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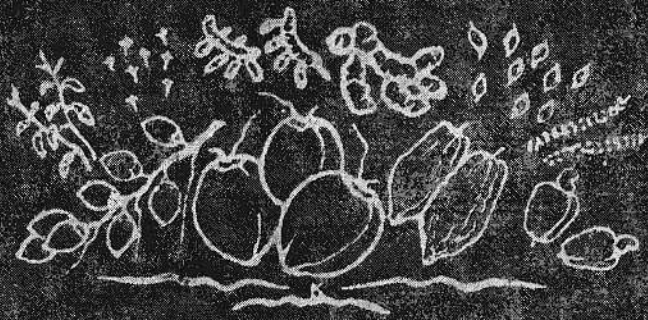
AICRPS - ANNUL REPORT- 1971-1977

1971

ANNUAL REPORT

1971



ICAR

Central Plantation Crops Research Institute

KASARAGOD

1972

I. DIRECTOR'S INTRODUCTION

HISTORICAL

The Institute continued to make its impact by pursuing research activities and disseminating the research findings to various agencies connected with plantation crops. The Institute was established in the year 1970 by the amalgamation of the Central Coconut Research Station, Kasaragod (established in 1916), the Central Coconut Research Station, Kayangulam (established in 1947). the Central Arecanut Research Station, Vittal (established in 1957) and the Regional Arecanut Research Stations at Palode, Peechi, Hirehalli, Mohitnagar and Kahikuchi to tackle the problems of coconut, arecanut, cashewnut, cacao, pepper, cardamom, ginger, turmeric and other spices

Located on the Bombay-Cape Comorin West Coast Road, the headquarters of the Institute is in Kudlu Village, Kasaragod taluk, Cannanore district, Kerala State, 43 km south of Mangalore, and 5 km north of Kasaragod Railway Station. It lies on northern latitude of 12.3° and the eastern longitude of 75°. The maximum altitude is 10.7m above mean sea level. The farm of the Institute is 74.36 ha in extent and the soil type varies from littorals and to laterite, with pH ranging from 5.0—6.5.

The Regional Station, Kayangulam is in Kayangulam village of Karthikappally taluk in Alleppey district, Kerala State, and is situated on the eastern side of the National High way, 43 km south of Alleppey town and 5 km south of Kayangulam Railway Station. It lies on the northern latitude of 9.8° and eastern longitude of 76 31°.Altitude is 3.05m above mean sea level. The farm, which has an area of 27 28 ha has the soil varying from sandy to loamy sand, with a pH ranging from 5.0—6.0

The Regional Station, Vittal is situated in Vittal Village, Buntwal taluk, South Kanara district, Mysore State. It is 45 km south-east of Mangalore Railway Station on the Mangalore-Vittal-Puttur highway. It lies on the northern latitude of 12.25° and the eastern longitude of 75 42°. It is about 200m above mean sea level The rivulet Vokkethur is the main source of irrigation to the farm which has an area of 57.67 ha The soil is typically lateritic and is admixed with sand, alluvial deposits and gravel. It is acidic and has a pH of about 5.25

The Sub-Station at Kahikuchi established in the year 1958, is under the charge of an Assistant Agronomist. It is located near the Gauhati Air-Port in Assam State and is 22 km away from Gauhati Railway Station. It is 48m above mean sea level and the latitude and longitude are 20.18° north and 91.78° east respectively. The total area of the Station is 12.14 ha and the soil is new alluvium with a lower lateritic strata. The pH varies from 4.4 - 4.8. Research at this Station is carried out in the disciplines of Agronomy and Pathology relating to arecanut.

The Sub-Station at Mohitnagar, established in the year 1958 and under the charge of an Assistant Agronomist, carries out research in the disciplines of Agronomy and Pathology. It is located in Mohitnagar of Jalpaiguri district, West Bengal at a distance of 9.6 km north-west of Jalpaiguri Railway Station on the Jalpaiguri-Siliguri road. The area of the Station is 10.12 ha and the soil is alluvium with a pH ranging from 4.5-6.0. It lies on the north latitude of 26.52° and east longitude of 88.72°.

The Sub-Station at Hirehalli, established in the year 1958 also under the charge of an Assistant Agronomist, carries out research in the disciplines of Agronomy and Pathology related to coconut and arecanut. It is located near Hirehalli Railway Station on the Bangalore-Poona National Highway and 58 km away from Bangalore. It lies on 13.08° north latitude and 77.12° east longitude. It is 854 m above mean sea level. The Station has an area of 16.24 ha and the soil is clay to clay loam with a pH of about 6.2.

The Sub-Station at Peechi in Trichur district of Kerala State, established in the year 1958, under the charge of a Junior Agronomist conducts research in the disciplines of Agronomy and Pathology and tackles the agronomic and plant protection problems of arecanut and cacao. It is 19.3 km east of Trichur Railway Station, located at 10.50° north latitude and 76.17° east longitude. The altitude of the Station varies from 49—55 m above mean sea level. The total area of the Station is 14.16 ha and the upper layer of the soil is alluvial with good admixture of sand and silt and lower layers lateritic. The pH of the soil varies from 5.6—6.8.

The Sub-Station at Palode, established in the year 1959, offers facilities for conducting research in Pathology, Botany and Agronomy of plantation crops. It is under the charge of a Junior Pathologist and is located at Palode village in Nedumangad taluk of Trivandrum district of Kerala State, 36 km away from Trivandrum city, on Trivandrum-Shenkotta road. It lies at 8.07° north latitude and 77.03° east longitude. The altitude ranges from 210-240m above mean sea level. The total area of the Station is 11.77 ha and the soil is mainly lateritic with pH ranging from 4.2—5.0.

The Sub-Station at Andamans which started functioning in November, 1971, is situated within 20 km of Port Blair. The Station deals with coconut and arecanut and has Genetics, Agronomy and Pathology sections. The soils of the area are generally coastal alluvium with coral deposit.

Preliminaries connected with the establishment of the Sub Station at Laccadives were commenced.

OBJECTIVES

The main functions of the Central Plantation Crops Research Institute are (1) conducting research in the different disciplines related to plantation crops, (2) guiding research work carried out at the different Regional and Sub Stations in the country, (3) co-ordinating work done on plantation crops by the Institutes, Universities and State Departments of Agriculture,(4) servicing the All India Co-ordinated Project on Coconut and Arecanut and Project on Cashew and Spices and (5) serving as a centre of information on all matters relating to these crops.

ORGANISATIONAL STRUCTURE AND CHANGES

The research work of the Institute is carried out at its headquarters at Kasaragod, Kerala, 2 Regional Stations and 6 Sub Stations in the disciplines of Agronomy, Genetics, Soil Chemistry, Physiology, Biochemistry, Pathology, Entomology and Extension. There is a section on Statistics at the headquarters and the 2 Regional Stations. The problems of each crop are identified disciplinewise and formulated into projects which are allotted to different scientists. The extension wing is responsible for disseminating research findings to scientific personnel, different extension agencies and farmers. The administration of various units is carried out with the help of separate administration sections headed by Administrative and Accounts Officers. Each of the Regional Station is under the charge of a Joint Director. The Sub Stations are under the charge of either a Junior Agronomist or Junior Pathologist or Assistant Agronomist. The Director is the Head of the Institute and the overall controlling authority.

The headquarters of the Institute has a library with 2000 books and subscribing to 142 Indian and foreign journals. The Regional Station at Vittal has a library consisting of 1100 books and subscribing to 140 journals; there are also 85 photostats and 120 microfilms. In the library of the Regional Station, Kayangulam, there are 1101 books and 100 periodicals.

HONOURS, AWARDS etc.

Under the Merit Promotion and Advance Increments Scheme instituted by the Indian Council of Agricultural Research for the benefit of

various scientific workers employed at the Research Institutes of the Council, awards for the years 1966-68 were announced during 1971.

Shri. K. V. Ahamed Bavappa, working then as the Arecanut Specialist at Vittal was awarded a Merit Promotion in the scale of pay of Rs. 1100-1400 with effect from 1st January, 1969 for his work on arecanut breeding. Under the same award, Shri K. Satyabalan, Botanist of the then Central Coconut Research Station, Kasaragod was awarded two advance increments in the scale of pay of Rs. 350-900 from 1st January, 1969.

SALIENT FEATURES OF WORK DONE

In view of the success obtained with Tall x Dwarf, Dwarf x Tall and Tall x Gangabondam hybrids in respect of early flowering, better yield and disease tolerance, comprehensive programme of testing hybrids involving materials from a large germplasm bank was initiated. Screening of large number of cultivars and mutants for high yield potentials coupled with disease tolerance is in progress. Studies to break the prebearing age barrier and investigations on the genetics and floral biology of the crop to base further breeding on sound basis were commenced. Fertilizer experiment on young palms of the high yielding varieties and hybrids showed that such palms are capable of giving response to higher fertilizer applications. Studies on the rooting pattern of coconuts in sandy loam soil showed that nearly 74 % of the main roots do not extend beyond 2 m laterally. Research projects on raising mixed crops like pepper, cacao, cinnamon and pineapple and mixed farming in coconut plantations are in progress. The pathological, physiological and soil aspects of etiology of root (wilt) disease of coconut and yellow leaf disease of arecanut are being investigated. Electronmicroscopy and chemotherapy with base analogues are being used as aids in diagnosis of the pathogenic agents. The photoperiodic experiment conducted on the West Coast Tall variety of coconut with reference to induction of early flowering habit has yielded encouraging results. Investigation on the physiological basis for variation in yield have been undertaken so as to utilise such information in the breeding programmes Use of radio tracer technique for investigating the physiological derangements caused by the root (wilt) disease of coconut palm is under way. A preliminary survey to study the resistance of different coconut varieties and hybrids revealed that Dwarf x Tall and Tall x Dwarf hybrids are tolerant to the root (wilt) disease.

Integration of insecticidal, biological and cultural means is effected in controlling important pests of coconut and arecanut. Work on male sterile technique was commenced to control red palm weevil of coconut. Employment of exotic nematode parasite *Neoaplectana carpocapsa* and

Rhabdionvirus oryctes are done to check the rhinoceros beetle. VTL–3 has been found to be yielding 71% more than the local in the first batch of the exotic collection of arecanut and the same is under release for larger cultivation.

DISTINGUISHED VISITORS

A large number of scientists from various scientific organisations, officials of various departments, students from different Universities, Parliamentarians and farmers from various parts of the country and abroad visited the Institute during the period under report. The important visitors to the headquarters at Kasaragod include Shri C. Achutha Menon, Hon'ble Chief Minister of Kerala, Shri Vakkom Purushothaman, Hon'ble Minister for Agriculture, Kerala, M/s Ramachandran Kadannappally and Hameed Ali Schamnad, both members of Parliament, Shri. B. M. Abdul Rahman, M.L.A. Kasaragod, Shri P. V. Gajapathi Raju, Shri P. K. Thampan, Chairman and Director respectively of Directorate of Coconut Development, Mr. Justice T. S. Krishnamoorthy Iyer, High Court of Kerala, Shri. V. Balagangadharan, District Collector, Cannanore, Shri. Arupkumar Gangolly, Agriculturist and Dairy Farmer, Bangalore, Shri Hari Bhasker and Shri. T. Sivasubramanian, Director and Joint Director of Agriculture respectively of Tamil Nadu, Smt. Devaki Gopidas, Commissioner, Linguistic minorities in India, Shri Balaraman Nair, Secretary, Spices Export Promotion Council, Shri T. T. Poulose, Director, Directorate of Arecanut and Spices Development, Calicut, Dr. K.P V. Menon, retired director, Central Coconut Research Station, Kayangulam, Shri O. V. Ummer Kutty, Joint Director of Agriculture, Calicut, Dr. Shao Yen Tzie and Shri. Aripen Ampong, Department of Agriculture, Malaysia, Dr. J. M. Jiwenga, Director of Cashew Research, Tanzania, Africa, Shri. M. J. Pook, Premier Irrigation Equipment Ltd., Calcutta, Dr. M. Oostenbrink, Senior Advisor, Nematology, F. A. O/ U. N., Dr. M. Puttarudriah, Director of Instruction, University of Agricultural Sciences, Bangalore, Shri. T. B. Dasarathi, State Horticulturist, Hyderabad, Shri. S. D. Kololgi and Dr. R S. Deshpande, Chief Scientific Officers, R. R. S., Mudigere, Dr. M.R.G.K. Nair, Professor of Entomology, Agricultural College, Vellayani, Shri. K A. Muthanna, Cacao Advisor, Cadbury Fry India Ltd., Calicut, Shri. K. V. George, Director, Cardamom Board, Cochin, Dr. K. S Venkitaramani, Director, UPASI, Shri. H. D. Amin, Prof. of Agriculture, and Dr. N.D. Desai, Professor of Botany, College of Agriculture, Junagadh, Shri. C. P Natarajan, CFTRI., Mysore, Dr. V. N. Madhava Rao, Professor of Horticulture, Agricultural College, Coimbatore, Dr. P. S. Rao, Head, Forest Research Laboratory, Bangalore, Dr. P. C. Kesavan, Jawaharlal

Nehru University, New Delhi, Dr G. W Rahalkar, Head, Insect Sterilization and Pest Control Section, BARC, Trombay, Shri. K. R. Venketesan, State Silviculturist, Madras, Sarvashree S Raghavan, A. Krishnaswamy and B Marappa, Conservators of Forests, Guntur, Mangalore and Coorg respectively, Brig. N. N. Rao, Director, N.C.C. Trivandrum, Shri. C. O Obasola, Plant Breeder, NIFOR, Nigeria, and Shri. N. C. Mehta, Director, National Institute of Bank Management, Bombay.

The important visitors of Regional Station, Kayangulam, include among others Dr. R.M. Jackson, University of Surrey, England, Shri. K. K. Mahanti, retired Joint Development Commissioner, Orissa, Bhubaneswar, Dr. W. Klatt, St Antony's College, Oxford and Mr. C. O. Obasola, Nigerian Institute for Oil Palm Research, Nigeria.

The important visitors to Vittal include Dr. D. N. Srivastava, Assistant Director General; Dr. N. G. Dastane, Project Co-ordinator (Crops and Water), Shri R. N. P. Sinha, Internal Financial Advisor, Shri. S. L. Katyal, Assistant Director General (Horticulture) Shri C. Kempanna, Assistant Director General of the Indian Council of Agricultural Research; Dr. J. M. Lewienga, Director, Cashew Research Station, Tanzania, East Africa, Shri. Daljit Singh, Deputy Commissioner (Horticulture), Ministry of Agriculture, Shri K. Fazhululla Khan, Joint Director of Agriculture, Madras; and Mr. C. O. Obasola, Nigerian Institute for Oil Palm Research, Nigeria.

The station at Kahikuchi was visited by Shri. A. K. Sharma, Joint Director of Agriculture (I.P.), Shillong, Assam, and Dr. A. S. Sandhu, Chief Agricultural Officer, State Farms Corporation, New Delhi.

The station at Peechi had important visitors like Dr. T. R. Mehta, Deputy Director General (Crop Science), Indian Council of Agricultural Research; Shri. S. Sankara Pillai, Deputy Chief Agronomist, FACT Alwaye and Shri. P. R. Francis, M. L. A. Kerala.

IMPORTANT EVENTS OF THE YEAR

The first All India Plantation Crops Research Workshop was held at the Central Plantation Crops Research Institute, Kasaragod from 20th to 23rd October, 1971. One hundred and twenty six delegates representing various agricultural universities, state departments of agriculture, forest departments, CSIR, BARC, department of agricultural meteorology and ICAR participated in the Workshop. The first 2 days of the workshop were devoted to coconut and arecanut and the next 2 days for cashew and spices. A high yielding arecanut variety, VTL-3 developed at CPCRI was recommended for release. A special session on

root (wilt) disease of coconut was held on 21st October, 1971. Shri M. C. Nambiar took charge as Project Co-ordinator cum Breeder, in July, 1971, under the All India Co-ordinated Spices and Cashewnut Improvement Project.

The first meeting of the study group on plantation crops organised by the ICAR was held on 24th October, 1971 at Kasaragod. Problems on plantation crops requiring further work were identified at this meeting. The fifth meeting of the Indian Arecanut Development Council, Calicut, was held at the regional station, Vittal, in August 1971.

The study circle organised 7 meetings at the headquarters and 3 meetings at the regional station, Kayangulam during the year under report in which papers intended for publication were presented and discussed by the scientists.

The annual research council meeting was held during the year at the regional station, Kayangulam. The technical programme for the year was drawn up in this meeting.

To increase amenities to the staff members of the different units, building programmes were strengthened and 32 quarters for Kasaragod, 15 quarters for Kayangulam and 35 quarters for Vittal were under construction at a total cost of about Rs. 21 lakhs. The Farmer's Week of the Institute was celebrated at the headquarters on 24th October, 1971 and was inaugurated by Shri. Vakkom Purushothaman, Hon'ble Minister for Agriculture and presided over by Shri. Kadannappally Ramachandran, M. P.

RESEARCH COLLABORATION AT NATIONAL AND INTERNATIONAL LEVEL

Trials for producing haploidy using anther culture have been initiated in collaboration with Nuclear Research Laboratory, IARI, Eight introductions of coconut seednuts were also effected through the Division of Plant Introduction, IARI. Fundamental studies on mutation breeding have been initiated in collaboration with the Jawaharlal Nehru University, New Delhi.

Work on electron microscopy in connection with the studies on root (wilt) disease of coconut and yellow leaf disease of arecanut was in progress in collaboration with IARI, the Advanced Centre for Research in Botany, Madras and Kerala University Laboratory, Trivandrum. The collaborated project on agrostology and mixed farming with the Indo-Swiss Project at Mattupatti and Intensive Cattle Development Project of Kerala was in progress.

At the international level investigations on the budrot of coconut was in progress under PL-480 programme. Collaboration with Commonwealth Institute of Biological Control, Bangalore, was made use for work on biological control of mites. Introduction of cacao seed material was made from Malaysia through M/s. Cadbury Fry Ltd., Bournvilla, London.

FELLOWSHIPS AND STUDENTSHIPS

Shri V. T. Markose, Senior Research Assistant who was undergoing postgraduate degree course in Agronomy and recipient of ICAR fellowship joined duty after successfully completing the course. Shri V. T. Prabhakaran, Statistical Assistant who was undergoing Professional Statistician's Certificate Course and the recipient of ICAR fellowship also joined duty after successful completion of the course. Sarvashri K. B. Abdul Khadar and Vellaichamy, recipients of ICAR fellowship joined for postgraduate studies in Agronomy and Botany respectively. Smt. V. G. Lilly, Senior Research Assistant (Pathology) underwent a month's training course at Sree Venkiteswara University, Tirupathi, Andhra Pradesh on "Technique of isolation, identification and inoculation of lower fungi."

RESEARCH ASSOCIATION

The third research council was held at regional station, Kayangulam in April, 1971, wherein the progress of work under the projects on diseases and pests of coconut and arecanut and mixed farming was reviewed. Joint discussions on the mixed farming projects were held with the Indo-Swiss Project and Intensive Cattle Development Project in June and December.

Seven meetings of the study circle were conducted at the headquarters. Dr. P. C. Kesavan, School of Life Sciences, Jawaharlal Nehru University, New Delhi. Dr. N. G. Dastane, Project Co-ordinator (Crops and water) IARI, Dr. Oostenbrink, Head of the Department of Nematology, Agricultural University, Wageningen, Netherlands, Dr. T. C. N. Singh, Scientist on the governing body of ICAR and Mr. C. O. Obasola, Nigerian Institute for Oil Palm Research, addressed the meetings.

At the regional station, Kayangulam 3 meetings were held and 21 papers intended for publication were presented and discussed. Dr. G. Varghese, University of Malaya, Dr. R. M. Jackson, Department of Biological Sciences, University of Surrey, Mr. C. O. Obasola, Plant Breeder, Nigerian Institute for Oil Palm Research addressed the meetings.

ADVISORY SERVICES RECEIVED AND PROVIDED

The Institute organised 3 training courses for the benefit of extension staff, research workers and cultivators at the headquarters and at the 2 regional stations in which a total number of 44 trainees participated.

Director was member of the Development Councils for coconut, arecanut spices and cashewnut, Cardamom Board, research and development cell of the Coir Board, export promotion councils for cashew and spices the research wing of the Tamil Nadu Khadi and Village Industries Board, cacao and its sub committee AFDC 39:3 of the Indian Standards Institute and committee to consider the proposal for introduction of cess for tea research. He was also a member of study team on National Commission on Agriculture and the leader of the working group on plantation crops. He attended meetings of the above organisation and rendered useful advice.

The Entomologist of the Kayangulam regional station toured the coconut growing tracts in Orissa where termites and red palm weevil were serious problems to coconut cultivation. Necessary advice on control measures of these pests were given to the Development and Extension Officers of the state for tackling the problem.

Advice was also given to the large number of querries that were received at the different units on problems such as cultivation practices, spacing and lay out, fertilizers and manures to be applied, control of pest and disease etc., wherever necessary. Requests for on the spot inspection for selection of site and lay out of gardens and on the spot study of diseases and pests and connected problems were also attended to wherever feasible. The units were also centres of study tour for students of graduate and postgraduate levels of various agricultural universities.

EXTENSION

A very impressive exhibition was arranged by the Institute in connection with the Farmer's Week Celebrations in which several firms and organisations participated. The headquarters and regional stations actively participated in several exhibitions conducted by various agencies including the agricultural exhibition organised at Parliament House Lawns, New Delhi. Coconut seedlings numbering 20,804 of West Coast Tall and 6,230 hybrids and varieties were distributed from Kasaragod.

At the regional station, Kayangulam, 1,94,800 Eulophids, 36,720 Bethylids, 85,330 Braconids and 31,845 Elasmids were bred in the insectary for supply as seed stock to the Zonal Parasite Breeding Stations in Kerala, Mysore, Tamil Nadu and Andhra Pradesh for liberation in the *Nephantis* infested areas along the adjoining coconut tracts.

1972

Annual Report

1972

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CENTRAL PLANTATION CROPS RESEARCH INSTITUTE

KASARAGOD 670 124

1973

SPICES

Germplasm collections of 31 types of ginger (3 exotic and 28 indigenous) and 38 types/selections of turmeric are being maintained. Initial evaluation of these collections is in progress. Manurial *cum* seed rate trial in ginger and control trials against soft-rot and shoot borer incidence in ginger and turmeric using different fungicides and granular insecticides are in progress. Studies on the biology and bionomics of shoot borer *Dichocrocis punctiferalis* and leaf roller *Udaspes folus* and incidence of pests and diseases on different types/selections of ginger and turmeric are being made. Observations on the host range of *U. folus* have revealed that the pest infests *Elettaria cardamomum, Aframomum melegueta,* and *Hedychium* sp. also besides ginger and turmeric.

For germplasm collection and evaluation 16 varieties of pepper have been planted and their growth characters are being studied. Field trials on the control of 'quick wilt' and 'slow wilt' diseases of pepper have been laid out in cultivators' fields and at the Agricultural Research Station, Taliparamba. Biology and bionomics of 'pollu' beetle and top shoot borer, their seasonal abundance and intensity, pest incidence on different varieties of pepper, and chemical control of 'pollu' beetle are being studied.

Field trials on the contorl of "azhukal" disease of cardamom were laid out in cardamom plantations in the High Ranges of Kerala. Studies on seasonal abundance of thrips, *Taeniothrips cardamomi* and incidence of thrips on different varieties/types of cardamom and allied genera have been initiated. Control trials using different insecticides have been laid out at the Cardamom Research Station, Pampadumpara.

GENETICS

Expersment 13. **Germplasm collection and screening of pepper**

Location: CPCRI, Kasaragod and Vittal

Sixteen pepper varieties were assembled during the period. Two hundred seeds of the variety 'Punjaranmunda' were sown in alkathene bags to study their germination. Germination began one month after sowing and continued for about 50 days. But only 15% of the seeds germinated.

Experiment 18. **Germplasm collection and screening of ginger**

Location: CPCRI, Kasaragod

During the current season, 31 types (3 exotic and 28 indigenous) of ginger were maintained adopting a randomised block design with 3 replications. Maximum germination was recorded in the varieties Poona (87 . 8%), Bajpai (88 . 0%), Karkal (88 . 9%), Ernad Chernad (86 . 7%), Nadia (90 . 6%), Mysore (90 . 0%), Uttar Pradesh (86 . 0%), Burdwan (85 . 6%), and Maran (91 . 0%).

Experiment 20. **Germplasm collection and cataloguing of turmeric**

Location: CPCRI, Kasaragod

Thirty eight types (including 18 selections) were raised adopting a randomised block design with 2 replications. Germination percentage and different growth characters like number of tillers, height of the plant, number of leaves, etc. were noted. The 8 varieties, G. L. Puram I, CLL 320 Amalapuram, CLL 325 Duggirala, CLL 321 Ethamukala, CLL 323 Avanigadda, CLL 328 Sugandham, CLL 322 Vontimitta, and No. 24 (local) recorded complete germination.

AGRONOMY

Experiments 16 and 17. **Trials with NPK fertiliser, dead and live standards**

Location: CPCRI, Vittal

The area for this experiment has been cleared and the experiment is being laid out using 3^3 x 2 factorial split design.

Experiment 19. **Manurial cum seed rate trial in ginger**

The objective of the experiment is to find out the optimum levels of N, P, and K and seed rate required for obtaining maximum yield in ginger. The experiment was started in May on a 3^3 x 2 split factorial confounded design with 2 replications. .The bed size was 5 sq. m and each bed had 100 plants. Nitrogen, P, and K were applied at 3 levels and seed rate at 2 levels (Table 35).

TABLE 35 - Application of N,P, and K in kg/ha for manurial *cum* seed rate trial in ginger

N	P_2O_5	K_2O	Seed rate
N_1 — 60	P_1 — 30	K^1 — 150	S_1 — 1200
N_2 — 90	P_2 — 45	K_2 — 225	S_2 — 1900
N_3 —120	P_3 — 60	K_3 — 300	

Full dose of P_2O_5 and half the dose of K_2O were applied at the time of planting, half the dose of N and half the dose of K_2O applied 40 days after planting, and the remaining quantity of N applied 3 months after planting. The variety under trial was Maran. Observations on germination percentage and morphological characters were recorded. The experiment is in progress.

PATHOLOGY

Experiment 32. **Clump rot (Azhukal) disease of cardamom in the High Ranges of Kerala**

Location : CPCRI, Kasaragod and Santhampara

The disease occurs during the South West monsoon period in the High Ranges of Kerala. A *Phytophthora* species has been isolated from affected capsules. A field trial was laid out in 2 private cardamom estates at Santhampara in August with a randomised block design.

The treatments consisted of (1) Bordeaux mixture 1% (2) Aureofungin-sol 50 ppm (3) Dithane Z-780.2% (4) Dithane M-450.2% (5) Ziride 0.2% (6) Thiride 0.2% (7) Captan 0.2% and (8) Control (no fungicide treatment).

One plot had 5 plants and there were 4 replications. Observations were recorded at monthly intervals on total number of pseudostems, number of infected pseudostems, total number of panicles, and number of infected panicles. Data on the percentage of incidence of 'Azhukal' disease are given in Table 36.

TABLE 36 – Effect of different fungicides on the incidence of 'Azhukal'

Sl. No.	Treatment	Percentage of panicle infection (mean)
1.	Bordeaux mixture 1%	1.73
2.	Dithane Z-78 0.2%	8.26
3.	Dithane M-45 0.2%	5.20
4.	Ziride 0.2%	3.17
5.	Thiride 0.2%	6.14
6.	Captan 0.2%	3.97
7.	Aureofungin-sol 50 ppm	2.29
8.	Control	10.99

A. V. table	DF	SS	MSS	F
Block	3	299.44	99.81	24.28**
Treatment	7	199.29	28.47	6.93**
Error	21	86.25	4.11	
Total	31	685.13		

CD = 2.954

$\underline{T_1, T_7, T_4, T_6, T_3, \overline{T_5, T_2, T_8}}$

The data reveal that Bordeaux mixture 1% is efficient in controlling the disease. However fungicides like Aureofungin-sol, Ziride, and Captan are on par with Bordeaux mixture in reducing the disease incidence.

Experiment 35 'Slow' wilt and 'quick' wilt diseases of pepper

Location: CPCRI, Kasaragod, ARS, Taliparamba, Naduvil, Alakode, and Bandadka.

Field trials were laid out in cultivators' fields at Alakode in Taliparamba taluk and Chamakuchi in Kasaragod taluk of Cannanore district for devising suitable control measures for 'quick' wilt. The lay out employed was a randomised block design having 8 treatments and 4 replications, with 10 plants/plot. The treatments were Bordeaux mixture 1%, Ceresan wet 0.1%, Aureofungin-sol 50 ppm, Captan 0.2%, Difolatan 0.1%, Dithane Z-78 0.2%, Thiram 0.2%, and Control (untreated).

Five litres of fungicide suspension/solution were used in spraying the vines and drenching the base soil of each standard.

The trials are in progress.

Similar field trials for the control of 'slow' wilt disease were laid out in cultivators' fields in Naduvil and at the Agricultural Research Station, Taliparamba (both in Kerala state) using the fungicides, Ceresan wet 0.1%, Captan 0.2%, Dithane Z-78 0.2%, Thiram 0.2%, Ziride 0.2%,

Cardamom

Studies on seasonal abundance of cardamom thrips *Taeniothrips cardamomi* Ramak. were begun in June, at the Cardamom Research Station, Pampadumpara, Idikki district, Kerala state. For this, 2 plots are being maintained with 25 clumps per plot and observations were being made at fortnightly intervals on 2 clumps selected at random from each plot.

Data collected include total number of pseudostems, number of pseudostems infested by thrips, population counts of thrips (adults and immature stages) present on 20% pseudostems, and total number of panicles. Sample panicles drawn at the rate of one per clump are examined and population counts of thrips, total number of capsules, number of thrips, and infested capsules are recorded. Meteorological data also are maintained.

Incidence of thrips on different varieties/types of *Elettaria cardamomum* and other allied genera is under study. Population counts of thrips present on cardamom varieties such as Malabar (prostrate panicled), Mysore (erect-panicled), 'Vazhukka (flexuous panicled), 'Kanniclam' and Ceylon and allied genera like *Amomum subulatum, Amomum* spp., and *Aframomum melegueta* are being recorded.

Experiment 39. **Chemical control of pests**

Location: CPCRI, Kasaragod, ARS, Taliparamba, and CRS, Pampadumpara

Ginger and turmeric

A field trial with granular insecticides was laid out for the control of ginger shoot borer *D. punctiferalis* Guen. at Kasaragod, with a randomised block design having 7 treatments.

T_1 — Control

T_2 — Phorate granules 10% @ 4 . 5 g/bed

T_3 — Thiodemeton 5% granules @ 9 g/bed

T_4 — Carbaryl 4% granules @ 15 g/bed

T_5 — Carbaryl + Lindane 4 : 4 granules @ 15 g/bed

T_6 — Carbaryl + Lindane 4 : 4 granules @ 15 g/bed + drenching with 0.2% Thiride 15 *l.*

T_7 — Carbaryl + Lindane 4 : 4 granules @ 15 g/bed + drenching with 0.2% captan.

Soil application of insecticides is done prior to sowing and after germination along with fertilisers.

The variety used is Maran and the trial has 4 replications. The experiment was begun in May. Observations on total number of shoots, infested shoots, and incidence of other pests are recorded at montly intervals.

Another field trial was laid out for the control of shoot borer *D. punctiferalis* and rhizome rot of turmeric using insecticide granules and fungicides. It has been laid out in a randomised block design with 10 treatments and 3 replications. The treatments are :

T_1 — Phorate granules 10% @ 4.8 g + Ceresan wet 37.5 g/bed

T_2 — Phorate granules 10% @ 4.8 g + Ziride 30 g/bed

T_3 — Phorate granules 10% @ 4.8 g + Thiram 30 g/bed

T_4 — Carbaryl granules 4% @ 16 g + Thiram 30 g/bed

T_5 — Carbaryl granules 4% @ 16 g + Dithane Z-78 30 g/bed

T_6 — Carbaryl granules 16 g + Ceresan wet 37.5 g/bed

T_7 — Carbaryl + Lindane 4 : 4 granules 16 g + Ziride 30 g/bed

T_8 — Carbaryl + Lindane 4 : 4 granules 16 g + Thiram 30 g/bed

T_9 — Thiodemeton 5% granules 9.6 g + Thiram 30 g/bed

T_{10} — Control (no treatment)

The bed size is 3.2 m × 1 m

The insecticide granules were applied to the beds along with fertilisers before sowing and drenching with fungicides suspension/solution done prior to mulching with green leaves. Each bed was treated with 15 *l* fungicide.

The experiment was started in May. Observations on germination and incidence of pests and rhizome rot are recorded at monthly intervals.

Pepper

A field experiment for the chemical control of 'pollu' beetle *L. nigripennis* Mots. was laid out at the Agricultural Research Station, Taliparamba in a randomized block design with 13 treatments and of replications having 4 vines per plot. The treatments are :

T_1 — Untreated contral			Treatment of the base soil
T_2 — Phorate 10% granules		@ 5 g/per standard	
T_3 — ,,		@ 7.5 g/per standard	
T_4 — Thiodemeton 5% granules		@ 10 g/standard	
T_5 — ,,		@ 15 g/ ,,	
T_6 — Carbaryl 4% granules		@ 15 g/ ,,	
T_7 — ,,		@ 18.75 g/ ,,	
T_8 — Carbaryl + Lindane 4 : 4 granules		@ 12.5 g/ ,,	
T_9 — ,,		@ 18.5 g/ ,,	
T_{10} — Dimethoate	0.03%		Spraying the vines
T_{11} — ,,	0.05 ,,		
T_{12} — Phosphamidon	0.03 ,,		
T_{13} ,,	0.05 ,,		

Insecticide treatments were done twice in July and October.

Observations on total number of spikes and number of infested spikes present at 3 unit areas each of 50 cm sq. from each of the vines are recorded at monthly intervals.

The experiment is in progress.

Cardamom

A field experiment for the control of cardamom thrips *Taeniothrips cardamomi* Ramak. was laid out at the Cardamom Research Station, Pampadumpara in June in a randomised block design with 20 treatments and 2 replications having 3 clumps per plot. The treatments are :

T_1	— Trichlorphon	0 . 01 %	Spraying toe pseudostems and panicles
T_2	— ,,	0 . 02 ,,	
T_3	— Malathion	0 . 025,,	
T_4	— ,,	0 . 05 ,,	
T_5	— Fenitrothion	0 . 02 ,,	
T_6	— ,,	0 . 03 ,,	
T_7	— Dichlorvos	0 . 02 ,,	
T_8	— ,,	0 . 03 ,,	
T_9	— Phosphamidon	0 . 02 ,,	
T_{10}	— ,,	0 . 03 ,,	
T_{11}	— Dimethoate	0 . 02 ,,	
T_{12}	— ,,	0 . 03 ,,	
T_{13}	—Carbophenothion	0 . 02 ,,	
T_{14}	,,	0 . 03 ,,	
T_{15}	—Phorate 10% granules	2 . 5 g/clump	Soil application
T_{16}	,,	@ 5 g/clump	
T_{17}	Thiodemeton 5% granules	@ 5 g/clump	
T_{18}	— ,,	@ 10 g/clump	
T_{19}	—Untreated control		
T_{20}	— ,,		

Insecticide treatments are done in June, August, October, December, and February.

Data on total number of pseudostems, infested pseudostems, total number of panicles, total number of capsules, and thrips infested capsules are collected at monthly intervals. Incidence of other pests, if any, also is recorded. The experiment is in progress.

In addition to CPCRI, Kasaragod and Regional Station, Vittal, the All India Co-ordinated Spices and Cashewnut Improvement Project is in operation at the following centres.

Indian Institute of Horticultural Research, Hassarghatta
Centre : Gonicoppal

Kerala Agricultural University
Cashew Research Station, Anakkayam
Cardamom Research Station, Pampadumpara
Pepper Research Station, Panniyur

Tamil Nadu Agricultural Department
Cashew Research Station, Vridhachalam

University of Agricultural Sciences, Bangalore
Cardamom Research Station, Mudigere

Andhra Pradesh Agricultural University
Cashew Research Station, Bapatla

Mahatma Phule Krishi Vidyapeeth, Rahuri
Cashew Research Station, Vengurla

Himachal Pradesh Agricultural University
Spices Research Station, Kandaghat

The highlights of work done at these centres are as follows.

Cashew

From the initial evaluation of the 645 indigenous and exotic collections available at Bapatla, Vridhachalam, and Vengurla, 70 types/ collections have been selected as high yielders. These are being studied in detail for yield and associated characters, and 16 of these high yielders are being put under comparative yield trial. Two hybrids evolved at Anakkayam and 3 at Bapatla are very promising and further hybridization work is in progress at the above centres. Diallel crosses have been effected between parents selected for size of the nuts, high shelling and setting percentage, shorter flowering phase, and mean difference between the length of style and stamen. At Vengurla, budding and grafting have been observed

successful and the best season for veneer grafting is July-August and for budding in September-October. Manurial trials reveal that there is very good response for N, P, and K. Preliminary trials conducted at different centres have shown that cashew responds well to fertiliser application. Trials are in progress at Vridhachalam and Vengurla. At Vengurla, the plants just started flowering and it is too early for any valid conclusion. Results of trials at Vridhachalam indicate that the application of N, enhances the yield of cashewnut whereas K is essential for increasing the dry weight per nut. Though P alone is not having any significant influence the effect of K is enhanced by the presence of P. Therefore a balanced NPK fertilisation is essential.

Cardamom

From the initial evaluation of the germplasm, 20 types from Mudigere and 7 from Pampadumpara have been selected based on their yield, size of the capsule, earliness in flowering and resistance/tolerance to pests and diseases. Intergeneric crosses have not been successful so far. Diallel crosses are effected between parents selected for economic characters.

Studies on 'Katte' disease reveal that the spread of the disease within the plantation is internal. Under laboratory conditions 'Katte' could be transmitted by 13 different aphid species. Host range studies of 'Katte' agent revealed that *Amomum cannecarpum, A. involucratum, Alpinia* sp., *Hedychium corononarium, Zea mays, Vigna sinensis,* and *Crotalaria striata* can be infected with 'Katte' agent through viruliferous aphids, *Pentalonia nigronervosa*. None of the available types of *Elettaria cardamomum* screened so far was resistant to 'Katte'. One isolate of 'Katte' was sap transmissible to *Vigna sinensis* cv., Black eye and *Crotalaria striata*.

Pepper

At Panniyur research on different aspects of pepper giving due priority to fertiliser trial and varietal improvement is in progress.

1973

ANNUAL REPORT

1973

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
KASARAGOD 670 124
KERALA STATE. INDIA
1974

GENETICS

SUMMARY

A systematic survey of wild and cultivated pepper has been initiated. So far, 136 collections have been made and this include 38 wild collections. In a comparative yield trial with 31 ginger types, *Wynad Kunnamangalam*, *Poona*, *Wynad Local*, *Turan*, and *China* were high yielding. In a similar trial in turmeric with 38 types, *Ca 69 Dindigam*, *CLL 326 Mundukur*, and *Wynad Local* were the best.

Work in progress

Gen. I (813) and Experiment 13. **Collection, maintenance, and evaluation of pepper germplasm**

(P.K. Thankamma Pillai, N.M. Nayar, K.N. Murthy, and P. M. Kumaran)

A systematic survey of Western Ghats was taken up for collection of wild pepper. To begin with, collections were made from parts of Idikki (Devikulam and Peermedu), Kottayam (Periar, Konni, and Ranni), and Palghat (Silent Valley) districts of Kerala. So far, 136 indigenous and exotic accessions of pepper have been assembled.

Rooted pepper cuttings of seven cultivated varieties, *Uthirankotta*, *Kalluvally*, *Arikotanadan*, *Nilgiri*, *Panniyur-I*, *Sullia*, and *Narayakodi* were sent to the Nematologist, Kayangulam, to study their reaction to the root-knot nematode.

Seedlings of *Poonjaranmunda* raised during the last season are being planted in the main field for studying their performance.

Gen. I (813) and Experiment 14. **Intervarietal hybridisation in pepper**

(M. C. Nambiar)

Crosses were made among eight varieties possessing economically desirable characters. Seedlings raised from open pollinated seeds of several varieties had been planted at Panniyur in 1972. Three seedlings of *Kottanadan* and *Sullia* flowered during the year *i. e.*, in the first year of their orchard life itself. One of the progenies of *Kottanadan* was vigorous in growth and produced 36 spikes. The spikes are long with closely set berries. Further evaluation is in progress.

Gen. II (813) and Experiment 18. **Germplasm collection and screening in ginger**

(P. K. Thankamma Pillai and Sr. Res. Asst., (Agronomy, Kasaragod)

Analysis of data on number of tillers, height of plants, and number of leaves collected from 31 types (three exotic and 28 indigenous) showed that they differed significantly for these characters. The types *Wynad Kunnamangalam*, *Poona*, *Wynad Local*, *Turan*, and *China* were high yielding, and *Peechi* and *Uttar Pradesh* were low yielding. Plant height and leaf number were found to be associated with rhizome yield.

Thirty five types including six exotic types were assembled during the year.

Gen. III (813) and Experiment 20.

Germplasm collection and catalogueing in turmeric

(P. K. Thankamma Pillai, Sr. Res. Asst., (Agronomy Kasaragod), and M. C. Nambiar)

Data collected from 38 types (including 18 clonal selections) showed that they differed significantly for all the characters studied except for tiller number. The type *Ca 69 Dindigam* gave the highest yield followed by *CLL 326 Mundukur* and *Wynad Local*. It was lowest in *Armoor, Kodur types*, and *T. Sunder*. The characters, height of shoots and size of leaves, were associated with yield. Based on the morphological characters of rhizomes and yield, further clonal selections have been made from the 37 types and their field performance will be studied in progeny row trials. Quality characters of the selections are also being determined.

AGRONOMY

SUMMARY

In a manurial *cum* seed rate trial in ginger a seed rate of 1800 kg/ha was found to be the best. A field experiment has been laid out in pepper to determine its agronomic requirements.

Work in progress

Agr. I (813) and Experiment 19. **Manurial *cum* seed rate trial in ginger** (Sr. Res. Asst., (Kasaragod) and P. K. Thankamma Pillai)

To study this, an experiment was laid out in a $3^2 \times 2$ split plot factorial design with two replications. Higher levels of N produced significant effect on the number of tillers, number of leaves, length of leaves, and breadth of leaves. A seed rate at 1800 kg/ha produced significantly superior effect on number of tillers, height of plants, length and breadth of leaves, and yield of rhizomes.

Agr. IV (813). **Determining agronomic requirements of pepper**

(1) Experiment 17. NPK requirements

(P. M. Kumaran and Sr. Res. Asst., (Vittal)

The field experiment has been laid out in a 3^3 factorial split plot design with 16 standards (eight dead and eight live) per plot and two replications. The variety used is Panniyur-1.

Fertilizers were applied at the recommended dose. The growth of the variety was uneven.

(2) Experiment 16. Efficacy of live and dead standards

(Sr. Res. Asst., (Vittal) and K. N. Murthy)

Both the live *(Erythrina indica)* and dead (teak wood) standards were planted in the field.

(3) Effect of shade on growth and yield

It is proposed to lay out an experiment to determine the shade tolerance of selected varieties of pepper by planting them in the open and in an arecanut garden containing variable numbers of trees per unit area.

BIOCHEMISTRY

SCh. II (176 and 813). **Quality studies on spices**

(C. K. Mathai and Biochemist (Vittal)

1. Determination of chemical constituents of ginger, pepper, and turmeric germplasm

Twenty ginger varieties were analysed for their dry matter and oleoresin contents. Dry matter varied from 11·1% in *Rio de Janeiro* to 28.4% in *Ernad Chernad*. Acetone-extracted oleoresin was the highest in *Jorhat* (10.1%). The full data are given in Table 60.

Table 60. Dry matter and oleoresin contents of ginger varieties

Sl. No.	Name of variety	Oleoresin (%)		Dry matter (%)
		Acetone extracted	Alcohol extracted	
1	Maran	5.0	10.7	16.1
2	Rio de Janeiro	6.6	8.1	11.1
3	Thingpuri	4.8	5.4	21.3
4	Nadia	5.6	7.4	17.0
5	Himachal Pradesh	5.2	6.5	22.0
6	Sierra Leone	6.8	8.7	21.4
7	Narasapattom	9.0	10.3	17.4
8	Burdwan	5.7	7.9	12.7
9	Poona	8.6	7.2	27.5
10	Karakkal	7.6	11.6	20.4
11	Vengara	6.8	7.5	13.5
12	Ernad Manjeri	5.6	7.4	25.5
13	Jorhat	10.1	10.2	20.0
14	Turan	6.4	8.8	16.3
15	Thodupuzha	6.7	6.9	19.3
16	Bajpai	8.8	9.2	17.9
17	Ernad Chernad	7.3	9.1	28.4
18	Tinladium	8.6	9.0	24.1
19	Valluvanad	6.6	10.8	19.7
20	Mananthody	9.3	13.0	12.4

2. Seasonal variation in chemical constituents of spices

The rate of accumulation of oleoresin, crude fibre, and dry matter was studied in seven ginger varieties at monthly intervals beginning from third month onwards (Tables 61 and 62). Yield of oleoresin was higher when alcohol was used as the solvent. Dry matter increased with maturity and crude fibre content decreased with age.

Table 61. EFFECT OF TIME OF HARVESTING (MATURITY) ON OLEORESIN CONTENT IN GINGER

Varieties	Acetone-extracted (%)					Alcohol-extracted (%)				
	3rd month	4th month	5th month	6th month	7th month	3rd month	4th month	5th month	6th month	7th month
Maran	12.5	11.5	9.0	5.3	5.0	22.6	18.2	12.5	13 2	10.7
Rio de Janeiro	11.2	13.6	11.9	11.0	6.6	22.3	19.4	16.7	14.7	8.1
Thingpuri	11.9	10.0	7.2	6.5	4.8	21.6	17.6	10.6	9.3	5.4
Nadia	11.4	6.6	5.6	4.2	5.6	23.2	10.1	8.3	6.4	7.4
Himachal Pradesh	16.1	13.1	5.7	5.4	5.2	26.5	19.7	10.8	7.6	6.5
Sierra Leone	13.5	14.2	7.9	5.6	6.8	22.1	23.7	15.5	11.3	8.7
Narasapattom	11.9	9.7	5.5	5.6	9.0	19.7	16.0	9.7	7.4	10.3
Burdwan	10.1	11.8	7.5	4.4	5.7	18.6	17.8	12.9	6.9	7.9

Table 62. EFFECT OF TIME OF HARVESTING (MATURITY) ON CRUDE FIBRE AND DRY MATTER CONTENT IN GINGER

Varieties	Dry matter					Crude fibre				
	Period of harvest					Period of harvest				
	3rd month	4th month	5th month	6th month	7th month	3rd month	4th month	5th month	6th month	7th month
Maran	5.5	7.8	5.9	7.1	16.1	15.6	14.2	10.3	12.7	9.0
Rio de Janeiro	5.6	6.4	5.4	11.6	11 1	15.4	14.4	13.2	11.5	12.5
Thingpuri	5.5	9.8	6.5	18 7	21.3	17.0	9.4	6.7	6.8	7.8
Nadia	6.4	8.5	16.4	17.5	17.0	16.0	6.6	4.1	4.5	6.0
Himachal Pradesh	6.4	7.1	16.9	11 5	22.0	. .	15.0	6.5	7.2	1 6
Sierra Leone	7.7	6.9	12.7	11.1	21.4	. .	16.5	7.9	6.1	4.8
Narasapattom	5.5	7.0	9.0	9.2	17.4	. .	11.0	6.3	6.0	3.7
Burdwan	5.8	5.6	7.5	11.8	12.7	. .	13.4	7.3	5.0	1.8

PLANT PATHOLOGY

SUMMARY

In the field trial laid out at Santhampara (High Ranges, Kerala) using ten fungicides for the control of 'azhukal' disease of cardamom, Bordeaux mixture 1% was the most effective. *Phytophthora* sp. was isolated from quick wilt affected pepper vines, and *Fusarium* sp., and frequently, *Diplodia* sp. and *Rhizoctonia* sp., were isolated from slow wilt infected pepper vines. For rhizome rot of ginger and turmeric, treatment with Ceresan wet 0.1%, reduced the rot by nearly 50% and almost doubled the yield over the control.

Work in progress

Path. IV (813) and Experiment 32. **'Azhukal' disease of cardamom** (K. K. N. Nambiar and Y. R. Sarma)

Based on last year's data obtained from field trials and laboratory screening of different fungicides against the pathogen, a fresh field trial was laid out at Santhampara (High Ranges, Kerala) using ten different fungicides comprising Bordeaux mixture, copper oxychlorides, dithiocarbamates, and systemic fungicides. A wetting agent was used along with the fungicides except Bordeaux mixture. The trial was laid out in a randomised block design with 11 treatments, three replications, and ten plants per treatment. Two sprayings were given in June and August. The data on incidence of disease confirmed last year's results that Bordeaux mixture 1% was most effective in reducing the disease incidence (2.0%) against 28.2% in the untreated control. Copper oxychlorides were on par with Bordeaux mixture in reducing the disease incidence.

Five large scale demonstration *cum* trial plots have been maintained in Santhampara and Udumbanchola (Kerala) using Bordeaux mixture 1% @ 1 and 2 *l* / clump. The results showed that Bordeaux mixture at 1 *l* / clump was as equally effective as 2 *l* dosage in reducing the incidence.

Path. II (813) and Experiment 35. **Slow wilt and quick wilt diseases of pepper** (K. K. N. Nambiar and Y. R. Sarma)

Phytophthora sp. isolated from quick wilt-affected vines was found to be pathogenic to betel vine *(Piper betel L.)* and a wild species of *Piper*.

In the case of slow wilt disease, extensive necrosis was noticed in the functional lateral roots. *Fusarium* sp. was constantly isolated from roots of affected vines. In addition, *Diplodia* sp. and *Rhizoctonia* sp. were also isolated frequently.

Since the nematode *Radopholus similis* also has been observed to be associated with the slow wilt disease, observational trials using nematicides have also been laid out.

Based on the *in vitro* screening of fungicides against the fungi isolated from quick and slow wilt affected pepper vines, separate field control trials have been laid out using Bordeaux mixture, and copper oxychlorides. They have nine treatments, and three replications with ten vines per treatment.

Path. III (813) and Experiment 36. **Rhizome rot of ginger and turmeric** (Y. R. Sarma and K. K. N. Nambiar)

In addition to *Pythium* sp., a bacterium has also been isolated from soft rot affected ginger rhizomes. The actual role played by this bacterium in the incidence of disease is yet to be determined.

In vitro screening of fungicides showed that Ceresan wet 0.1%, Thiride, and Ziride (both at 0.3%) were fungicidal. The field control trials conducted during the previous season showed that the incidence of soft rot was reduced to 45.8% in Ceresan wet-treated plots as against 71.4% in control. The fungicide treatment produced a mean yield of 4.0 kg rhizomes/bed (3 m^2) as against 2.2 kg / bed in the untreated control. A fresh field trial using 14 fungicides has since been laid out.

Field inoculation tests conducted on 29 types of ginger showed that none of them was resistant to the disease.

Path. V (813) and Experiment 40. **Leaf spot disease of ginger** (Y. R. Sarma and K. K. N. Nambiar)

Based on the *in vitro* screening of fungicides against the causal organism *Phyllosticta zingiberi*, a field trial for the control of the disease was laid out using 16 fungicides. The incidence of disease was less in the field during the period under report as compared to the previous year, and hence no conclusions could be drawn.

ENTOMOLOGY

SUMMARY

Biology of the ginger and turmeric leaf roller *Udaspes folus*, seasonal abundance of the pepper 'pollu' beetle *Longitarsus nigripennis* and the cardamom thrips *Taeniothrips cardamomi* were studied. The caterpillars of *U. folus* was found to be infected by two entomogenous bacteria and two hymenopterous parasites. In a field trial against the turmeric shoot borer, mephospholan 5% granules @ 1.5 kg active ingredient per ha was the most effective.

Work in progress

Ent. II (813) and Experiment 38. **Biology and bionomics of insect pests** (V. A. Abraham and G. B. Pillai)

1. Ginger and Turmeric

Biology of the leaf roller *Udaspes folus* C. was studied. Under a temperature range of 27–33°C and 71–100% relative humidity, the incubation period lasted for four days, the caterpillar phase comprising five instars, 15.3 days in turmeric and 18.2 days in ginger, the prepupal period one day, and the pupal period 6.2 days. The average duration from egg to adult worked out to 26.5 days in turmeric and 29.4 days in ginger. The longevity and fecundity of adults are being studied.

Diseased caterpillars of *U. folus* collected from the field yielded two bacterial isolates. These have been identified as *Enterobactor cloacae* and *Pseudomonas* sp. In further tests, the former has proved to be a potential pathogen. The actual role played by the bacterium in producing septicaemia in caterpillars is under study. Two species of parasites were also obtained from *U. folus*. They are *Apanteles* sp. from prepupal caterpillar and a chalcid from pupae.

Observations on incidence of shoot borer, *Dichocrocis punctiferalis* Guen. on different varieties/types of turmeric showed that all the varieties were equally susceptible to the pest.

2. Pepper

Studies on the seasonal abundance of 'pollu' beetle *Longitarsus nigripennis* Mots. showed that the pest was present in the field during August–January with a peak in October–November. The intensity of incidence of the top shoot borer *Laspeyresia hemidoxa* Meyr. on three age groups of Panniyur–1 showed 6.4–26.1% shoot attack in 1972 and 1.7–5.4% in 1973.

3. Cardamom

The cardamom thrips *Taeniothrips cardamomi* was observed to be present almost throughout the year with a peak in February and a very low population during the SW monsoon period. The reaction of different varieties of cardamom and allied genera to this thrips is being studied.

Ent. III (813) and Experiment 39. **Chemical control of pests** (G. B. Pillai and V. A. Abraham)

1. Ginger and Turmeric

A field trial on the control of ginger and turmeric shoot borer using nine granular insecticides, lindane, carbaryl, carbaryl + lindane, carbofuran,

trichlorphon, mephospholan, phorate, thiodemeton, and disulfoton has been laid out during the current season. The incidence of shoot borer in ginger was negligible, and as such, it was not included for analysis. In the case of turmeric the data showed that mephospholan 5% granules @ 9 g/3 m² (1.5 kg active ingredient/ha) reduced shoot borer incidence significantly. The mean percentage incidence in mephospholan-treated beds was 8.4 as against 15.3 in control.

2. Pepper

Based on the indications obtained from the previous year's trials, two series of trials using quinalphos, malathion + fenitrothion, dimethoate, phosphamidon, and endosulfan (all 0.1%), and DDT 0.2% as foliar spray, and granular insecticides like phorate 10 g, thiodemeton 20 g, carbaryl 15 g, carbaryl + lindane 15 g, carbofuran 15 g, mephospholan 10 g, and trichlorphon 10 g applied to the basal soil of vines twice in August and October, have been in progress during the current season The data on incidence of 'pollu' beetle on spikes and berries are given in Table 63. The study is in progress.

Table 63. Effect of insecticides on the incidence of 'pollu' beetle

	Treatment	% attacked spikes (Mean value)*	% attacked berries (Mean value)*
1	Quinalphos 0.1%	18.9 (24.7)*	2.0 (7.2)*
2	Malathion + fenitrothion 0.1%	24.5 (28.8)	2.4 (8.1)
3	Dimethoate 0.1%	12.6 (19.2)	0.9 (4.5)
4	Phosphamidon 0.1%	29.5 (31.7)	3.4 (19.1)
5	Endosulfan 0.1%	16.8 (22.9)	2.3 (8.0)
6	DDT 0.2%	35.8 (36.1)	5.6 (13.6)
7	Control	68.5 (57.2)	17.6 (24.0)

* Transformed values in parenthesis

S.E/plot	6.8*	3.3
C.D	12.0	5.8

Table 64. PROGRAMME OF WORK (ALL INDIA CO-ORDINATED SPICES AND CASHEWNUT IMPROVEMENT PROJECT) FOR 1974

Project No.	Name of the Project	Venue
(a) CASHEW		
Gen. I (176) and Experiments 1 & 3	Collection, maintenance, and evaluation of germplasm	Vittal, Anakkayam, Bapatla, Vridhachalam, Coimbatore, Timkur, and Mohitnagar
Gen. II (176)	Varietal improvement of cashew	Vittal, Vridhachalam, Bapatla, and Vengurla
Experiment 22	Floral biology	
Experiment 2	Standardisation of seedlings selection methods	
Experiment 4	Hybridisation and selection	
Gen. III (176) and Experiment 5	Propagation studies	Vittal, Bapatla, Vridhachalam, Vengurla, and Vatapalam
Agr. I (176) and Experiments 6 & 7	Nutritional requirements	Kasaragod and Vridhachalam
Agr. VI (176) and Experiment 8	Pruning trials	Vittal and Vridhachalam
Path. I (176) and Experiment 34	Inflorescence blight	Vittal and Kasaragod
Ent. I (176) and Experiment 37	Studies on the biology and bionomics of insect pests	Kasaragod
Ent. III (176) and Experiment 39	Chemical control of pests	Kasaragod
(b) SPICES		
Gen. I (813) and Experiment 13	Collection, maintenance, and evaluation of pepper germplasm	Kasaragod, Vittal, and Panniyur

1974

ANNUAL REPORT

1974

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
KASARAGOD 670 124
KERALA STATE, INDIA
1975

GENETICS

SUMMARY

A total of 781 accessions of pepper including wild types was assembled at Vittal. Thirtyfive collections of ginger and 41 collections of turmeric were under preliminary yield trials. Among these, Nadia, Poona, Tinladium, Burdwan, Jugijan, and Taiwan recorded higher yield than rest. Out of 41 types of turmeric under evaluation, CLL 326 Mydukur, CLL 324 Armoor, CLL 328 Sugandham, CLL 323 Avanigadda, Kasturi, Chayapasupu, CLI 320 Amalapuram, Armoor, and Sugandham were the best yielders.

Gen. I (813) and Experiment 13 **Collection, maintenance, and evaluation of pepper germplasm**

(NM Nayar, KN Murthy, PM Kumaran, and MC Nambiar)

The survey of wild pepper in the Western Ghats of Karnataka State was continued. A total of 508 collections was made from Mangalore, Chickmagalur, Bhadravathi, Shimoga, Sagar, Koppa, Coondapur, Karwar, Haliyal, Yellapur, Sirsi, and Honavar forest divisions. The total number of collections including cultivated forms is 781.

All the cultivated types available in the Pepper Research Stations at Sirsi (Karnataka) and Panniyur (Kerala) were collected.

Gen. II (813) and Experiment 18 **Germplasm collection and screening of ginger**

(PK Thankamma Pillai, and Senior Research Assistant (Agronomy), Kasaragod)

Analysis of yield data from 35 types (six exotic and 29 indigenous) showed maximum yield in types Nadia, Poona, Tinladium, Burdwan, Jugijan, and Taiwan.

Thirtytwo types were planted and observations recorded on percentage of germination and morphological characters, *viz.*, number of tillers, height of the plant and number of leaves.

Gen. III (813) and Experiment 20 **Germplasm collection and cataloguing of turmeric**

(PK Thankamma Pillai, Senior Research Assistant (Agronomy), Kasaragod, and MC Nambiar)

Yield data collected from 41 types (including 18 clonal selections) showed that yield was maximum in type CLL 326 Mydukur, followed by CLL 324 Armoor, CLL 328 Sugandham, CLL 323 Avanigadda, Kasturi, Chayapasupu, CLI 320 Amalapuram, Armoor, and Sugandham.

Thirtyseven clonal selections made on the basis of rhizome characters were under progeny row trial. Maximum yield was recorded in Tekkurpetta followed by CLL 328 Sugandham, Rajpuri Local, Armoor, Nandyal type, and Kasturi Tanuka. No significant variation was noticed in rhizome characters within lines. The yield of plants from mother rhizomes was more than that from plants from fingers.

During this season a germplasm collection of 42 types has been planted adopting a randomised block design with two replications. One hundred and one lines selected during the previous seasons were under multiplication.

PROGRAMME OF WORK (GENETICS), 1975

Project No.	Name of the Project	Venue
Gen. I (813)	Germplasm collection and screening of pepper	Vittal and Kasaragod
Gen. II (813)	Germplasm collection and evaluation of ginger	Kasaragod
Gen. III (813)	Germplasm collection and evaluation of turmeric	Kasaragod and Vittal
Gen. IV (813)	Cytological studies in ginger with special reference to sterility and induced polyploidy	Vittal and Kasaragod
Gen. V (813)	Breeding cardamom for resistance to 'Katte' disease	Vittal, Appangala, and Trivandrum

AGRONOMY

Agr. IV (813) and Experiment 17 — **Determining the agronomic requirements** (Horticulturist, KN Murthy, and PM Kumaran)

1. NPK requirements

The field experiment was laid out in a 3^3 factorial split plot design with 16 standards [eight dead (teak wood) and eight live (*Erythrina*)] per plot and two replications in 1972. The variety used is Panniyur–1. The growth of the vines was very uneven.

Analysis of soil samples collected from the plot before planting the experiment is given in Table 37. The data show that the soil is very poor in its general fertility, particularly for P and K nutrients.

Table 37. Fertility status of the pepper experimental plot

Pit No.	Depth	pH	Organic carbon (%)	Total N (%)	Available P_2O_5 (ppm)	Available K_2O (ppm)
1. i)	0–25cm	5.0	1.17	0.098	Trace	Trace
ii)	25–50cm	5.2	0.54	0.060	,,	,,
2. i)	0–25cm	5.3	1.17	0.112	,,	,,
ii)	25–50cm	5.0	0.60	0.084	,,	,,
3. i)	0–25cm	5.2	0.75	0.100	,,	,,
ii)	25–50cm	5.3	0.45	0.070	,,	,,

2. Effect of live and dead standards

The stand of the crop was very uneven.

3. Effect of shade on growth and yield

An experiment is to be laid out to determine the performance of five varieties of pepper under different intensities of shade when planted in an arecanut garden.

PROGRAMME OF WORK (AGRONOMY), 1975

Project No.	Name of the Project	Venue
Agr. IV (813)	Determining the agronomic requirements of pepper 1. NPK requirements 2. Effect of live and dead standards 3. Effect of shade on growth and yield	Vittal

SUMMARY

Oleoresin content in eight varieties of ginger varied widely, decreasing with maturity. Total pungency (as piperine) also varied from 8.9% to 83.9% in six wild pepper types. Curcumin content of turmeric varied from 3.0% to 8.0%

Bch. I (176 and 813) **Quality studies in cashew and spices**
(CK Mathai, Biochemist, and Senior Research Assistant)

In ginger, oleoresin content was higher in early stages of growth. In eight varieties, it was 10.1–16.1% in the third month and 4.8–9.0% in the seventh month (acetone extract). At harvest, it varied from 5.0–10.0% in acetone extracts and 5.4–17.6% in alcohol extracts in the germplasm.

Oleoresin and the piperine contents in six of the wild pepper types collected from the Western Ghats showed great variation. Oleoresin content varied from 6.4% to 25.7%, piperine from 8.9% to 83.9% and crude fibre varied from 5.1% to 18.9%.

The curcumin and essential oil contents of 38 turmeric types available in the germplasm collection were also determined. Curcumin content varied from 3.0% (Nandyal B32) to 8.1% (Vontimitta CLL 322) and essential oil content varied from 2.4% (Tekkurpetta CLL 327 B 24) to 7.2% (Kasturi).

PROGRAMME OF WORK (BIOCHEMISTRY), 1975

Project No.	Name of the Project	Venue
Bch. I (813 & 176)	Quality studies in cashew and spices	Vittal

SUMMARY

None of the 22 cultivars of *Piper nigrum* L. screened against *Phytophthora* sp., causal agent of quick wilt of pepper was resistant to the pathogen. At Alakode, root-knot nematodes were also observed in roots of pepper vines exhibiting yellowing and wilting. Captafol treated plots showed the least incidence of soft-rot of ginger. Association of *Fusarium* sp. and *Pratylenchus* sp. was noticed with the brown rot disease of turmeric. In the field trials on the control of leaf spot of ginger, Thiram 0.1% was the most effective.

Path. II (813) and Experiment 35 **Slow wilt and quick wilt diseases of pepper** (KKN Nambiar and YR Sarma)

A technique was perfected to isolate *Phytophthora* sp., the causal agent of quick wilt from the soil using castor seed and pepper leaf petiole baits.

Twentytwo cultivars of *Piper nigrum* L. were screened for resistance/ susceptibility to *Phytophthora* sp., the causal agent of quick wilt of pepper. Mycelial suspension containing sporangia was used for inoculating rooted cuttings by pouring the suspension in the root zone at 15 ml per cutting. The inoculated plants were kept in air conditioned room under a temperature regime of 22–25°C. None of the tested cultivars was resistant to the pathogen.

In one garden affected by slow wilt, root-knot nematode (*Meloidogyne* sp., has been observed in roots of vines, exhibiting yellowing and wilting. The role of this nematode and also of *Radopholus similis* in the incidence of slow wilt is being investigated.

Field control trials laid out in cultivators' fields against quick and slow wilt diseases using different fungicides did not indicate the superiority of any fungicide over the other. In the case of quick wilt, leaf infections and decay of vines with different degrees of intensity were present in all the treatments.

Path. III (813) and Experiment 36 **Rhizome rot of ginger and turmeric** (YR Sarma and KKN Nambiar)

A field trial with three replications on a randomised block design was laid out on the control of the disease using 14 fungicides. The incidence of soft rot was 22.78% in plots treated with Aureofungin sol at 200 ppm and 28.34% in those treated with captafol 0.1% as against 68.88% in control. The fungicide treatments produced a mean yield of 7.19 kg and 7.91 kg rhizomes per bed ($3m^2$), respectively as against 3.80 kg in control. A fresh field trial was laid out using the above fungicides at different concentrations.

Rhizome rot of turmeric was observed for the first time in the campus. The variety infected was Kuchipudi. *Pythium* sp., was isolated from affected rhizomes and pathogenicity established.

While recording various diseases affecting turmeric rhizomes in the germplasm, a new disease, *viz.*, 'Brown rot' was noticed affecting only *aromatica* types. The affected rhizomes showed brown necrotic lesions starting from the margin into the internal tissues. *Fusarium* sp., along with a nematode, *Pratylenchus* sp., was associated with the disease.

Path V (813) and Experiment 40 **Leaf spot disease of ginger** (YR Sarma and KKN Nambiar)

Field control trials against the disease were laid out on 14×3 randomised block design using Maran variety. The experimental plants were artificially inoculated under field conditions by spraying a spore suspension, two days prior to treatment with fungicides. Three rounds of sprayings were given at 15 days intervals starting from September onwards. The incidence of disease was the least in plots treated with thiram 0.1% (15.8%), followed by carbendazim 0.1% (19.1%) as against 36.7% in control. All the varieties of ginger were susceptible to the disease under field conditions, in different degrees of intensity (27.8% to 68.33%).

PROGRAMME OF WORK (PLANT PATHOLOGY), 1975

Project No.	Name of the Project	Venue
Path. II (813)	Slow wilt and quick wilt in pepper	Panniyur and Kasaragod
Path. III (813)	Rhizome rot of ginger and turmeric	Kasaragod
Path. IV (813)	'Azhukal' disease of cardamom	Santhampara (High Ranges, Kerala)
Path. V (813)	Leaf spot of ginger	Kasaragod

ENTOMOLOGY

SUMMARY

Studies on the prepupal and pupal parasites, as well as a nematode parasite on *Udaspes folus* are in progress. High yielding types of pepper like Kari munda, Panniyur–I *etc.* were highly susceptible to the infestation of 'pollu' beetle. Pepper in the early stages of growth is more susceptible to top shoot borer, *Laspeyresia hemidoxa.* Based on previous year's results on the control of 'pollu' beetle, a fresh trial was laid out at Panniyur for the control of both 'pollu' beetle and 'pollu' disease. In cardamom, thrips infestation of capsules was the least in Malabar variety. Cardamom thrips could be effectively controlled by spraying quinalphos or PAP or dimethoate 0.1%. Studies on biology and bionomics of cinnamon leaf caterpillar were initiated. *Enterobacter cloacae* parasitises the caterpillar.

Ent. II (813) and Experiment 38 **Biology and bionomics of insect pests** (VA Abraham and GB Pillai)

1. Ginger and turmeric

Observations on the intensity of natural parasitisation of *Udaspes folus* Cram. (Lepidoptera: Hesperiidae) the leaf roller pest of turmeric and ginger, showed that 25.5% of the caterpillars in the prepupal stage were parasitised by the Vipionid parasite *Apanteles* sp. Biology of the parasite, its mode of parasitisation *etc.* are being studied. One more species of hymenopteran parasite (Pteromalidae) was recorded from *U. folus* caterpillars. A nematode parasite belonging to family Mermithidae has been found parasitising *U. folus* caterpillars during the monsoon period. A pair of nematodes was seen coiled round in the haemocoel of the host,caterpillar. The nematodes make their way out by making injury to the larval skin. Further studies on the mode of parasitisation, extent of parasitism *etc.* are being made.

Studies on the intensity of incidence of shoot borer *Dichocrocis punctiferalis* Guen. (Lepidoptera: Pyralidae) on different varieties/types of turmeric available in the germplasm assemblage during the current season also showed that no variety as such was tolerant to the pest.

2. Pepper

Studies on seasonal abundance of 'pollu' beetle *Longitarsus nigripennis* Mots. (Coleoptera: Chrysomelidae) showed the maximum pest population in November. Pest infestation was noticed on 46.84% spikes with 14.55% berries damaged by the pest. Data on the intensity of 'pollu' beetle infestation on different varieties of pepper available in the germplasm assemblage at Panniyur, collected from five sample vines each during 1972, 1973, and 1974 showed that high yielding types like Karimunda, Panniyur-I *etc.* recorded higher percentage incidence whereas in Kalluvalli, a popular local type, the incidence was only negligible. No alternate host or natural enemy of 'pollu' beetle could be recorded so far.

Incidence of top shoot borer *Laspeyresia hemidoxa* Meyr. in three age groups of Panniyur-I vines (1970, 1971, and 1972 plantings) showed 13.6, 12.1 and 9.8% shoot attack, respectively.

3. Cardamom

Data on the incidence of cardamom thrips *Taeniothrips cardamomi* Ramak. on different cultivars of *Elettaria cardamomum* and allied genera, collected during the period from October 1972 to April 1974 showed maximum thrips population in Vazhukka (Semierect panicled) variety followed by Kannielam and Ceylon and minimum in *Aframomum melegueta*. Percentage of infested pseudostems (showing the physical presence of the adults and

immature stages of thrips) was maximum in 'Vazhukka' followed by 'Kannielam' and minimum in *Aframomum melegueta*. Among the different cultivars of *E. cardamomum*, Kannielam recorded the maximum percentage of infested capsules followed by Ceylon variety. Capsule infestation was the least in Malabar (Prostrate panicled) variety.

Ent. III (813) and Experiment 39 **Chemical control of pests**
(GB Pillai and VA Abraham)

1. Ginger and turmeric

Based on the results of last year's field trials that soil application of mephospholan granules @ 9g / bed (3m×1m), thrice is effective in reducing shoot borer incidence in turmeric, a new series of trial was laid out. The treatments involved soil application of granules only, presowing soil treatment with granules and post emergence spraying with dimethoate 0.1% and three sprayings with dimethoate 0.1% only. The trial is yet to be completed.

2. Pepper

Last years' field trials revealed that pepper 'pollu' beetle could be effectively controlled with dimethoate 0.1% or quinalphos 0.1% applied twice as sprays in late July and early October and these insecticides are more effective than the presently recommended DDT 0.2%. A fresh field trial has been laid out at Pepper Research Station, Panniyur, Taliparamba, Kerala involving treatment of pepper vines with insecticides and fungicides individually and in combination to work out a suitable control schedule against 'pollu' beetle and 'pollu' disease caused by *Colletotrichum* sp., The trial is in progress.

3. Cardamom

Data on the chemical control of cardamom thrips *Taeniothrips cardamomi* Ramak. using different insecticides laid out at Cardamom Research Station, Pampadumpara, Kerala showed that insecticides like quinalphos 0.1%, PAP 0.1%, and dimethoate 0.1% were effective in reducing thrips infestation on pseudostems and capsules. These insecticides treated plots recorded 22.85%, 19.85% and 23.85% infestation on pseudostems and 14.37%, 22.30%, and 31.18% capsule attack, respectively as against 39.04% pseudostem infestation and 81.93% capsule attack in the untreated control. Quinalphos and dimethoate are now being tested in large scale demonstration *cum* trial plots in three agroclimatic zones, at Ayyappankoil and Vandanmettu in the High Ranges of Kerala, and Bhagamandala in Coorg area of Karnataka with the active collaboration of Cardamom Board.

Ent. IV (813) **Bionomics and control of insect pests of cinnamon**
(CP Radhakrishnan Nair, VA Abraham, and GB Pillai)

The important pests are the cinnamon butterfly (whose caterpillars feed voraciously on the leaves), the leaf miner, shoot and leaf webber, jassids

loopers, and leaf beetles. Biology of cinnamon butterfly was studied. No egg laying was noticed in laboratory cages. Field-collected eggs hatched in four days. The caterpillar phase comprising five instars was completed in 15–18 days and pupal stage in 7–11 days. Longevity of adults is being studied. Under field conditions, the eggs of cinnamon buterfly were heavily parasitised by a Mymarid parasite which is characterised by long and pedunculated hind wings. Laboratory studies showed that the entomogenous bacterium *Enterobacter cloacae* isolated from *Udaspes folus* produced septicaemia in cinnamon leaf caterpillars when the inoculum was applied to leaves as a spray.

Seven species of insect pests and the mymarid egg parasite of cinnamon leaf caterpillar were sent to the Commonwealth Institute of Entomology, London, for identification.

PROGRAMME OF WORK (ENTOMOLOGY), 1975

Project No.	Name of the Project	Venue
Ent. II (813)	Biology and bionomics of insect pests	Kasaragod, Panniyur, Taliparamba, and Pampadumpara
Ent. III (813)	Chemical control of pests of spices	Kasaragod, Taliparamba, and Pampadumpara
Ent. IV (813)	Studies on bionomics and control of the pests of cinnamon	Kasaragod

STATISTICS

Stat. I (176 & 813) **Optimum size and shape of plots and blocks in experiments with spices and cashew**

(MV George and Jacob Mathew)

Yield data from 300 cardamom plants for two years were collected from Cardamom Research Station, Mudigere, Karnataka and the optimum size of plot was worked out. A plot size of 4×3 across the slope and 2×5 along the slope were found to have minimum CV%. Another set of data from 1000 plants was also collected from Mudigere and the work is in progress.

PROGRAMME OF WORK (STATISTICS), 1975

Project No.	Name of the Project	Venue
Stat. I (813 & 176)	Optimum size and shape of plot and blocks in experiments with spices and cashew	Kasaragod and Vittal

ABSTRACT OF REPORT OF THE CO-ORDINATING CENTRES OF THE ALL INDIA CO-ORDINATED SPICES AND CASHEWNUT IMPROVEMENT PROJECT

Besides the CPCRI, Kasaragod and Vittal, the All India Co-ordinated Spices and Cashewnut Improvement Project was operating at the following centres:

Indian Institute of Horticultural Research, Hessarghatta
CENTRE: GONICOPPAL

Kerala Agricultural University, Mannuthy
CASHEW RESEARCH STATION, ANAKKAYAM
CARDAMOM RESEARCH STATION, PAMPADUMPARA
PEPPER RESEARCH STATION, PANNIYUR

Tamil Nadu Agricultural University, Coimbatore
CASHEW RESEARCH STATION, VRIDHACHALAM

University of Agricultural Sciences, Bangalore
REGIONAL RESEARCH STATION, MUDIGERE

Andhra Pradesh Agricultural University, Hyderabad
CASHEW RESEARCH STATION, BAPATLA

Konkan Krishi Vidyapeeth, Dapoli, Maharashtra
CASHEW RESEARCH STATION, VENGURLA

Himachal Pradesh University, Agricultural Complex
FRUIT RESEARCH STATION, KANDAGHAT

An abstract of work carried out at these centres is presented as follows:

CASHEW

The germplasm assemblage comprises 177 types in Vridhachalam, 252 in Bapatla, 88 in Anakkayam and 78 in Vengurla. At Vridhachalam 10 trees yielded more than 10 kg nuts, 71 between 5 and 10 kg, and 93 below 5 kg. At Bapatla, 19 types yielded more than 10 kg nuts per tree. Two selections 3/3 Simhachalam and 9/8 Epurupalem were proposed for release as best performers. At Anakkayam, the highest yield was given by the type Bla 139-1 followed by Bla 273–1 were promising and were proposed for release. At Bapatla, hybrids 2/11 and 2/12 and the F_1 hybrid progenies, the best performance was recorded in H–3–17, H–4–7, and H–1–4.

In vegetative propagation studies, layers prepared in July–August and separated in October–November established better at Vridhachalam. Patch budding done in July gave 76% success. At Bapatla, veneer grafting and budding were not successful. Budding and grafting have been found successful under Vengurla conditions. The periods from July–October for patch budding, and July to September for veneer grafting were found to be most suitable. At Vengurla 70% success on side grafting on 3–4 year-old stock was obtained in September.

CARDAMOM

In performance studies of 80 clones, clones CL 664, CL 731, CL 722, CL 719, CL 686, CL 688, and CL 730 were high yielders, the average yield ranging between 135 and 200 kg of dry capsules per acre. The yield performance of early bearing types showed that types S. 1288–41 and S. 1294–80 recorded more than three times the average clump yield. Selections like S. 1301, 1295, 1303, 1239, 1300, and 1302 are leaf rot-resistant.

At Gonicoppal, the varieties Alleppey green and Ceylon were tolerant to the nursery leaf spot. Spraying with Captafol 0.2% at 15 days intervals controls the disease. None of the 40,000 seedlings was resistant to the 'Katte' disease when screened under glass house conditions using viruliferous aphids. Virus-vector relationship was studied in the case of 'Katte' disease using *Pentalonia nigronervosa*

PEPPER

At Panniyur, the germplasm comprised 42 varieties including two from Indonesia. Intervarietal hybridisation involving 15 parental combinations was taken up, seeds collected and sown. Up to 45% germination was obtained. Field trials were laid out in cultivators' fields on the control of quick and slow wilt diseases.

PROGRAMME OF WORK (GENETICS), 1975

Project No.	Name of the Project	Venue
Gen. I (670)	Oil palm breeding	Palode

PROGRAMME OF WORK (AGRONOMY), 1975

Project No.	Name of the Project	Venue
Agr. I (670)	Nutritional requirement of oil palm	Anchal

CACAO

PROGRAMME OF WORK (PLANT PATHOLOGY), 1975

Project No.	Name of the Project	Venue
Path. I (299)	Investigations on the pod rot of cacao	Vittal and Kannara

PROGRAMME OF WORK (ENTOMOLOGY), 1975

Project No.	Name of the Project	Venue
Ent. I (299)	Survey of pests of cacao in India	Vittal
Ent. II (299)	Biology and control of Coccoidea affecting cacao	Vittal

SUMMARY OF THE REPORT

COCONUT

The germplasm collection maintained at the Institute consists of 59 exotic and 32 indigenous varieties. Seednuts of the varieties Chowghat Dwarf Orange and Dwarf Green were sent to Surinam during the year. Among the three Kulasekharam Dwarf types, Dwarf Orange type was superior to Green and Yellow forms, yielding 6.64 kg copra per palm per year. Copra content was also higher in the hybrids Tall × Cochin China, Tall × Kappadam, and Tall × SS Green, than in the other hybrids studied. Response of palms to better management was studied by giving them twice the recommended quantity of fertilisers and irrigation. Total yield was higher in the hybrids, which gave more nuts per palm (106 in T × D and 103 D × D) than the pretreatment yield. Studies on meiosis showed that it was nearly normal in T × D and WCT palms. The cultivar Chowghat Dwarf Orange continued to show the highest (58 %) selfing intensity. A high positive correlation was observed between the total yield of copra and the yield of nuts and the copra content per nut.

Trials on nutritional requirements of palms under various soil types showed that during the early bearing stage in the Talls leaf production increased with more doses of nitrogen, and number of functional leaves with increasing levels of potash. But in a littoral sandy soil the increase in the level of nitrogen reduced the number of functional leaves. The best response to fertiliser was noticed in the D × T hybrids. In the irrigation experiments higher levels of fertiliser increased the rate of leaf production. Efforts to improve the productivity of coconut plantations were continued through inter and mixed cropping trials and mixed farming. Among the tubers tried as intercrop with coconut, ginger gave the highest returns, followed by coleus and yam. Mixed cropping with cacao increased the yield of coconuts markedly (with 58.5 more nuts per palm per year in the plot with a double hedge of cacao). Such a system favoured a high activity of beneficial micro-organisms in the rhizosphere of both coconut and cacao. Dominant among the micro-organisms were nitrogen fixing and phosphate solubilising organisms. Fertilising nursery beds produced seedlings with more chlorophyll content and better quality. The agrostology plot at Kayangulam, where grass is mix-cropped with coconuts, and milch cows are maintained, the mean yield of palms increased by 29 % and the yellowing of leaves in the root (wilt) diseased palms was considerably reduced. Mixed cropping of coconut with napier grass resulted in an increase in the number of total bacteria, nitrogen fixing bacteria, and phosphate solubilising organisms in the rhizosphere of palms.

In a study to evaluate the comparative efficacy of different phosphatic fertilisers in laterite soil, available phosphorus content was found to be the highest with application of nitrophosphate. In a littoral sandy soil, seedlings receiving cattle manure continued to show better growth as compared to those

receiving other organic manures. Foliar yellowing and rubbery kernel in coconut was found to be associated with a lower sulphur content in the leaves.

In the physiological studies significant parent-progeny correlation was observed in chlorophyll content in ten families of the West Coast Tall variety. In a study on the role of hormones in reducing the prebearing age of coconut palm gibberellic acid like hormone activity was detected in the tender leaves of adult West Coast Tall palms.

Multidisciplinary investigations were continued on the root (wilt) disease. A comprehensive survey was conducted covering all soil types of Kerala by collecting soil (1125 numbers) and leaf (733 numbers) samples. Their nutrient content was studied in relation to the disease. The soils of the disease-affected tract had a low content of iron, manganese, and zinc. Soils collected from the diseased area showed higher amounts of exchangeable calcium and magnesium than those from the healthy areas. The diseased palms had a lower content of sulphur, iron, manganese, zinc, and molybdenum than the healthy ones. The disease-affected palms were found to release considerable amounts of electrolytes from their roots indicating a deranged cell permeability. The fungi, actinomycetes, and bacteria present in the rhizosphere of palms cultivated one either side of the areas demarcating the spread of the disease were enumerated. Roots from diseased palms were found to harbour bacteria, tentatively identified as *Erwinia*.

Fresh incidence of the disease was observed in Trichur taluk (Kerala). About 18% of the roots of apparently healthy T × D hybrids showed vascular discolouration. Electron microscopic studies of healthy and diseased root and leaf samples revealed the presence of flexuous rods. When broken up they resembled tobacco mosaic virus. Further studies suggested it to be a host protein.

The populations of the burrowing nematode, isolated from the roots of disease affected palms, ware identified as 'banana race'. Host range studies showed that it parasitised 23 out of the 70 plant species tested.

Mechanical, chemical, biological, and integrated methods of control trials were continued against the pests. In laboratory tests the insecticides BHC, carbaryl+lindane, and trichlorphon, in that order, showed residual toxicity against the adults of the rhinoceros beetle up to five months after treatment. In the biological control trials with the exotic predator *Platymeris laevicollis* some evidence for its establishment was obtained at Vittal. Surveillance was continued for pests. A weevil *Myllocerus* sp., was recorded for the first time to damage coconut leaves.

ARECANUT

Ten cultivars from Andamans were added to the germplasm collection. Large scale multiplication of six high yielding types was taken up at the Kidu

Farm. To evolve arecanut varieties tolerant to the yellow leaf disease, crosses were made in 16 combinations using *Areca triandra* as the pollen parent. The differences due to selection were not significant for number and weight of nuts per palm per year, in the experiment to fix selection standards.

The optimum spacing for planting varied from place to place. At Hirehalli it was 1.8m × 3.6m and at Kahikuchi (Assam) it was 2.7m × 2.7m. At Hirehalli the best cultural operation for increasing the yield was digging the garden twice a year with 'mammatty'. The plot planted at a depth of 90 cm and irrigated once in five days continued to give the best yield at Vittal. The response to green leaf was maximum at 21 kg per palm. In the fertiliser experiment at Vittal the yield was significantly more in palms fertilised at 100 g nitrogen. Among the six cacao hybrids tried as a mixed crop with arecanut, I 195 × ICS 60 continued to give the highest yield. The cost of cultivation of arecanut varied from place to place. At Vittal it worked out to Rs. 5033.00 per ha with a yield of 2308.9 kg 'chali'. At Hirehalli it amounted to Rs. 6394.00 per ha and the yield to 3154.0 kg nuts (cured produce). At Palode under rainfed conditions, the corresponding figures were Rs. 3843.00 per ha and 1395.0 kg ripe nuts.

Application of phosphatic fertilisers at 160 g per palm brought the available phosphorus status of subsoil up to a depth of 100 cm to the level of sufficiency (25 ppm). Work has been initiated to determine the amounts of nutrients removed by six-month old arecanut seedlings of nine arecanut varieties.

Investigations on the technological aspects were continued in collaboration with several public and private agencies. Fat extracted from arecanut was suitable for edible purposes and for toiletry preparations. Quality of tannins from defatted arecanut was good for tanning leather.

Investigations on the yellow leaf disease were continued. A survey was conducted in Trivandrum, Quilon, and parts of Alleppey districts of Kerala, and Chickmagalur and South Kanara districts of Karnataka to study the association of the disease with water stagnation and nutrient imbalance in leaves. The survey revealed the occurrence of a higher water table in diseased areas. Four unidentified fungi were obtained from the roots of diseased plams besides the common soil fungi. The roots of diseased palms were also found to harbour a larger number of the burrowing nematode, *Radopholus similis*.

Pathogenicity of the fungus causing the die-back of arecanut inflorescence was studied. In the field trials the fungicides zineb, captan, and DMOC reduced the incidence of the disease. The hormones NAA and ascorbic acid when sprayed twice, were effective in retaining buttons on the inflorescences.

Studies on the biology and control of the mites were continued. The red mite *Raoiella indica* was parasitised for the first time by a cecidomyid larva. The white grub could be controlled by the application of dimethoate, thiodemeton, and chlordane, at 1.5 kg (active ingredient) per ha. Populations of storage

pests of arecanut were higher during the monsoon months (June-September); they caused 15–20% damage to the nuts.

Investigations on the insect pests of cacao were continued. Besides the six already identified during 1973, seven more pests affecting cacao have been identified, out of the 20 pests collected so far. Effect of certain antifeedants on two leaf eating pests of cacao was studied.

CASHEW

A total of 500 accessions has been added to the germplasm collection; it now consists of 699 indigenous and exotic accessions. Floral biology studies showed that the ratio of male flowers to hermaphrodite flowers varied from 6–498 to 1. The time taken to complete flowering in a panicle ranged from 13–128 days. The effect of hormones on fruit set was studied, using five hormones; The best result was obtained with 2, 4–D.

In an NPK fertiliser experiment laid out on bearing trees (both seedlings and air layers) the main effect of nitrogen was significant for number of nuts per tree and weight of nuts in seedling trees. As during the previous years 300 g nitrogen per tree continued to give the highest yield (1.54 kg nuts per tree). Foliar application of urea in combination with pesticides had no significant effect.

The population of tea mosquito causing inflorescence blight reaches its peak during January. The build up of the pest population synchronises with the emergence of new flushes. The insecticide endosulfan continued to be effective in controlling tea mosquito infestation and in reducing the loss due to inflorescence blight. In the treated plots, the yield of nuts per tree was 2.5 kg as against 1.3 kg in the untreated ones. Biological control trials under laboratory conditions using the nematode *cum* bacterium culture (DD-136) showed that an inoculum dosage of 100 nemas per gram of body weight of host grubs effected 60% mortality in 24 days against the cashew stem borer.

PEPPER

The survey for wild pepper in the Western Ghats of Karnataka was continued; A total of 781 accessions has been assembled in the germplasm. The field experiments laid out to determine the NPK requirements, the effect of live and dead standards, and the effect of shade on growth and yield were continued.

Twentytwo cultivars of pepper were screened for resistance to the fungus *Phytophthora* sp., the causal agent of the quick wilt disease of pepper. None of them was resistant. The root-knot nematode was also observed in the roots of pepper vines exhibiting yellowing and wilting. The role of the nematode is being investigated.

Studies on the abundance of 'pollu' beetle showed maximum population in November. Studies on the intensity of 'pollu' beetle infestation on different varieties of pepper at the Pepper Research Station, Panniyur, showed that the incidence was high on high yielding types like 'Karimunda', Panniyur—I, *etc.*, whereas in 'Kalluvalli' a popular local type, it was only negligible.

CARDAMOM

Studies on the incidence of cardamom thrips on different cultivars showed the maximum thrips population in 'Vazhukka' variety, followed by 'Kannielam' and 'Ceylon' types. The maximum percentage of infested capsules was in 'Kannielam' and the minimum in 'Malabar'. The insecticides quinalphos 0.1 %, PAP 0.1 %, and dimethoate 0.1 % were effective in reducing thrips infestation on pseudostems and capsules. To confirm these results three large scale demonstration *cum* trial plots have been laid out in different agroclimatic zones in Kerala and Karnataka with the collaboration of the Cardamom Board.

GINGER AND TURMERIC

The ginger types Nadia, Poona, Tinladium, Burdwan, Jugijan, and Taiwan were high yielders. All the varieties of ginger available in the germplasm collection have been found to be susceptible to the leaf spot disease. Control trials using the variety 'Maran' showed that the incidence was the least (15.8 %) in the plots treated with the fungicide thiram 0.1 % followed by carbendazim 0.1 % (19 %) as against 36.7 % in the control.

In turmeric, the maximum yield was obtained from types CLL 326 Mydukur, CLL 324 Armoor, CLL 328 Sugandham, CLL 32 Avanigadda, Kasturi, Chayapasupu, CLL 320 Amalapuram, Armoor, and Sugandham, in that order. The yield of plants from mother rhizomes was more than that from plants from fingers. The *aromatica* types of turmeric were found to be affected by a new disease, 'brown rot'. The fungus *Fusarium* sp., in association with a nematode *Pratylenchus* sp., was associated with the disease. The leaf roller pest of ginger and turmeric has been found to be parasitised by a nematode, besides the insect parasite *Apanteles* sp.

1975

CPCRI
Annual Report
1975

Central Plantation Crops Research Institute

Indian Council of Agricultural Research

Kasaragod 670 124 Kerala India

1976

SPICES

GENETICS

SUMMARY

The survey of the Western Ghats of Karnataka region was continued and 75 collections added bringing the total of accessions to 856 (107 cultivated and 749 wild).

Among 30 ginger types tried during 1974–75, Wynad Manantody, Ernad Manjeri, and Jorhat were high yielders. The somatic chromosome number for three cultivars was determined as 2n=22. A medium constituting 15% sucrose, 300 ppm Ca $(NO_3)_2$ and 100 ppm boric acid gave 1.3-1.6% pollen germination.

Ten types of turmeric were high yielders during 1974–75. The tentative classification of the *longa* types based on rhizome characters showed that group III gave the maximum yield and curcumin and essential oil contents. Seed setting was noted in both *longa* and *aromatica* types; rhizome development in seedlings was noticed during the second year.

Capsules and seeds of cardamom were irradiated with gamma rays. Seeds treated with dose above 30 krads did not germinate while a few seedlings were obtained from capsules treated at the above dose. In the primary nursery of M_1 seedlings certain abnormalities were noticed.

Gen. I (813) and Experiment 13 **Collection, maintenance, and evaluation of pepper germplasm**

(NM Nayar, KN Murthy, PM Kumaran and MC Nambiar)

The survey of Karnataka region of the Western Ghats except in Coorg, Hassan, and Mysore districts, was continued and 75 collections were added. The total number of accessions now available is 856 (107 cultivated and 749 wild). A tentative identification showed that these might include 11 species. These are now being planted in the field.

Gen. II (813) and Experiment 18 **Germplasm collection and evaluation of ginger**

(PK Thankamma Pillai and Sr. Res. Asst. (Agronomy))

Among the 32 cultivars yield was maximum (during 1974–75) in Wynad Manantody followed by Ernad Manjeri and Jorhut. During the current season (1975–76), 30 types were planted adopting a randomised block design with two replications. Maximum germination percentage was observed for UP (98.8), Bajpai (97.5), Burdwan (93.8), Vengara (91.3), and Assam (91.3) types.

The flowers opened between 14.30 and 16.30 hrs. Anthesis also took place simultaneously. The flowers were trimerous with an attractive three-lobed labellum and a single fertile stamen. The ovary was inferior, tricarpellary and syncarpous. There were many ovules in an axile plancentum.

Gen. III (813) and Experiment 20 **Germplasm collection and cataloguing of turmeric**

(PK Thankamma Pillai, MC Nambiar, and Sr. Res. Asst. (Agronomy))

In the germplasm comprising 42 cultivars the yield was maximum in Karhadi local followed by Kasturi and Tekkurpetta for the period 1974–75. In the trials on clonal multiplication of selections, the yield was maximum in Nandyal type followed by C11 328 Sugandham, Rajapuri local, C11 326 Mydukur, Cli 316 Gorakhpur, Ca 69 Dindigam, and Kasturi tanuka.

Based on the rhizome characters, the *longa* types were tentatively classified into four groups (Table 49). Group III gave the highest yield, and high curcumin and essential oil contents. The groups differed in rhizome characters such as size of mother rhizomes and fingers, number of nodes, and internodal distance (Table 50).

Among the 56 lines of 29 types maximum recovery was observed for types Vontimitta (25.5%), Kodur type (25.0%), Karhadi local (20.0%), and Wynad local (19.0%), among *C. longa*. Among the *aromatica* types Ca 68 Dahgi (22.5%), Ca 67 Jobedi (21.1%), Ca 69 Dindigam, and Ca 73 Amalapuram (20.2% each) gave the maximum recovery of dried turmeric.

Colour of the turmeric powder was determined for *longa* and *aromatica*. In general, the colour of the *longa* types (except for Gr. II) was found to be 10

Table 49. Rhizome characters in *longa* types of turmeric

Characters		Groups				SE Mean	CD
		I	II	III	IV		
Mother rhizomes	No. of nodes	12.08	12.36	11.04	11.20	0.242	0.69
	Length (cm)	7.76	8.18	7.00	6.44	0.180	0.51*
	Breadth (cm)	4.04	3.75	3.47	3.49	0.077	0.22
Fingers	No. of nodes	9.68	8.84	6.96	9.96	0.190	0.54
	Length (cm)	9.54	9.42	5.62	7.86	0.146	0.41
	Breadth (cm)						
	Bottom	1.56	2.11	1.93	1.54	0.058	0.16*
	Middle	2.18	2.34	2.07	1.83	0.056	0.16
	Top	2.02	2.29	2.06	1.77	0.045	0.13
Internodal distance (cm) (fingers)		1.27	1.72	0.88	0.95	0.094	0.27*

*Significant at P = 0.01

Table 50. Vegetative characters during the fourth month and yield of the four groups of *Curcuma longa* (3 years' average—1972–1975)

Sl. No.	Characters	Groups			
		I	II	III	IV
1.	No. of tillers	2.0	1.9	2.5	2.7
2.	No. of leaves	9.7	9.4	11.6	12.3
3.	Height of the shoot (cm)	75.9	75.0	82.0	81.5
4.	Length of last fully opened leaf (cm)	38.7	39.5	42.5	43.7
5.	Breadth of last fully opened leaf (cm)	15.2	14.8	16.6	16.5
6.	Average yield/plant (g)	240	235	276	237
7.	Recovery of dry turmeric (%)	18.8	16.7	—	18.0
8.	Curcumin content (%)	5.04	4.9	9.0	5.25
9.	Essential oil (%)	3.4	4.5	6.25	4.0

YR 7/10-Strong orange yellow and *aromatica* types belong to the group 10 YR 6/8-Dark orange yellow.

The inflorescence in turmeric was terminal and the flowers open in the morning between 6 and 7 hrs. Pollination was brought about by ants and other insects. The flowers were trimerous with a broad yellow labellum, lateral staminodes and a two-lobed fertile stamen. The fruit was a capsule dehiscing irregularly. Seed setting was noted in nine *longa* and eight *aromatica* types.

Seeds stored for a period of four months were found to be viable, the germination percentage being 16. However, the germination could be improved by seed treatment with fungicides like carbendazin (Bavistin) 0.1% or Aureofungin sol 50 ppm. The seeds germinated on an average, within 15 days after sowing (range 5-25 days). The seedlings yielded root tubers and very small rhizomes only in the first year of their growth, but produced normal rhizomes and flowered during the second year.

During the current season, 43 types were planted. One hundred and twenty two lines of 48 clonally selected types (11 *C. aromatica* and 37 *C. longa*) were planted in a randomised block design with two replications.

Gen. IV (813). **Cytological studies in ginger with special reference to sterility and induced polyploidy**

(MK Nair, PN Ravindran, and PK Thankamma Pillai)

The somatic chromosome numbers in the Rio-de-janeiro, Maran, and Wynad Local cultivars of ginger were determined from root tip squashes. It was found to be 2n=22.

Preliminary meiotic studies showed trivalents and quadrivalents in two of the cultivars. The pollen was found to germinate in a medium containing 15% sucrose, 300 ppm $Ca(NO_3)_2$, 100 ppm boric acid, 200 ppm KNO_3, 100 ppm $MgNO_3$, and 1% Agar. However, the germination ranged from 1.3 to 1.6% in the varieties Rio-de-janeiro, Wynad Local, Maran, Burdwan, and Assam.

A high population of a bacterium was found associated with the cells in the anothers collected from Vittal and Kasaragod. The bacterium was found to be a gram-positive coccus.

Gen. V (813). **Breeding cardamom for resistance to 'Katte' disease**

(AA Mohamed Sayed, DG Rao (IIHR, Gonicoppal), and CA Ninan (Kerala University, Trivandrum)

This experiment was initiated during January, 1975 to isolate mutants possessing resistance to 'Katte' disease and drought, and earliness to yield. Cardamom capsules and seeds were irradiated in the Gama Shine Unit at the Department of Botany, University of Kerala, Trivandrum. The doses of 2, 5, 7, 10, 15, 20, 25, 30, 40, 60, 70, and 80 k rads were given. The dose above 30 krads was found to be lethal. Seeds treated with above 30 krads did not germinate while a few seedlings (0.1%) were obtained from capsules treated at the above dose.

Abnormalities like leaf-splitting, chlorophyll mutation, production of twin seedlings *etc.*, were noticed in the primary nursery in M_1 generation.

PROGRAMME OF WORK (GENETICS), 1976

Project No.	Name of the Project	Venue
Gen. I (813)	Germplasm collection and evaluation of pepper	Vittal and Calicut
Gen. II (813)	Germplasm collection and evaluation of ginger and turmeric	Kasaragod, Vittal, and Calicut
Gen. IV (813)	Cytological studies in ginger with special reference to sterility and induced polyploidy	Calicut, Kasaragod, and Vittal
Gen. V (813)	Breeding cardamom for resistance to 'katte' disease	Appangala
Gen. VI (813)	Germplasm collection, evaluation, and selection in tree spices (nutmeg, clove, and cinnamon)	Calicut
Gen. VII (813)	Standardisation of vegetative methods of propagation in tree spices	Calicut

AGRONOMY

SUMMARY

In order to find out the optimum fertiliser requirement for turmeric, an experiment was started in May. A manurial experiment was initiated on pepper using the Panniyur-I hybrid.

Agr. II (813) and NPK fertiliser experiment on turmeric
Experiment 21

(P Thomas Varghese and PK Thankamma Pillai)

An experiment was laid out on the variety No. 24, a local selection, to determine the optimum dose of NPK with and without mulch. Treatments included all possible combinations of N, P, and K at three levels of each with and without mulch. The fertiliser doses tried were 30, 60 and 90 kg N, 15, 30 and 45 kg P_2O_5 and 45, 90 and 135 kg K_2O/ha. Side treatment of absolute control without fertiliser was also included. A 3^3 factorial confounded split factor design was adopted. Full dose of P_2O_5 and half the dose of K_2O were given at the time of planting, half the dose of N 40 days after planting and the remaining doses of N and K three months after planting. The experiment is continuing.

Another field trial on turmeric variety No. 24, a local selection, was in progress to study the effect of manures and mulches under different combinations of N, P and K fertilisers. The treatments applied at the time of planting included (1) no manure and no mulch, (2) cattle manure alone as basal dressing, (3) green leaf alone, (4) basal dressing with cattle manure and mulching with green leaf, and (5) cattle manure alone. The fertiliser dose included the combinations (1) no fertilisers, (2) 30 kg N, 15 kg P_2O_5 and 45 kg K_2O and (3) 60 kg N, 30 kg P_2O_5 and 90 kg K_2O/ha.

The experiment was laid out with 15 treatment combinations in Randomised Block Design and replicated thrice. In general the treatments which received no mulching showed retarded growth.

Agr. IV (813) and Experiment 17 NPK requirements of pepper and effect of live and dead standards

(Horticulturist and KN Murthy)

The field experiment was planted in 1972 in a 3^3 factorial split plot design with 16 standards per plot–8 dead (teak wood) and 8 live (*Erythrina indica*)–and two replications. The variety used is VTP 14 (Panniyur-I). The manurial treatments will be superimposed after all vines attain uniform growth.

It has been observed that the vines have trailed on to live standards (*Erythrina indica*) faster than to dead standards (teak wood).

PROGRAMME OF WORK (AGRONOMY), 1976

Project No.	Name of the Project	Venue
Agr. II (813)	NPK fertiliser Experiment on turmeric	Kasaragod
Agr. IV (813)	Determining agronomic requirements of pepper 1. NPK requirement 2. Effect of dead and live standards	Vittal
Agr. V (813).	Standards and spacings for pepper	Calicut

BIOCHEMISTRY

SUMMARY

The pattern of accumulation of oleoresin, piperine, starch, crude fibre, and essential oil was observed in the berries of two black pepper cultivars. Oleoresin, piperine, and essential oil percentages increased up to 6½–7½ months and then began to go down. The percentage of crude fibre was the highest at 8½ months and then it gradually decreased to maturity. Starch accumulation showed a reverse pattern.

Four Agmark grades each of black pepper and dry ginger and six grades of turmeric were studied for their physical and chemical characters.

BCh. I (813 and 176) **Quality studies in spices and cashew**

(CK Mathai and Biochemist, Vittal)

1. Seasonal variations in the chemical constituents of spice cultivars

(*a*) BLACK PEPPER. The pungency in black pepper is due to group of piperidine alkaloids presesnt in these berries. Piperine is the major alkaloid in that group.

Two black pepper varieties, Panniyur-1 and the local variety grown under identical conditions, were used to study the accumulation patterns of important chemical constituents in pepper berries. For this, the berries were collected at monthly intervals from 3½ to 8½ months and analyzed. Results are given in Table 51.

Table 51. The pattern of accumulation of oleoresin, piperine, starch, crude fibre, and essential oil (%) in the berries of two black pepper cultivars during development (On oven dry weight basis with an average moisture of about 8-12%)

Constituents/varieties	Maturity in months					
	3½	4½	5½	6½	7½	8½
Oleoresin						
Panniyur-1	10.56	12.00	14.64	17.15	21.05	9.51
Local	9.63	6.07	15.55	10.16	10.93	3.12
Piperine in oleoresin						
Panniyur-1	34.00	40.00	46.00	63.00	47.50	48.00
Local	45.00	46.00	57.00	75.00	32.00	43.00
Piperine in berries						
Panniyur-1	3.59	4.80	6.73	10.80	9.99	4.56
Local	4.35	2.79	8.86	7.62	3.49	1.34
Starch						
Panniyur-1	5.00	4.50	8.43	8.43	10.35	27.90
Local	6.12	5.62	15.75	21.12	20.12	33.68
Crude fibre						
Panniur-1	36.52	37.67	35.56	29.48	26.14	13.79
Local	36.66	32.78	23.97	19.13	18.96	8.91
Essential oil						
Panniyur-1	1.81	3.52	3.39	3.50	4.50	1.75
Local	1.84	1.84	1.57	2.00	2.50	1.00

Table 52. Chemical and physical characters of Agmark grades of spices

GRADES	CHEMICAL CHARACTERS						PHYSICAL CHARACTERS		
	Oleoresin %		% Essential oil	% Moisture (Toluene distillation method)	% Crude fibre	% Starch		Aver. dia	Wt. of 100 berries
	Acetone extr.	Alcohol extr.							
Black pepper									
1. Malabar Garbled 1	8.43	10.20	2.10	19.60	14.27	30.82		0.51 cm	3.830 g
2. Pinheads	1.96	2.37	1.50	14.00	29.23	8.43		0.24 „	0.324 „
3. Pinheads Spl.	10.67	12.18	1.00	9.60	29.56	7.87		0.22 „	0.272 „
4. Ungarbled light pepper (Spl)	13.15	16.58	2.70	9.16	29.44	13.72		0.49 „	0.491 „
							Average length	Average breadth	Average wt. of fibre
Dry ginger									
1. Ungarbled nonbleached Calicut ginger	5.39	6.98	1.66	17.80	3.12	40.16	5.83 cm	2.98 cm	6.78 g
2. Ungarbled nonbleached Cochin ginger (good)	5.18	5.53	2.16	15.60	3.59	40.72	4.53 „	2.45 „	4.68 „
3. Ungarbled bleached Calicut ginger	3.81	9.13	1.58	14.60	3.00	42.18	3.59 „	2.10 „	2.96 „
4. Ungarbled bleached Cochin ginger (good)	3.95	6.51	1.50	12.70	3.32	38.70	3.34 „	2.26 „	2.68 „
Turmeric									
1. Kodur turmeric		16.32	4.50	19.00	3.72	32.06	4.07 „	0.99 „	2.89 „
2. Duggirala pure quality		13.87	2.90	11.00	1.84	32.85	3.97 „	1.35 „	5.28 „
3. Rajamundry Kasturi turmeric		18.96	6.30	8.00	3.70	30.82	4.35 „	0.78 „	2.22 „
4. Hariathode unpolished Cudappah		22.72	1.40	18.30	3.47	34.20	5.69 „	1.26 „	5.56 „
5. Alleppey finger turmeric (good)		24.25	3.40	11.00	4.00	30.82	3.86 „	1.01 „	2.48 „
6. Alleppey turmeric bulbs (spl.)		16.20	3.40	12.00	4.60	26.32	2.50 „	1.57 „	4.13 „

(*i*) *Oleoresin.* The hybrid Panniyur-1 contained more oleoresin than the Local throughout its growth. At full maturity, it contained three times more oleoresin than the Local.

(*ii*) *Piperine.* Piperine in oleoresin showed an hyperbolic pattern of accumulation during the development of berries in both the varieties. The hybrid Panniyur-1 possesses higher piperine content than the Local variety.

(*iii*) *Starch.* It increased with increase in maturity in both the varieties. The Local variety contained more starch than Panniyur-1.

(*iv*) *Crude fibre.* Unlike starch, crude fibre content decreased with maturity. Panniyur-1 contained more crude fibre at maturity than the Local.

(*v*) *Essential oil.* Its pattern of accumulation was similar to that of oleoresin and piperine. Panniyur-1 contained much higher quantities of essential oil than the Local.

(*b*) Turmeric. A similar study has been taken up.

2. Chemical and physical characters of export grades of spices

During the year, four each out of 16 grades each of black pepper and dry ginger and six out of 20 grades of turmeric were studied. The data are given in Table 52.

PROGRAMME OF WORK (BIOCHEMISTRY), 1976

Project No.	Name of the Project	Venue
BCh. I (813 & 176)	Quality studies in spices and cashew	Vittal

SUMMARY

Phytophthora palmivora causing quick wilt when inoculated on to rooted cuttings of pepper induced symptoms quicker at lower temperature (20-26°C) than at a temperature range of 28-30°C. The fungus infected *Piper longum*, *Areca catechu* and *Theobroma cacao*. *Phytophthora* sp. isolated from rubber and cacao caused root necrosis in pepper cuttings. All the cultivars and three wild varieties of pepper tested were susceptible to the fungus. Field control trials indicated that the disease incidence was the least in treatment "Bordeaux mixture spray + Bordeaux paste application in vines up to one meter above ground level + soil drench with 0.1 % ceresan wet".

Observations on slow wilt affected vines showed that many vines are affected by root knot nematode, *Meloidogyne* sp.

The incidence of soft rot of ginger was the least in cultivars Jorhut and Sierra Leone (11.25%) as against 82.5% in Kuruppumpadi. In control trials there was no significant difference in disease incidence among treatments.

Pythium vexans was isolated from rot-affected cardamom capsules and pathogenicity established. *Phytophthora palmivora* isolated from coconut and *Pythium* sp. from damping-off affected cardamom seedlings also caused capsule rot on inoculation. All the cultivars of cardamom were susceptible to the disease.

Field control trials using different fungicides did not show any significant difference in disease incidence between treatments.

Path. II (813) and Experiment 35 **Quick wilt and slow wilt diseases of pepper**

(KKN Nambiar, YR Sarma, NG Pillai, PA Wahid, and CP Radhakrishnan)

Isolates of *Phytophthora palmivora* causing infection on leaves and roots were used for cross inoculation studies. They were cross inoculable and caused necrosis in foliage and roots. Five-month-old rooted pepper cuttings when inoculated and kept in the open (28-30°C) exhibited symptoms of foliar yellowing only after 8-10 days whereas the inoculated plants incubated in air conditioned room (20-26°C) developed the symptoms within 3-4 days indicating that lower temperature quickened the symptom expression.

The pepper isolate infects *Piper longum*, fruits of *Areca catechu* and *Theobroma cacao*. *Phytophthora* isolate from rubber trees and cacao caused root necrosis in pepper on inoculation. Cross inoculation tests with isolates of the fungus from arecanut, coconut, and citrus are in progress.

Rooted cuttings of three cultivars, seedlings of 12 cultivars of *P. nigrum* and three wild varieties of pepper (Accession No. FC 440, FC 455 and FC 780) were screened for resistance/susceptibility to *Phytophthora palmivora*. All the cuttings/seedlings tested were susceptible to the pathogen.

Field control trials have been laid out in cultivators' fields at Bandadka in Kasaragod Taluk against quick wilt using seven fungicides (12 treatments including control, three replications, plot size: 10 plants). The incidence of the disease was the least (13.3%) in treatment "Bordeaux mixture spray + Bordeaux paste application on vines up to one meter above ground level + drenching the soil with 0.1% ceresan wet @ 3 l per standard", as against 41.9% in control. Another control trial is in progress at Thiruvambadi near Calicut using fungicides, nematicides and adoption of good management practices.

Observations were recored on the degree of yellowing, dieback *etc.*, on 350 vines in slow wilt-affected gardens in Alacode area (Kerala) at frequent intervals. A few plants which exhibited yellowing symptoms during summer months recovered with the onset of monsoon, indicating that this type of yellowing might be due to soil moisture stress. However, many plants exhibiting yellowing symptoms were infected by root knot nematodes, *Meloidogyne* sp. Such plants did not recover in the monsoon period.

Path. III (813) and Experiment 36 **Rhizome rot of ginger and turmeric**

(YR Sarma, KKN Nambiar, and B Sathiamma)

Field control trials were laid out on a randomised block design using six fungicides at different concentrations either individually or in combination. There was no significant difference between treatments in the incidence of pre-emergence and post-emergence damping off. However, plants treated with

captafol (difolatan) 0.1% recorded the least disease incidence (42.5%) as against 86.6% in control.

The incidence of soft rot disease was the least in ginger cultivars Jorhut and Sierra Leone (11.25%) as against 82.5% in Kuruppumpadi, in the germplasm collection.

Based on the results obtained during the previous years, three fresh control trials have been laid out in the field involving a) fungicides and nematicides, *b*) soil amendments and *c*) management practices. The trials are in progress.

Investigations on the association of maggots with rhizome rot of ginger are being conducted at Vittal.

Path. IV (813) and **'Azhukal' disease of cardamom**
Experiment 32

(KKN Nambiar and YR Sarma)

Pythium vexans (IMI 172537) was also isolated from 'azhukal'-affected cardamom capsules in addition to *Rhytophthora* sp. and pathogenicity established. *Phytophthora palmivora* isolated from bud rot-affected coconut and *Pythium* sp. isolated from cardamom seedlings affected by damping off were pathogenic to cardamom capsules.

The disease incidence in the three cultivars of cardamom *viz.*, *Malabar*, *Mysore* and *Vazhukka* was 51.2%, 33.3% and 65.9%, respectively, showing that all are susceptible to the disease.

Path. V (813) and **Leaf spot disease of ginger**
Experiment 40

(YR Sarma and KKN Nambiar)

Field control trials against the disease were laid out using 13 fungicides in randomised block design. The plants were artificially inoculated under field conditions, by spraying spore suspension of the causative fungus *Phyllosticta zingiberi* using an atomiser. They were treated with respective fungicides after two days. A total of four sprayings was given at monthly intervals starting from July. Incidence of the disease was assessed by a scoring system. There was no significant difference between different system. There was no significant difference between different treatments although plots treated with captafol 0.1% gave the least infection (26.6%) as against 35.9% in control.

PROGRAMME OF WORK (PATHOLOGY), 1976

Project No.	Name of the Project	Venue
Path. II (813)	Quick wilt and slow wilt diseases of pepper	Kasaragod, Calicut, and Vittal
Path. III (813)	Rhizome rot of ginger and turmeric	Kasaragod, Calicut, and Vittal
Path. V (813)	Leaf spot disease of ginger	Kasaragod

ENTOMOLOGY

SUMMARY

The turmeric and ginger leaf roller caterpillars were parasitized by *Apanteles* sp. and an unidentified species of dipteran parasite, the overall mean percentage parasitisation being 8.58 and 13.27, respectively.

None of the cultivars of ginger and turmeric maintained in the germplasm collections was tolerant to the shoot borer *Dichocrocis punctiferalis*. Two species of cerambycid beetles, *Pterolophia annulata* and *Diboma procera* were recorded as new stem borer pests of pepper.

Large-scale demonstration-cum-trials were laid out for the control of pepper 'pollu' beetle and cardamom thrips.

Biology of *Chilasa clytie* infesting cinnamon leaves was studied. *Telenomus remus* Nixon (Scelionidae) was recorded as an egg parasite of *C. clytie*. The intensity of parasitisation went up to 50% during June. *Apoderus scitulus* and *Myllocerus subfasciatus* have been observed to feed on cinnamon foliage. Seven more species of insect pests collected from cinnamon were sent to the Commonwealth Institute of Entomology, London, for identification.

Ent. II (813). and **Biology and bionomics of insect pests**
Experiment 38

(OP Dubey, GB Pillai, and Vijay Singh)

1. Ginger and turmeric

Observations on the seasonal abundance of parasites and intensity of natural parasitisation of *Udaspes folus* Cram. (Lepidoptera: Hesperiidae), the leaf roller pest of turmeric and ginger, showed that the overall mean percentage parasitisation of caterpillars in the field during the entire season went up to 21.85. Out of this 8.58% was by *Apanteles* sp. (Vipionidae) and 13.27% by an unidentified species of dipteran parasite. The maximum parasitisation by the dipteran parasite was recorded during the first half of November (25.52%) and that by *Apanteles* sp. was during December (64.28%). The mode of parasitisation of different parasites was studied in the laboratory. In the case of dipteran parasite 23 maggots emerged from a single host caterpillar. This parasite normally parasitises the fourth instar caterpillars of *U. folus*.

In the case of *Apanteles* sp. as many as 69 parasite grubs emerged from a single host. *Apanteles* sp. parasitises caterpillars of the fourth instar to prepupal stages. However, in two cases parasitisation of the first instar caterpillar also was observed in laboratory cages. The pupal parasite *Brachymeria coxodentata* Joseph *et al* (Chalcididae) could not be reared in the laboratory. Biology of different species of parasites, their mode of parasitisation and feeding and mating habits are being studied. This year again the nematode parasite (Mermithidae) was observed parasitising *U. folus* caterpillars during the monsoon period.

Turmeric rhizomes were found to be infested by the maggots of an unidentified species of dipteran flies in the field. The adult flies and a species of hymenopteran parasite reared from the puparia have been sent to the Commonwealth Institute of Entomology, London, for identification.

Studies on the intensity of incidence of shoot borer *Dichocrocis punctiferalis* Guen. (Pyralidae) on different cultivars of ginger and turmeric available in the germplasm assemblage at Kasaragod were made. None of the cultivars was tolerant to the pest.

2. Pepper

Incidence of two stem borer pests was recorded on pepper during a survey of pepper gardens for studying the intensity of pests. The adult beetles reared from the affected vines were identified by the Commonwealth Institute of Entomology, London as *Pterolophia annulata* Chevr. and *Diboma procera* Pasc. (Lamiinae; Cerambycidae: Coleoptera). The grubs of these longicorn beetles tunnel into the stem causing damage to the vines. Feeding tunnels are tightly packed with frass as the grub progresses forward. Studies on the bionomics of these pests are in progress.

Other borer beetles like *Dinoderus minutus* (F.) (Bostrychidae: Coleoptera), *Derispia coccinelloides* (Wst. W.) and *Himatismus fasciculatus* (F.) (Tenebrionidae: Coleoptera) also have been reared from dead pepper vines. Further observations on the bionomics of these insects are being made.

Ent. III (813) and Chemical control of pests
Experiment 39

(GB Pillai and Vijay Singh)

Ginger and Turmeric

Field control trials against the shoot borer *Dichocrocis punctiferalis* Guen. involving three rounds of soil application of insecticide granules only, presowing soil application of granules and two rounds of post emergence spraying with dimethoate 0.1%, and three sprayings with dimethoate 0.1% only, were continued for the second season. The crop is to be harvested shortly.

Pepper

Based on the results of earlier field trials on the control of pepper 'pollu' beetle *Longitarsus nigripennis* Mots. large scale demonstration-cum-trials using dimethoate 0.1% and quinalphos 0.1% were laid out during the current season in four plots each in Calicut and Idikki districts under the adaptive research programme of the Department of Agriculture, Kerala State. The trials are continuing.

A field trial on the control of stem borer pests, *Pterolophia annulata* Chevr. and *Dihoma procera* Pasc. is being laid out.

Cardamom

Demonstration *cum* trials on the control of cardamom thrips *Taeniothrips* (*Sciothrips*) *cardamomi* Ramak. laid out under the adaptive research programme of the Cardamom Board, were in progress at three centres *viz.* Ayyappancoil and Vandanmettu in Kerala and Bhagamandala in the Coorg area of Karnataka. The data on the incidence of thrips on capsules collected from these centres were analysed. Even though the results did not show any significant difference between treatments, reduction in percentage infestation of capsules was substantially less in the treated plots (14.6 to 24.2) as compared to that in the control plots (43.7) at Ayyappancoil centre.

Ent. IV (813). **Bionomics and control of insect pests of Cinnamon**

(OP Dubey, Vijay Singh, and GB Pillai)

The cinnamon butterfly *Chilasa clytie* L. was observed in abundance in the field during the period from December to June. The eggs are laid singly on the upper surface of tender leaves, particularly on the mid ribs or the margins of leaves. Since no egg laying could be noticed in laboratory cages the exact

duration of incubation could not be worked out. However, the field collected, eggs hatched four days after collection. The caterpillar stage with five instars is completed in 9-12 days and pupal period in 13 days. Studies on the longevity of the adults have also been made. *Telenomus remus* Nixon (Scelionidae) was recorded as the egg parasite of *C. clytie* L. Average number of parasites emerged from a single egg varied from 5-8. Fifty percent of the eggs collected during June was found to be parasitised by *T. remus*. The pest and parasite populations showed a gradual decline with the onset of monsoon. The biology of the parasite is being studied. The weevils, *Apoderus scitulus* Walker and *Myllocerus subfasciatus* Guen. were observed to feed on cinnamon foliage. Seven more insect pests were recorded from the new flushes of cinnamon. These were sent to the Commonwealth Institute of Entomology, London, for identification.

PROGRAMME OF WORK (ENTOMOLOGY), 1976

Project No.	Name of the Project	Venue
Ent. II (813)	Biology and bionomics of insect pests of spices	Kasaragod
Ent. III (176 & 813)	Chemical control of pests of cashew and spices	Kasaragod Calicut
Ent. IV (813)	Bionomics and control of pests of tree spices	Calicut Kasaragod

ABSTRACT OF REPORT OF THE CO-ORDINATING CENTRES OF THE AICSCIP

Besides the Central Plantation Crops Research Institute, Kasaragod and Vittal, the All India Co-ordinated Spices and Cashewnut Improvement Project was operating at the following centres:

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Kerala Agricultural University, Mannuthy

CASHEW RESEARCH STATION, ANAKKAYAM/MANNUTHY
CARDAMOM RESEARCH STATION, PAMPADUMPARA
PEPPER RESEARCH STATION, PANNIYUR

Tamil Nadu Agricultural University, Coimbatore

CASHEW RESEARCH STATION, VRIDHACHALAM
DEPARTMENT OF HORTICULTURE, TNAU, COIMBATORE

University of Agricultural Sciences, Bangalore

REGIONAL RESEARCH STATION, MUDIGERE

Andhra Pradesh Agricultural University, Hyderabad

CASHEW RESEARCH STATION, BAPATLA
MILLET RESEARCH STATION, LAM, GUNTUR

Konkan Krishi Vidyapeeth, Dapoli, Maharashtra

CASHEW RESEARCH STATION, VENGURLA

Himachal Pradesh Agricultural University, Himachal Pradesh

FRUIT RESEARCH STATION, KANDAGHAT

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DEPARTMENT OF HORTICULTURE, OUAT, BHUBANESWAR
HIGH ALTITUDE RESEARCH STATION, POTTANGI

University of Udaipur, Rajasthan

DEPARTMENT OF AGRICULTURAL BOTANY, SKN COLLEGE OF AGRICULTURE, JOBNER

Gujarat Agricultural University, Gujarat

WHEAT BREEDING STATION, VIJAPUR

CASHEW

At Bapatla, a Tanzanian Selection EC 110888 and at Vengurla, 7 indigenous types collected from Dahanu area of Thana District, Maharashtra were added to the germplasm collection. Among the 27 promising types at Bapatla, five recorded yields ranging from 25-50 kg, while 14 yielded 10-15 kg nuts per tree. At Vridhachalam, three types *viz.* M. 15/4, M. 57/4 and M. 16/3 recorded more than 10 kg nuts, while at Anakkayam 19 trees yielded more than 10 kg nuts with BLA 139-1 yielding 34.192 kg and BLA 273-1, 20.523 kg. At Vengurla 98 trees yielded more than 10 kg nuts each. Vengurla 37/3 produced an yield of 28.04 kg. Hybrids 2/5, 2/11, 2/12, 5/7, 8/11, 5/8 and 2/4 are promising at Bapatla, H-4-7, H-3-19, H-3-17 at Anakkayam, and Midnapur Red × Veture 56, Ansur 1 × Veture 56, Veture 56 × WBDC VI at Vengurla.

The results of fertilizer trials carried out at vengurla showed that although the main effects of N and P on growth parameters were significant, responses to higher levels of N and P were controlled by the K dose. Hence a proper balanced of all three nutrients is essential for obtaining significant response.

CARDAMOM

At Mudigere the yield performance of early bearing types showed that S-1286-35, S-1289-50, S-1289-54, S-1294-77 and S-1294-80 recorded more than 1000 g green capsules per clump. Among the 80 clones, three clones *viz.* CL 722, CL 726 and CL 730 recorded more than 1000 g green capsules per clump.

Mass scale screening of nursery seedlings at cotyledonary stage for resistance to 'katte' disease is being carried out at Mudigere, Pampadumpara and Gonicoppal. Studies on the vector-virus relationship in 'katte" disease are in progress at Gonicoppal. Among the three isolates of the 'katte' agent, isolate 'C' is more virulent, and is different from isolates A and B.

At Pampadumpara, host range of *Phytophthora palmivora*, causal agent of "azhukal" (capsule rot) has been studied.

PEPPER

Seedlings raised from seeds obtained after hybridisation between 15 parental combinations have been planted in the main field at Panniyur after recording their morphological characters. Seeds obtained from intervarietal hybridisation between 7 parental combinations have been sown in the nursery. Floral biological studies showed that most of the cultivars are protogynous. A few cultivars like 'Karimunda' and 'Kalluvalli' however showed synchronous flowering. Observations on percentage incidence of fungal "pollu" in different cultivars of pepper available in the germplasm collections at Panniyur showed that all are susceptible to the disease in different degrees of intensity.

GINGER AND TURMERIC

At Kandaghat, recovery of dry ginger was more when the rhizomes were washed and treated with lime water for four hours prior to sun drying. Storing

in a room covered with grass and plastered with cowdung caused less damage to the seed rhizomes than storing in underground pits or in ordinary rooms. The germplasm comprises 17 types of ginger and 11 types of turmeric. In turmeric, the types 'Red streaked' and 'China scented' were the maximum yielders. There was no advantage of wider spacing on yield of ginger.

MINOR SPICES

For work on minor spices, *viz.*, coriander, cumin, fennel and fenugreek, the following centres started functioning from April 1975: Coimbatore, Guntur, Jobner and Vijapur.

1976

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Kerala Agricultural University, Mannuthy
- Cashew Research Station, Anakkayam/Mannuthy
- Cardamom Research Station, Pampadumpara
- Pepper Research Station, Panniyur

Tamil Nadu Agricultural University, Coimbatore
- Cashew Research Station, Vridhachalam
- Department of Horticulture, TNAU, Coimbatore

University of Agricultural Sciences, Bangalore
- Regional Research Station, Mudigere

Andhra Pradesh Agricultural University, Hyderabad
- Cashew Research Station, Bapatla
- Millet Research Station, Lam, Guntur

Konkan Krishi Vidyapeeth, Dapoli, Maharashtra
- Cashew Research Station, Vengurla

Himachal Pradesh Agricultural University, Solan, Himachal Pradesh
- Fruit Research Station, Kandaghat

Orissa University of Agriculture & Technology, Bhubaneswar
- Department of Horticulture, OUAT, Bhubaneswar
- High Altitude Research Station, Pottangi

University of Udaipur, Rajasthan
- Department of Agricultural Botany, Skn College of Agriculture, Jobner

Gujarat Agricultural University, Gujarat
- Wheat Breeding Station, Vijapur

CASHEW

The present germplasm assemblage comprise 264 types at Bapatla, 177 at Vridhachalam, 88 at Anakkayam, 96 at Vengurla, and 161 at Vittal. The high yielding selections isolated at these centres include 3/3 Simhachalam, 9/8 Epurupalem of Bapatla, BLA-139-1 and K-22-1 of Anakkayam and Vengurla 1 (Ansur 1) and Vengurla 37/3 of Vengurla. Among the F_1 progenies at Anakkayam, hybrids from crosses involving Tree No. 30 local, Tree No. 30A local and Brazil 18 continued to give higher yields. The hybrids include H-3-17 and H-4-7. Only two hybrids 2/11 and 2/12 had yielded on an average above 10 kg nuts at Bapatla over the last seven years. Progenies of 2/11 and 2/12 are being multiplied vegetatively.

Among the vegetative propagation methods tried, budding was successful at Vengurla during July-October and March-April periods. Under Bapatla and Anakkayam conditions, budding was a failure. However at these Centre veneer grafting continued to be successful during June-September (64-88%). Trials on the hormonal application to increase fruit rot were also in progress at Anakkayam, Bapatla and Vridhachalam. While at Vridhachalam 2,4-D sprays at 5 ppm increased the yields significantly, no such response was seen at Anakkayam with the chemical.

CARDAMOM

Among the 80 clones being maintained at Mudigere, CL 730 maintained its lead over others in giving yield higher than 1000 g green capsule per clump. In the yield trial involving progenies of 25 high yielding clumps, selection Nos. S1372, S1374 and S1267 gave more than 1000 g green capsule per clump. Among early bearing types S 1289-53 and S 1294-78, and among leaf rot resistant progenies S 1295-17, S 1299-61, S 1301-154 and S 1304-217 yielded more than 1000 g green capsule per clump. The F_1 progenies obtained from intergeneic crosses involving cardamom, *Amomum* sp., *Alpinea* sp. and *Hedychium* sp. have been planted in the field. The sucker production varies from 8 to 16.

All the cultivars of cardamom tested using viruliferous aphids were found to be susceptible to 'Katte' disease. At Mudigere, 19,728 seedlings were screened at nursery stage for resistance to 'Katte'. In addition, 2000 seedling progenies of gamma irradiated plants were screened against 'Katte' agent. The escapes will be subjected to reinoculation for confirmation of results.

At Pampadumpara, studies on 'Azhukal' disease and at Mudigere and Gonicoppal on nursery leaf spot disease are in progress. The early sown seedlings were able to withstand nursery leaf spot disease to a considerable extent as compared to late sown ones.

A new disease on cardamom ('Chenthal' disease) prevalent in some pockets in the High Ranges of Kerala was identified to be caused by a bacterium *Corynebacterium* sp. Preliminary trials showed that the disease could be effectively controlled by spraying 100 ppm commercial penicillin on both surfaces of leaves three days consecutively in two rounds at monthly intervals.

PEPPER

Evaluation of 42 cultivars of pepper in the germplasm assemblage at Panniyur showed that Panniyur-I gave an average yield of 6.42 kg green pepper per standard with a maximum yield of 16.67 kg green pepper from a single vine, thus establishing its superiority over other cultivars. At Panniyur, intervarietal hybridisation involving 22 crosses among 13 cultivars was done. The best pollinating variety was found to be Karimunda (28.5%) followed by Kuthiravally (27.7%) and Panniyur-I (19.3%). A total of 1776 hybrid seeds and 5845 seeds of open pollinated seeds were sown in the nursery.

At Panniyur, a field experiment to determine the ecological factors conducive to the incidence of quick wilt disease (*Phytophthora palmivora*) has been initiated. Control trials against 'pollu' disease caused by *Colletotrichum necator* are also in progress.

GINGER AND TURMERIC

Evaluation of different types of ginger and turmeric has been in progress at Bhubaneswar and Kandaghat. In an experiment on method of planting of ginger, Maran and Kunduli local types yielded higher when planted on raised beds than on flat beds or trenches. Mulching had beneficial effects on germination, vegetative growth and rhizome yield in ginger. At Kandaghat no significant difference was evident in the fertilizer trials on ginger and turmeric. The yield of ginger increased with closer spacing.

MINOR SPICES

Thirty five types of coriander were assembled in the germplasm assemblage at Udaipur centre, 48 at Guntur, and 256 at Coimbatore. Type Cs 352 gave the highest yield of mericarp at Coimbatore. In the comparative yield trial in coriander conducted at Udaipur and Coimbatore, Co-1, a medium duration type, gave the highest yield. In control trials against powdery mildew laid out at Guntur, no singificant difference was obtained between different fungicides.

In fenugreek ten types were collected and evaluated at Guntur, and 38 types at Coimbatore. At Guntur, twelve types of cumin and six of fennel and at Udaipur 130 types of cumin and 45 types of fennel were assembled in the germplasm. In fertilizer trial on cumin at Udaipur, application of N or P in addition to the common basal dose of 30 kg/ha each, did not significantly increase the yield.

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1977

SUMMARY OF THE WORK UNDER THE ALL INDIA CO-ORDINATED SPICES AND CASHEWNUT IMPROVEMENT PROJECT

Cashew

The germplasm collection consists of 90 types at Anakkayam, 241 at Bapatla, 112 at Vengurla, 177 at Vridhachalam, and 47 at Bhubaneswar. Among these, Bla-139-1, Bla-273-1, and NDR-2-1 of Anakkayam, 9/3 Ambujam, Tree No. 5/1 Ramabadrapuram at Bapatla, and Vengurla 37-3 of Vengurla gave a mean tree yield of over 20 kg during the last five years. Selections K-22-1 of Anakkayam, 9/8 Epurupalem and 3/3 Simhachalam of Bapatla, Vengurla-1 of Vengurla, M 26/1 of Vridhachalam, and hybrids H-3-17 and H-4-7 of Anakkayam, H 2/11 and H 2/12 of Bapatla, and H. 19 (Midnapore Red x Venture 56) of Vengurla continued to give good performance as in previous years. At Vengurla, 8 F_1 progenies planted in 1970 - 72 recorded more than 15 kg nuts/tree. The high yielding selections and hybrids are being multiplied vegetatively at different centres. In the comparative yield trials conducted at different centres, Vridhachalam types performed better at all the centres except at Vridhachalam.

The highest percentage of succese in all methods of vegetative propagation (side grafting, veneer grafting, and patch budding) was obtained in June-July in Anakkayam. At Bapatla, veneer grafting was highly successful (96%) in July while the best results at Vengurla was obtained (90%) in June-September with side grafting. At Vridhachalam, July-October was the best (up to 71% success) for patch budding. Patch budding continued to be a failure at Bapatla.

In the NPK fertiliser trial at Vengurla, planted in 1969, there was response to nitrogen up to 75 kg N/ha when P and K were also applied. In the hormone trials at Vridhachalam, 2, 4-D gave the highest yield of 5 . 8 kg/tree at 10 ppm and 5 . 0 kg at 5 ppm against 2 . 6 kg/tree in control.

In the minikit trials in progress at Bapatla, Vittal and Vridhachalam, trees receiving fertiliser and plant protection chemicals at recommended doses yielded significantly higher (50 to 90%) than those in control plots (Table 54)

Table 54. Mean yield of cashew in minikit trials

	Anakkayam/ Mannuthy	Bapatla	Vengurla	Vittal	Vridhachalam
		(kg nuts/tree/year)*			
Expt. plots	3.6 a	6.1 a	0.47 a	1.5 a	1.9 a
Control plots	2.7 a	3.4 b	0.25 a	1.0 b	1.0 b

*Means in the same column not followed by the same small case letter are significantly different (P = .01).

Cardamom

The germplasm collection comprises 12 types and 8 species of related genera at Mudigere and 9 types and 8 species at Pampadumpara. Among the 80 clones maintained at Mudigere, CL 654 and CL 726 recorded the highest yield of 1040 g and 844 g green capsules/clump. The early bearing types, S 1272–7, S 1282–25, S 1289–50 and S 1289–53, recorded 900–1290 g green capsules/clump. Intergeneric crosses have been made among cardamom, *Alpinia* sp , *Amomum* sp., *Hedychium* sp. and Assam cardamom. The F_1 progenies, planted in 1974 produced 8–34 suckers as against 6–12 by their parents. In the diallel crosses combinations involving multiple branch x bold capsules yielded poorly. The combinations, bold capsules x long panicle, bold capsules x early bearing, long panicle x early bearing, and early bearing, x leaf rot resistant yielded 3861, 2593, 1802, and 1094 g green capsules/clump, respectively as against a plot average of 50 g.

At Gonicoppal and Mudigere, 8000 cardamom seedlings were screened against katte using viruliferous aphids. At Pampadumpara, testing of seedlings raised from irradiated seeds was in progress. Cross protection tests involving three strains A, B, and C confirmed the earlier finding that strains A and B were related and that strain C was the most virulent.

In the trials for the control of thrips at Pampadumpara, quinalphos 0.03% sprayed at an interval of 40 days reduced thrips infestation.

Pepper

There are 72 cultivars in the germplasm collection at Panniyur. In a survey conducted during the year, 150 accessions (both cultivated and wild) were added to the collection. As in previous years, Panniyur-I continued to give the maximum yield (7.3 kg green berries/standard) with the highest yield of 14.5 kg from a single vine. During the year, 429 hybrid seeds and 3620 open pollinated seeds were sown in the nursery. Among the 2012 F_1 progenies so far transplanted, 27 have flowered. The spike characters

of Karimunda x Panniyur-I (No. 354), Karivilanchy x Cheriyakaniakadan (No. 406), and Kuthiravally open pollinated (No. 94) are promising. Studies on the control of quick and slow wilt diseases and pollu disease are in progress.

Ginger/Turmeric

During a survey conducted in north eastern India, more than 600 types of ginger and 400 of turmeric were collected These are being multiplied at Kandaghat. At Pottangi, Vengara gave the maximum yield of 31.6 tonnes/ha and No. 316 Gorakhpur turmeric gave the highest yield of 47.6 tonnes/ha. Recovery of dry ginger varied from 26.3% in Jugijan to 11.0% in Wynad Local. Mulching with wheat straw gave the highest yield in ginger (16.0 tonnes/ha). In a multilocation trial, CL No. 15 gave significantly higher yield (39.4 tonnes/ha) than the local types of turmeric (25.2 tonnes/ha). The fertiliser trials in ginger and turmeric at Kandaghat did not show any difference in yield in different treatments. The highest yield in ginger (11.2 kg/plot of 4m²) was obtained with a spacing of 15 cm x 22.5 cm.

Minor Spices

The germplasm assemblage in coriander comprises 264 types at Coimbatore, 103 at Guntur, and 84 at Udaipur. In the initial evaluation trial at Coimbatore Cs 1085 gave the highest yield (600.5 g/7.5 m²). The high yielding selection of coriander at Guntur was Cs 568 (893 kg/ha) and at Udaipur UD-21 (28.6 g/7.5 m²).

The germplasm collection in fenugreek consists of 38 accessions at Coimbatore, 25 at Guntur, and 39 at Udaipur. The accession CS 112 gave the maximum yield at Coimbatore (4.2 g seed/plant) and Nagpur local (5.2 g/plant) at Udaipur. In the comparative yield trial using 6 types at Coimbatore, CS 2336 gave the maximum yield (223 g/15 m²).

At Udaipur, the cumin germplasm consists of 146 entries. The promising accessions were UC-19 (5.0 g/plant), UC-38 (4.7 g/plant), UC-64 (4.6 g/plant) and UC-65 (4.6 g/plant). The fertiliser trials conducted at Udaipur in cumin did not give significant differences among treatments in any of the characters studied.

The germplasm assemblage in fennel comprises 25 types at Guntur and 85 at Udaipur. At Udaipur, while October-sown crops took 170-190 days for maturity, the November-sown ones matured in about 150 days. In general, late sown fennel gave less yield than early sown ones. The type UF-32 was the best yielder at Udaipur (18.8 g/plant).