes during maturity and Chemical changes after a certain stage of maturity ('A' Stage) and post harvest stage in four varieties of Mango and to see whether prediction of maturity and ripening can be done based on certain parameters.
2. To find out the effects of different storage methods on the shelf life and quality of mango.

6. Brief review of work done:

Various parameters have been used for determining the stage of maturity of mango. Cobin (1950), Teatota et. al. (1967) and Jauhari et. al. (1969) suggested that specific gravity was a good index for predicting maturity in Mango variety Haden, Hangra and Bombay Green respectively. Popenoe, Hattam and Harding (1958) found that starch content decreased as the maturity of fruits approached in mangoes. Lombard (1963) and Teatota et. al. (1965) reported a direct correlation of TSS and sugar with maturity in citrus and guava. Mann and Singh (1976) reported that number of lenticels per unit area can be taken as a parameter for judging the maturity of mango fruits.

According to Wartlow and Leonard (1936) Karmarkar and Joshi (1942) and Cheema et. al. (1950) many varieties if picked when fully mature could be stored for about 4-7 weeks at a ~~xxx~~ temperature ranging from 3.9°C to 8.9°C. Srivastava (1967) suggested a storage temperature of 8.9°C to 11.1°C for mango. Sadasivan et. al. (1971) observed chilling injury in Neelum and Banglora mangoes coated with wax emulsion or wrapped in polythene and stored at 6 ± 1°C or 9 ± 1°C.

Contd.....2/-

7. Scientific and/or practical importance of research:

The study of physiological and bio-chemical changes during maturity and the determination of the proper stage of harvesting is very important from the point of making good quality fruits available. It also helps in predicting the first suitable date for picking and the longevity of picking is useful to the grower in working out a particular period spread over a few days and adjusting the harvest time.

Knowledge on prolonging the post-harvest life of mango and the adaptability of cold storage will help in reducing the post-harvest losses and making the fruits available for a longer period.

8. Technical Programme:

- I) Technical programme includes the study of 5 varieties of Mango, viz., Bannet Alphonso, Mundappa, Neelum, Swarnarekha and Oluv. There will be 4 plants under each variety.
- 1) Sufficient number of fruits will be tagged at fruit setting stage and observations will be made on the following physical characteristics.
 1. Rate of increment in length.
 2. Rate of increment in girth.
 3. Rate of increment in breadth.
 4. Weight at maturity.
 5. Specific gravity at maturity
 - 2) The fruits will be harvested at two weeks interval starting from 'A' stage (shoulder in line with the stem and the colour of the fruit green). Each sample harvested will be divided into 2 groups. One group will be analysed fresh and the other group will be ripened. Observations will be made in the following chemical changes.
 1. Polythene bag of different guages.
 2. Polythene bag + Potassium Permanganate.
 3. Wax coating;
 4. Polythene + Wax coating.
 - 3) Studies on the following aspects before and after storage:-
 1. T.S.S.
 2. Acidity
 3. Reducing sugars
 4. Non-reducing sugars
 5. Total sugars
 6. Ascorbic acid content
 7. Vitamin A.

Contd.....3/-

The quality of ripened fruits will be assessed based on organoleptic test.

9. Estimate of expenditure (including fellowship) : Cost of chemicals, Polythene, etc. : Rs. 7,500/-
10. Receipts : Nil
11. Location of research : Mango Orchard, Mannuthy.

Sd/-
Signature of the candidate.

Sd/-
Signature of the Chairman of
Advisory Committee.

Sd/-
Signature of the Head of the
Department.

Vellanikkara,
Date: 1--3--1980.

FRC XII.

RESEARCH PROJECT

242

1. Institute Code No. : No. AG.H. 5(d).19. Proc.Tech. 1.01.
2. ICAR Code No. :
3. Name and address of the Research Institute/
Centre : College of Horticulture,
Vellanikkara P.O., Trichur.
4. Title of the Project : Studies on the suitability of
popular varieties of mango in
5. Title of the problem : Kerala for canning.
6. Name and designation of the Principal Investigator : V.K. Damodaran, Professor
of Horticulture.
7. Name(s) and designation of the Associate(s) : P.K. Valsalakumari, Junior
Instructor.
N.K. Vimalakumari, Asst.Professor.
T. Vilasachandran, Jr. Instructo.
8. Location of the research project : College of Horticulture,
Vellanikkara.
9. Objective:
To find out the suitability of popular varieties of
mango in Kerala for canning.
10. Practical utility : The suitability of popular
varieties of mango in Kerala
has not been studied so far.
11. Technical programme:
1. Analysis of the varieties for fibre, T.S.S., total
sugars, reducing sugars, acidity, ascorbic acid
and carotene contents before canning.
2. To find out the percentage recovery from the
different varieties.
3. Canning and preservation of the products in tin
cans using the standard procedure (CFTRI)
4. Storage at room temperature for 12 months and
monthly analyses - organoleptic evaluation and
analyses for pH fibre, TSS, reducing sugars,
acidity, ascorbic acid and carotene contents.
12. Date of starting : 1979 January.
13. Date of completion : 1980.
14. Estimated cost : Rs. 1,000/-
15. Facilities required : No additional facilities
required.
16. If organised by our organisation other than the
institute : Organised by the College.

Signature of

Sd/-

Sd/-

PRINCIPAL INVESTIGATOR. HEAD OF DIVISION

DIRECTOR OF RESEARCH.

RESEARCH PROJECT

1. Faculty of Agriculture : Department of Agronomy
2. Name of Research Station : Banana & Pineapple Research Station, Kannara.
3. Project number : AG. 5(f).14. Agron. 1.02.
4. Title of the project : Potash requirements of pineapple.
5. Name and designation
 - a) Project Leader : I.P.S. Nambiar.
 - b) Associates : Junior Instructor.
6. Objectives

The response of pineapple to potassium has been reported to be variable. It is, therefore, important to find out the requirements of potassium for pineapple in different agro-climatic zones of the country.

7. Practical utility : To make recommendation to pineapple growers.
8. Location : Pineapple Research Centre, Vellanikkara.
9. Technical programme

Treatments

- | | | | |
|---------------------|------------------|---------------------|------------------|
| 1. K ₂ O | - 0 g/plant/crop | 2. K ₂ O | - 4 g/plant/crop |
| 3. K ₂ O | - 8 g/plant/crop | 4. K ₂ O | -12 g/plant/crop |
| 5. K ₂ O | -16 g/plant/crop | | |

Design : R.B.D. No. of plants/treatment : 60
 Nitrogen at 600 kg/ha and P₂O₅ 100 kg/ha will be given uniformly for the crop.

No. of replications : 4
 Planting density : 53330 in 25 x 60 x 90 cm.

Observations

1. Leaf number, 'D' leaf weight and leaf area will be recorded at six monthly intervals.
2. Data on days taken for flowering, fruit age, fruit weight, fruit yield and quality of fruits will be recorded.
3. Soil sampling will be done before planting at 15 cm. depth for analysis of p^H and available N, P and K.
4. Leaf analysis for Potassium will be done at six monthly intervals.

10. Date of start : 1980.
11. Likely date of completion: 1983.
12. Financing organisation : I.C.A.R.
13. Approximate cost : Rs. 8000/-
14. Duration : 4 years.

Sd/- Sd/- Sd/-
 Project Leader. Head of Department. Director of Research.

P R O F O R M A

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE

DEPARTMENT OF HORTICULTURE (POMOLOGY)

COLLEGE OF HORTICULTURE, VELLANIKKARA.

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE

(for approval of the University)

1. Name of candidate : Jayachandran Nair, C.S.
2. Date of admission & admission number : 15--10--1979. } No. AG.H. 5(f).19.
79-12-07. } Bot. 3.01.
3. Name and designation of Chairman of Advisory Committee : Sri. V.K. Damodaran, Professor of Horticulture (Pomology), College of Horticulture, Vellanikkara.
4. Topic of research thesis : Floral biology, pollination and fruit development in pineapple (Ananas comosus Lin)

5. Objective of Research:

The objectives of the proposed investigations are:-

1. To study the floral biology of pineapple varieties.
2. To study the cross compatibility or otherwise in pineapple varieties.

6. Brief review of previous work done in the topic:

In pineapple, so far no work has been done on the floral biology of different varieties. Collins (1960) reported that seed production in pineapple is restricted by self-incompatibility. It has also been noted that intervarietal hybridization leads to seed setting in pineapple. But no experimental evidence is available in respect of specific varieties.

7. Scientific and/or practical importance of the research:

The commercial varieties of pineapple need improvement in some of the important economic characters. For example, the 'Kew' variety is having low T.S.S. and sugar content and shy in sucker production. But, there are varieties like Queen, Mauritius and Charlotte-Rothschild which have these desirable attributes, but with some other undesirable characters. By well planned programme of hybridization, it will be possible to evolve varieties containing the above characters to a large extent. A study of the floral biology, pollination and cross-compatibility between varieties is a pre-requisite for undertaking such a breeding programme. Hence the study

Contd.....2/-

8. Technical programme:

The floral biology of four varieties of pineapple - Kew, Queen, Mauritius and Charlotte Rothschild will be studied in detail which will include the following:

1. Pattern of flowering including the stages of development from the initial visual induction of flower.
2. Time of anthesis.
3. Morphology of flowers.
4. Anther dehiscence.
5. Stigmatic receptivity.
6. Pollen studies including morphology and fertility.
7. Estimation of pollen production and standardisation of media for pollen germination.
8. Pollen storage.
9. Mode of pollination and percentage of fruit set.
10. Fruit development.

The cross-compatibility studies by intervarietal crossing will be undertaken using the above mentioned four varieties available in Pineapple Research Station, Vellanikkara. Compatibility will be assessed based on seed setting.

9. Estimate of expenditure:-

a) Cost of cultural operations, chemicals, etc.	Rs. 5,000/-
b) Fellowship	Rs. 4,800/-

Total	Rs. 9,800/-
	=====

10. Receipts : Nil
(Fruits will be utilized for seed extraction)

11. Location of Research : Pineapple Research Station, Vellanikkara.

Place: Vellanikkara.

Date : 3--3--'80.

Sd/-

Signature of candidate.

KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE

DEPARTMENT OF AGRIL. ENTOMOLOGY
COLLEGE OF HORTICULTURE, VELLANIKKARA.

PROGRAMME FOR RESEARCH FOR MASTER'S DEGREE

No. AG.H. 5(f).19. Ent. 2.01.

1. Name of the candidate : C.P. Hamza Koya.
2. Date of Admission and Admission Number : 10-10-1979.
79-11-39.
3. Name and designation of Chairman of Advisory Committee : Dr T.S. Venkitesan, Assoc. Professor (Nematology).
4. Topic of Research Thesis:

The plant parasitic nematodes associated with pineapple (Ananas comosus) in Kerala.

5. Objective of the Research:

To gather information on the plant parasitic nematodes associated with pineapple crop in Kerala, and to find out how far they are responsible for reducing the yielding potential of the crop.

6. Brief review of previous work done:

The occurrence of the plant parasitic nematodes particularly Meloidogyne spp. in the pineapple crop has been reported as early as 1911 by Bessey.

The other spp. recorded on this crop include Pratylenchus brachyru (Godfrey 1929) Radopholus Similis (Uassidy et al 1927), Rotyleuchulus reniformis (Linford and Yap 1940) and Rotyleuchulus crythrina (Parris 1940). Ayala et al (1970) reported that out of 15 genera of plant Nematodes associated with pineapple Helicotylenchus, Meloidog, Rotylenchus, Pratylenchus and oriconemoides are associated with root decay. Ketch (1978) estimated the extent of yield reduction in pineapple due to nematode infection at about 50%. Several workers have reported increase in yield by adopting control methods of nematode associated with pineapple. In Kerala no work has been carried out on the plant parasitic nematode associated with the pineapple.

7. Scientific importance and practical importance of the Research:

Pineapple is cultivated in Kerala in 8245 hectares producing about two lakh tonnes of fruits. Several factories and industries are dependent on the crop for production of Pineapple juices and canned slices. This crop is cultivated as a ratoon crop also. Some of the planters have reported that yield of the fruit is reduced every year. Association of parasitic

nematodes have been observed recently on this crop. The results obtained from these research studies will be useful in knowing whether nematodes have any role in affecting the yield and if so, checking nematode infestation can be practiced for boosting the yield.

8. Technical programme:

1. Survey:- A faunistic survey will be conducted in different parts of Quilon, Ernakulam, Trichur, Calicut and Cannanore Districts of the State to identify the parasitic nematodes associated with pineapple. Soil and root samples will be collected from different regions and the nematode population level in the sample will be ascertained and their identity established.
2. Pot culture ~~xxx~~ experiment:- A pot culture experiment will be conducted to study the effect of different population levels of Meloidogyne incognita on growth of pineapple. Pineapple suckers will be planted in only pots (10 litre capacity) containing sterile (denomatized). Soil and the soil will be inoculated with 10, 100, 1000 and 10,000 level populations of Meloidogyne incognita and a check also will be sown. After 180 days of inoculating the nematode, the growth characters like number of leaves, height, top weight, root length, root weight etc. will be recorded and nematode multiplication will also be recorded.

9. Estimate of expenditure : Particulars attached separately.
 Total : Rs. 3250.00
 =====

10. Location of Research if : Pot experiment will be done within campus.
 The survey work will be carried out in private holdings in various districts.

Place: Vellanikkara.
 Date : 29--2--1980.

Signature of the candidate: Sd/-

Signature of the Chairman
 (Advisory Committee) Sd/-

Signature of the Assoc. Dean. Sd/-

P R O F O R M A
KERALA AGRICULTURAL UNIVERSITY

Faculty of Agriculture
Department of Horticulture (Pomology)
College of Horticulture, Vellanikkara.
PROGRAMME OF RESEARCH FOR MASTER'S DEGREE

(For approval of University)

No. AG.H. 5(f).19. Hort. 2.02.

1. Name of candidate : BABYLATHA, A.K.
2. Date of admission and admission number : 16--10--1978.
78-12-08.
3. Name and designation of Chairman of Advisory Committee : Dr M. Aravindakshan, Professor of Horticulture (Pomology), College of Horticulture, Vellanikkara.
4. Topic of Research for thesis: Regulation of fruit size and maturity in pineapple.
5. Objective of research:

In Kerala we are recommending one plant crop and two ratoons for ~~xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx~~ pineapple cultivation. It is a common occurrence that in ratoons the size of fruit is reduced compared with plant crop. Similarly within a crop itself size variation in fruits is noticed. Application of ethrel or combination spray of ethrel brings about uniformity in flowering, but does not ensure uniform fruit size always. Hence the present investigations are planned with the following objectives.

1. To find out the factors affecting fruit size and maturity.
 2. To find out the effect of growth regulators, NAA at different concentrations at different stages or fruit growth.
 3. To study the effect of NAA on fruit size, maturity and quality of fruit.
6. Brief review of previous work done in the topic (give reference to important publications or thesis)

Studies on the effect of plant hormones on fruit development and maturity in pineapple dates back to 1943, when Clark and Kerns (1943) reported that the application of 0.5% Naphthlene acetic acid sprays on the fruit at development stage markedly increased fruit size and weight of fruits. Similar positive response of plant hormones on fruit size in pineapple have been reported by Barbier (1964), Kwong and Chin (1965) Wee (1971) and Huang (1974).

The reported results also show that the post-shooting application of growth hormones delays maturity (Alliand

Talukdar, 1938) and results in homogeneous ripening and briefer harvest (Avdinay, 1970). In the light of above mentioned preliminary reports, the present study aims to have a detailed investigation on the effect of NAA on fruit size, maturity and quality of pineapple fruit in Kerala conditions.

7. Scientific and/or practical importance of the research:

The several aspects proposed to be studied is expected to give the details regarding the effect of growth regulators on fruit size and maturity and will also help to assess whether the fruit yield can be stabilized in ratoons, besides regulating maturity of fruits. This will also help to ensure uniformity of fruit size, when ethrel or combination treatments are applied for induction of flowering.

8. Technical programme in brief:

The ratoon crop available in the pineapple research project will be selected for study:

Variety : Kew

Treatments : 25 (Combination of (A) and (B))

(A). Main plot treatments (Stages of fruit growth)

1. At inflorescence emergence
2. One month after flowering
3. Two months after flowering
4. Three months after flowering
5. Four months after flowering

(B). Sub plot treatments: (levels of NAA and control)

1. 50 ppm
2. 100 ppm
3. 200 ppm
4. 300 ppm
5. Control

The following observations will be made

1. Nutrient status of leaves in relation to fruit size
2. The C:N ratio of leaves at the time of growth regulator application and at harvest
3. Days taken from flower emergence to harvest
4. Growth rate of fruits at monthly intervals
5. Fruit characters namely:
 - a. Weight of fruits
 - b. Length of fruits
 - c. Breadth of fruits
 - d. L/B ratio and canning ratio

6. Qualitative analysis:

- a. Total soluble solids
- b. Acidity of juice
- c. Sugar content of juice
- d. Ascorbic acid content

The effect of hormone on plants having different leaf numbers will also be studied. The correlation between C:N ratio with fruit size and maturity will be assessed.

- 9. Estimate (including fellowship) : Cost of cultivation, cost of laboratory chemicals etc. Rs. 5000/-
- 10. Receipts Rs. 1600/-
- 11. Location of research : College of Horticulture, Vellanikkara.

Sd/-
Signature of candidate.

Vellanikkara,
22--2--1979.

Sd/-
Signature of Chairman of
Advisory Committee.

Sd/-
Signature of Dean.

1. Institute Code No. :
2. Name and address of the Research Institute : College of Horticulture, Vellanikkara.
3. Title of the project : Research on Grapes.
Title of the problem : Adaptability studies on grape varieties.
4. Name and designation of Principal Investigator : Joseph Philip, Junior Instructor (Hort.)
5. Name and designation of Associate : Dr M. Aravindakshan, Professor of Pomology.
6. Location : College of Horticulture, Vellanikkara.

7. Review of work done:

Some grape varieties like 'Bangalore Blue' evolved at the Coimbatore Agricultural College were proved to be suitable for growing under the agro-climatic conditions of South India. Existence of a grape orchard at Vellayani, in the early period showed that it is possible to grow grapes in Kerala conditions. However, no detailed work has been done with regard to the adaptability of grape varieties in our State.

8. a. Objectives:-

- i. To find out the suitability of growing grapes under Kerala conditions.
- ii. To screen varieties suitable and to evaluate the performance of the varieties screened.

b. Practical utility:-

Though grape is not cultivated on a large scale in Kerala the fact that certain varieties like 'Bangalore Blue' are grown in isolated homesteads indicate the possibility of growing this crop at least on a limited scale. If suitable variety could be screened, it is possible to cultivate this crop under favourable conditions in Kerala.

9. Technical programme:-

Both indigenous and exotic varieties will be collected from Coimbatore and Bangalore, and will be grown for adaptability evaluation.

The preliminary studies will be conducted by training the varieties under head system and later on the successful varieties will be grown under pandal system for detailed observations.

10. Date of start : 1978.
11. Likely date of completion: 5 years.
12. Estimated man months : 60
13. Facilities required : The facilities available in the College of Horticulture will be utilised.
14. Financing organisation : Kerala Agricultural University.
15. Approximate cost : Rs. 5,000/-
16. Signature of:

Sd/-
(PROJECT LEADER)

P R O F O R M A

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE

DEPARTMENT OF HORTICULTURE (PLANTATION)

COLLEGE OF HORTICULTURE, VELLANIKKARA.

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE
(for approval of University)

1. Name of candidate : No. AG. 6(a) 19. Agron. 1.02.
SALIKUTTY JOSEPH
2. Date of admission and : 16-10-1978.
admission no. : 78-12-14.
3. Name and designation of : Dr N. Mohanakumaran, Professor
Chairman of Advisory of Horticulture, College of
Committee Horticulture, Vellanikkara.
4. Topic of research for : Effects of graded doses of
thesis : N,P and K on the growth and
leaf nutrient status in Cocoa.
5. Objective of research:
1. To study the effect of graded doses of N,P & K on the growth characters of Cocoa.
 2. To examine the relationship between nitrogen status of leaves and production of Cocoa.
6. Brief review of previous work done in the topic:

Verliere (1969) reported that foliar N increased in response to N fertilizer applications, but P applications had a gradually increasing depressive effect on foliar N. Large seasonal variations were recorded for foliar K, which was significantly reduced by Dicalcium phosphate applications.

Schroo (1960) made an attempt to compare the results of soil analysis with those obtained from leaf analysis. The closest agreement was found for P and Mg and that of N and K was less satisfactory. So he recommended leaf analysis, as a complementary method only.

Murray (1967) concluded that leaf analysis values are limited by problems of seasonal and sample variation. It is of use where marked deficiencies or toxicities exist, but lacks precision in the normal range.

Wessel (1965, 67) reported that leaf P content and yield are highly positively correlated.

However, in Banana (Hewitt and Osborne, 1962) and in Coconut (Ziller and Prevot 1961) the leaf analysis technique has been projected and is used as an effective tool in the diagnosis of deficiencies and also for corrective steps.

Contd.....2/-

7. Scientific and/or practical importance of the research:

Foliar sampling is a better means of detecting the early stages of, or trends towards, the nutritional deficiencies, excesses and imbalances in plants. Leaf analysis will thus help to maintain soil fertility and better the management practices.

8. Technical programme in brief: a) Pot culture:

Soil with known N.P.K. content will be used for growing the seedlings. N,P and K will be applied to the seedlings. Growth habits of the seedlings, such as the rate of increase in height and girth, rate of leaf production, etc. will be recorded at periodical intervals and the leaf samples will be collected and analysed. Thus (1) the nutrient uptake and distribution pattern and (2) Influence of graded doses of NPK on morphological characters will be studied.

b) Existing crops:

The existing plants in the cultivator's fields also will be utilised for the studies. Leaf samples will be collected from plants growing on soils of different nutrient status. The soil samples of the same will also be analysed. Attempts to correlate the leaf analysis data as well as soil analysis figures with the growth and production of Cocoa plant will be made.

9. Estimate	:	Rs. 9,000/-	Cost of experimentation and laboratory chemicals.
		Rs. 3,000/-	Fellowship

Total		12,000	

10. Receipts : Nil

11. Location of research : Main campus, Vellanikkara (Pot culture)
Cultivators' field (existing crop)

Place: Vellanikkara,
Date : 12--3--1979.

Sd/-
Signature of the candidate.

Sd/-
Signature of the Chairman
of Advisory Committee.

Sd/-
Signature of the Head of the
Department.

P R O F O R M A

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE

DEPARTMENT OF AGRONOMY, COLLEGE OF HORTICULTURE, VELLANIKKARA.

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE

(For the approval of the University)

1. Name of the candidate : No. AG. 6(a).19. Agron. 4.02.
R. Gopinathan.
2. Date of admission and : 16-10-'78.
admission number : 78-11-50
3. Name and designation of : Dr R. Vikraman Nair, Assoc.
the chairman of advisory : Professor (Agronomy)
committee
4. Topic of research for : Effect of shade and moisture
thesis : regimes on the growth of cocoa
seedlings.
5. Objectives of the research:
 - 1) To study the effect of varying shade intensities on the growth of cocoa seedlings.
 - 2) To arrive at the suitable moisture regimes on its growth.
 - 3) To study the possible interactions between shade and moisture regimes on young Cocoa.
6. Brief review of past work done:

According to Hardy (1962) the most suitable light intensity for Cocoa seedlings is about 25 per cent full sunlight. The amount of light may be gradually increased to 50% and later if all other environmental conditions are favourable it may be increased to 100 per cent when complete leaf shading has been attained. In an experiment at Cocoa Research Institute of Ghana, Bonaparte (1967) found that in mature Amalonado Cocoa, yield increased almost linearly with increase in distance from shade trees. This gradient was considered to be due to competition for light.

Smith (1964) reported that for young Amazon Cocoa, grown in the field for 2 years, irrigation increased flower production and growth rate but did not affect the percentage setting of flowers or wilting of cherelles. In an experiment at Cocoa Research Institute, Ghana (Anon 1972) it was found that growth of Cocoa seedlings was best when the soil was allowed to dry to about 60 per cent available moisture.

Significant positive interactions between irrigation and removal of shade on the yield of Cocoa were reported by Ahenkora and Akrofi (1967) and also in an experiment at Cocoa Research Institute, Ghana (Anon 1972).

Contd.....2/-

7. Scientific and or/practical importance of research:

The result from present investigations will give information on the light requirement of cocoa seedlings at varying moisture conditions in a representative environment in Kerala. The results will also give an idea of the suitable irrigation frequency for Cocoa seedlings.

8. Technical programme:

a) Treatments: Treatments consist of 4 shade regimes and 3 levels of soil moisture.

i) Shade regimes:

- | | |
|------------------------------|-------------------------------|
| 1. Heavy shade (75 per cent) | 2. Medium shade (50 per cent) |
| 3. Low shade (25 ") | 4. Full sunlight |

ii) Soil moisture regimes:

1. Irrigation at 25 per cent available water
2. Irrigation at 50 per cent available water
3. Irrigation at 75 per cent available water

Total number of treatment combinations - 12

Design : CRD Replications: 10

b) Observations:-

i) Growth characters (monthly intervals)

- | | |
|--------------------------------|------------------|
| 1. Plant height | 2. Girth of stem |
| 3. Number of leaves | 4. Leaf area |
| 5. Net assimilation rate (NAR) | |
| 6. Dry weight | |

ii) Chemical analysis

- | | |
|-----------------------------|----------------|
| 1. N Uptake of N | 2. Uptake of P |
| 3. Uptake of K | |

9. Estimates of expenditure and receipts if any

- : 1. Cultivation expenses Rs. 500 (approx.)
2. Fellowship for a period of two years from October 1978 Rs. 3000/-

Receipts : Nil

10. Location of research

: College of Horticulture, Vellanikkara or Instructional Farm, Mannuthy.

Vellanikkara,
Date: 15-3-1979.

Sd/-
Signature of candidate.

Sd/-
Signature of the Chairman,
Advisory Committee.

Sd/-
Signature of Head of Department.

P R O F O R M AKERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE.

Department of Horticulture (Plantation Crops)
College of Horticulture, Vellanikkara, Trichur Dist.

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE
(For approval of University)

No. AG. 6(a) 19. Bot. 1.01.

1. Name of candidate : Rajamony, L.
2. Date of Admission & Admission No. : 16-10-1978.
78-12-11
3. Name and designation of Chairman of Advisory Committee : Dr N. Mohanakumaran, Professor of Hort. (Cocoa), K.A.D.P., College of Horticulture, Kerala Agrl. University.
4. Topics of research for thesis : Studies on the Floral biology and fruit set in cocoa (Theobroma cacao.L.)
5. Objectives of the research:
 1. To study the flower bud differentiation, flowering, pollination etc. of cocoa under Kerala condition.
 2. To study the problems of fruit set and fruit development in cocoa.
 3. To examine the feasibility of increasing fruit set and yield in cocoa.
6. Brief review of the previous work done on the topic -

Cocoa, being a new beverage crop introduced in Kerala no work on the flowering pattern, floral biology and fruit set has been done either in Kerala or in any other states of India. Work done by scientists of African Countries (Ghana, Cameroon, Ivory Coast, Nigeria etc.) and Tropical America (Brazil, West Indies, Colombia, Costa-Rica, Ecuador, Mexico etc.) will form the basis for the proposed studies.

7. Scientific and/or Practical importance of the research:-

Cocoa is the most nutritious beverage crop cultivated in almost all tropical countries. There is vast scope in improving the production of cocoa in South India especially Kerala, where large case is given to this new perennial crop.

The productive capacity of the tree is directly related to the nature of flowering and fruit-set. Fruit-set depends upon several factors such as climate, pollinating agents, Temperature, viability of pollen, time of availability of pollination etc.

Contd.....2/-

Though profuse flowering is seen under Kerala conditions, fruit-set obtained is rather poor. Full grown trees may produce as much as 10,000 flowers annually, but only 10-50 will develop as mature fruits.

A thorough study about the factors affecting fruit set and fruit development will enable us to achieve good percentage of fruit set and thereby increase the yield.

8. Technical programme:-

Bearing plants will be selected in different gardens. The following studies will be undertaken.

1. The time of flower bud initiation.
2. Time of flower opening (Anthesis).
3. Period of receptivity of the stigma.
4. Time of another dehiscence.
5. Structure and viability of pollen (Pollen morphology).
6. Mode of pollination.
7. Pollen storage & germination of pollen in vitro.
8. No. of flowers produced (seasonal influences).
9. Extent of cherelle wilt at various period of the year.
10. No. of fruit developed.
11. Hormonal influences.
12. Natural cross pollination (NCP) rate.
13. Study of self incompatibility.

9. Estimated expenditure : Rs. 4,000/-

10. Location of Research : College of Horticulture,
Vellanikkara.

Candidate: Sd/-

Chairman : Sd/-

Dean/Associate Dean : Sd/-

FRC - VIII.

KERALA AGRICULTURAL UNIVERSITY

FACULTY OF AGRICULTURE, DEPARTMENT OF AGRL. BOTANY
COLLEGE OF HORTICULTURE, VELLANIKKARA.

PROGRAMME OF RESEARCH FOR MASTER'S DEGREE
(For approval of the University)

AG. 6(a) 19. Bot. 2.01.

1. Name of the student : Gregory Zachariah.
2. Date of admission and admission number : 10--10--1979.
79-11-18.
3. Name and designation of the chairman of the advisory committee : Dr K. Kumaran, Assoc. Professor, ICAR Jack Scheme, College of Horticulture, Vellanikkara.
4. Topic of research for thesis : Genetic variability and correlation studies in cocoa, Theobroma cacao L

5. Objective of Research:

1. To study the extent of genetic variability existing in important plant, pod and bean characters of cocoa.
2. To find the interrelation between yield and its contributing characters.
3. To identify superior genotypes which can be developed into clones for future studies, and
4. To derive selection criteria for mother plants.

6. Brief review of previous work done:

Soria (1959) reported variability of cocoa types in some Nicaraguan plantations. Ruinad (1961) suggested variability of various pod characters as a factor in cocoa selection.

Variation of bean characteristics in hybrid cocoa progenies was reported by Alvarado and Bullard in 1961. There is a significant correlation between bean size and fat content and a negative correlation between bean size and percentage of hulls.

Enrique and Soria (1968) made an assessment of variability in wet weight, length, width, thickness of shell and pulp, percentage and number of beans per pod in fresh samples from cacao clones of different genetic origin. Interclonal differences in these characteristics were highly significant indicating that they are useful for clonal classification. The best sample size was 3 seeds of 20 pods per clone.

7. Scientific and practical importance of Research:

This study will help for identifying superior geno-

types which can be used as proven mother trees for future studies. These can also be developed into clones for utilization in hybridization and further establishment of hybrid seed gardens.

8. Technical programme:

A total number of 300-500 bearing trees conforming to the Forastero type at same age and subjected to uniform cultural treatments will be selected. Observations on plant, pod and bean characters as given below will be made for a period of one year (two crop seasons) beginning from July 1980. Data will be collected from individual trees. Characters like flushing and flowering will be scored while leaf area, no. of flowers per tree etc. will be estimated from a unit area. Pod value and conversion ratio will be on a tree basis as far as possible. However, if sufficient no. of pods are not available, the latter will be worked as 40% of the wet weight of the beans. Data collected will be subjected to statistical analysis following appropriate biometrical methods.

Observations to be taken:

Vegetative characteristics

1. Jorquetting height
2. Leaf area
3. Frequency of flushing

Flowering:

- Frequency and intensity of flowering
- No. of flowers per tree
- No. of cherule set per cushion and tree
- No. of pods developed/year
- Pollen fertility
- Colour of pods
- Weight of pods
- Thickness of husk
- Volume of pod
- Number of beans per pod
- Number of flat/germinated beans per pod
- Volume of beans
- Pod value
- Conversion ratio
- Percentage of shell and cotyledon
- Incidence of Black pod

9. Estimate of expenditure :

Cost of cocoa pod from about 300 trees		
6000 pod @ Rs. 1.50	=	9000.00
Cost of chemicals, label, buckets, trays and boxes	=	1000.00
Labour charges - 60 man-days	=	800.00
Unforseen items	=	200.00
Total:	=	<u>11,000.00</u>
		=====

10. Location of Research if outside the College Campus:
Cocoa plantations in Alpara, Kannara and Peechi.

Sd/-

Signature of the candidate.

Sd/-

Signature of the Chairman.

Sd/-

Signature of the Dean.

Vellanikkara,
Date: 29-2-1980.

FRC - XII.

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KERALA AGRICULTURAL UNIVERSITY
FACULTY OF AGRICULTURE

Department of Soil Science and Agricultural Chemistry,
College of Agriculture, Vellayani.

POST-GRADUATE RESEARCH PROGRAMME (M.Sc. (Ag.))

1. Name of student : Kumari ANNIE KORUTH.
2. Date of admission and register No. : 10-10-1979. ; No. AG. 6(a) 18.
79-11-27. ; Che. 1.01.
3. Name and Designation of Chairman, Advisory Committee : Dr V. Gopalaswamy, Assoc. Professor of Soil Science and Agrl. Chemistry, College of Agriculture, Vellayani.

4. Title of Research programme:

The relationship between soil nutrient status and foliar analysis of cocoa of different age groups in the various soil types of Kerala.

5. Objective of the programme:

- i) To correlate the nutrient levels in foliar diagnostic samples, based on established foliar diagnosis techniques, with the soil test results for N, P and K.
- ii) To relate the foliar diagnosis tests and soil tests with yield data of bearing cocoa plants.
- iii) To locate deficiency or toxicity levels based on field observations and analysis.

6. Brief review of work done.

The General studies pertaining to the nutritional aspects of cocoa were mainly carried out in cocoa producing countries of the British Commonwealth. Mc. Donald (1934) carried out the nutritional requirements of cocoa with respect to N, P and K. Greenwood and Djolesto (1952) conducted sand culture experiments dealing with deficiency and excess of N, P and K in Ghana. Deficiency levels of the major nutrients in cocoa leaves were conducted by Murray (1956). Now the cultivation of cocoa is vastly spreading in Kerala. Two projects are in progress one in K.A.U. and one under K.A.D.P. on (1) 'Effect of graded doses of N, P and K on the growth and leaf nutrient status in cocoa' and (2) Nutritional studies on Cocoa 'Standardisation of leaf analysis technique in Cocoa' respectively. The programme envisaged in this project aims to assess the relationship between the soil nutrient status and the healthy performance of cocoa in various soil types as diagnosed by foliar analysis techniques.

Contd.....2/-

7. Scientific and practical importance of the Research.

The cultivation of cocoa is spreading rapidly in the State. The proposed study will enable the prediction of nutrient status of cocoa plants of different age groups and for formulating recommendations on the basis of foliar diagnosis and soil test data which are of high practical value for the cultivators.

8. Technical Programme.

The age group of cocoa plants for collection of leaves for foliar diagnosis are:-

- i) First year of planting (seedling)
- ii) Young plants up to 5 years
- iii) Plants in full bearing (5-10 years)

I. (1) Collection of foliar diagnostic leaf samples of the following rank order from the first green leaf on 10 branches from each plant.

- a) 2nd leaf
- b) 3rd leaf
- c) 4th leaf

Leaf laminae and leaf petiole will be separately sampled. The branches will not be under the shade of the tree itself or under shade of other trees.

(2) Three flushes will be sampled from each tree during the sampling period of one year.

(3) Five plants will be selected in each age group.

(4) The samples will be located in the

- i) Vithura - Nedumangad area.
- ii) Vellayani - Neyyattinkara area.
- iii) Coastal sandy area of Trivandrum district.

II. Collection of soil samples from 120 cm radius of the plant and within a depth of 15 cms at all the three stages of F.D. samples collection.

III. Recording the yield of plants chosen for sampling. Information on pre-experimental yield will be collected if available.

IV. Correlating leaf concentrations of nutrients in F.D. samples with soil test data and yield.

V. Observations will also be made on symptoms of deficiency/toxicity or other abnormalities. Collection and analysis of such samples after recording symptoms and noting physiological peculiarities.

9. Period of experiment : 2 years.

Contd.....3/-

10. Date of start : 10-10-1979.
11. Likely date of completion : 10-10-1981.
12. Estimate of expenditure : Rs. 4000/-
13. Anticipated receipts : Nil
14. Location of study : College of Agriculture,
Vellayani.

Sd/-
(ANNIE KORUTH)

Signature of P.G. student.

Sd/-
Signature of Chairman,
Advisory Committee.

Signature of Head of the Dept.

Signature of the Dean.

Place: Vellayani.
Date :

FRC - XI. Approved. One year old plants may be deleted and
Ca and Mg may be included in the analysis.

RESEARCH PROJECT

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1. Institute Code No. : No. AG. 6(a) 19. Pro.Tech. 1.01.
2. ICAR Code No. :
3. Name and address of the Research Centre : College of Horticulture,
Vellanikkara.
4. Title of the project : Research on Cocoa.
Title of the problem : Studies on processing of Cocoa.
5. Location : College of Horticulture,
Vellanikkara.
6. Name and designation of the Principal Investigator : Dr N. Mohanakumaran, Professor
of Horticulture (Cocoa).
7. Name and designation of Associate(s)
 1. Dr P.C.S. Nair, Associate Dean, College of Horticulture.
 2. Dr K. Kumaran, Assistant Professor (Botany),
College of Horticulture, Vellanikkara.
 3. Dr R. Vikraman Nair, Associate Professor (Agronomy),
College of Horticulture.
 4. Vimalakumari, Assistant Professor (Nutrition),
College of Horticulture, Vellanikkara.
8. a) Objectives:
 1. To develop methods suitable for small scale extraction of cocoa butter and cocoa powder from cocoa beans.
 2. To study the manufacturing aspects of cocoa powder.
 3. To develop alternate uses for cocoa and cocoa powder.
 4. Studies on the utilisation of bye-products.

b) Practical utility:

Even though the basic principles involved in the processing of cocoa have been explained, the details of the methods still remain trade secret of companies. With the massive planting programme being undertaken in our State, understanding of the technology and evolving methods suitable to our conditions (particularly small scale processes) assume great importance.
9. Review of literature:

The basic principles involved in processing of cocoa has been outlined by Wood (1975). The details of the processing still remain as trade secret. No work has been reported from anywhere.

10. Technical programme:

Cocoa beans will be cleaned, roasted and after kibbling

Contd.....2/-

and winnowing the shells will be separated, and nibs extracted. The nib will be ground to obtain the mass or liquor, which on processing will give the cocoa powder and cocoa butter.

Manufacturing of chocolate and other cocoa products will also be attempted.

Attempts will be made to utilise powdered cocoa beans in combination with milk powder for making beverages.

- 11. Date of start : 1979.
 - 12. Likely date of completion : 1985.
 - 13. Facilities required : Facilities of the KADP will be utilised.
 - 14. Financing organisation : KADP - research and training.
 - 15. Approximate cost
 - a. Staff :
 - b. Equipment : Rs. 75,000.00 (For raoster, hydraulic press, winnowing machine, grinder)
 - c. Contingencies : Rs. 5,000.00
- Total

 Rs. 80,000.00
 =====

Sd/-
SIGNATURE OF THE PRINCIPAL INVESTIGATOR.

FRC IX - Approved.