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Annual Report 1989-90

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NATIONAL RESEARCH CENTRE FOR SPICES

CALICUT - 673 012, KERALA, INDIA.

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Published by :

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Cover Photo : Cardamom (clone 37) single clump with panicles.

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Director's Introduction

Research on spice crops by ICAR commenced during 1971 with the inception of All India Coordinated Research Project located at Central Plantation Crops Research Institute, Kasaragod. To strengthen Spices Research, a separate regional station of CPCRI was set up during 1975 at Calicut. During 7th Plan, regional station of CPCRI, Calicut along with Cardamom Research Centre, Appangala was merged together as National Research Centre for Spices to intensify the research on spice crops viz., black pepper, cardamom, ginger, turmeric, clove, cinnamon, nutmeg and seed spices. The headquarters of the All India Coordinated Research Project on Spices which coordinates research on spices including seed spices was shifted from CPCRI, Kasaragod to National Research Centre for Spices, Calicut in 1985, which has 15 centres located in 9 states.

MANDATES

The National Research Centre for Spices has the following mandates :

* To serve as a national centre for research on black pepper, cardamom, ginger, turmeric, clove, cinnamon, nutmeg and seed spices with special reference to production, protection and improvement.
* To serve as a centre of excellence for providing research support in basic areas to other institutions and agencies engaged in research on spice crops.
* To develop agro-techniques and location specific crop varieties to suit different agro-climatic regions of the country.
* To function as a nodal agency for germplasm exchange of spice crops.
* To service the All India Coordinated Research Project on spices.
* To serve as a centre for the storage and dissemination of information on spices and related crops.
* To function as an agency for imparting specialised training to extension personnel and for the production and distribution of elite planting materials to developmental agencies.

Location

The National Research Centre for Spices, Calicut has an area of 14 ha. located on the Calicut—Wynad road 10 km. away from city. The research farm is at Peruvannamuzhi which is 51 km. away from Calicut, near Kuttiady Irrigation Project. The farm has an area of 94 ha. of land, of which about 50 ha. have been used for various field experiments. The Cardamom Research Centre at Appangala has an area of 14 ha. located 8 km. away from Madikeri, on the Madikeri—Bhagamandala Road in Kodagu district of Karnataka.

Staff & Budget

The sanctioned strength of NRCS is 152, consisting of 39 scientific, 18 administrative, 28 technical, 5 auxiliary and 62 supporting staff. The budget allocation for 1989—90 is Rs. 84 lakhs.

Research Programmes

The research programmes of this Centre are organised into three mini-missions and a supportive research programme in accordance with the mandate and the priorities identified which are multi-disciplinary in approach.

Mini Mission I : Increasing production of spice crops through management of diseases and pests. This has 10 projects; 5 in pathology, 3 in entomology and 2 in nematology.

Mini Mission II	: Developing agro-techniques for increasing production of spice crops. This has 4 projects; 2 in agronomy, one each in soil science and statistics.
Mini Mission III	: Increasing productivity of spice crops through crop improvement. This has eleven projects; 6 in genetics and plant breeding, 3 in physiology and 2 in biotechnology.
Supportive Research Programmes	Increasing productivity of black pepper and cardamom through large scale demonstration and extension training.

Research Achievements

* *Piper colubrinum*, a wild relative of black pepper, which was found immune to *Phytophthora capsici* was found to be resistant to *Meloidogyne incognita* and *Radopholus similis*, the two endoparasitic nematodes of black pepper.
* The optical brighter Stilbyl-naphtho-triazole was found to be a vital stain for *Phytophthora*, which can be used as a flurochrome.
* In monocropping system, raising black pepper on non-living standards (RCC posts) was found to be economically viable.
* Two new taxa of *Piper* viz., *P. sugandhi* and *P. sugandhi* var. leiospicata were described and reported.
* Two high yielding and high quality selections, each in black pepper (KS 14 and KS 27) and turmeric (PCT 13 and PCT 14) were recommended for release.
* Micropropagation of ginger through leaf tissue was standardised.

About this Report

The report is organised into research highlights both in English and Hindi, detailed reports of the projects as per the mini missions, report of the All India Coordinated Research Project on Spices and general information about the institute.

A. Ramadasan

Calicut,
Date : 25.10.1990.

(A. Ramadasan)
Offg. Director

Research highlights

* One hundred and twenty three collections of wild and related species of *Piper nigrum*, 29 collections of turmeric and related species, 80 collections of ginger and related species, 10 collections of cinnamon and 9 collections of nutmeg were added to the germplasm.

* Two new taxa of *Piper* viz. *P. sugandhi* and *P. sugandhi* var. *leiospicata* were described and reported.

* Two selections of black pepper cultivar Karimunda, viz., KS 14 and KS 27 and two high yielding high quality lines of turmeric-PCT 13 and PCT 14 were recommended for release by the X Workshop of the All India Coordinated Research Project on Spices.

* In a comparative yield trial with five cultivars, cv. Aimpiriyan outyielded the rest.

* Application of neem oil-coated urea improved the N content in soil and leaf tissue and significantly increased the yield of black pepper.

* In monocropping system, raising black pepper on non-living standards like RCC posts was found to be economically viable as revealed by BC ratio (1.23) and IRR (20.61%).

* In the spacing-cum-varietal trial, closer spacing i.e., 2 x 1 m showed the superiority with highest yield. The cumulative yield data (1986—90) showed the superiority of cv. Karimunda over Panniyur-1 and Aimpiriyan.

* In the trial on systems of planting-cum-fertilizer levels in cardamom, trench system gave maximum yield (294.2 kg dry capsules/ha). Application of 160:160:320 kg of N, P_2O_5 and K_2O/ha. recorded a maximum yield of 390.4 kg dry capsules/ha.

* *Piper colubrinum* which was found immune to *Phytophthora* earlier, was found resistant to *Meloidogyne incognita* and *Radopholus similis*, the two endoparasitic nematodes of black pepper.

* Open pollinated lines of black pepper P-1352 and P-24, tolerant to *Phytophthora capsici*, under field evaluation at Sirsi, in a diseased area remained healthy and one of the vines of P-24 yielded 4.25 kg green berries in the fourth year.

* The optical brightner Stilbyl naphtho-triazole was found to be a vital stain for staining *Phytophthora* for fluorescence microscopy.

* Infestation of leaf gall thrips in black pepper was found to be positively correlated with altitude (r = 0.760).

* Of the twenty Karimunda selections of black pepper screened for drought resistance, Sel. Nos. 51 and 114 were found to be relatively tolerant over the rest.

* Quality evaluation of 46 Karimunda selections of black pepper showed the superiority of Sel. Nos. 180 and 200 with respect to piperine, oleoresin and essential oil.

* Out of the 29 germplasm accessions evaluated in cardamom, Acc. Nos. 81, 85 and 160 had better oil content and flavour ratio. From the comparative yield trial with 40 selections, PVS. 37, PVS. 39 and Nel. 1-4-8 had better oil content and flavour ratio.

* Micropropagation of ginger through callus from leaf tissue was standardised. About 500 micropropagated plants were transferred to soil in polybags.

* Vegetative propagation of clove by approach grafting was standardised with a success of

80% and 73% during December and August respectively. In cinnamon, IAA and IBA treatment improved the rooting per cent of the terminal shoots. In nutmeg, detopping of bearing trees at 2 m height was found to produce large number of orthotrophic shoots.

* In research-cum-demonstration plot an average yield of 723.3 kg. dry cardamom capsules/ha. was recorded.

* Rooted cuttings of elite lines of black pepper were distributed to farmers and developmental agencies. A total of 865 kg of C1.37 (cardamom) seed capsules were supplied to Spices Board, Department of Horticulture and farmers.

* A Kisan Mela was organised on 26 December, 1989, which was inaugurated by Shri V.V. Raghavan, Hon'ble Minister for Agriculture, Government of Kerala and was attended by about 500 farmers.

* Twelve training courses were organised on different aspects of spices production in which 71 officials participated.

* Package of practices for black pepper, ginger, turmeric, cardamom and tree spices and technical bulletins on high production technology on cardamom and black pepper were brought out.

All India Coordinated Research Project on Spices

* From Panniyur Centre of AICRP on Spices two cultures of black pepper viz., Panniyur 2 and 3 with an average yield of 1954 and 1749 kg/ha, and 10.89 and 12.67% oleoresin content were released.

* In cumin, UC 194, a wilt tolerant line, with an oil content of 2.6% and yield of 5.9 q/ha. was released from Jobner.

अनुसंधान उपलब्धियाँ

* कालीमिर्च और उनकी वन्य प्रजातियों टाक्सा के 123 नमूने हल्दी के 29 नमूने, अद्रक के 80 नमूने, जायफल के 9 नमूने और दालचीनी (सिन्नामन) के 10 नमूने समन्वित किये गये ॥

* **पैपर सुगंधी** और **पैपर सुगंधी** वेर. **लियोस्पैकेटा** नामक काली मिर्च की दो नयी प्रजातियों के लक्षणों का विवरण किया गया और उनके बारे में रिपोर्ट भी की ॥

* के एस - 14 तथा के एस - 27 नामक काली मिर्च की दो उन्नत किस्में और पी.सी.टी - 13 तथा पी.सी.टी - 14 नामक हल्दी की दो नई उन्नत किस्में बाहर करने केलिये शिफारिश की गयी। कालीमिर्च की ही अयिम्पिरियन नामक एक नई जनुस अभी तक के निरीक्षणों में बेहतर दिखा रही है ।

* यूरिया नीम तेल में मिलाकर देने से काली मिर्च का उत्पादन बढ गया । उनकी पत्तों और माटी में हए नैड्रजन की मात्रा में भी बढ़ाव आया।

* कालि मिर्च की एकमात्र फसल रवेती (Monocropping) केलिए आर. सी.सी.स्तंभ (RCCPost) जैसा अजीवित (non-livingstandard) मानक आर्थिक दुष्टि से बेहतर मालूम कीया गया (बी.सी.रेषियो 1.23 और आई. आर. आर. 20.61%)

* काली मिर्च के उत्पादन 2 ×1 m जैसे नज़दीक जगही में अधिक दर्शाया गया, ऐसे नज़दीक अंतर में लगाने केलिए किस्म करिमुन्टा, पन्नियूर - 1 तथा अयिम्पिरियन किस्में सें अच्छा जी पहचान किया गया।

* इलायची की फसल लगाने का तरीका एवं उर्वरक की मात्रा की बारे में कीयो हए परिक्षणों से मालूम हुआ कि जब इलायची खाई (ट्रेच्च) में लगाता है तब उनकी उत्पादन बढता है। (294 k.g.सुखा काप्स्यूल है) 160:160:320 किलो ग्राम मात्रा में एन. पी. के ढ़ेने से इलायची का उत्पादन 390.41 किलोग्राम सुखा कापस्यूल तक जाया गया।

* पैपर कोलु**ब्रैनम** गोलकुमियों (**मेलोटोगयन इनकग्निटा** और **राडोफोलस सिमिलिस**) का प्रतिरोध पहचान कीया। इसी जनुस पहले **फाईटोफतोरा** के भी प्रतिरोधी मालूम कीया था।

* कालीमिर्च की पी - 1352 तथा पी - 24 नामक जनुस जो पहले सिरसी में क्षेत्रीय निरिक्षण के दौरान शोग (**फाईटोफथोरा कापसिसि**) विमुक्त पाया गया था वे अभी भी शोग विमुक्त रहे और पी - 24 की एक पौधे से 4.25 किलोग्राम कच्चामिर्च पाया गया।

* **फाईटोफथोरा** की फलूरेसेन्ट मैक्रोस्कोपी निरीक्षण केलिए ओपटिक्कल ब्रैटनर नाफतो - ट्रायासोल रेंग (स्टेयिन) एक बहतर स्टेयिन मालूम पडा।

* कालिमिर्च की पत्ते में गालव्रिपस का आक्रमण फसल लगाने की ऊँचाई के अनुसार बढना हुआ दिखाई पडा (4 =0.760)।

* कालीमिर्च के ऊषर प्रतिरोध (drought resistance) मूल्यांकन में करिमुन्टा सेलक्षन - 51 और 114 नामक दो जनुसें बहतर दिखाई पडी।

* पैपरिन, ओलियोरेसिन, एसनषियल आयिल (essential oil) आदी रसायन अशों की मात्रा में कालीमिर्च की करिमुन्टा सेलकषन 180 और 200 नामक जनुसें बहतर मालूम कीया। तेल की मात्रा में और फ्लेवर रेषियो (flavour ratio) में इलायची की 81,85,160 नम्बर वाली अकतेपनों तथा पी.वी.एस -37, पी.वी.एस.39 और नेल 1-4-8 किस्में बेहतर पाये गये।

* अद्रक की पत्ते के कालस (callus) से पौधे तैयार किसे जाने की तकनीक (ऊतक सवंर्धक) विकसित की गयी। सूक्ष्म ससांधीत की गई अद्रक की 500 पौधों को रवेती में लाभ दिया ।

* जायफल, लौंग, दालचीनी आदी पेड मसाले फसल के पादप प्रजनन में अच्छी प्रगति हुई। उत्तेजानीषध (1BAऔर 1AA)इस्तेमाल करने से दालचीनी की जड अधिक होते दर्शाया गया । दो मीटर ऊँचाई पर जायफल की पेड काटने से अधिक मात्रा मै नयी आरतोट्रोपिक शारवा निकलता हुआ देखा। लौंग के पादप प्रजनन केलिए अप्रोच ग्राफ्टिंग (approach grafting) रीति अधिक सफल रही।

* इलायची के अनुसंधान एवं विवरण खेत से 723.3 किलोग्राम/ हें सूखा कापस्सूल का उन्पादन हुआ। इलायची की - cL37 जनुस की 865 किलोग्राम बीज किसानों, स्पैसस बोर्ड और वागवानी विभागों को दे दिया। काली मिर्च की उन्नत किस्म की अनेक जडवाल पौधे किसानों और अन्य विवरण अभिकरणों को दिया।

* इस वर्ष का कृषिदिवस 26 डिसंबर 1989 को मनाया गया। माननीय कृषिमंत्रि (केरल राज्य) वी.वी. राघवन ने कृषिदिवसका उघ्घाटन कीया , लगभग पाँच सौ किसानों ने इस मेला में भाग लीया।

* सेन्टर ने मसाल फसलों के विभिन्न क्षेत्रों में 12 अलप अवधि प्रशिक्षण प्रदान कीया।

* कालीमिर्च, अद्रक, हल्दी, इलायची और पेड मसाले फसल की खेती का पूर्णविवरण छोटी किताबों के रुप में प्रकाशित किया। इसके अलावा इलायची एवं कालीमिर्च के अधिक उत्पादन तकनीक के बारे में भी बुलेटिन प्रकाशित किया गया।

अखिल भारतीय समन्वित अनुसंधान परियोज्नाओं के निर्देशक और समन्वयकर्त।

* AICRP (स्पैसस) के पन्नियूर केद्र ने पन्नियूर - 2, तथा पन्नियूर - 3 नामक कालीमिर्च की दो उन्नत किस्मौं को बाहर की गयी।

* जोबनर केंद्र से जीरक (कुमिन) का एक नया रोग प्रधियेघ किस्म के (UC-19) बाहर कीया, इस किस्म से एक में से 5.9 क्विन्टल जीरा पाया गय। इस किस्म में तेल कि मात्रा 2.6% है।

MINI MISSION - I : INCREASING PRODUCTION OF SPICE CROPS THROUGH MANAGEMENT OF DISEASES AND PESTS

1. Path.II.1(813) : Epidemiological studies on *Phytophthora* foot rot disease of black pepper
(M.Anandaraj, Y.R. Sarma & K.V. Ramana)

The experiment on the effect of age of black pepper vines to infection by *Phytophthora* was concluded. This experiment has shown that all the age groups tried (1-5 years) are susceptible. The feeder root damage leads to declining symptoms and such symptoms are not expressed until a considerable proportion of feeder roots are damaged. Root infection culminates in collar rot (Table 1).

Table 1. Effect of age on infection

Age group (years)	Mortality %	Declining symptoms %	No symptoms %
5	58	17	25
4	67	33	Nil
3	67	25	8
2	25	34	41
1	42	17	41

A pot culture experiment on interaction of *Phytophthora* and *nematodes* on 1 year old vines showed that, wherever Phytophthora was inoculated either alone or in combination with nematodes the vines were killed within 20 days (Table 2).

Table 2. Interaction of *Phytophthora* and nematodes

Treatment	No. of vines dead/ No. of vines inoculated	
	After 20 days	After 2 months
T_1 *Meloidogyne incognita*	0/3	0/3
T_2 *M. incognita* + *Phytophthora capsici*	1/3	3/3
T_3 *M. incognita* + *Radopholus similis* + *P. capsici*	2/3	3/3
T_4 *M. incognita* + *R. similis*	0/3	0/3
T_5 *R. similis* + *P. capsici*	2/3	3/3
T_6 *R. similis*	0/3	0/3
T_7 *P. capsici*	2/3	3/3
T_8 Control	0/3	0/3

A new fluorochrome, stilbyl-naphtho-triazole was found to be suitable for staining *Phytophthora*. Studies on feeder root production during different periods have shown that maximum feeder roots are produced during July—August coinciding with the south—west monsoon.

2. **Path. II. 2 (813) : Screening germplasm material for reaction to *Phytophthora* foot rot disease of black pepper**
(Y.R. Sarma & M. Anandaràj)

a) Screening :

Out of a total of 1,40,083 open pollinated seeds (OP) sown in contaminated soil, 21,484 germinated. Germination in steamed soil ranged from 17 to 85 per cent. Among the existing seedlings only 26 that remained unaffected are being maintained. Out of the escapes of 1987-88 only eight seedlings survived and are being maintained. Of the 205 hybrids, 33 Karimunda selections and 10 Kottanadan selections screened by stem inoculation, none showed any tolerant reaction.

b) Field evaluation :

(i) Sirsi : Among the 15 *Phytophthora* tolerant lines (10 OP seedlings and 5 hybrids) under field evaluation, P-1352 and P-24 (OP lines) continued to show good growth. One of the vines of P-24 yielded 4.25 kg green berries in 4th year. Since these vines are grown under areca-pepper mixed cropping system with a heavy shade the yields were poor.

(ii) Peruvannamuzhi : Sixty six lines planted during 1988 in the proposed sick plot and 44 OP lines planted during 1987-88 were maintained for their field evaluation.

(iii) Central State Farm, Aralam : Forty tolerant lines (OP) were planted during 1989 in a diseased plot to study their field reaction.

3. **Path. II. 3 (813) : Disease management in *Phytophthora* foot rot affected black pepper plantations**
(Y.R. Sarma, M. Anandaraj & K.V. Ramana)

Field trials were undertaken at 3 locations viz., Idukki, Wynad and Peruvannamuzhi with 13 treatments, with three systemic fungicides (Ridomil MZ 72 WP, Aliette and Akomin), with and without nematicide (Phorate). The death of vines in treatments viz., Ridomil MZ 72 WP (100 ppm metalaxyl) + phorate (two rounds), Ridomil MZ 72 WP (100 ppm metalaxyl) (three rounds), Ridomil MZ 72 WP (200 ppm metalaxyl) and Akomin (2 rounds) were 30, 31, 32, 32% respectively and were superior to bordeaux mixture (36%) treatment and control (53.3%). The experiments also indicated ineffectiveness of fungicidal treatment on disease control under poor drainage conditions.

In an observational trial two concentrations of Ridomil MZ 72 WP (100 and 200 ppm of metalaxyl) were sprayed and drenched (one to four rounds) during the season and the berries were harvested for residue analysis.

There was severe foliar infection and vine death in the phosphorus amendment plot treated with different levels of phosphorus, thereby indicating that application of different levels of phosphorus had no effect on the disease incidence.

Antagonistic actinomycetes did not reduce the disease incidence in pot culture experiments.

4. Path III(813) : Rhizome rot of ginger and turmeric

(Y.R. Sarma, C.K. Parthasarathy Prasad,
M.Anandaraj, K.V.Ramana & T.G.Nageshwar Rao)

A field control trial was laid out in *Pythium* inoculated sick soil. The trial included two main plot treatments of soil solarisation and non-solarisation and seed treatment with seven different fungicides as sub-plot treatments. There was a spectacular suppression of weed growth in solarised beds compared to non-solarised beds. Germination ranged from 94—98 per cent in solarised plots compared to 88—93 per cent in non-solarised plots (Table 3).

The population of root knot nematodes in the soil was low but no correlation was noticed with disease incidence.

In general, the disease incidence was less and yield was more in solarised plots compared to non-solarised plots. However, the results were not statistically significant. Pooled data showed minimum incidence (2.67%) in capatafol treatment in solarised plots, 10.8% in phorate treated plots compared to 25.5% in control. The yield in plots treated with captafol, Ridomil MZ 72 WP and Aliette in solarised plots were 3.6, 4.3 and 4.28 kg/3 x 1 m bed compared to 1.26 kg in control (Table 4). The experiment also indicated that split plot design is not suitable for the experiments with soil solarisation and non-solarisation treatments as there was inter-plot interference.

Table 3.

Effect of soil solarisation on germination, incidence of rhizome rot in ginger and weed growth

(60 days after sowing)

Observations	Treatments	
	Solarised	Non-solarised
1. Weed growth (in kg dry weight for 3 x 1 m bed)	0.209	1.15
2. Germination (%)	94.90	88.90
3. Soil temperature (at 5 cm depth)	45°C	39°C
4. Rhizome rot incidence (%)		
a) Seed treatment with Ridomil MZ 72 (500 ppm metalaxyl)	15.2	33.3
b) Seed treatment with Dithane M-45 (0.3%)	17.2	57.2
c) No seed treatment	25.5	47.7

Table 4. Effect of soil solarisation and fungicides on rhizome rot incidence in ginger

Treatments	Disease incidence (%)		Yield in kg/ 3 x 1 m bed	
	S_0	S_1	S_0	S_1
1. Dithane M-45 (0.3%)	57.2	17.2	0.09	0.66
2. Captafol (0.3%)	46.5	2.6	0.19	3.60
3. Ridomil MZ 72 WP (500 ppm metalaxyl)	33.3	14.3	0.32	4.30
4. Aliette (3000 ppm)	44.4	20.7	0.12	4.28
5. Ridomil + Thimet	44.9	25.5	0.18	1.12
6. Aliette + Thimet	33.8	10.8	0.79	0.90
7. Thimet (30 g/bed)	40.6	10.8	0.31	0.90
8. Control	47.7	25.5	0.20	1.26
C.D. (0.05)		NS		

S_0 = Non-solarised S_1 = Solarised

5. Path IX (813) : Investigations on the rhizome rot disease of cardamom

(M.N. Venugopal & Santhosh J. Eapen)

a) Epidemiology :

(i) *Monitoring of pathogens :* Monitoring of pathogens from infected rhizomes in different seasons revealed the predominance of *Pythium vexans* in wet period. Dominance of *Rhizoctonia solani* was distinct in pre-monsoon and post-monsoon period.

(ii) *Survival of pathogens :* Studies made to re-isolate rhizome rot pathogens from soil and debris which were stored for 4 days to 29 months under laboratory conditions, yielded positive isolations upto 15 months of storage. This indicated that *P. vexans* and *R. solani* survive in soil and debris in infected plantations and these serve as primary source of inoculum for the next season.

(iii) *Effect of rainfall :* Monitoring of agro-meteorological parameters in relation to disease incidence and severity was carried out in two plots, one each in rainfed and irrigated conditions. The studies confirmed the profound impact of rainfall on disease incidence and severity. Under rainfed conditions 98% of the new infections occur during monsoon whereas under irrigated conditions 82% of new infections occur during monsoon period.

b) Control trial :

A field control trial was laid out in growers field in 7 year old plantation having 4 years history of rhizome rot. Four fungicides viz., Ridomil MZ 72 WP, Aliette, PCNB and Copper oxychloride were tested singly and in combination with Phorate. The disease severity, was recorded by adopting 1-5 rating scale. The first year's result indicated the superiority of Ridomil MZ 72 WP, copper oxychloride and Ridomil MZ + Phorate over untreated control.

6. Ent X (813) : Bionomics of major pests of black pepper and evolving integrated control measures against them

(T. Premkumar)

a) 'Pollu' beetle :

i) *Screening of black pepper cultivars :*

Observations were recorded on 234 black pepper accessions maintained at NRCS Farm, Peruvannamuzhi for their reaction to 'pollu' beetle infestation. Eight accessions were free of infestation, 31 accessions had 1 per cent infestation, 67 accessions had 1-5 per cent infestation and 27 accessions had > 5 per cent infestation.

ii) *Screening of wild germplasm :*

Among seven wild relatives of pepper screened adopting leaf screening technique, *P. argyrophyllum, P. mullesua, P. chaba* and *P. hookeri* were not fed by the beetle.

b. Top shoot borer :

i) *Survey for pest incidence :*

A survey for pest incidence was carried out in Calicut and Kasaragod districts. Thirty six gardens were surveyed in Calicut district and the infestation ranged from 13 to 100 per cent. In Kasaragod district, 32 gardens were surveyed and the infestation ranged from 36 to 100 per cent.

ii) *Nature of damage :*

One hundred new shoots were labelled and observed. Fifty shoots were sprayed with 0.05% monocrotophos to protect the shoots from infestation and the remaining 50 were left

unsprayed. The average number of laterals produced was high in unsprayed shoots. The average height was high in sprayed shoots. However, these values were not significant.

iii) *Control trials :*

Trial with granular insecticides : Phorate and carbofuran @ 3 g a.i. were tried on one year old black pepper vines to study their efficacy in controlling shoot borer infestation. The insecticides were applied twice, once during July and another during September. The analysis revealed that the insecticides were not effective in controlling the pest infestation.

Number of sprayings : Three insecticides found effective for controlling top shoot borer viz., monocrotophos, endosulfan and quinalphos were tried to standardise the number of sprays required for controlling the pest. The treatment consisted of four (June, July, August and September), three (June, August and September) and two (June and September) sprays. The insecticides were sprayed on one year old vines. Analysis of the data revealed that there was no significant difference between the number of sprays in controlling the pest infestation.

7. Ent VIII (813) : **Bio-ecology and control of marginal gall forming thrips *Liothrips karnyi* Bagnall infesting black pepper**

(S. Devasahayam)

a) Incidence of gall thrips in relation to altitude and cultivars

The data on the incidence of gall thrips recorded earlier during surveys conducted in 116 locations in Kerala, Karnataka and Tamil Nadu was analysed. A significant and positive correlation ($r = 0.760^{**}$) existed between pest incidence and altitude of the location. The incidence of gall thrips among the various cultivars showed the following trend : Wynad local = Kalluvally = Arakulamunda > Karimunda = Panniyur 1 > Vellamunda.

b) Seasonal population of gall thrips :

Studies on the seasonal population of gall thrips were continued at Kalpetta (Wynad district). Leaf galls were collected at monthly intervals and the population of eggs, juveniles and adults were counted. The pest population (juveniles and adults) was high during June—August and low during September—April. Peak population occurred during July.

c) Seasonal population of natural enemies :

The population dynamics of common predators of gall thrips viz., *Montandoniola moraguesi, Androthrips flavipes, Rhodesiella* sp. and *Lestodiplosis* sp. was studied at Kalpetta. The populations of *M. moraguesi* and *A. flavipes* were high during July—September and June—September, respectively. *Rhodesiella* sp. and *Lestodiplosis* sp. occurred in low numbers during May—November and July—December, respectively.

d) Effect of insecticides on natural enemies :

The effect of insecticide sprays (monocrotophos and dimethoate - 0.05% each) on field populations of natural enemies of gall thrips was studied at Kuppadi (Wynad district). Two sprays of the recommended insecticides were given during June and July. Observations carried out one month after treatment indicated that all the natural enemies were killed by the sprays. Preliminary studies were also conducted to study the effect of monocrotophos and dimethoate on *M. moraguesi* under greenhouse conditions. Rooted cuttings of black pepper were sprayed with the test insecticides. Leaves of the sprayed plants were clipped off at 2 day intervals and *M. moraguesi* adults were introduced. The predators were removed after 10 hours and their mortality was recorded after 24 hours

after providing adequate food materials. The trials indicated that monocrotophos and dimethoate were toxic upto 9 and 7 days, respectively after application.

e) Propagation of anthocorid predator :

The feasibility of propagating *M. moraguesi* on rooted cuttings of black pepper was attempted. However, because of the early drying up of cut shoots and the closed nature of galls which was damaged while examination, the predator could not be multiplied. Thrip galls of various other plant species were examined to detect the presence of *M. moraguesi*. The predator was observed in leaf galls of *Mimusops elangii* induced by *Arrhenothrips ramakrishnae*. Seedlings of *M. elangii* are being raised for propagation of the predator.

8. Ent IX (813) : Studies on the coccids infesting black pepper

(K.M. Abdulla Koya)

a) Survey :

During the survey conducted to record the incidence of coccids, 540 pepper vines spread over in 36 gardens and 480 vines in 32 gardens respectively were observed in Calicut and Kasaragod districts. In Kasaragod district mild infestation by mealy bug and scale insects were recorded in 11 villages. The mealy bug collected was *Pseudococcus longispinus* and the scale insect collected other than *Aspidiotus destructor* is to be identified. However, in Calicut district, the presence of neither scale insect nor mealy bugs were noticed.

b) Seasonal abundance of coccids:

Studies carried out at Kalpetta by taking samples from infested vines and recording the population at monthly intervals showed that maximum population of *Lepidosaphes piperis* was during April and the minimum during October. The population was found to increase from November onwards.

c) Natural enemies :

The population of natural enemies especially that of the hymenopteran parasite was low during May—October. Other natural enemies such as a red mite *Bdella* sp., *Cybocephalus* sp., *Karnyothrips melaleucus* and *Aleurodothrips fasciatus* were observed throughout the year. The coccinellid beetle predaceous on scale insects was identified as *Chilocorus circumdatus* and the hymenopteran parasite as *Encarsia (Aspidiotiphagus) lounsburyi* Berlese and Paoli.

d) Biology :

Though attempts were made to culture *L. piperis* on pumpkin at different temperature ranges, the crawlers did not establish. Hence, preliminary studies on the biology of *L. piperis* were carried out by establishing the crawlers on rooted pepper cuttings. The crawlers took more than one day for establishment. The pepper cuttings were kept undisturbed for 24 h after releasing the crawlers. The measurements of the egg, crawlers and other stages on 1st, 2nd, 3rd, 7th, 14th, 28th and 30th day after releasing the crawlers were recorded.

e) Insecticide screening :

For screening insecticides against *L. piperis* 400 rooted pepper cuttings have been inoculated with the pest for uniform establishment.

9. Nema II (813) : Role of nematodes in the incidence of slow decline of black pepper

(K.V. Ramana)

a) Screening of black pepper germplasm :

(i) *Cultivated germplasm* : Thirty two accessions of cultivated germplasm were tested for their reaction to *M. incognita* and *R. similis* during the year 1989-90. All the accessions were found susceptible to both the nematode species.

(ii) *Related species* : *Piper colubrinum* was found resistant to both *M. incognita* and *R. similis*.

(iii) *Karimunda selections* : Fifteen selections of Karimunda (including six selections which showed resistance in the preliminary tests) tested for their reaction to *M. incognita* and *R. similis* were found susceptible to the nematodes.

(iv) *Open pollinated seedlings* : About 10,100 open pollinated seedlings of different cultivars viz., Panniyur-1, Karimunda, Aimpiriyan, Balankotta, Valiyakaniyakadan and CLT-P-812 were tested for their reaction to *R. similis* and none was found resistant/tolerant to the nematode.

b) Pot culture studies for the control of nematodes infesting black pepper using biological agents and nematicides :

A pot culture study was initiated to study the efficiency of VAM for the control of root-knot nematode infestation in black pepper with the following treatments replicated five times. Single node rooted cuttings of balck pepper hybrid Panniyur-1 were planted in 8" earthen pots filled with sterile soil mixture (6kg/pot). One month after planting, VAM were introduced into the pots. Six weeks after introducing VAM, the plants were inoculated with freshly hatched second stage juveniles of *M. incognita* @ 2000/pot. Four weeks after nematode inoculation nematicides were applied to the pots as per the treatments.

Treatments :

T_1 - *Glomus mosseae* + *M. incognita*

T_2 - *Acaulospora laevis* + *M. incognita*

T_3 - *Glomus fasciculatum* + *M. incognita*

T_4 - *Gigaspora margarita* + *M. incognita*

T_5 - *M. incognita* + *Phorate*

T_6 - *M. incognita* + *Ekalux*

T_7 - *M. incognita* alone

T_8 - Absolute control

The above experiment is in progress

c) Field control trials :

A plot consisting of 300 pepper vines was raised and maintained for taking up control trials under field conditions.

10. Nema I (813) : Investigations on plant parasitic nematodes associated with cardamom

(Santhosh J. Eapen)

a) Pathogenicity trial :

The trial initiated in December, 1987 was continued. Observations on growth, yield and *Meloidogyne incognita* level of each test plant were monitored. The plants were harvested at fortnightly intervals. The compiled data revealed a highly significant reduction in the yield of inoculated plants compared to that of control plants (Table 5). They have also shown significant reduction in the number of tillers and panicles.

A pot culture study was conducted to assess the influence of plant age on root-knot nematode infestation and multiplication, C1.37 seedlings of four age groups viz., 2, 12 and 24 months old and adult suckers with two levels of initial nematode population were tested. It was found that number of galls/g root is negatively correlated to the age of the plant. The average gall size was maximum in young seedlings while it was on par in all other categories. The root population showed a curvilinear relationship with the maximum population (per g root) recorded in 12 months old seedlings. There was a gradual decline in the root population beyond this level.

b) Screening of germplasm :

Twenty one germplasm accessions were screened using the standardised methodology and all were found susceptible to root-knot nematode.

c) Control trial :

Soil application of three chemicals (carbofuran, phorate and quinalphos) @ 2.5 and 5 g a.i./ plant and neem cake @ 250 and 500 g/plant was done during June and October. The growth of the plants as well as the nematode level in the roots and soil were monitored.

d) Studies on Population dynamics :

The roots yielded the highest populations of root-knot nematodes during the post-monsoon period while there are two peaks viz., March—April and September—October in the case of soil samples. This seasonal abundance was found to be related to soil temperature and crop phenology.

Table 5. Effect of *M. incognita* on growth and yield of cardamom

Inoculum level	height of the plant	No. of tillers	No. of panicles	Mean inter nodal length (cm)	No. of capsules	Yield (dry wt.)	Recovery rate %
0	2.48	36.0	30.6	2.08	952.3	161.0	21.6
100	2.31	24.4	21.4	2.03	548.1	94.9	21.6
1000	2.45	25.6	19.4	2.09	454.0	78.3	18.7
10000	2.39	25.9	19.3	2.03	458.5	73.3	20.4
100000	2.50	26.3	20.2	2.01	578.2	98.9	21.2
C D 5%	N.S	4.7	7.3	N.S	233.0	42.5	N.S
1%	N.S	6.3	N.S	N.S	310.9	56.7	N.S

MINI MISSION-II : DEVELOPING AGRO—TECHNIQUES FOR INCREASING PRODUCTION OF SPICE CROPS

1. Agr. VI (813) : Studies on the impact of input technology on the yield performance and quality attributes of black pepper

(B.N. Reddy & A.K. Sadanandan)

a) Spacing-cum-varietal trial :

The yield data on spacing-cum-varietal trial in black pepper, started during 1983, with four spacings (3 x 3 m, 2.5 x 2.5 m, 2.5 x 1.5 m and 2 x 1 m) and three varieties (Panniyur-1, Karimunda and Aimpiriyan) using RCC posts as standard, showed that there was no significant difference in yield among the varieties (Table 1).

However, the variety Panniyur-1 recorded the highest yield (5013 kg/ha) followed by Karimunda (4086 kg/ha). Significant differences in yield was recorded among the spacings. The highest yield (7250 kg/ha) was recorded in the closest spacing 2 x 1 m. There was no significant interaction between varieties and spacing with respect to yield. The highest yield (8249 kg/ha) was obtained in Panniyur-1 in the spacing of 2 x 1 m followed by Karimunda (6874 kg/ha) and Aimpiriyan (6627 kg/ha).

The yield data for 3 years when pooled, revealed no significant difference due to varieties. However, significant differences in yield were observed among spacings (Table 2). The closer spacing of 2 x 1 m proved significantly superior to all other spacings. The soil nutrient status in different treatments revealed that there is depletion of nutrients under high planting density.

Table 1 : Yield of black pepper as influenced by Spacings and Varieties during 1989-90

Varieties	Spacing (m)				
	3.0 x 3.0	2.5 x 2.5	2.5 x 1.5	2.0 x 1.0	Mean
	(1100)*	(1600)	(2600)	(5000)	
Panniyur - 1	2870**	4199	4734	8249	5013
Karimunda	2130	2859	4481	6874	4086
Aimpiriyan	2048	2989	4323	6627	3997
Mean	2349	3349	4513	7250	
		Variety	Spacing	Interaction	
C.D 5%		N.S	2002	N.S	

* Values in parentheses are number of vines/ha

** Values indicate mean yield in kg/ha (fresh)

Table 2 : Yield of black pepper as influenced by Varieties and Spacing (Average of 3 years - 1988-90)

Varieties	Spacing (m)				
	3.0 x 3.0	2.5 x 2.5	2.5 x 1.5	2.0 x 1.0	Mean
	(1100)*	(1600)	(2600)	(5000)	
Panniyur - 1	1593**	2537	3491	5114	3184
Karimunda	1963	2525	4542	7358	4097
Aimpiriyan	1466	1910	3207	5520	3026
Mean	1674	2324	3747	5997	

	Variety	Spacing	Interaction
C.D 5%	N.S	920	N.S

* Values in parentheses are number of vines/ha
** Values indicate mean yield in kg/ha (fresh)

b) Fertilizer trial :

The soil and leaf samples were drawn and analysed for major and secondary elements from the fertilizer experiment with 4 levels of N (50, 100, 150 and 200 g/vine/year) and 4 levels of K (70, 140, 210 and 280 g/vine/year) with five additional treatments viz., $N_0P_0K_0$, $N_{50}P_{60}K_{140}$, $N_{50}P_{60}K_{140}Ca_{50}Mg_0$, $N_{50}P_{60}K_{140}Ca_{50}Mg_{50}$ and $N_{50}P_{60}K_{140}Ca_0Mg_{50}$ initiated during 1987. Data showed that application of nitrogen upto 150 g per vine increased the organic matter status of soil as well as the leaf status of N (Table 3). Application of potash upto 280 g per vine increased the exchangeable K in the soil and also in the leaf tissue (Table 4). Application of calcium and magnesium increased the exchangeable calcium in the soil compared to control plots, thereby indicating the significance of these elements in the balanced nutrition of black pepper.

Table 3 : Effect of application of NPK, Ca and Mg on Soil organic matter and leaf concentration of N, Ca, Mg and Al.

Treatment g/vine	Organic matter %	Leaf N g/kg	Soil Ca g/kg	Leaf Ca g/kg	Soil Mg mg/kg	Leaf Mg g/kg	Soil Al mg/kg	Leaf Al mg/kg
N Levels								
0	2.75	12.0	268	27.0	64	2.8	14.0	160
50	3.41	16.8	827	22.8	43	3.0	4.8	186
100	3.49	17.8	819	25.3	45	2.6	6.1	180
150	3.53	20.0	760	26.9	47	2.8	7.0	171
200	2.92	18.0	564	24.0	37	2.1	7.5	148
$N_{50}P_{60}K_{140}$	3.35	18.0	986	22.0	46	3.0	5.2	177
$N_{50}P_{60}K_{140}Ca_{50}Mg_0$	3.01	18.0	1278	34.0	45	2.9	8.1	215
$N_{50}P_{60}K_{140}Ca_0Mg_{50}$	3.18	14.0	742	22.0	65	3.5	10.3	232
$N_{50}P_{60}K_{140}Ca_{50}Mg_{50}$	3.35	13.5	1368	24.0	79	2.8	8.4	194

Table 4 : Effect of application of potash on soil availability and leaf tissue content of 'K'

Potassium levels g/vine	Soil K mg/kg	Leaf K g/kg
0	56	20.0
70	179	23.0
140	240	24.0
210	305	26.0
280	407	26.5

2. Agr. XIII (813) : Systems of planting-cum-fertilizer levels in cardamom under rainfed conditions

(V.S. Korikanthimath)

In the experiment on systems of planting-cum-fertilizer treatment under rainfed conditions, as in the previous year the trench system of planting proved to be superior to pit method in most of the characters.

a) Growth character :

The trench system of planting recorded significantly higher total number of tillers per plant (18.01) as against pit system of planting (14.70). There was a significant difference between the number of tillers per plant under trench system in the treatments applied with fertilizer 40 : 40 : 80 (15.02), 80 : 80 : 160 (18.02), 120 : 120 : 240 (20.25) and 160 : 160 : 320 (23.75) kg NPK/ha as compared to control (12.82). Even in the case of pit system with higher levels of fertilizer i.e., 120 : 120 : 240 and 160 : 160 : 320 kg NPK/ha. the maximum number of tillers per plant were 17.42 and 19.07 respectively compared to control (8.37).

b) Soil moisture :

The soil moisture was determined by Gravimetric method during March 1990 at 0-15 and 15-30 cm depths, after a dry spell of over 150 days. The soil moisture was highest at 15-30 cm depth under trench (21.43 %) and pit (17.46%) systems respectively as compared to 0-15 cm depth where again the trench system recorded higher moisture (17.85) as against the pit (14.89%).

c) Yield :

Amongst the two systems of planting, trench system of planting was found to record significantly higher dry cardamom yield (202.32 kg/ha) as compared to pit system (176.16 kg/ha).

Regarding fertilizer levels the two higher levels viz., 120 : 120 : 240 and 160 : 160 : 320 kg NPK/ha were at par recording 246.90 kg and 262.97 kg dry cardamom/ha respectively (Table 5). The lowest yield was observed in control (95.30 kg/ha in trench and 68.85 kg/ha in pit system, respectively).

Table 5 : Yield of Cardamom as influenced by system of planting and fertilizer levels

Systems of Planting	NPK fertilizer levels (kg/ha)					
	0:0:0	40:40:80	80:80:160	120:120:240	160:160:320	Mean
Pit	68.85	146.82	182.40	231.30	251.42	176.16
Trench	95.30	175.60	203.70	262.50	274.52	202.32
Mean	82.07	161.21	193.05	246.90	262.97	

Gen. Mean 189.24
C.V. % 9.18

C.D. for system of planting 11.273
C.D. for fertilizer treatments 17.824

3. SSc. I (813) : Mineral nutrition studies of black pepper :
Nitrogen management through slow release N-fertilizers

(A.K. Sadanandan)

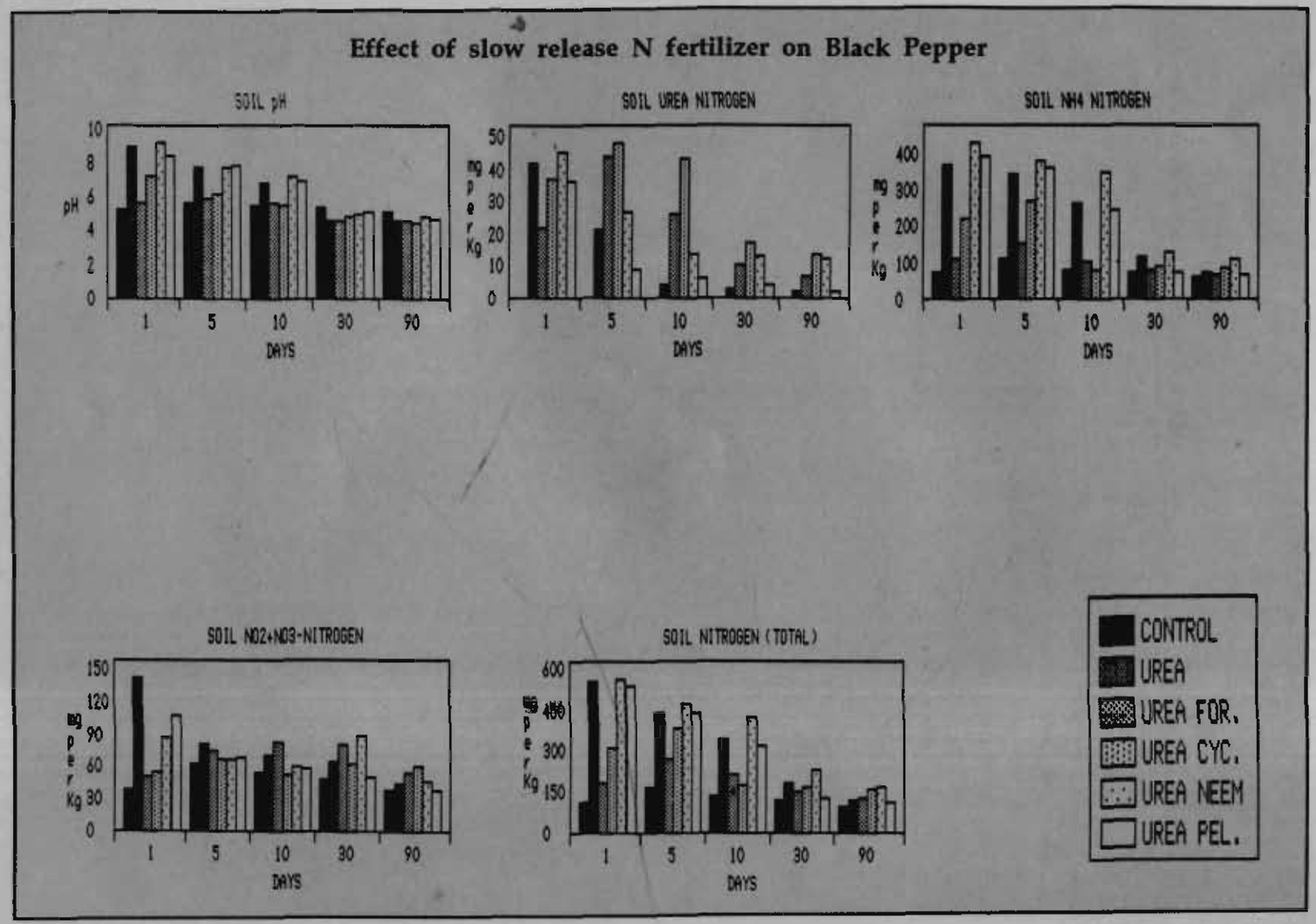
a) Field studies :

Slow release N-fertilizers viz., Neem oil-coated urea, urea formaldehyde, Cyclo-di-urea, urea pellet, urea and an untreated control, were applied to Panniyur-1 pepper grown in a laterite soil. The soil samples were drawn on 1, 5, 10, 30 and 90th day after the application of fertilizers and were analysed for soil pH, urea—N, NH_4-N and NO_3-N to study the mineralisation and release pattern of nitrogen in the soil. The leaf tissues were analysed for total N. The yield of pepper was also recorded.

Soil analysis revealed the mineralisation pattern of slow release N—fertilizers in the laterite soil (Fig.1). The release of urea-N, ammoniacal and nitrate nitrogen were significantly higher and persistent in the soil for a longer period in the case of neem oil-coated urea. The recovery of applied nitrogen was also high in the case of neem oil-coated urea. The total N content in the soil and in the leaf tissues were also high due to this treatment. The application of neem oil-coated urea increased the yield of pepper by 280% compared to urea, showing its superiority compared to other slow release N fertilizers.

b) Laboratory incubation studies :

Laboratory incubation studies were carried out in the laterite soil at the moisture level of 80% water holding capacity. In this case two more fertilizers viz., urea-gypsum and urea-rock were tested besides the five slow release N-fertilizers tested for the field study. Nitrogen was applied at 200 ppm and incubated at 28°C ± 2°C and soil samples were drawn on 1, 5, 10, 30 and 90 days after the application of fertilizers and analysed for urea-N, NH4-N and NO3-N. The results showed that the release of urea-N persisted for a longer period in the case of neem oil-coated urea, and least in the case of urea. The release of NH4-N and NO3-N was also steady and high in the case of neem oil-coated urea, indicating the superiority of this fertilizer over others.


Effect of slow release N fertilizer on Black Pepper
SOIL pH
pH
DAYS
SOIL UREA NITROGEN
mg per Kg
DAYS
SOIL NH4 NITROGEN
mg per Kg
DAYS
SOIL NO2+NO3-NITROGEN
mg per Kg
DAYS
SOIL NITROGEN (TOTAL)
mg per Kg
DAYS
CONTROL
UREA
UREA FOR.
UREA CYC.
UREA NEEM
UREA PEL.

4. Stat. III (813) : **Optimum size and shape of plots and blocks for experiments in black pepper**

(Jose Abraham)

Analysis of data on yield for the selected 288 black pepper vines in 12 rows and 24 columns for the two years viz., 1988-89 and 1989-90 revealed that there was significant reduction in the coefficient of variation as the plot size increased from single vine to 8 vines per plot. Different plot sizes and coefficient of variation are given in the Table 6.

Table 6 : Plot size and coefficient of variation

Plot Size	Coefficient of variation (%)	
	1988-89	1989-90
1	66.4	55.8
2	52.1	43.4
4	40.2	34.3
6	36.3	32.2
8	32.5	28.4
12	29.0	26.8

MINI MISSION - III : INCREASING PRODUCTIVITY OF SPICE CROPS THROUGH CROP IMPROVEMENT

1. Gen. I (813) : **Collection, conservation, cataloguing and evaluation of black pepper germplasm**

(P.N. Ravindran, B. Krishnamoorthy, K.Nirmal Babu, V.S. Korikanthimath & Johnson K. George)

a) Collection and conservation :

Forest ranges of Brymore, Palode, Silent Valley, Sugandhagiri, Sholayar and Ranni of Kerala and Courtellam area of Tamil Nadu were surveyed and 123 collections of *Piper nigrum* and related taxa were collected, making the total germplasm holding to 750, including one line each of *P. chaba* and *P. magnificum* and two lines of *P. barberi.*

The germplasm conservatory was expanded by planting 200 more accessions making the total accessions in the field to 450. At the NRCS Cardamom Research Centre, Appangala, 98 accessions of wild and related *Piper* spp. were planted for conservation.

b) Characterisation :

Two new taxa of Piper viz., *P. sugandhi* and *P. sugandhi* var. *leiospicata* were described. Morphological studies have given the indication that these might have originated through natural hybridisation between *P. nigrum* and *P. trichostachyon* (in the case of *P. sugandhi*) or between *P. nigrum* and *P. galeatum* (Table 1).

Table 1 : Certain characters of *P. sugandhi* and its putative parents (*P. nigrum* and *P. trichostachyon*)

Character	*P. nigrum*	*P. trichostachyon*	*P. sugandhi*
Habit	Woody climber	Woody climber	Woody climber
Spike	Flowers closely arranged	Flowers spaced	Flowers less spaced (intermediate)
Bract	Cupular with decurrent base	Connate, forming Fleshy cup	Deeply cupular and some what fleshy base decurrent
Texture	Glabrous	Minutely hairy	Minutely hairy
Stamens	Two	Two	Two
Fruit shape	Round	Oblong	Oblong
Taste	Pungent	Bitterly pungent	Pungent
Chromosome number	2n = 52	2n = 52	2n = 52

All the wild collections were studied morphologically and chemically. Based on these studies a new dichotomous key has been formulated for South Indian *Piper* spp. In this, the genus is subdivided into two sub-genera based on the orientation of spike viz., Pipali (spikes-erect) and Maricha (spikes-pendent). Studies have given the indications that the cultivated *P. nigrum* might have originated as a hybrid between *P. wightii* and *P. galeatum*.

Data on morphological and spike characters of 70 accessions have been recorded for characterisation.

c) Evaluation :

Preliminary evaluation of germplasm collections showed that the collection CLT-P-125 is promising having good yield characters.

2. Gen. IX (813) : **Collection, conservation, cataloguing and evaluation of cardamom germplasm**
(Regy Lukose)

Germplasm collections were maintained and yield data was collected.

Vegetative character and yield parameters were collected from 25 accessions for preparing the descriptors.

3. Gen. II (813) : **Collection, conservation, cataloguing and evaluation of germplasm of ginger and turmeric**
(P.N. Ravindran, K. Nirmal Babu, J. Rema & B. Sasikumar)

a) Collection and conservation :

Twenty nine collections of turmeric and related species, 80 collections of ginger and related species including one cultivar each of ginger and turmeric from Arunachal Pradesh were added to the germplasm. These include one collection of wild ginger and two collections of turmeric viz., *Zingiber macrostachyum* *Curcuma ecalcarata* and *C. raktakanta* from Silent Valley. One stable tetraploid line of ginger (KUB x 4) received from the Botany Deparment, Kerala University was also added to the germplasm.

Turmeric PCT – 13

Turmeric PCT – 14

b) Characterisation :

Morphological data on 135 accessions of turmeric was recorded for characterisation and cataloguing.

c) Evaluation :

Two high yielding lines were shortlisted from 10 promising turmeric cultivars from multilocation trial conducted for three years (Table 2). These lines are PCT 13 and PCT 14 with mean yields of 29.2 and 28.8 t/ha of fresh

rhizomes, respectively (Table 3). These two lines were recommended for release by the X Workshop of All India Coordinated Research Project on Spices held at Coimbatore during August 1989. Among 100 lines of seedling progenies of turmeric planted for preliminary yield evaluation during 1989, two lines were found to be promising. These yielded 28 and 25 kg of fresh rhizomes per 3 x 1 m bed, respectively.

In the MLT of 12 selections from NRCS, TNAU, KAU and HRS, Pottangi, the better yielders are PCT 8, PCT 5 and VK 7, with mean yields of 11.7, 10.5 and 8.6 kg/3 x 1 m beds, respectively.

Table 2 : Yield Analysis of turmeric in the multilocation trial

Sl. No.	Treatments	Mean yield in Kg/ 3 x 1 M plot (fresh rhizomes)			Projected yield in tonnes/ha (average) @ 2010 bed/ha	Projected yield potential in tonnes/ha (based on max. yield in one location)
		Calicut	Jagtial	Grand Mean		
1.	PCT 10	18.97	7.03	13.00	26.13	53.46
2.	" 11	14.10	5.30	9.70	19.50	37.79
3.	" 12	14.52	5.34	9.93	19.96	41.81
4.	" 13*	19.62	9.50	14.56	29.26	60.30
5.	" 14*	19.83	8.84	14.34	28.82	54.87
6.	" 15	16.49	4.55	10.52	21.15	57.68
7.	" 16	16.07	5.76	10.92	21.95	47.23
8.	" 17	14.54	4.88	9.71	19.52	51.85
9.	" 18	13.15	4.89	9.02	18.13	29.55
10.	" 19	14.72	5.17	9.95	19.99	44.22
	Control					
11.	PCT 2	10.73	7.48	9.11	18.31	40.20
12.	" 5	15.63	5.26	10.45	21.00	50.25
13.	Suvarna 15.21	—	—	17.42	43.50	

* PCT 13 & PCT 14 : Crop duration — 190 days

Table 3 : Yield and Curcumin content of two turmeric selections, compared to "Suvarna"*

Selection	Yield of fresh rhizomes t/ha		Curcumin %
	Mean	Yield potential	
* Suvarna (PCT 8)	17.4	43.5	8.7
** PCT 13 (Suguna)	29.2	60.3	4.9
** PCT 14 (Sudarsana)	28.2	54.8	7.9

* A variety released by NRCS
** New varieties recommended for release

4. Gen. VI (813) : **Collection, conservation, cataloguing and evaluation of germplasm in tree spices**

(B. Krishnamoorthy & J. Rema)

a) Collection & Conservation :

i) *Cinnamon* : Ten collections of *Cinnamomum verum* and one collection of *Cinnamomum aromaticum* were added to the germplasm.

ii) *Nutmeg* : A wild collection, *Myristica dactyloides* having powdery coated fruits, from Silent Valley and 8 collections of *Myristica fragrans* were added to the germplasm. Quality planting materials were raised by collecting seeds and scion materials from elite trees.

iii) *Clove*: Fourteen elite trees at Nagercoil were identified and marked for seed collection.

b) Characterisation :

Clove: Floral biology observations were carried out on indigenous and Zanzibar collections. The mean number of flower buds per bunch was higher in Zanzibar (8.46), as compared to indigenous collections (7.07). The pollen grains are light yellow in colour, triangular in shape with 3 furrows and the apertures fused to form a ring.

c) Evaluation :

Cinnamon : In order to characterise the germplasm, observations on morphological characters of 379 lines were recorded. Bark extraction was carried out in the progenies of the 9 elite lines and the preliminary observations on yield indicated that the clonal progeny of Sri Lanka line 63, performed comparatively better (Table 4).

Seedling progenies of the lines 44 and 53 have recorded high mean values for fresh and dry weight of bark as well as percentage recovery of bark with comparatively minimum coefficient of variation (Table 5).

d) Vegetative propagation :

i) *Cinnamon* : A good rooting of terminal shoots of cinnamon was obtained when treated with different concentrations of IAA and IBA (Table 6).

ii) *Nutmeg* : Conversion of male trees to female by top working was found to be successful. In the trial on inducing orthotrophic shoots, it was found that detopping of trees at a height of 2 m produces large number (Average 38) of orthotrophic shoots.

iii) *Clove* : Vegetative propagation by approach grafting of clove on its own rootstock had been standardised. A success of 80% and 73% was obtained in December and August, respectively.

Approach grafting of clove on *Eugenia jambolana* was not successful.

Table 4 : Yield data of Elite lines of cinnamon — clonal progeny

Sl. No.	Elite Line No.	Bark wt/plant (g) (fresh)	Bark wt. (dry) (g) plant	% recovery
1	44	75	17.5	23.33
2	53	130	50.0	38.46
3	63	147	58.5	39.69
4	65	120	40.0	33.33
5	189	99	31.0	31.31
6	203	160	43.3	27.08
7	310	165	65.0	39.39

Table 5 : Performance of seedling progenies of different elite lines of cinnamon

Sl. No.	Elite Line No.	Height (cm)		Total number of branches		Fresh wt. of bark (g)		Dry wt. of bark (g)		% recovery of bark	
		Mean	CV(%)	Mean	CV(%)	Mean	CV(%)	Mean	CV(%)	Mean	CV(%)
1	5	88.75 (20)	29.88	1.63 (20)	40.86	77.22 (9)	26.72	31.67 (9)	41.02	40.97 (9)	39.42
2	44	84.95 (20)	41.98	2.00 (20)	50.00	130.67 (15)	42.21	43.00 (15)	35.11	34.28 (15)	17.36
3	53	99.00 (20)	33.10	1.87 (20)	28.00	137.08 (12)	42.55	44.58 (12)	39.86	33.51 (12)	20.29
4	63	107.63 (20)	20.30	1.85 (20)	31.73	112.35 (17)	69.20	40.00 (17)	89.38	34.99 (17)	20.49
5	65	96.25 (20)	26.41	1.93 (20)	38.87	113.00 (15)	37.91	37.00 (15)	36.40	36.33 (15)	47.72
6	189	92.00 (20)	37.00	1.85 (20)	26.45	134.5 (10)	54.31	49.50 (10)	54.80	37.45 (10)	24.49
7	203	104.55 (20)	36.02	1.88 (20)	31.05	100.39 (13)	51.74	39.23 (13)	63.27	37.19 (13)	32.49
8	310	102.10 (20)	24.69	2.15 (20)	37.02	79.09 (11)	59.02	29.55 (11)	51.58	39.90 (11)	29.23
9	312	94.40 (20)	32.33	1.70 (20)	32.22	90.00 (16)	43.84	32.81 (16)	52.48	36.35 (16)	27.56

(Figures in parantheses indicate the number of seedling progenies studied)

Table 6 : Percentage of Rooting with different Hormones

	Hormonal Treatment (ppm)	Rooting %	
		Cuttings	Layering
IBA	1000	11.1	33.3
	2000	86.6	43.3
	3000	75.5	70.0
Etiolation + IBA	3000	—	15.0
IAA	1000	2.2	—
	2000	82.2	—
	3000	13.3	—
NAA	1000	33.3	—
	2000	35.6	—
	3000	17.7	—
Control	0	20.0	20.0

5. Gen. VIII (813) : Breeding for high yield and resistance to *Phytophthora* and nematodes in black pepper

(K. Nirmal Babu, P.N. Ravindran, P.S. Ravindran, B. Sasikumar & Johnson K. George)

a) Karimunda selections :

In the comparative yield evaluation of Karimunda selections of black pepper, selections 14, 27 and 88 with mean yields of 4.78, 4.18 and 4.32 kg of fresh berries per vine respectively at 5th year were identified as superior lines among the 100 lines tested. Of these selections KS 14 and KS 27 were recommended for release by the X Workshop of All India Coordinated Research Project on Spices held at TNAU, Coimbatore. These lines performed well this year also giving mean yield of 5.7 and 6.1 kg per vine.

Karimunda Selection – 27

These two selections were also found to be better with respect to quality parameters compared to local karimunda and Panniyur-1 (Table 7).

b) Comparative yield trial :

In the comparative yield evaluation trial of 5 promising cultivars, Aimpiriyan was the best, recording a mean fresh berry yield of 5.66 kg/ vine. Kuching, an exotic cultivar and Ottaplackal-1, a nematode tolerant line have performed reasonably well (Table 8).

Table 7 : Yield and quality attributes of Karimunda selections in comparison with local Karimunda and Panniyur-1

Selection	Yield (Kg)					Quality Parameters		
	Per vine* at 5th year	Per hectare** Fresh	Dry	Yield Potential*** Fresh	Dry	Piperine %	Oleoresin %	Essential oil %
KS-14 (Sreekara)@	4.78	7650	2677	12000	4200	5.1	13.0	7.0
KS-27 (Subhakara)@	4.18	6720	2352	12640	4487	3.4	12.4	6.0
Local (*Karimunda*)	2.55	4080	1428	6240	2184	4.4	11.0	4.0
Panniyur-1	1.77	2832	977	4000	1380	3.6	9.5	3.5

* Fresh Weight
** at the rate of 1600 vines per hectare
*** based on highest yield recorded at 5th year (per ha)
@ tentative names

Table 8 : Yield data of promising cultivars (CYT-1)

Sl. No.	Variety	Mean yield kg/vine		
		1987-88	1988-89	1989-90
1.	Kuching	0.54	0.61	4.62
2.	Ottaplackal	0.49	0.62	3.98
3.	Karimunda	0.79	1.72	3.90
4.	Panniyur-1	0.65	0.82	4.05
5.	Aimpiriyan	0.84	1.40	5.66

c) New yield evaluation trial :

Three new yield evaluation trials were initiated this year :

(1) At NRCS Farm, Peruvannamuzhi involving 75 hybrids, (2) At Central State Farm, Aralam involving 100 hybrids, 44 Karimunda selections and 13 Kottanadan selections (3) At Tata Tea Ltd., Valparai, Anamalais involving 100 hybrids and 20 cultivars : to identify suitable varieties for various agro-climatic zones.

A hybridisation block of bush pepper was developed with high yielding cultivars, *Phytophthora*, nematode and Pollu tolerant lines, along with wild and related species of *Piper* to be used as parents in future hybridisation programme. A pilot study was initiated to study the performance of bush pepper in the field.

6. Gen. X (813) : Breeding Cardamom for high yield and resistance to 'Katte' disease
(Regy Lukose & M.N. Venugopal)

a) Comparative yield trial :

Cumulative yield data of 3 years for CYT I-III and two years of CYT IV and V were analysed. Significant differences were found among treatments in CYT I, III and V and no significant differences in CYT II and IV. From CYT 1, 4 OP seedlings and 4 *inter-se*, which yielded more than mean + 1 S.D. were selected. The yield of the above lines ranged from 49.4 g dry capsules/clump to 62.39 g dry capsules/clump. The potential yield ranged from 247 to 312 kg dry capsules/ha.

b) Resistance to 'katte' disease :

Forty two natural 'katte' escapes were screened against local severe strain. Five viruliferous alate aphids were released per test clone. Eighteen entries took infection in the green house screening.

The inoculation of 1987 and 1988 M_1 plants were completed. After 45 days of inoculation, 181 plants of 1987 batch and 44 plants of 1988 batch were found to be free from 'katte' symptoms.

A field screening trial has been initiated with the disease escapes of previous screening. Planting of tester lines and infector lines have been completed.

7. Phy. V (813) : **Characterisation of drought tolerance in black pepper and cardamom**

(S. Vasantha & A. Ramadasan)

a) Screening of Karimunda Selections :

Twenty Karimunda selections were screened in two sets under greenhouse conditions. The first set was screened during April 1989 and second set during March 1990. The first set included Karimunda lines 60, 63, 83, 94, 114, 117, 154, 158, 159 and 183. Line 114 was found to be relatively tolerant over the rest. The stomatal resistance, transpiration rate and leaf water potential recorded for this line at critical moisture content (13.9%) were 11.77 Scm^{-1}, 2.86 mg $cm^{-2}S^{-1}$ and —8.0 bars respectively. The second set included Karimunda lines 25, 51, 62, 80, 85, 92, 98, 163 and 176. Line 51 performed better followed by line 92. At 12.5% soil moisture, the stomatal resistance, transpiration rate and leaf water potential recorded for lines 51 and 92 were 16.36 S cm^{-1}, 1.27 mg cm2 / s^{-1}, —9.0 bars and 15.66 S cm^{-1}, 1.21 mg $cm^{-2}S^{-1}$ and —9.9 bars respectively.

b) Characterisation of drought tolerance :

Estimation of total sugars, phenolics and assay methods of enzymes viz., Nitrate reductase activity and peroxidase activity were standardised. Desiccation and heat tolerance studies were initiated in different cultivars.

8. Phy. VII (813) : **Quality evaluation in cardamom**

(T. John Zachariah & A. Gopalam)

A statistical scoring technique was developed to identify lines rich in quality i.e., by giving individual score to parameters like essential oil, oleoresin etc. in cardamom. Adding the score will give a total picture of lines rich in quality or line rich in individual quality components. The score is based on the mean of all the lines analysed. Based on this technique, 29 cardamom accessions were evaluated for physical, chemical and aroma quality. Accessions with high oil content and flavour ratio (F.R. = terpinyl acetate/ 1,8 cinceole) are 85 (8.4% oil, F.R. =1.8), 160 (8.3% oil F.R. = 1.7) and 81 (7.9% oil F.R. = 1.6). Accession 181 contained high oil (9% v/w) but low flavour (F.R. = 0.9).

Among the 40 CYT cardamom samples evaluated for quality, selections with high oil content and flavour ratio are PVS-37 (7.8% F.R. = 1.3), Nel 1-4-8 (8.1% F.R. = 1.2) and PVS 39 (7.8% F.R. = 1.3). Selections MA 10KRM2-3 and CL-671 - 2-5 contained high oil (9% v/w) but low flavour (0.9 and 0.7 respectively).

9. Phy. III (813) : **Quality evaluation in black pepper**

(A. Gopalam & T. John Zachariah)

(a) The statistical scoring technique developed for cardamom was adopted for black pepper. Among the 45 Karimunda lines evaluated for quality, selections rich in Piperine, oleoresin and essential oil are 180 (4.5% piperine, 9.3% oleoresin and 3% (v/w) oil) and 200 (4.2% piperine, 9% OR and 3.3% oil). Selections with high piperine are 123 (4.7%) and 169 (4.5%), with high oleoresin 89 (9.7%) and with high essential oil are 197 and 200 (3.3%).

(b) *White Pepper* : White pepper preparation by boiling/steaming and rolling of matured green pepper is standardised. Panniyur-1 is best for white pepper among the large berry cultivars. Arakulamunda, Kaniakkadan and Balankotta are suitable among the medium sized cultivars.

10. Bio-tech. 1 (813) : Tissue culture for rapid multiplication of elite clones of cardamom

(Regy Lukose)

Vegetative parameters viz., no. of tillers, no. of panicles, no. of capsules, and yield were recorded from the plants of C.Y.T. - 1 where tissue cultured plants and seedlings of C1.37 are being compared. No significant difference was found among the treatments (Table 9).

In C.Y.T.II where mono-clonal tissue cultured plants, suckers and seedlings of P1-Mudigere have been compared. Vegetative parameters viz., no. of tillers, height of the tallest tiller and no. of panicles were recorded. No significant difference was found among treatments (Table 10).

The plantlets of the selected clones were sub-cultured. On repeated sub-culturing the plantlets were found to lose the vigour and multiplication rate.

About twenty combinations of auxins and cytokinins were tried for inducing regeneration from the callus obtained from rhizome. Callus was induced from panicle explants.

Table 9 : Comparison of growth parameters of CYT-I

Treatments	Number of Tillers	Height of the tallest tiller (m)	Total leaf areas (m^2)	Number of panicles	Number of Capsules	Yield (g)
1. Tissue Cultured Plants	19.73	1.65	4.38	8.35	58.46	34.93
2. Suckers	19.17	1.63	5.09	10.56	78.38	48.00
3. Seedlings	20.99	1.69	5.55	7.45	47.10	40.20
F ratio at 5% level	1.006 (N.S)	0.23 (N.S)	1.94 (N.S)	1.92 (N.S)	0.90 (N.S)	0.38 (N.S)

N.S = Not Significant

Table 10 : Comparison of growth parameters in CYT - II

Treatments	Number of Tillers	Height of the tallest tiller (m)	Number of Panicles	Total leaf area (m^2)
1. Tissue Cultured Plants	20.76	1.52	4.44	5.20
2. Suckers	18.32	1.62	5.11	4.95
3. Seedlings	17.54	1.58	4.19	5.29
F ratio at 5% level	2.92 (N.S.)	1.33 (N.S)	0.64 (N.S)	0.27 (N.S)

N.S = Not Significant

11. Bio-tech. II (813) : *In-vitro* selection for resistance to soft rot and bacterial wilt in ginger

(K. Nirmal Babu & T.G. Nageswar Rao)

Organogenesis from callus, derived from tender leaf segments of ginger was achieved when cultured on Murashige and Skoogs basal medium supplemented with 10 mg/1 of BAP and 0.2 mg/1 of 2,4-D for 4-5 culture cycles. The rate of organogenesis further increased when hormones were completely removed from the culture medium after 5th or 6th sub-culture. The regenerated plants developed extensive root system in MS medium with 1 mg/1 of NAA. The root system was better in the liquid medium with a mean of 8-10 roots per plant.

Micropropagation of Ginger through Tissue Culture

Establishment of these plantlets in soil was above 80% when high humidity was maintained for the first 20 days after transplanting. Five hundred micropropagated plantlets were tranferred to soil for field screening.

MS basal medium (liquid) with either 1 mg/1 NAA alone or with 2-5 mg/1 BAP was found to be good for *in vitro* multiplication of ginger, using vegetative bud. The number of multiple shoots ranged from 5-10 in 50 days of culturing.

Preliminary bio-assay of *Pseudomonas solanacearum* toxin was done using sorghum and ragi seedlings.

SUPPORTIVE RESEARCH PROGRAMMES :

INCREASING PRODUCTIVITY OF BLACK PEPPER AND CARDAMOM THROUGH LARGE SCALE DEMONSTRATION AND EXTENSION TRAINING

1. Extn. I (813) : Increasing productivity of black pepper and cardamom through large scale demonstration of improved technology in the farmers' fields

(A.K. Sadanandan, Jose Abraham, M. Anandaraj, V.S. Korikanthimath & M.N. Venugopal)

a) Black Pepper :

(A. K. Sadanandan, Jose Abraham & M. Anandaraj)

The transfer of High Production Technology (HPT) in black pepper in fifty one farmers fields in three villages, under two TTCS (Transfer of Technology Centres) was continued during the year. The inputs were supplied to the farmers. Advisory Committee meetings were held four times and pre-season training was imparted to the farmers.

The nutrient analysis of soil samples in HPT plots revealed a substantial buildup of nutrients compared to control plots due to the integrated nutrient management system followed.

The overall productivity of vines in the mixed cropping at Peruvannamuzhi TTC was about 175% whereas in a mono-cropping system followed at Puthupadi TTC, it was 250%. Generation of additional employment of 15-20% was made possible due to the adoption of HPT programmes.

The mean incidence of *Phytophthora* foot rot and root rot has decreased to 1.9% from the original level of 6.1%, while the incidence of slow-decline has decreased to 2.2% from the original level of 6.4%.

b) Cardamom :

(V.S.Korikanthimath & M.N. Venugopal)

The yield obtained both under rainfed and irrigated conditions after adopting HPT is as follows:

i) Trials under rainfed condition : Dry cardamom yield of 213 Kg/ha (average of two years crop i.e., 1988-89 and 1989-90) was obtained resulting in a net profit of Rs. 26,000/ha.

ii) Trials under irrigation : Taking the average of two crop seasons (1988-89 and 1989-90) dry cardamom yield of 418 kg/ha was recorded, giving a net profit of Rs. 57,415/ha.

Prolonged dry spells followed by heavy monsoon showers coupled with gale and wind in July 1989, caused damage and loss of 12-15% cardamom plants due to falling of shade trees.

2. Extn. IV (813) : Research-cum-Demonstration Plots

(A.K. Sadanandan & V.S. Korikanthimath)

a) Black Pepper:

(A.K. Sadanandan)

Cropping models, for raising pepper in coconut and arecanut based cropping system: as well as mono-cropping system of raising pepper were demonstrated to the farmers in the Research-cum-Demonstration Plots.

In the coconut based cropping system 200 nos. of Panniyur-1 vines trailed on *Erythrina indica* planted in the interspace of coconuts (WCT) were maintained. There was no incidence of *Phytophthora* foot-and-root rot, as well as slow decline of pepper. In the arecanut based cropping system, 240 nos. of Karimunda vines trailed on areca palms were maintained. There was no disease incidence. In the plot to

demonstrate the performance of black pepper cultivars, in a mono-cropping system, congo signal grass were grown. Growing this grass, has enriched the soil fertility, maintained subsoil moisture and minimised soil erosion.

b) Cardamom :

(V.S. Korikanthimath)

i) *Conventional management followed by intensive cultivation of cardamom :*

By adopting High Production Technology in the conventional management the yield of dry cardamom was 245 kg/ha (1989-90) with a cost-benefit ratio of 4.15 as compared to 3.61 in the previous 3 years. The average yield for 5 years (1985-86 to 1989-90) was 480 kg dry cardamom/ha as compared to the national average of 58 kg/ha.

ii) *Pure (mono) crop of cardamom under intensive care and cardamom mix cropped with Robusta coffee :*

Pure crop of cardamom (mono crop) : By adopting HPT an yield of 450 kg/ha of dry cardamom was recorded in 1989-90 with a cost-benefit ratio of 3.14.

Cardamom mix cropped with Robusta Coffee : The yield was 560 kg/ha dry cardamom. The average of cardamom yield for 3 years (1987-88 to 1989-90) was 820 kg/ha. In this trial the yield of coffee was 600 kg/ha during 1989-90 whereas, 3 years average (1987-88 to 1989-90) was 1303 kg/ha. The cost-benefit ratio of cardamom was 4.14 and coffee 2.05.

3. Gen. I (443) : Production of parental materials and breeder's stock of black pepper and cardamom

(B.N. Reddy & V.S. Korikanthimath)

a) Black Pepper:

A large scale multiplication of 20 selections of Karimunda and 28 selections of Kottanadan was undertaken for distribution to the various developmental agencies. The multiplication of two pre-released varieties viz., KS 14 and KS 27 as well as elite line KS 88 was also carried out. A small number of Panniyur-1 and Aimpiriyan was also multiplied for the distribution to farmers and for research purpose. The rooted cuttings of 1050 Panniyur-1, 1000 Aimpiriyan, 6565 Kottanandan, 10,616 Karimunda, 150 KS 14 and 75 KS 27 and 150 KS 88 were produced (Table 1).

Table 1 : The distribution of rooted cuttings to different agencies

Name of the Agency	Karimunda	Kottanadan	Panniyur-1	Aimpirian	Total
Dept. of Agrl. Govt. of Kerala	3435	2100	—	—	5535
CPCRI/NRCS	3052	1010	631	282	4975
Farmers	1229	55	78	365	1727
Total	7716	3165	709	647	12237

A rapid multiplication nursery was established at Cardamom Research Centre, Appangala for production of nucleus planting material of pepper. A total of 650 rooted cuttings of elite Karimunda, Kottanadan, Panniyur-1 and Aimpiriyan were produced and supplied to farmers for multiplication and planting in coffee estates in Coorg District at Appangala.

b) Cardamom :

A total of 865.3 kg of C1. 37 seed capsules were supplied to Spices Board, Department of Horticulture and farmers. A clonal multiplication plot (0.6 ha) was established for generating sufficient elite materials of cardamom viz., P1 (2540 Nos.), C1. 37 Sel. Nos. 262, 112 and 800 (55 Nos.) and other promising materials (304 Nos.).

4. Extn. I (443) : Training of Research & Extension Workers and Farmers.
(K.M. Abdulla Koya & M.N. Venugopal)

a) Printing and distribution of annual training schedule :

The training schedule was printed and distributed to various extension and developmental agencies of different states and union territories and to universities having centres of All India Coordinated Research Project on Spices.

b) Organising Training Programmes at Calicut and Appangala :

The National Research Centre for Spices has organised twelve traning programmes in which 71 officials of Agriculture/Horticulture departments and developmental agencies from different parts of the country participated. Out of the 12 programmes, 7 were conducted in different aspects of spices production other than cardamom, 4 on the cardomom production and 1 on spices including cardamom (Table 2).

Apart from this 58 and 18 progressive farmers from Kerala and Karnataka respectively were trained in Spices Cultivation. At Appangala apart from the regular programme, 32 Progressive Planters and 113 Trainees from RTDC, kudige were explained about different aspects of Cardamom Cultivation.

Table 2 : Participation of officials in the training from different areas

State/Union Territory	No. of officials participated
Kerala	31
Karnataka	17
Tamil Nadu	7
Assam	6
Andhra Pradesh	2
Goa	2
Tripura	2
New Delhi	2
Meghalaya	1
Mizoram	1

Shri V.V. Raghavan Hon'ble Minister for Agriculture, Govt. of Kerala visiting the exhibition.

A Kisan Mela was conducted at NRCS, experimental farm, Peruvannamuzhi which was inaugurated by Sri V.V. Raghavan, Hon'ble Minister for Agriculture, Govt. of Kerala. In this about 500 farmers from Kerala and Karnataka participated. An exhibition, field visit and panel discussion were arranged in connection with the Kisan Mela to educatate the farmers. Package of practices for Black Pepper, Ginger, Turmeric, Cardamom and Black Pepper and Tree Spices and one folder each on Rapid Multiplication of Black Pepper and storage of Ginger and Technical Bulletins on High Production Technology of Cardamom and Black Pepper were brought out. Comprehensive pamphlets on Package of Practices of Spices and Rapid Multiplication of Black Pepper and a writeup on aims, achievements and future programmes of NRCS in Malayalam were also brought out during this period.

ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES (AICRPS) :

SUMMARY REPORT : (S. EDISON)

The All India Coordinated Research Project on Spices (AICRPS) has 15 Centres located in nine States and conducts coordinated research on important spices. The coordinating centres working on different spice crops are as follows :

Black Pepper	..	Panniyur, Sirsi and Chintapalli
Small Cardamom	..	Pampadumpara, Yercaud and Mudigere
Ginger	..	Pottangi and Solan
Turmeric	..	Pottangi, Solan and Jagtial
Cumin & Fennel	..	Jobner and Jagudan
Coriander & Fenugreek	..	Jobner, Jagudan, Guntur & Coimbatore
Large Cardamom	..	Gangtok

The main objectives of the project are :

* Evolving high yielding varieties resistant/ tolerant to diseases and pests.
* Evolving control measures for major diseases and pests.
* Working as an interface and feed back among the Agricultural Universtities, NRCS and ICAR.

The following is the brief report (crop-wise) of the work carried out during 1989-90.

a) *Black Pepper :*

The varieties recommended for release Panniyur-2 (Krishna) and Panniyur-3 (Shyama) from Panniyur Research Station gave an average yield of 1954 kg/ha and 1749 kg/ha and have oleoresin content of 10.89% and 12.67% respectively.

Among the fifty eight black pepper cultivars evaluated at Panniyur Centre, Balankotta Type II yielded 5.875 kg of berries followed by Kumbhakodi (5.660 kg). In an evaluation of 9 varieties at Chintapalli, Panniyur-1 performed well followed by Kottanadan, Aimpiriyan and Kuthiravally. Fertilizer dose of 50 : 50 : 150 g of NPK/vine/year was found economical for Panniyur conditions.

Spraying, drenching and pasting with Bordeaux mixture or spraying and drenching with Ridomil MZ 72 WP were found comparatively better for the control of *Phytophthora* foot rot of pepper. Two sprays of 0.2% Aliette or 3 sprays of 1% Bordeaux mixture at 15 days interval controlled the suspected foot rot disease at Chintapalli.

b) *Cardamom :*

In the evaluation of germplasm at Yercaud, the local Malabar and local Mysore types showed consistently better performance. The promising clones, Cl:679 (652.8 kg/ha), Cl. 683 (704.4 kg/ha) and Cl. 726 (494.4 kg/ha) from Mudigere were identified as high yielders and are being evaluated in multi-location trials (MLT) along with promising selections from other centres. A Selection APG.7 from Yercaud also showed consistently higher yield (for 3 years). The promising selections viz., P1, P3 and P5 from Mudigere has been recommended for pre-release multiplication. At Mudigere P1 has been recommended for release. PV 1 from Pampadumpara has been approved by Kerala Agril. University Variety Release Committee.

In the spacing trial with 4 different spacings under rainfed conditions of Shevroy Hills (Tamil Nadu) the yield data for 7 years (1982-89) indicated the superiority of high density planting with closer spacing of 1 x 1 m for Malabar types. A fertilizer dose of 75:75:150 kg NPK/ha (half the dose for 1 year old plants) has been found to be optimum. A fair degree of drought tolerance has been recorded in Clone P6 at Mudigere.

The variety pink pseudostem was found to be tolerant to diseases. Azhukal disease has been controlled by spraying as well as soil drenching of 1% Bordeaux mixture. Seed treatment by slurry method with Bavistin 2.5% + TMTD or Bavistin + Captan or Bavistin or Captan alone @ 4 g/kg of seed after nitric acid treatment minimises the seed rot. Combination spraying with Dithane M 45 (0.25%) + Ridomil (0.1%) or Bavistin (0.05%) + Ridomil (0.1%) were most effective in controlling damping off and leaf spot disease in cardamom nursery. Application of Temik granules controlled nematode infestation in cardamom seedlings in nursery. Root grubs could be effectively suppressed by timely application of granular insecticides like Carbofuran 3% @ 8-10 g/clump or row of seedlings during June-July or November-December.

c) *Ginger :*

Germplasm in ginger was enriched by the addition of 90 collections at Solan and 20 at Pottangi. In the MLT with 10 selections 'Rajgarh' recorded high yield followed by SG 666. In the evaluation of 32 lines of ginger at Solan, highest essential oil (2.5%) was recorded in SG 54, oleoresin was maximum in Ausu (7.92%). The combination treatment of Dithane M 45 (0.25%) and Bavistin (0.1%) was found to be effective in controlling rhizome rot disease in storage as well as in the field. A significantly higher yield was obtained by soil drenching twice with Ridomil MZ 72 WP @ 0.25% and 0.4% by reducing the disease incidence.

d) *Turmeric :*

In the MLT at Vellanikkara, types 15B and 21A gave better yields. During the period, PCT 13 had given significantly higher fresh rhizome yield (38.91 t/ha) followed by PCT 14 (35 t/ha). PTS 9 recorded the highest yield in the MLT at Pottangi followed by PTS 38.

In the evaluation of 32 germplasm accessions the curcumin content was maximum in ST 323 Yellow, essential oil and oleoresin content were maximum in ST 595 and ST 55 respectively.

e) *Cumin :*

A wilt tolerant selection, UC 19 from Jobner was released under the name RZ 19 (5.9 q/ha) with volatile oil content of 2.6%. In MLT the entry MC 43-73 recorded maximum grain yield (8.9 q/ha). At Jobner also the above entry recorded highest yield (8.3 q/ha).

The exotic selection EC 109635 from Jagudan was found moderately resistant to *Fusarium* wilt.

The cumin blight can be controlled by spraying of Dithane M 45 (0.2%). The fungicide Emisan 6 significantly reduced the cumin wilt incidence resulting in maximum grain yield followed by TOPSIN-M at Jobner.

f) *Coriander :*

Out of the 17 varieties evaluated in CYT at Jobner, UD 1 and GC 1 recorded maximum yield (8.9 q/ha), while mean performance (1987-89) revealed superiority of UD 374 (7.6 q/ha). The newly released varieties viz., Sadhana (Lam CS-4) and Swati (Lam CS-6) gave an average yield of 10.3 q/ha and 8.9 q/ha with an essential oil and fixed oil content of 0.2% & 9.2% and 0.3% & 9.6% respectively. Both are tolerant to aphids and white fly, while Sadhana is resitant to powdery mildew and grain mould. A new culture, an early maturing accession viz., CS 287 is suitable for dry rainfed tracts of Tamil Nadu and had recorded minimum wilt incidence of 6.9% as against more than 40% in UD 21, CS 2 and UD 373. Application of 60 kg N/ha in 3 equal splits recorded maximum grain yield in irrigated coriander at Jobner.

The causal organisms of grain mould were identified as *Alternaria* sp., *Fusarium* sp., & *Curvularia* sp., which cause discolouration of grains. This can be controlled by spraying Carbendazim 0.1%, 20 days after grain set. Spraying of Karathane 0.1% or Bavistin 0.1% or Wettable sulphur 0.25% effectively controlled powdery mildew caused by *Erysiphe polygoni*.

g) *Fennel :*

In the varietal trial at Jobner, the variety GF 1 recorded higher yield (5.5 q/ha) followed by local (4.9 q/ha). Application of N and P_2O_5 @ 90 kg/ha and 45 kg/ha combined with picking of umbels when seed turned to yellow colour has given highest yield (3.5 q/ha).

Transplanting of fennel by 15th October after the crop of bajra (pearl millet) was beneficial than the normal transplanting done in August in Gujarat.

h) *Fenugreek :*

A medium maturing fenugreek variety RMt 1 (1.5 q/ha) was released for the State of Rajasthan by the State Variety Release Committee. From the Germplasm lines (70 Nos.) evaluated at Guntur, JF 6 recorded maximum yield of 2.7 q/ha. At Jobner UM 118 yielded 13.5 q/ha as against local (11.6 q/ha). The entry Co 2 had given the highest yield (12.3 q/ha) in the multilocation varietal yield trial for 3 years. Significantly higher yield of 5 q/ha was obtained at irrigation level IW/CPE ratio of 1.0 and by application of 40 kg P_2O_5/ha. UD 41 was found to be completely free from stem gall disease. In the screening of varieties UM 34, UM 35, UM 70, UM 75, UM 81, UM 105, UM 113 and UM 114 were found to be resistant against root knot nematode at Jobner.

The variety CO 1 and Acc. No. 1084 were found to be tolerant to root rot at Coimbatore. The causal organism of root rot has been identified as *Rhizoctonia solani* and its pathogenicity established. Drenching of 0.1% Bavistin or 0.1% Brassicol effectively controlled the disease. Drenching twice with carbendazim 0.1% once at initial appearance of the disease and again at 30 days interval was found to be effective besides the application of neem cake @ 1 t/ha to control root rot disease.

i) *Large Cardamom :*

A few promising types with good yield have been identified for evaluation. Among the germplasm entries evaluated, pink golsey gave maximum yield of 1.3 q/ha of fresh capsules and is adapted to high and mid altitudes of Sikkim and Darjeeling Districts. Spraying with copper fungicides like Fytolan or Blitox 50 @ 0.3% completely controlled the leaf blotch disease followed by Cuman L @ 0.2% and Foltaf 0.2% with a total 3 spraying at an interval of 15 days.

GENERAL INFORMATION

BUDGET FOR 1989-90 (CALICUT AND APPANGALA)

Budget allocation :

Non-Plan	Rs.	25,00,000
Plan	Rs.	59,00,000
Total	Rs.	84,00,000

Acutal Expenditure :

Non-Plan	Rs.	24,90,064
Plan	Rs.	58,99,795
Total	Rs.	83,89,859
Receipts	Rs.	3,18,149

LIBRARY AND DOCUMENTATION SERVICE

The library has subscribed for 52 foreign journals, 86 Indian journals and procured 143 books and 122 reprints during the year.

Library continued to provide documentation and information service to scientists and other research workers of the research centre as well as research scholars and students of the universities.

Library started to publish "Agri Sci tit bits" — a bi-monthly information service containing news items and notes pertaining to agriculture and science.

Photo copies of six doctoral thesis on spices and condiments were added to the library.

Reprographic services were provided to research workers and nearly 45,000 copies of various scientific papers/documents have been taken either for distribution or preservation.

Institute publications were distributed to various organisations and individuals.

Indexing journals and contents pages of other journals were circulated to NRCS Cardamom Research Centre, Appangala.

Research/Review Articles :

1. ABRAHAM, V.A., ABDULLA KOYA, K.M. AND CHANDY KURIAN, 1989. Integrated management of red palm weevil (*Rhynchophorus ferrugineus* f.) in coconut gardens, *J. Plant, Crops* **16** : 159 - 162 (suppl.)

2. ANANDARAJ, M., JOSE ABRAHAM AND BALAKRISHNAN, R. 1989. Crop loss due to foot-rot disease of black pepper. *Indian Phytopath.* 42 : 473 - 476.

3. ANANDARAJ, M., JOSE ABRAHAM, SARMA, Y.R. AND BALAKRISHNAN, R. 1989. Incidence of foot rot disease of black pepper (*Piper nigrum* L.) in Kerala in relation to cultivation practices. *Ind. J. Agri. Sci.* 59 (11) : 751 - 753.

4. ANANDARAJ, M., SIVARAMAN, K. AND KRISHNAMOORTHY, B. 1989. Effective weed control through weedicides in plantation crops. *Indian Cocoa, Arecanut and Spices J.* **13** (2) : 63 - 64.

5. DEVASAHAYAM, S. 1989. Residual toxicity of certain insecticides to leaf gall thrips (*Liothrips karnyi* Bagnall) on black pepper. *Entomon* **14** : 79 - 80.

6. DOHROO, N.P. and EDISON, S. 1989 Compendium of rhizome rot of ginger (*Zingiber officinale* Rosc.) *J. Hill. Res.* **2** : 4-13.

7. EDISON, S. 1989. Coordinated research on black pepper. *Indian Cocoa, Arecanut and Spices J.* **13** (1) : 3 - 6.

8. EDISON, S. 1989. Scope for crop diversification in the North-eastern region with special reference to Arunachal Pradesh, *J. Hill, Res.* **2** : 1 - 3.

9. EDISON, S. 1989. Transfer of technology in agriculture in North-eastern hill region. *J. Hill. Res.* **2** : 47 - 52.

10. JOHN ZACHARIAH, T., GOPALAM, A., RAVINDRAN, P.N. and KRISHNAMOORTHY, B. 1989. Anthocyanin pigments of young flushes of cinnamon. *Indian Cocoa, Arecanut and Spices J.* **12** (4) : 127.

11. KORIKANTHIMATH, V.S., VENUGOPAL, M.N. and SADANANDAN, A.K. 1989. Labour utilisation pattern in relation to other input requrirements in cardamom plantations. *Spice India* **11** (2) : 5 - 12.

12. RAMACHANDRAN, N., DAKE, G.N. and SARMA, Y.R. 1989. Effect of systematic fungicides on *in vitro* growth of *Pythium aphanidermatum*, the rhizome rot pathogen of ginger. *Indian Phytopath.* 42 : 463 - 465.

13. RAMACHANDRAN, N., DAKE, G.N. and SARMA, Y.R. 1989. Evaluation of systemic fungicides for efficacy against rhizome rot of ginger. *Indian Phytopath.* 42 : 530 - 533.

14. RAMANA, K.V., and MOHANDAS, C. 1989. Endoparasitic nematodes infesting roots of black pepper (*Piper nigrum* L.) in two districts of Karnataka, India. *International Nematology Network Newsletter* 6 : 33 - 35.

15. SARMA, Y.R., ANANDARAJ, M. and RAMACHANDRAN, N. 1989. Epidemiology of *Phytophthora* foot rot of black pepper (*Piper nigrum* L.) caused by *Phytophthora capsici* ('*P. Palmivora*' MF_4). diseases of plantation crops with special reference to *Phytophthora*. *Indian Phytopath.* **42** (2) : 272 Abs.

16. VASANTHA, S. and RAMADASAN, A. 1989. Plastid pigments of black pepper cultivars under heat stress. *Indian J. Plant. Physiol.* Vol. XXXII (i) : 78 - 79.

17. VIDYASAGAR, P.S.P.V., ABDULLA KOYA, K.M., DEVASAHAYAM, S. and PREMKUMAR, T. 1989. Record of Wax scales - *Ceroplastes floridensi* Comstock (Homoptera : Coccidae) infesting clove seedlings in Kerala, India. *Entomon*, **14** : 359 - 360.

Popular Articles :

1. ABRAHAM, C.C., PREMKUMAR, T. and ABDULLA KOYA, K.M. 1989. Black pepper - pest incidence and control measures. In *Sugandha Keralam* Ed. P. Madhusudana Kurup and K.G. Nayar, Spices Board, Cochin. pp. 82 - 84 (Malayalam).

2. ABRAHAM, C.C., PREMKUMAR, T. and ABDULLA KOYA, K.M. 1989. Ginger - pest incidence and control measures. In *Sugandha Keralam*, Ed. P. Madhusudana Kurup and K.G. Nayar, Spices Board, Cochin. pp. 168 (Malayalam).

3. JOHN ZACHARIAH, T. 1989. Vilaved-uppum samskaranavum. In. *Sugandha Keralam*, Ed. P. Madhusudana Kurup and K.G. Nayar, Spices Board, Cochin pp. 196 - 200 (Malayalam).

4. GOPALAM, A. and VASANTHA, S. 1989. Aushadh Vigyan Me Masalo Ka Yogdhan. *Spice India* **1** (7) : 9 - 12 (Hindi).

5. KORIKANTHIMATH, V.S., VENUGOPAL, M.N. and NAIDU, R. 1989. Production of cardamom - a success story. *Spice India* **II** (9) : 19 - 24.

6. KRISHNAMOORTHY, B. and REMA, J. 1989. Grafting - a solution to sex problem in nutmeg. *Spice India* **2** (6) : 13 - 15.

7. KRISHNAMOORTHY, B. and REMA, J. 1989. Lavangam valarppom labham peruvom. *Spice India* **2** (6) : 5 - 7 (Tamil).

8. KRISHNAMOORTHY, B. and REMA, J. 1989. Ottumarathil Jathikkai. *Spice India* **2** (2) 13 - 14 (Tamil).

9. KRISHNAMOORTHY, B. and REMA, J. 1989. Jathilingabjathathina grafting *Mangalam* **1** (193) : 7 (Malayalam).

10. KRISHNAMOORTHY, B. and REMA, J. 1989. Mara vasanaipayirgalin Natrangal thayarippu. *Spice India* **2** (11) : 8 - 11 (Tamil).

11. KRISHNAMOORTHY, B. 1989. Inji. *Spice India* **2** (12) : 5 - 8 (Tamil).

12. KRISHNAMOORTHY, B. and VASANTHA, S. 1990. Kadamba Vasanaipayir. *Spice India* **3** (3) : 7 - 9 (Tamil).

13. PREMKUMAR, T. and DEVASAHAYAM, S. 1989. Control of pests of black pepper. *Indian Farming* **38** (10) : 33 - 34 & 45.

14. REMA, J. and KRISHNAMOORTHY, B. 1989. Economic uses of tree spices. *Indian Cocoa, Arecanut and Spices J.* **12** (4) : 120 - 121.

15. SADANANDAN, A.K. 1989. Growing pepper as a mono-crop. In. *Sugandha Keralam*. Ed. P. Madhusudana Kurup, and K.G. Nayar, Spices Board, Cochin. pp. 75 - 78 (Malayalam).

16. SADANANDAN, A.K. 1989. Turmeric cultivation, manuring and management. In. *Sugandha Keralam*. Ed. P. Madhusudana Kurup, and K.G. Nayar, Spices Board, Cochin, pp. 61 - 67 (Malayalam).

17. SADANANDAN, A.K. 1989. Turmeric Cultivation, manuring and processing. In. *Sugandha Keralam*. Ed. P. Madhusudana Kurup, and K.G. Nayar, Spices Board, Cochin. pp. 180 - 183 (Malayalam).

Papers presented in Symposia/Workshop :

1. ANANDARAJ, M. and SARMA, Y.R. 1989. Use of baits for assaying chemicals applied as soil drench to control *Phytophthora* foot rot of black pepper (*Piper nigrum* L.). Presented at the Symposium on Plant Disease Problems and their Management in South India, 7 - 9, December, 1989. Indian Phytopthological society. I.I.H.R., Bangalore.

2. EDISON, S. 1989. Perspectives in plant pathology of seed spices. Presented as a lead paper at the National Seminar on Seed Spices, 24 - 25, October, 1989, Jaipur.

3. EDISON, S. 1989. Research results and new varieties of spices for cultivation in Madhya Pradesh. Presented in the Workshop on Export Promotion of Spices in Madhya Pradesh, 4, November, 1989, Bhopal.

4. EDISON, S. 1990. Plant protection in spices production in India. Paper presented in the III International Conference on Plant Protection in the Tropics, 20 - 23, March, 1990, Kaulalumpur, Malaysia.

5. KORIKANTHIMATH, V.S. 1989. Efficient management of evergreen forest for cultivation of cardamom (*Elettaria cardamomum* Maton). Paper presented at the International Symposium on Natural Resources Management for Sustainable Agriculture. Feb. 6 - 10, Indian Society of Agronomy, IARI, New Delhi-12.

6. PRABHA, C.D. and SARMA, Y.R. 1989. Biological control of *Phytophthora capsici* the pathogen of black pepper (*Piper nigrum* L.). In. Abstracts - presented in Symposium on Plant Disease problems and their management in South India, 7 - 9 Dec. 1989. p. 39

7. RAMANA, K.V. 1989. Problems and progress in research on nematodes of black pepper (*Piper nigrum* L.). Fourth Group Meeting on Nematological Problems of Plantation Crops, U.A.S., Bangalore, 5 - 7 Sep. p.29.

8. RAMANA, K.V. 1989. Problems and progress in research on nematodes of ginger (*Zingiber officinale* Rosc.). Fourth Group Meeting on Nematological problems of Plantation Crops held at U.A.S., Bangalore, 5 - 7, September, p. 29.

9. SADANANDAN, A.K. and REDDY, B.N. 1990. Resources conservation and black pepper productivity in India (Abst.). Proceedings of the International Symposium on Natural Resources Management for a Sustainable Agriculture. Feb. 6 - 10, New Delhi.

10. SADANANDAN, A.K., RAMADASAN, A. and NAIR, M.K. 1990. Spice based farming system (Abst.), Proceedings of the 77th Session of Indian Science Congress, Cochin (Agricultural Science), p. 85.

11. SARMA, Y.R., ANANDARAJ, M. and RAMACHANDRAN, N. 1989. Integrated disease management of *Phytophthora* foot rot of black pepper (*Piper nigrum* L.). Poster paper presented at *Phytophthora* - An international Symposium, 18 - 21 September, 1989, Dublin, Ireland.

Technical Reports :

1. DAKE, G.N., ANANDARAJ, M., RAJU, C.A. and ROHINI IYER, 1989. Storage method of ginger seed rhizomes. National Research Centre for Spices, Calicut, Kerala.

2. PREMKUMAR, T., SARMA, Y.R. and SASIKUMAR, B. 1988-89. Annual Report, National Research Centre for Spices, Calicut, Kerala. pp. 82.

3. RAMADASAN, A., PREMKUMAR, T. and ANANDARAJ, M. 1989. Research Highlights 1988-89, National Research Centre for Spices, Calicut, Kerala. pp. 5.

4. SADANANDAN, A.K., JOSE ABRAHAM, and ANANDARAJ, M. 1990. High Production Technology in Black Pepper, National Research Centre for Spices, Calicut.

PARTICIPATION IN WORKSHOPS, SEMINARS AND SYMPOSIA

Workshop on strategies for export development of spices, Cochin April 9 - 11, 1989.

S. Edison

NARP-KAEP (KAU) Regional Workshop, Pilicode, 26th June 1989.

S. Edison

ICAR Regional Committee VIII, Pondicherry, 7 - 8 August 1989.

S. Edison

Tenth Workshop of All India Coordinated Research Project on Spices, TNAU, Coimbatore, 22 - 24 August 1989.

A. Ramadasan, S. Edison,
A.K. Sadanandan, Y.R. Sarma,
P.N. Ravindran, V.S. Korikanthimath,
M.N. Venugopal, K. Nirmal Babu,
T. John Zachariah.

National Workshop on Decontamination of Spices by Gamma Irradiation, Cochin, 29 August 1989.

A.K. Sadanandan and T. John Zachariah

Fourth Group meeting on nematological problems of plantation crops, U.A.S. Bangalore, 5 - 7th September 1989.

S. Edison, K.V. Ramana and Santhosh J. Eapen

Phytophthora - An International Symposium, Dublin, Ireland, 18-21 September 1989.

Y.R. Sarma

Cardamom, Pepper and Clove - Seminar, Southern Spices Planters Association & Spices Board, Rajapalayam, Tamil Nadu, 27th September 1989.

B. Krishnamoorthy

First National Seminar on Seed Spices, Jaipur, 24 - 25th October, 1989.

S. Edison

Tenth Workshop on AICRP on Palms, Kasaragod, 6 - 9 November 1989.

S. Edison

Pepper Seminar - Organised by Kodagu Planters Association, Madikeri, 30th January 1990

A. Ramadasan, S. Edison, Y.R. Sarma,
A.K. Sadanandan, P.N. Ravindran,
K.V. Ramana, T. Premkumar,
V.S. Korikanthimath, M.N. Venugopal,
Regy Lukose, Santhosh J. Eapen

International Symposium on Natural Resources Management for a Sustainable Agriculture, New Delhi, 6 - 10 February 1990.

A.K. Sadanandan & V.S. Korikanthimath

Symposium on plant disease problems and their management in South India 7 - 9 Dec. 1989. Indian Phytopathological Society Zonal meeting at I.I.H.R., Bangalore.

M. Anandaraj.

Seminar on Pepper 16 Dec. 1989 at K.A.U. Pepper Research Station, Panniyur.

S. Edison, M. Anandaraj,
B.N. Reddy, K.M.A. Koya,
Jose Abraham and Johnson K. George.

77th Session of Indian Science Congress, Cochin, 5 - 9 Feb. 1990.

A. Ramadasan, A.K. Sadanandan &
Y.R. Sarma

MEMBERSHIP IN COMMITTEES

1. Dr. A. Ramadasan :

   Member, Indian Spices Development Council

   Member, Bureau of Indian Standards Institute - Subcommittee on FADC.9.

   Member, Committee on Spices - Working Group I on Spices Production.

2. Dr. S. Edison :

   Convenor & Rapporteur, Government of India - Committee on Spices - Working Group II on Spices Research.

   Member, Planning Commission - Working Group on Horticulture & Plantation Crops - Subgroup on Spices and Cashew.

   Member, Indian Spices Development Council.

   Executive Councillor, Indian Society of Plantation Crops.

   Alternate Member, Bureau of Indian Standards-Subcommittee FADC 9.

   Member, Government of India, Ministry of Agriculture, Study Team on Spices Development for Mizoram.

   Member, Forum for Export Promotion of Spices, Spices Board, Cochin.

3. Dr. Y.R. Sarma :

   Member, *Phytophthora* Committee, International Society for Plant Pathology (ISSP).

4. Dr. T. Premkumar :

   Asst. Editor, Journal of Plantation Crops.

IMPORTANT VISITORS

CALICUT :

Shri. V.V. Raghavan

Hon'ble Minister for Agriculture, Govt. of Kerala

Mr. C. Mubarak

Asst. Director, Sri Lanka Export. Development Board

Mr. P.V. Jayakrishnan

Chief Secretary, Govt. of Goa.

Dr. A.K. Bandopadya

Director, CARI, Port Blair.

APPANGALA :

Mr. Jawahar Sircar, I.A.S

Director, Ministry of Commerce, New Delhi.

Mr. Mahendra Jain, I.A.S.

Deputy Secretary (Agriculture), Government of Karnataka, Bangalore.

Dr. P.C. Sivaraman Nair

Director of Research (Retd.), Kerala Agril. University.

Air Commodore R.S. Sehgal, VSM

Deputy Director General, NCC (Karnataka & Goa)

Dr. Gopal Swarup

Professor of Nematology (Retd.), I.A.R.I., New Delhi.

Dr. R.M. Nachiappan

Reader and Head I/C, Faculty of Agriculture, Annamalai University, Tamil Nadu.

Brig. S.K. Bammi

HQ Recruiting Zone, Bangalore.

CALICUT :

MANAGERIAL :

A. Ramadasan, M.A., M.Sc., Ph.D.	Officiating Director
S. Edison, Ph.D.	Project Coordinator (Spices)

SCIENTIFIC :

Genetics & Plant Breeding :

P.N. Ravindran, M.Sc.(Ag.)	Scientist (SG)
B. Krishnamoorthy, M.Sc.(Ag.)	Scientist (SG)
K. Nirmal Babu, M.Phil.	Scientist
Johnson K. George, M.Sc.	Scientist (joined on 7-8-89)
B. Sasikumar, Ph.D.	Scientist (joined on 16-8-89)

Horticulture :

J. Rema, Ph.D.	Scientist

Agronomy :

K. Sivaraman, M.Sc.(Ag.)	Scientist (SG) (On study leave)
B.N. Reddy, Ph.D.	Scientist (SG)

Plant Pathology :

Y.R. Sarma, Ph.D.	Scientist (SG)
G.N. Dake, M.Sc.(Ag.)	Scientist (SG) (on study leave)
M. Anandaraj, M.Sc.	Scientist (SG)
T.G. Nageswar Rao, Ph.D.	Scientist S-2 (joined on 5-10-1989)
C.K. Parthasarathy Prasad, Ph.D.	Scientist

Entomology :

T. Premkumar, Ph.D.	Scientist (SG)
S. Devasahayam, M.Sc.	Scientist (SG)
K.M. Abdulla Koya, M.Sc.(Ag.)	Scientist

Nematology :

K.V. Ramana, Ph.D.	Scientist (SG)

Plant Physiology :

S. Vasantha, M.Phil.	Scientist

Biochemistry :

A. Gopalam, Ph.D.	Scientist (SG) (upto 11-7-89)
T. John Zachariah, Ph.D.	Scientist

Agricultural Statistics :

Jose Abraham, M.A., M.Sc.	Scientist (SG)

TECHNICAL :

A.K. Johny, Ph.D.	Technical Officer
N.R. Aditya Varma	Sr. Farm Asst. (T4) (Upto 31-5-1989)
P. Azgar Sherif	Sr. Library Asst. (T4)
Binnami Singh, M.Sc.(Ag.)	Farm Superintendent (Joined on 7-9-1989)

ADMINISTRATION & ACCOUNTS :

U. Sukumaran	Asst. Adm. Officer
N.S. Sekharan	Asst. Fin. & Accts. Officer (upto 7-8-1989)
K. Usha	Superintendent

APPANGALA

SCIENTIFIC :

Agronomy :

V.S. Korikanthimath, M.Sc.(Ag.)	Scientist-in-charge & Scientist (SG)

Genetics & Plant Breeding :

Regy Lukose, M.Sc.	Scientist

Plant Pathology :

M.N. Venugopal, Ph.D.	Scientist (SG)

Nematology :

Santhosh J. Eapen, M.Sc.	Scientist

TECHNICAL :

M.K. Appaiah	Sr. Farm Asst. (T4)

NRCS FARM, PERUVANNAMUZHI

Month	Total Rainfall No. of rainy days	Total Rainfall Rainfall (mm)	Mean Temperature °C Max.	Mean Temperature °C Min.	Mean relative humidity % Max.	Mean relative humidity % Min.
January	—	—	—	—	—	—
February	—	—	31.9	22.8	44.2	35.8
March	3	24.6	33.1	24.7	35.0	30.0
April	6	130.6	31.8	26.9	47.7	31.8
May	10	122.2	31.4	22.0	58.8	51.3
June	22	1144.0	28.4	27.1	76.6	73.2
July	19	989.0	26.0	25.0	77.9	70.7
August	22	573.0	—	—	—	—
September	14	42.5	31.0	23.1	89.3	63.4
October	14	354.5	32.0	23.9	89.9	59.3
November	5	157.0	33.2	21.8	89.6	42.9
December	—	—	35.5	22.4	89.0	39.0

NRCS CARDAMOM RESEARCH CENTRE, APPANGALA

	Rainfall		Mean Temperature °C	
	No. of rainy days	Rainfall (mm)	Max.	Min.
January	—	—	27.7	12.6
February	—	—	30.7	12.8
March	3	29.0	30.6	15.8
April	6	46.4	31.0	19.0
May	13	117.4	29.4	19.0
June	27	380.9	24.5	18.5
July	27	1106.6	22.8	18.2
August	30	654.5	21.9	18.1
September	18	262.8	25.1	18.3
October	9	161.2	26.8	18.1
November	2	3.5	27.3	16.2
December	—	—	26.4	14.9
Total	135	2762.3		

STATEMENT SHOWING THE TOTAL STAFF STRENGTH AS ON 31-3-1990 AND MEMBER OF SC/ST AMONG THEM

Category	No. of Sanctioned Posts	No. of Employees in position	No. of SC employees	No. of ST employees
Scientific	39	27	2	—
Technical	28	28	4	1
Administrative	18	17	1	—
Auxiliary	5	5	—	—
Supporting	62	62	17	1
Total	152	139	24	2