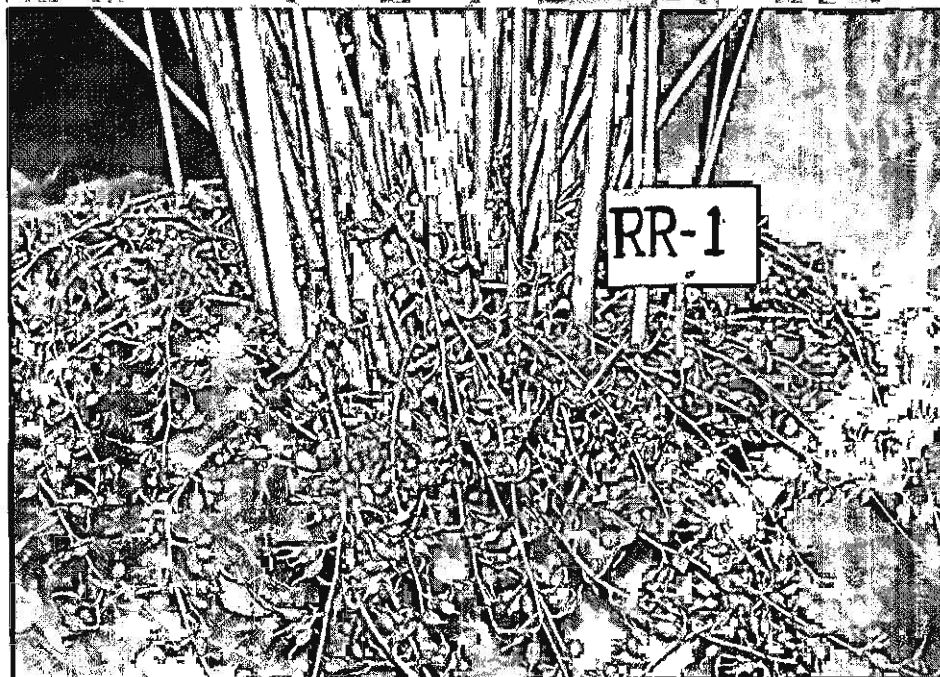
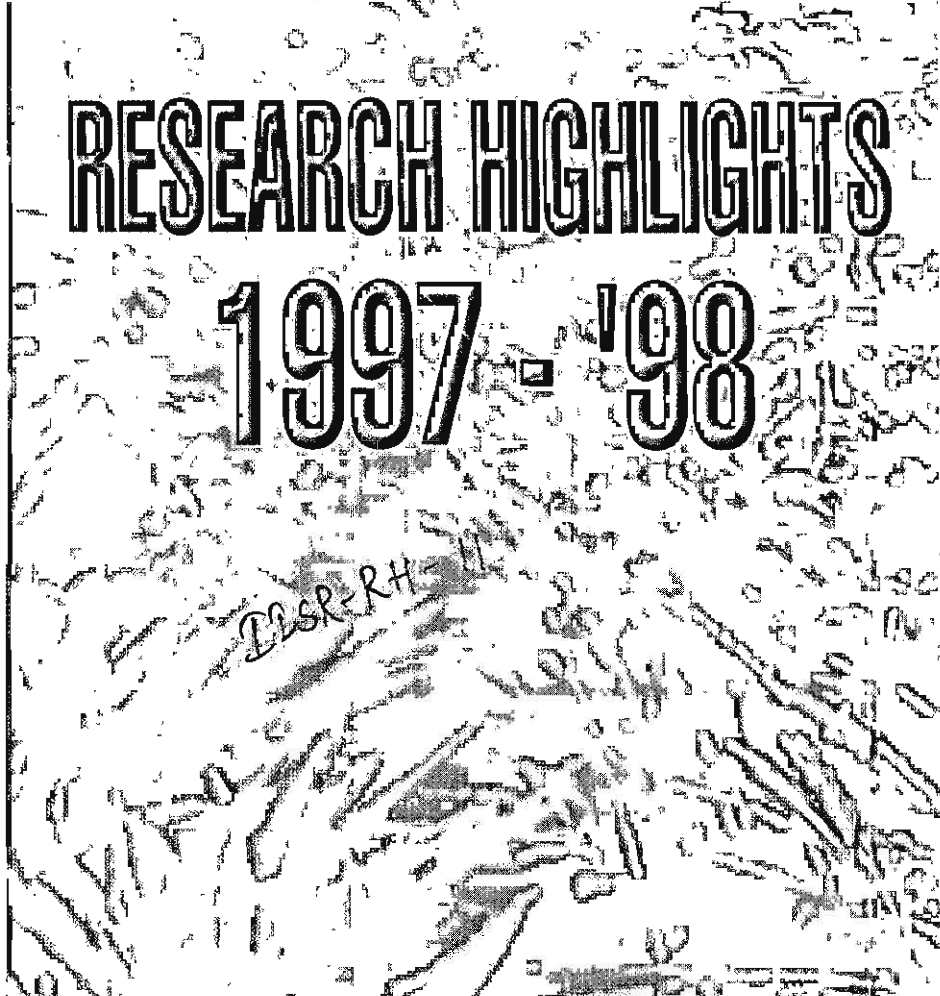
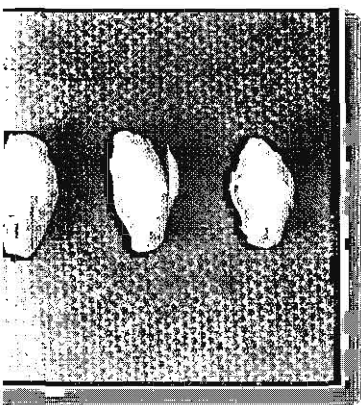


RESEARCH HIGHLIGHTS

1997 - '98



INDIAN INSTITUTE OF SPICES RESEARCH
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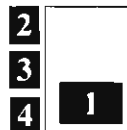
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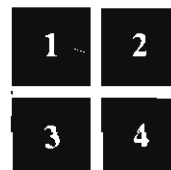
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Front Cover



1. RR-1 a rhizome rot tolerant cardamom selection.
2. Successful hybridisation of *Vanilla planifolia* x *V. aphylla*.
3. *In vitro* rhizomes in ginger
4. Plant regeneration from callus cultures of capsicum.

Back Cover



1. Acc. 585. Promising clone of Alleppey finger turmeric.
2. Acc. 15. Promising ginger accession with high yield, low fibre and high oil.
3. *Piper silent valleyensis* an endangered species.
4. Adult of *Chrysoperla carnea*-Predator of *Pentalonia nigronervosa* a caladic

TESR-RH-11

DIRECTOR'S INTRODUCTION

The year 1997-1998 witnessed surge in value of spices export especially due to higher unit value of black pepper. India exported 1.90 lakh tonnes of spices valued Rs. 1165.5 crores (US \$ 316.40 million) upto February, 1998, an all time record. The unit value of black pepper was Rs. 135.72 compared to Rs. 83.73 during April-February 1996-97. The global deficit in production of pepper (0.5 to 0.75 lakh tonnes) and the diversified usage of pepper, boosted up pepper prices. Unit value of cardamom is lower (Rs. 344.04) than in 1996-97 (Rs. 353.98) due to influx of Guatemalan cardamom, quoted Rs. 110 to Rs. 150 at UAE. Black pepper production is estimated to be 65000 tonnes during 1997-98 due to marginal increase in area in Karnataka, Tamil Nadu, Goa and North Eastern States.

Collection and documentation of genetic resources in black pepper, cardamom, ginger, turmeric, nutmeg, clove and cinnamon received priority envisaging the importance of trade-related intellectual property rights and plant breeders' rights. Two ginger accessions (15 and 27) with a dry recovery of 25% and one paprika accession (PBC-385) with a colour value of 205 ASTA were identified. Interspecific hybridization between *Vanilla planifolia* and *V. aphylla* through embryo rescue technique was achieved. Micropropagation of curry leaf was standardized and micropropagated plants were hardened and established. A hardening facility with control on temperature, light and humidity was established during the year.

Biological control trials of *Phytophthora* foot rot in black pepper, azhukal in cardamom and rhizome rot in ginger using *Trichoderma* and *Gliocladium* were successfully demonstrated in farmers plots of Kerala, Tamil Nadu and Karnataka. Tea waste is more ideal to multiply *Trichoderma* and *Gliocladium* on a large scale. Several natural enemies of insect pests of spices are identified. Green lacewing is highly predaceous to cardamom aphids.

Poly viral nature of particles involved in 'Kokke-Kandu' disease of cardamom is established. Several Kokke-kandu disease escapes were identified. Integrated disease management involving spraying of potassium phosphonate, application of neem cake @ 1 kg per vine and use of biocontrol agents was effective against *Phytophthora* foot rot of black pepper. Nineteen ginger accessions showed resistant reaction to root knot nematode *Meloidogyne incognita*.

Soil inoculation of *Azospirillum*, phosphobacteria and VAM alone and in combination enhanced biomass, dry matter production and nutrient uptake of black pepper. Black pepper accessions 1493 and 1372 are found tolerant to drought. A new white pepper and salted ginger production technologies are developed.

The year 1997-98 also witnessed several scientific recognitions to the Institute. This includes ICAR team research award, ICAR Hari Om Ashram Trust Award, ICAR Young Scientist Award and Dr. J.S. Pruthi Award.

The Division of Crop Improvement and Biotechnology operated 16 projects, the Division of Crop Production and Post Harvest Technology 11 projects, the Division of Crop Protection 12 projects and the section of Social Sciences 5 projects. The total possessions at library are 3368 books, 252 bound journals, 2088 reprints, 524 technical reports, 36 foreign journals and 90 Indian journals.

Seven training programmes were conducted during the year on various facets of spices production, protection and post harvest technology. The KVK at Peruvannamuzhi organised 49 training programmes during the year. One lakh cuttings of black pepper, 30 tonnes of seed rhizomes of turmeric and 2500 grafts of nutmeg and 3000 cinnamon seedlings were distributed during the year. The All India Co-ordinated Research Project on Spices with 20 countries spread over 16 states contributed substantially to spices production in the country.

The budget of the Institute was Rs. 90 lakhs under plan and Rs. 148 lakhs under Non-Plan. Besides, a sum of Rs. 75 lakhs was received from AP Cess Fund, KVK and IPDS (GOI). The year also witnessed fall in prices of cardamom, reduction in total export of black pepper and incidence of newer disease and pests. The Experimental Farm, Peruvannamuzhi needs protection from wild animals by erecting compound wall. The CRC, Appangala needs more land for research purpose. Human Resource Development in frontier areas of science, especially genetic engineering, has not received needed attention during the year.

31-3-1998
Calicut

(K. V. Peter)
Director

RESEARCH HIGHLIGHTS 1997-98

DIVISION OF CROP IMPROVEMENT AND BIOTECHNOLOGY

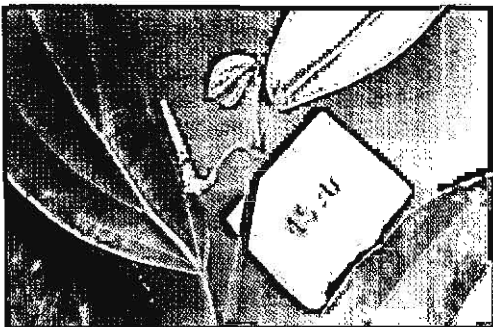
GENETIC RESOURCES



A scene from the scientific expedition to Eravikulam, Munnar

The germplasm conservatory of the institute was enriched by collections of *Piper* species, cardamom, ginger, turmeric, vanilla and tree spices. The important collections during the year are :

- * Fifty accessions of *Piper* spp. from, Nilgiris, Nilambur, Munnar and Pollibeta. Species collected from Paikara (Ooty) resemble *Piper mullesua* and *Piper silentvalleyensis* and the one from Munnar resembles *P. galeatum*. Thirty five accessions of cultivated black pepper were collected from Kannur, Palode, Thenmala and Pollibeta.



A putative new *Piper* species from Eravikulam



Variability in ginger germplasm collected from Nedumangad

- * Seven proximal branching types and one compact panicle type in cardamom.
- * Thirty seven accessions of ginger from Nedumangad, Aryanad, Kuttickal, Munnar and Ooty.
- * Five accessions of turmeric from Nedumangad and Ooty.
- * Three *Amomum* spp. from Gudalur.
- * Nine vanilla accessions from Thamarassery (Calicut) and Ernakulam.
- * Twelve wild types of *Cinnamomum* (one a very scented type), two wild types of *Myristica*, two species of *Knema*, one high yielding allspice, four types of *Garcinia* and one type of atao.

CROP IMPROVEMENT

Black pepper: Hybrids HP 813, 34, 105 and collection 1041 maintained superiority for yield at Valparai.

Cardamom: An 8x8 full diallel involving selections RR-1, CCS-1 and 'Katte' resistant lines NKE-3, NKE-9, NKE-12, NKE-19,

NKE-27 and NKE-34 was made. Ninety two per cent fruit set was observed in NKE-19 x NKE -34 followed by NKE-12 x NKE-19 (77%) and NKE-12 x RR-1 (69%).

Ginger: Accessions 15 and 27 performed better consistently in the second consecutive year with 25% dry recovery. Acc. 15 had 2.5% volatile oil and 3.2% crude fibre.

Turmeric: A high yielding and high quality Alleppey turmeric Acc. 585 was identified (30 kg fresh rhizome per 3 cm² bed with 7% curcumin).

Clove: B-95 is a promising line with high yield.

Paprika: Morphological and biochemical characters of 29 lines of *Capsicum annuum* indicated paprika types PBC-385, PBC-066 and Kt. pl- 19 as the best selections. PBC-385 had the highest colour value (205 ASTA) followed by Kt. pl-19 (139.5 ASTA) and PBC-066 (131 ASTA).

Characterization of inter specific hybrids

Two inter specific hybrids of *Piper* viz. *P. nigrum* x *P. attenuatum*, *P. nigrum* x *P. barberi* were characterised based on morphology, anatomy, isozymes and resistance to 'Pollu beetle'. The hybrids possessed heterosis and inherited resistance to 'pollu beetle' from resistant male parents.

Isolation of DNA

Genomic DNA was isolated from ginger, turmeric and nutmeg.

Cytogenetics and reproductive biology

Variation in chromosome number was detected in ginger cultivar Sabarimala as $2n=24$. Three tetraploid plants were produced from IISR Varada by colchicine (2%) treatment. Diploid number of nutmeg is $2n=38$.

Developmental morphology

Effect of growth hormones, Triacantanol, Paclobutrazole and GA₃ were studied in ginger and turmeric. GA₃ enhanced procambial activity, dimensional variation in xylem, phloem and fibre, thick cuticle in the epidermis and less fibre in ginger plants. In turmeric, GA₃ increased the cell size and number, more starch deposition, and the plant height while paclobutrazole induced dwarfening.

Propagation

- * Successful graft union was obtained with twenty varieties of black pepper and *P. colubrinum* Link as rootstock, which is relatively resistant to *Phytophthora capsici*.
- * Allspice cuttings treated with IBA 2500ppm + NAA 2500ppm in charcoal gave 63% rooting.

BIOTECHNOLOGY

- * A hardening facility with temperature, light and humidity control was established.
- * Interspecific hybridization was achieved between *Vanilla planifolia* (♀) x *V. aphylla* (♂) using embryo rescue technique.
- * Plant regeneration was successfully induced in *Capsicum annuum* using shoot tip and leaf explants.
- * Protoplasts were isolated from *C. annuum*.
- * Micropropagation protocols of curry leaf (*Murraya koenigii*) was standardised.

DIVISION OF CROP PRODUCTION AND POST HARVEST TECHNOLOGY

CROP PRODUCTION

Agro-physiological studies

Black pepper OP line P-24 acquired maximum canopy height of 504 cm and radius 117 cm during fourth year of planting. This was followed by Panniyur- 1 (492 cm and 105 cm) and the least was in Panniyur- 3 and Subhakara (313 cm and 77.7 cm). Among the 10 varieties evaluated Panniyur-5 gave the highest fresh yield of 2734 g vine⁻¹ followed by Subhakara (1337 g vine⁻¹).

Biofertilizers

Soil inoculation of *Azospirillum*, phosphobacteria and vesicular arbuscular mycorrhizae (VAM) alone and in combination increased biomass, dry matter production and nutrient uptake of black pepper.

Spices based cropping system

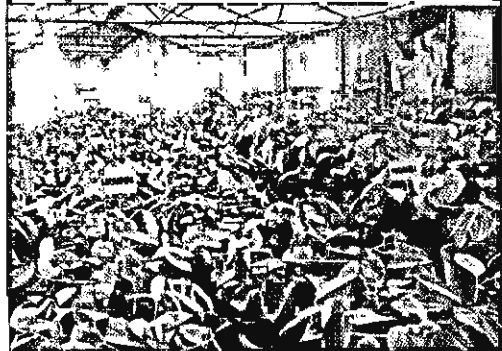
A crop combination with cardamom as a base crop with tree spices (clove, nutmeg, cinnamon and allspice), pepper and arabica coffee is under evaluation for the fifth year.

Nutritional requirements

- ✱ In black pepper, application of Zn, B and Mo @ 5, 2 and 1 kg ha⁻¹ along with 150, 60 and 270 kg ha⁻¹ of N, P and K increased the yield by 134 %.
- ✱ In turmeric, application of rock phosphate @ 25 kg P ha⁻¹ with FYM 100 t ha⁻¹ and micronutrients like Zn, B and Mo @ 5, 2 and 1 kg ha⁻¹ gave 27 % increased yield.
- ✱ Introduction of earth worms *in situ* in pots supplemented with FYM and *Glyricidia* leaves increased the nutrient availability in black pepper, ginger and turmeric.

- ✱ Application of coir compost (Terra Care) + neem cake + chemical fertilizer in turmeric increased the yield by 53% compared to chemical fertilizers.
- ✱ Application of coir compost (Terra Care) + FYM increased the ginger yield by 85% compared to sole application of chemical fertilizers.

PROTECTED BUSH PEPPER CULTIVATION



Technologies for protected cultivation of bush pepper with high density (350 pots per 140 m²) are standardised and 150 g dry pepper per pot was recorded during first year. There was no *Phytophthora* incidence.

Production of nucleus planting materials

One lakh black pepper rooted cuttings, 500 black pepper laterals, 12000 cardamom seedlings, 550 cardamom suckers, 29 kg, cardamom seed capsules, 30 tonnes of turmeric, 5 tonnes of ginger, 2500 nutmeg grafts, 3000 cinnamon seedlings, 2000 clove seedlings, 2500 allspice seedlings and 8000 vanilla rooted cuttings were produced and distributed this year.

DROUGHT TOLERANCE IN BLACK PEPPER

Based on physiological parameters like cell membrane stability, relative water content, stomatal resistance and transpiration rate black pepper accessions 1493 and 1372 were found tolerant to drought.

PRE AND POST HARVEST STUDIES

Chemical changes during maturity

Levels of mono and sesquiterpenes of black pepper essential oil were very low at 120 days after flowering which showed a sudden increase between 160-180 DAF and remained steady up to maturity. Varietal and agroclimatic influence were seen in the levels of oil, oleoresin and crude fibre among the 15 ginger accessions at different maturity stages.

White pepper

Spraying ethrel on the harvested black pepper berries hastened ripening and reduced the retting period for preparing white pepper.

Salted ginger

Based on colour, appearance, flavour and texture, ginger accessions 35, 64, 71, 117 and 179 were found good to prepare salted ginger.

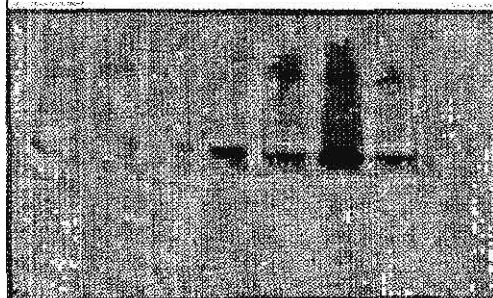
Curcumin rich turmeric lines

Acc. 583, 585, 605, 608 and 630 among the Alleppey collections and 650, 651 and 691 among Andhra Pradesh collections had more than 6.5% curcumin.

High quality cassia lines

C-5, C-7, D-7, D-3, B-1, D-1, B-2, A-7, D-6 and D-2 were the cassia lines with high leaf oil, bark oil and bark oleoresin.

ISOZYME CHARACTERISATION OF GINGER AND TURMERIC



Characterisation of 77 turmeric and 14 ginger accessions using Poly Acrylamide Gel Electrophoresis (PAGE) indicated more variability in turmeric (39-100%) compared to ginger (85-100%). Ten separate clusters in the former and two in the latter were established using dendrograms.

DIVISION OF CROP PROTECTION

PLANT PATHOLOGY

Biological control

- * *Verticillium tenerum* isolated from black pepper rhizosphere is antagonistic to *Phytophthora capsici*. A new strain of *Trichoderma* tolerant to copper has also been isolated.
- * Three fungal parasites viz. *Penicillium*

fellutanum Bourge, *Paecilomyces lilacinus* (Thom) Samson and *Verticillium lecanii* (Zimm) Vicgns were isolated from the vector *Pentalonia nigronervosa* f. *caladii* for the first time.

- * Biological control against *Phytophthora* has been demonstrated in 2254 hectares in Kerala, Tamil Nadu and Karnataka.

NEW MEDIUM FOR TRICHODERMA

Tea waste is more ideal than all other agricultural wastes for large scale multiplication of *Trichoderma* and *Gliocladium*. Tea waste supported a spore load of $1780 \times 10^6 \text{ g}^{-1}$ of *Trichoderma* after 21 days and $829 \times 10^5 \text{ g}^{-1}$ of *Gliocladium* after 28 days.

Etiology

Potyviral nature of the particles involved in 'Kokke kandu' disease of cardamom was established through Direct Antigen Coating (DAC) ELISA.

Disease resistance

- ✱ Eleven black pepper hybrid lines tolerant to *P. capsici* have been identified viz. HP 1786, 756, 1380, 1728, 754, 1344, 1382, 1748, 478, 92 and 490. Further evaluation is under progress.
- ✱ Accumulation of orthodihydroxy phenol and additional electrophoretic bands were observed in the tolerant lines of black pepper during pathogenesis.
- ✱ Black pepper OP line P-24 continued to show field resistance against *P. capsici* in large scale demonstration trials.
- ✱ Thirty four disease escapes against 'Kokke kandu' were identified in cardamom.

Disease management

- ✱ Integrated disease management involving potassium phosphonate spraying, application of neem cake at 1 kg vine^{-1} and biocontrol agents showed the lowest disease incidence in black pepper.
- ✱ Treatment of rhizomes with Ridomil mancozeb and soil application with *Trichoderma harzianum* reduced rhizome rot of ginger and turmeric.

ENTOMOLOGY

Documentation of natural enemies

Important natural enemies of insect pests of spices documented include *Blepyrus insularis* (Encyrtidae) on mealy bug (*Planococcus sp.*) infesting black pepper; *Anisopteromalus calandrae* (Pteromalidae) on cigarette beetle (*Lasioderma serricornis*) infesting stored ginger and turmeric; *Megommata sp.* (Cecidomyiidae) on shield scale (*Pulvinaria psidii*) infesting clove and *Sympiesis dolichogaster* (Eulophidae) on leaf miner (*Conopomorpha civica*) infesting cinnamon.

Biological control

- ✱ Release of 125 eggs vine^{-1} of the coccinellid predator *Chilocorus nigrita* for the control of mussel scale (*Lepidosaphes piperis*) infesting black pepper (5 releases at 7-10 day intervals) reduced the population by 44.5%.
- ✱ Release of 85 larvae (5 releases at 7-10 day intervals) of the coccinellid predator *C. circumdatus* against coconut scale (*Aspidiotus destructor*) reduced scale insects by 68.5%.
- ✱ Green lacewing (*Chrysoperla carnea stephens*), a predator of aphids was highly predaceous to cardamom aphid.

Toxicity of insecticides to biocontrol agents

Neem oil (0.3%) Neemgold (0.3%) and fish oil rosin (3%) were safe to the predator *C. nigrita* while monocrotophos (0.1%) and dimethoate (0.1%) were toxic up to 7 and 1 day after treatment, respectively.

NEMATODOLOGY

Resistance screening

Nineteen ginger accessions showed resistant reaction to *Meloidogyne incognita*. Turmeric

accession 84 showed high degree of resistance to *M. incognita*.

Biological control

Three isolates of bacteria showed 100%

suppression of root knot nematodes within 6 hours of exposure under *in vitro* conditions. Both *Verticillium chlamydosporium* and *Pasteuria penetrans* improved the growth of cardamom seedlings by suppressing root knot nematodes under field conditions.

SOCIAL SCIENCES

Effectiveness of Kurumulaku Samrakshana Samities

A study was conducted to evaluate the effectiveness of pepper welfare societies (Kurumulaku Samrakshana Samities) in black pepper production in Kerala. Due to various reasons, the perception of farmers about the samiti is only satisfactory. Farmers generally adopt advices on correct harvesting stage, cropping system, processing of pepper and adoption of improved varieties. Samities must be strengthened as they have good linkages with Krishi Bhavans, Cooperative Banks, voluntary organisations and other input agencies. Government should encourage the

samities so that farmers will have more trust in its functioning.

TRAINING PROGRAMMES

Seven training programmes were conducted during the year for Agricultural Officers, agricultural students and plantation officials. The programmes were on Spices Production Technology, Nursery Management and On Farm Processing.

Demonstration of Improved Technologies

Low lying marshy areas unsuitable for cultivation for any commercial plantation crops were successfully converted for profitable cultivation of cardamom at Appangala (Karnataka)

ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES (AICRPS)

AICRPS recommended release of three new varieties viz. cardamom (ICRI-4), mango ginger (Amba) and fennel (Guj Fen -2). ICRI-4 is an early maturing, malabar type with bold capsules and an yield of 455 kg ha⁻¹ under rainfed conditions.

Irrigation at IW/CPE ratio of 0.25 (100 litres once in 8-10 days) during Dec. - April increased the yield by 72% over no irrigation.

Fertilizer dose of 75:75:150 kg NPK ha⁻¹ was recommended for cardamom under natural shade in Karnataka.

Treating turmeric seed rhizomes with monocrotophos (@ 2 ml l⁻¹ of water) for 15 min is recommended to prevent scale insects. To prevent rhizome rot, bavistin treatment (2-g l⁻¹) is recommended.

KRISHI VIGYAN KENDRA

Krishi Vigyan Kendra organised 49 training programmes for farmers, rural youths and extension workers and conducted five exhibitions. Two innovative programmes, one on Horticultural Therapy for mentally handi-

capped and another on organisation of a Voluntary Vikas Vahini Club sponsored by NABARD at Kallanode (Calicut) were organised.

CONSULTANCY PROCESSING CELL

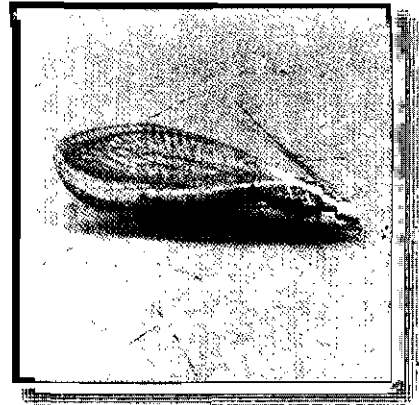
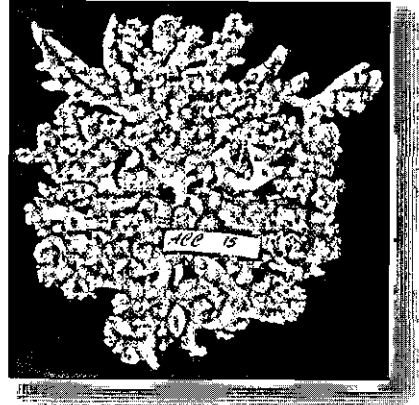
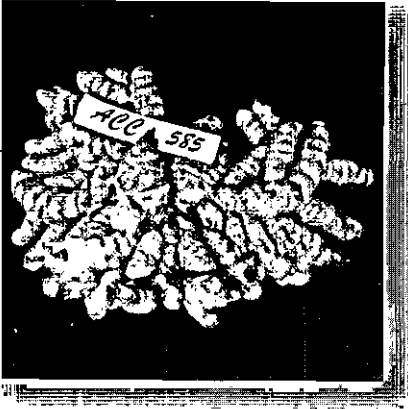
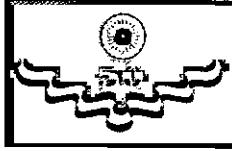
Institute has taken up contract research service and consultancy under this cell. Under contract research, a project on "Evaluation of Terra Care for growth, nutrient availability, yield response and quality of spices" with a financial outlay of Rs. 6 lakhs is already in progress with Dr. A.K. Sadanandan as Principal Investigator. Dr. Y.R. Sarma is functioning as consultant for the Indo-Swiss Project, Sikkim for the control of ginger diseases.

SEMINARS

Indian Society for Spices(ISS) in collaboration with Indian Institute of Spices Research (IISR), Calicut organised a National Seminar on "Water and Nutrient Management for Sustainable Production and Quality of Spices" at Madikeri, Karnataka during 5-6 October 1997. The Seminar covered three technical sessions viz. Integrated Nutrient Management, Water Use Efficiency and Developmental Problems and Strategies.

AWARDS FOR EXCELLENCE IN 1997

1. **ICAR Team Award for Multidisciplinary Research in Agriculture and Allied Sciences** for the Triennium 1994-96 to Dr. P. N. Ravindran, Dr. K. Nirmal Babu, Dr. (Mrs) J. Rema, Dr. B. Sasikumar, Dr. K. Samuddeen, Ms. M. Divakaran, Ms. G. S. Pillai, Ms. A. Sajina, Ms. M. P. Mathai, Sri. J. C. Zechariah and Mrs. C. Manjula for their outstanding contributions in the field of Horticultural Science.
2. **ICAR Hari Om Ashram Trust Award** for the research work "Development of Location Specific High Production Technology in Cardamom and Demonstration of the Same in Farmer's Field" to Dr. V. S. Karikanthimath, Dr. M. N. Venugopal, Dr. Rajendra Hegde and Dr. Ravindra Mulge.
3. **ICAR Young Scientist Award** for the research scheme "Substitution of Chemical Fertilizers with Organic and Biological Nutrient Sources for the Sustainable Cultivation of Cardamom" to Dr. Rajendra Hegde.
4. **Dr. J. S. Pruthi Award** for the best research paper published in Journal of Spices and Aromatic Crops. Vol. 5, 1996 to Dr. B. Sasikumar, Sri. Johnson K. George, Dr. T. John Zachariah, Dr. (Mrs.) M. J. Ratnambal, Dr. K. Nirmal Babu and Dr. P. N. Ravindran.



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