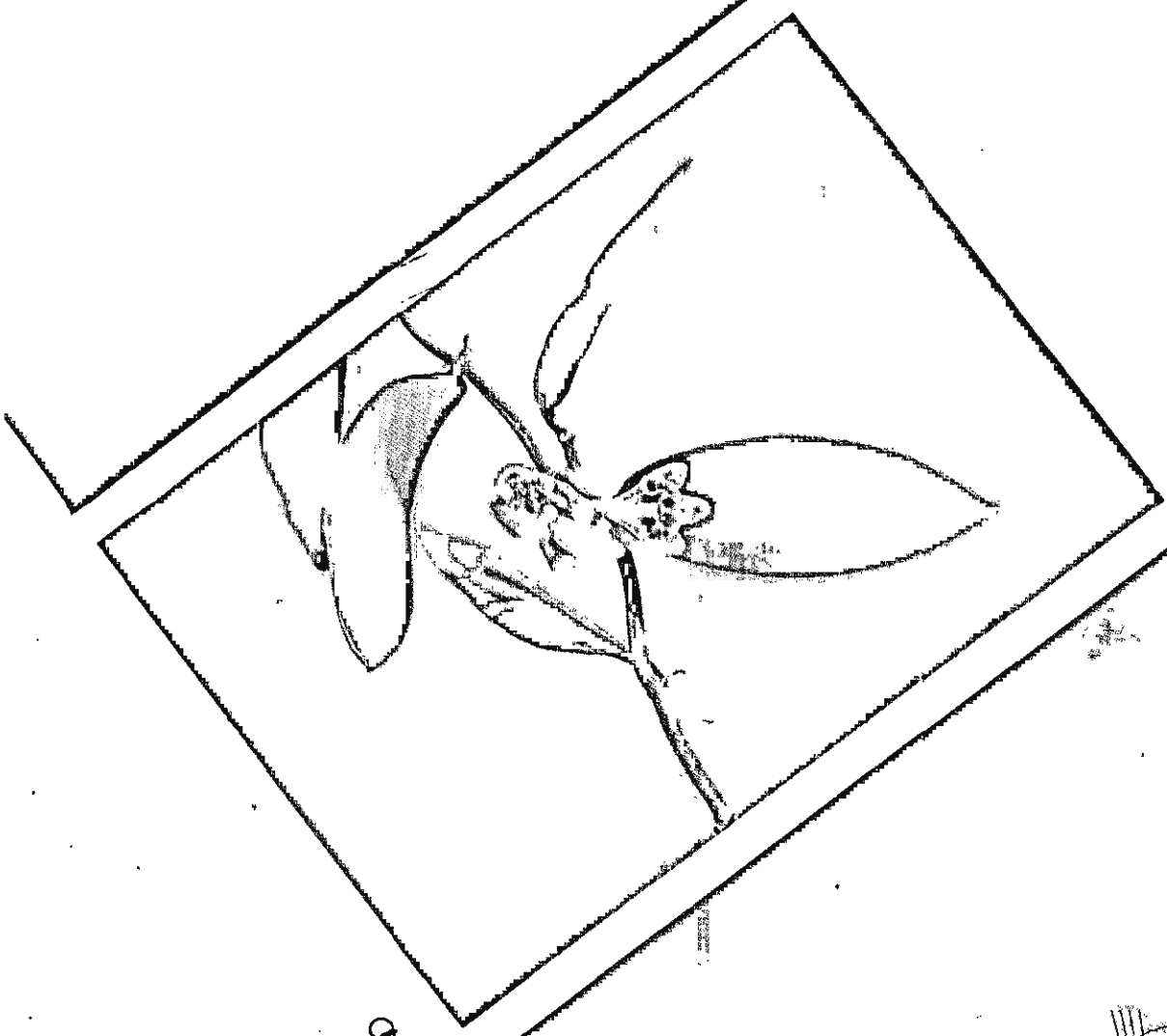
RESEARCH HIGHLIGHTS
1995 - '96



INDIAN INSTITUTE OF SPICES RESEARCH
(Indian Council of Agricultural Research)
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Photographs

Front cover — A wild *Vanilla* collection from Andaman and Nicobar Islands

Back cover (Top to bottom) — 'Synseeds' of camphor

Chilocorus nigrita, a potential biocontrol agent of scale insects, infesting black pepper

A root knot nematode egg parasitized by the antagonistic fungi, *Vertcillium chlamydosporium*

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DIRECTOR'S REPORT

The year 1995-96 witnessed an all-round growth and development in spices' research. The National Research Centre for Spices (NRCS) was upgraded to a full-fledged institute, 'Indian Institute of Spices Research' with effect from July 1, 1995. The ninth Staff Research Council was held during 9-10 November 1995. Five new research projects were initiated during the year.

The institute organised a 'Group Meeting on Virus Diseases of Black Pepper and Cardamom' from 13 to 14 June 1995. A 'Network Project on Viral Diseases of Black Pepper and Cardamom' is envisaged from the deliberations. The XIII National Group Meeting of the AICRP on Spices was organised at Jaipur during 23 to 24 August 1995. One ginger variety (IISR Varada), two varieties each of cinnamon (IISR Navasree and IISR Nithyasree) and turmeric (IISR Prabha and IISR Prathibha) were recommended for release. The institute also organised 'Biotechnology Popular Lecture Series' on 28, 29 September and 7 October 1995. The first Research Advisory Committee meeting was convened during 12 to 13 January 1996. Perspective Plan for the institute was debated and approved.

The research projects under mini missions were reallocated to the Divisions viz., Crop Improvement and Biotechnology (13 projects), Crop Production and Post Harvest Technology (11 projects), Crop Protection (7 projects) and Social Sciences Section (5 projects). In addition five ICAR (A. P. Cess Fund) projects and four DBT-funded projects were also in operation. Network programme on '*Phytophthora* Diseases of Horticultural Crops' and 'Drip Irrigation in Horticultural Crops' are on the anvil.

In the research front, plant regeneration protocols are standardised for callus cultures of cinnamon, camphor and several herbal spices. Protoplasts were isolated from *Piper colubrinum* leaves. 'Synseed' technology was developed by encapsulating the embryos / shoot tips in sodium alginate for ginger, turmeric, vanilla, cardamom, camphor, lavender, dill and fennel. There has been strides in the area of biocontrol. *Trichoderma* isolates suppressed damping off and pre and post emergence rotting of cardamom seedlings. *Chilocorus nigrita* (Coleoptera : Coccinellidea) was recorded for the first time to predate on *Lepidosaphes piperis* (a scale insect) infesting black pepper. Similarly, *Verticillium chlamydosporium*, a known nematode biocontrol agent, was isolated for the first time from the rhizosphere of black pepper.

Study Circle of the institute met 23 times during the year and approved 22 research papers for publication. Laboratory facilities were further improved during the year by the addition of sophisticated instruments like freeze drier, 'Perkin Elmer' autosystem gas chromatopraph, 'Hoefer' electrophoretic system for different types of electrophoresis and DNA sequencing and BIORAD gene cycler. During the year, the possessions in the library are 3278 books, 2354 bound volumes of journals and 1931 reprints. The budget of the institute was Rs.109 lakhs under Plan and Rs.113.51akhs under Non Plan.

The All India Coordinated Research Project on Spices with 20 centres functioned as per the approved technical programmes. Research on coriander, cumin, fennel and fenugreek received due attention during the year. The Krishi Vigyan Kendra, Peruvannamuzhi imparted short term trainings and also took part in many exhibitions.

IISR RH-9

(K V PETER)
DIRECTOR

CROP IMPROVEMENT

Genetic Resources

- *Piper cubeba* from Germany, 33 disease escapes from Idukki, 15 accessions from Wynad and 26 *Piper* taxa collections from Andaman and Nicobar Islands were added to the black pepper germplasm.
- A total of 60 new cardamom accessions comprising of compound panicle (multi branch), long panicle, compact panicle and sterile types were added to the germplasm.
- Ginger and turmeric germplasm was enriched with the addition of 9 *Curcuma* and 22 ginger accessions.
- Five cultivated and 8 wild cinnamon accessions, 13 cultivated and 16 wild nutmeg accesions and 4 clove accessions were collected from Andaman islands, South Kanara and Coorg districts in Karnataka. These include important species like *Cinnamomum macrocarpum* Hook f.c. *wighti* Meissn, *Myristica andamanica*, *Knema andamanica* and several variants.
- Seven accessions of *Vanilla* spp. from Andaman and Nicobar Islands, five lines of *Capsicum* and seven lines of *Ocimum* from the gene bank at Gatersleban, Germany were also added to the spices germplasm.

Yield Trials

- A new yield trial of hybrids and selected OP lines of black pepper was initiated at Peruvannamuzhi.
- In cardamom, APG 223, 215, 230 and Vazhukka suckers were found superior in the evaluation trials of Wynad collections. RR1, a rhizome rot resistant clone, and five mosaic virus resistant clones (NKE - 9, 29, 26, 27 and 34) were short listed for multilocation trials on the basis of their high yield and quality.
- The nutmeg accession A 9/4 yielded 800 fruits / tree in the 7th year after planting.

New Varieties

- One high yielding ginger variety, high quality varieties two each in turmeric and cinnamon were recommended for release at the XIII National Group Meeting of the AICRP on Spices held at Jaipur.
- Two of ginger lines with bold rhizomes are in advanced stage of evaluation.

BIOTECHNOLOGY

Micropropagation

- Micropropagation protocols for rapid clonal multiplication were standardized for tree spices like cinnamon and camphor and several herbal spices like thyme, spearmint, peppermint, sage, marjoram, oregano, lavender, sweet basil, anise, parsley, fennel, dill, caraway and celery.

'Synseed' Technology

- 'Synseeds' were developed by encapsulating somatic embryos / shoot buds in ginger, carda mom, turmeric, cinnamon, camphor, vanilla, anise, lavender and sage.

Somatic Embryogenesis

- Plant regeneration from callus cultures of vanilla was achieved for the first time. Somatic embryogenesis and plant regeneration were obtained from seed cultures of cinnamon, anther derived callus cultures of ginger and callus culture of herbal spices like lavender, fennel, anise and sage.

Protein Electrophoresis

- Isozyme profiles for esterases and SOD using PAGE indicated high variability in seed progenies of vanilla.

DNA Studies

- RAPD profiles were recorded in black pepper and long pepper and these can be used for genotype identification in these crops.

CROP PRODUCTION

Nutritional Requirements

- Preliminary studies showed that application of NPK @ 150:60:270 together with micronutrients Zn, B and Mo @ 5:2:0.5 Kg/ha respectively was optimum for improved varieties, Subhakara and Sreekara.
- Application of NPK @ 1:0.5:2 g/pot with 10 Kg soil at bimonthly interval increased the nutrient availability in soil and improved yield of bush pepper compared to slow release NPK tablets, applied in one dose.
- Potassium sulphate was a better source of K for bush pepper compared to the conventional potassium chloride

Crop Management

- Bush pepper was grown in field economically at a spacing of 2 x 2m with a fertilizer dose of NPK @ 10:5:20 g/bush during January, May and September.
- The performance of Panniyur I and Panniyur III was superior with respect to growth characters compared to other released varieties and a pre release line, P24.

Irrigation Needs

- Irrigating black pepper @ 7 l /day/vine through drip during October to March resulted in maximum yield (3.30 Kg green pepper / vine) compared to control (0.96 Kg / vine).

Organic Farming

- Soil application of *Azospirillum*, irrespective of fumigation of nursery mixture, enhanced the growth of black pepper in nursery.
- One year old clove seedlings raised by using vermicompost were as good as two year old, conventionally raised seedlings in terms of growth and vigour.
- African earthworms (*Eudrillus eugenia*) converted more than 90% of organic waste comprising of leaf litter, arecanut husk, coir dust, coffee husk and cowdung in three months and there was a two fold increase in their population.

Crop Physiology

- Chlorophyll content in Panniyur V and Sreekara increased after January while it remained almost constant during the growth period in other eight high yielding black pepper varieties. P24, Panniyur I and II had higher levels of chlorophyll content while it was low in Panniyur III and Panchami.

Drought Tolerance

- Preliminary screening of 50 black pepper germplasm accessions for drought tolerance revealed that Acc. Nos. 891, 908, 1079, 1092 and 1114 maintained greater membrane stability and higher relative water content during stress period.
- Two drought tolerant lines of cardamom (P3 and P6) were collected from RRS. Mudigere.

Production of Nucleus Planting Materials

- During the year 95,000 rooted cuttings,1250 rooted laterals of black pepper, 23 tonnes of turmeric, 800 nutmeg grafts and 5150 cinnamon seedlings were supplied to various agencies.

POST HARVEST TECHNOLOGY

Quality Evaluation

- In cardamom, out of the 44 natural katte escapes, NKE-3 contained high volatile oil (7.5%) and RR-1 and NKE-73 contained high alpha terpinyl acetate. Among the seven MLT-I lines, MI-1 and MI-5 contained more than 8% oil and MI-3, MI-2 and MI-6 contained high alphaterpinyl acetate. The Wynad cardamom selection, APG 221 consistently gave 7.8% essential oil containing 19% 1,8-cineols and 53% alpha terpinyl acetate.
- Among the ginger accessions evaluated for fibre content, Acc. Nos.18,13, 35, 51,151, 215,179 and 249 had crude fibre less than 3.5% Evaluation of popular cultivars indicated that fibre content of Maran, Thingpuri, Wynad, Karakkal, etc. is 3.1 to 3.7% at Brahmavar (Karnataka) compared to 5.5 to 5.7% in Kerala. Accession 164 contained 9% oleoresin.
- Curcumin content of Acc. 360, 361, Suguna and Sudarshana at Coimbatore, Jagtial and Dharward is about 40% less compared to the curcumin content of these varieties at Calicut and Moovattupuzha.
- Analysis of *Cinnamomum cassia* bark and leaf indicated that Acc. D-1, D-3 and D-5 had above 4% bark oil with high cinnamaldehyde content and A-6 had high leaf oil with about 72% cinnamaldehyde.

CROP PROTECTION

Survey and Distribution

- Surveys conducted in 162 locations in major black pepper areas in Kerala, Karnataka and Tamil Nadu indicated that 18 genera/species of scale insects and mealy bugs infested the crop among which 14 were new records on the crop. Among the various species, *Lepidosaphes piperis* and *Aspidiotus destructor* were the most common causing appreciable damage to the crop. The incidence of these two species was positively and significantly correlated with altitude.

Etiology

- Apart from stunting, four distinct symptoms of CMV infection in black pepper were identified and confirmed by ELISA test. *P.longum. P.sugandhi, P.argyrophyllum* and *P.hymenophyllum* were also found infected by CMV. The antigenie identity of CMV of black pepper and banana was confirmed.
- Studies on virus - vector relationship in 'Kokke kandu' disease of cardamom using the Hongadahalla isolate of the disease and the insect vector, *Pentalonia nigronervosa. Pcaladii* showed the semi persistent nature of the virus.
- Six root knot nematode (*Meloidogyne incognita*) populations, collected from various spices, showed considerable variations in their perineal patterns.

Pathogenicity

- *M.incognita* at Pi<2/100 cc of soil caused maximum reduction in growth and yield of ginger in a pot culture study.

Studies on *Trophotylenchulus piperis*

- Black pepper gardens in Coorg District were free of *Trophotylenchulus piperis*. Eleven species of common weeds in black pepper gardens were non hosts for *T.piperis*.
- *T.piperis* eggs hatched well in distilled water and root exudates had no role in hatching.

Resistance / Tolerance

- In a three year old field trial in hot spot areas of *Phytophthora* foot rot of black pepper, a

tolerant line P24, showed 20% disease incidence compared to 50% in the susceptible variety.

- Among the 26 wild and 35 cultivated *P.nigrum* accessions, screened for berry damage by pollu beetle, *Longitarsus nigripenins*, under field conditions, two wild and one cultivated accessions were free from berry damage.
- Clone-893, an elite selection of cardamom, showed field resistance against natural infection of 'Kokke kandu' disease in a two year old screening trial in a hot spot area near Sirsi. Twenty one natural disease escapes were collected from hot spots of 'Kokke kandu' disease in Uttara Kannada and Hassan Districts.
- Eleven ginger and 17 turmeric accessions showed varying degrees of resistance/ tolerance to root knot nematodes in the preliminary screening.

BIOTECHNOLOGY FOR CROP PROTECTION

- Successful protoplast isolation and regeneration of callus were achieved in *P.colubrinum*. Somaclones of black pepper screened for their reaction to *P.capsici* showed considerable variations.

Biocontrol

Vesicular Arbuscular Mycorrhizal Fungi

- In a five year old field trial for the management of *Phytophthora* foot rot disease in black pepper involving VAM inoculation, with and without agrochemicals, VAM treated plots recorded minimum disease incidence (11 %) compared to 50% in control.
- Copper oxychloride drenching had an adverse effect on VAM colonisation on the black pepper roots whereas systemic fungicide metalaxyl mancozeb (Ridomil MZ72WP) and potassium phosphonate (Akomin) did not affect the same.
- Solarite, soil, sand and FYM in equal proportion was optimum for production of root biomass of sorghum and can be effectively utilised for large scale VAM production.

Trichoderma *and* Gliocladium

- Field application of *Trichoderma harzianum* using coffee husk as carrier suppressed rhizome rot of cardamom with only 6.4% disease incidence in treated plots compared to 19.8% in untreated check.

Bacillus thuringiensis *for Shoot Borer Control*

- Evaluation of two commercial formulations of *B.thuringiensis* against shoot borer, (*Conogethes punctiferalis*) of ginger and turmeric indicated that four sprays (during July, August, September and October) of dipel 0.3% were more effective in controlling the pest infestation.

Natural Enemies and Predators of Scale Insects

- Surveys conducted in Dindigul Anna District, a major black pepper area in Tamil Nadu indicated that *Pseudoscymnus* sp., *Cybocephalus* sp. (Coleoptera), *Mallada boninensis* (Neuroptera) and *Encarsia lounsburyi* (Hymenoptera) were common natural enemies of scale insects infesting black pepper.
- *Chilocorus nigrita* was recorded as a predator of scale insects infesting black pepper for the first time from Kozhikode District, Kerala. Adults of the predator fed on 26-54 and 10-35 individuals of *L.piperis* and *A.destructor* per day respectively and is a potential biocontrol agent of these two species. Methods were also standardised for the mass rearing of *C.nigrita* in the laboratory.

Nematode Biocontrol

- *Verticillium chlamydosporium* was isolated for the first time from cases of *T.piperis* collected from Koothali, Kozhikode District. It suppressed hatching of *M.incognita* eggs by 56.3% within

24 hours. Parasitisation of root knot nematode eggs by *V. chlamydosporium* was also observed.

- Ten isolates of fluorescent pseudomonads were found promising in the management of root knot nematodes.

Natural Products

- Evaluation of commercial neem products and endosulfan against pollu beetle in the field indicated that three sprays with endosulfan 0.05% (during June, July and September) or one spray with endosulfan 0.05% (during July) and three sprays with Neemgold 0.3% (during August, September and October) or four sprays with Neemazal-F 0.05% (during July, August, September and October) were more effective in controlling the pest infestation.
- *In vitro* evaluation of commercially available neem products indicated that 'Econeem' was highly toxic to root knot nematodes at 2ml / l and above.

Integrated Disease Management

- Spraying and drenching black pepper vines with potassium phosphonate and soil application of biocontrol agents like *Trichoderma* and *Gliocladium* were found effective for *Phytophthora* foot rot management.
- Roguing coupled with spraying of insecticides had effectively kept the 'Kokke kandu' disease incidence under manageable level (<2%).

TRANSFER OF TECHNOLOGY

Demonstration Trials

- Demonstration trials on the efficacy of biocontrol against *Phytophthora* foot rot of black pepper, clump rot/root rot of cardamom and rhizome rot of ginger were laid out in 1074 ha.
- A maiden yield of 1945 Kg(dry) / ha was obtained in 1995-96 when cardamom was introduced as sole crop in place of arabica coffee. The cardamom yield was 1775 Kg(dry) / ha, where replanting was taken up in a phased manner. Cardamom cultivated in steep slopes by resorting to soil conservation measures recorded an average yield of 982Kg dry cardamom / ha. Cardamom planted by converting marshy areas gave 648Kg dry cardamom /ha during the year. In a farm forestry based cardamom cropping system (0.22 acres), raised in an open upland paddy area, the pepper plants trained on silver oaks gave an encouraging yield of 90Kg dry while the cardamom yield was 110 Kg drv.

Training Programmes

- Four training programmes on 'Nursery Management in Spices', 'Spices Production Technology' and 'Onfarm Processing of Spices' were conducted wherein 59 officers from different states had participated.

Participation in Exhibitions

- The institute participated in four exhibitions organised in connection with Madras Trade Fair (10-17 October 1995), National Rubber Conference at Cochin (3-6 November 1995), Anniversary of Farm & Home unit of AIR, Calicut (27-30 December 1995) and Karshika Mela at Koduvally, Calicut (6-7 January 1996).

- During the year, Dapoli (KKV, Maharashtra), Kumargunj (NDUAT, Uttar Pradesh), Raigarh (IGKVV, Madhya Pradesh), and Pundibhari (BCKVV, West Bengal) have been added as new centres of AICRP on Spices.

CROP IMPROVEMENT

Genetic Resources

- In black pepper, Panniyur centre collected a new cultivated type, 'Munda' from Kanjirapuzha near Palghat, Chintapalli centre added 4 wild types from Kumkumudi and Vangasara and Yercaud centre identified 20 elite lines from Shevroys hills.
- In tree spices, the lone centre at Yercaud identified 13 elite clove lines from the traditional areas,10 accessions of cinnamon from Anamalai hills and a nutmeg having yellow mace from Kolli hills.
- The Pottangi centre collected 4 each of ginger and turmeric from Cuttack, Koraput and Malkangiri Districts of Orissa. The Jagtial centre added turmeric germplasm from Adilabad, Rayalaseema and coastal Andhra Pradesh.
- Under seed spices, the Jagudan centre surveyed Gujarat and identified 27 coriander, 53 cumin, 9 fennel and 7 fenugreek entries showing distinct variability. In collaboration with NBPGR, Hyderabad, the Guntur centre assembled 110 accessions in coriander.

Yield Evaluation

- In the evaluation of OP and hybrid progenies of black pepper at Panniyur, Cultures 5489 (Cheriyakaniyakadan OP), 5403 (Karimunda OP) and 7156 (Perumkodi OP) recorded the maxi mum yield. Kuthiravally followed by Neelamundi and Arakkulam Munda were the highest yielders in the evaluation of promising cultivars of black pepper.
- In cardamom, Clones PS-31and PS-1 gave maximum yield at Pampadumpara. P-17, P-8, CL-728, CL-692, CL-681, P-12, CL-730, CL-757, P-20 and EB-1277-7 were identified as promising cul tures at Mudigere. The yield of clonal crop was 30 - 40% more compared to that of seedlings. Twenty months old seedlings yielded 18% higher than 10 months old seedlings. Tissue cultured selection TC-5 was most promising among the 8 tissue culture cardamom cultures evaluated at Mudigere.
- Use of non-precured orthotropic and semihard wood scions and the two leaved stage of root stock gave highest percentage of success in nutmeg.
- At Pottangi, PTS -19 followed by PTS -43 (long duration) and PTS - 59 (short duration) were identified as promising turmeric cultivars. In ginger. SG -666 and V1E8 gave highest yield.
- The Jagudan centre successfully crossed 'hairy cumin' and white flower cumin with Gujarat cumin -2. The fennel exotic culture and bloomless fennel were crossed with Gujarat fennel-1.

New Varieties

- The XIII National Group Meeting of the AICRPS held at Jaipur recommended 9 varieties of spices for release. They are SG -666 and Acc. 64 in ginger, Mudigere -2 in cardamom, PLD -2 in black pepper, Acc 360 and 361 in turmeric, UD - 20 in coriander and Sel. 63 and In. 189 in cinnamon.

CROP PROTECTION

- Combination of cultural practices + 1 Kg neem cake + 3g a.i. phorate + 1 % Bordeaux mixture spray first and second round Akomin (0.4%) spray reduced the *Phytophthora* foot rot and nema tode ineidences in black pepper at Chintapalli.

- Spraying and drenching with 1 % Bordeaux mixture and 0.2% Akomin, respectively, controlled nursery diseases in black pepper at Panniyur.
- Treatment with *T.harzianum* and *T. viride* reduced the incidence of *Phytophthora* foot rot to 8.3% compared to 33.3% in untreated control plots at Chintapalli.
- Three sprays, one in March (Monocrotophos 0.05%) followed by two during May - August (Phosalone 0.05%) were most effective for the management of cardamom thrips at Mudigere centre. Pooled analysis showed that the treatment of 'five insecticide applications' during the months of February / April / May / August / October was effective in controlling thrips and shoot borer of cardamom at Pampadumpara.
- Spraying of Dithane M45 (0.25%) to control *Taphrina* leaf spot disease of turmeric was recommended by the Jagtial centre.

Resistance / Tolerance

- Seventy seven turmeric entries showed field resistance to *Colletotrichum* leaf spot and 44 entries to *Taphrina* leaf spot at Jagtial. Cumin exotic entries viz.,EC - 232684, EC - 243373 and EC - 243375 were resistant to *Fusarium* wilt at Jagudan.

CROP PRODUCTION

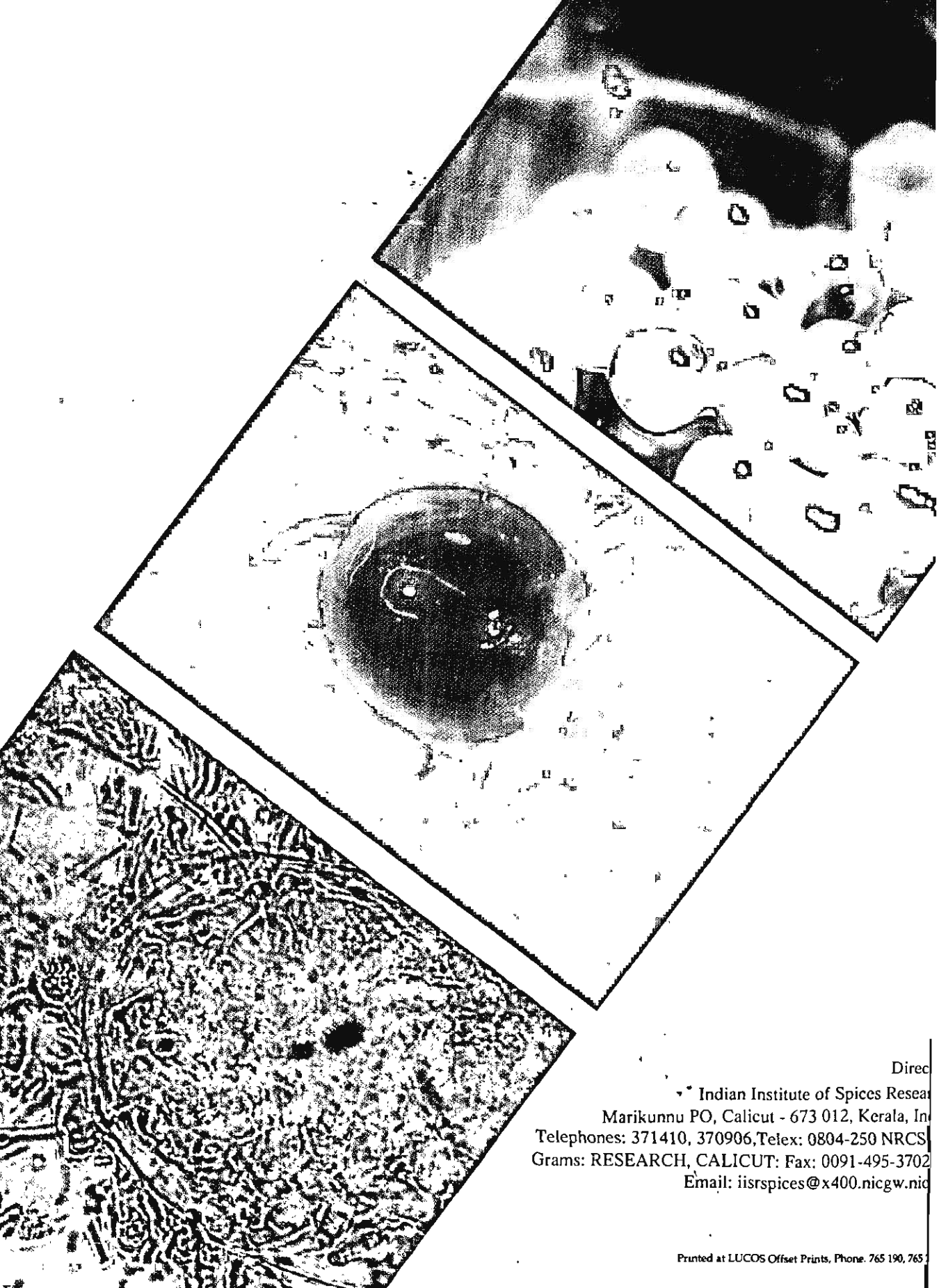
- High levels of fertilizers, 150:150:225 NPK, significantly increased yield of cardamom under natural shade at Mudigere.
- Application of N_{125}, P_{100}, K_{100} gave higher yield in ginger (Suruchi) with maximum benefit of Rs.53,000/ha at Pottangi.
- At Panniyur, irrigation at IW / CPE ratio of 0.25 was the best for maximum spiking in black pepper cv. Karimunda.
- Intercropping soybean in turmeric gave maximum rhizome yield (17t / ha) at Pottangi. This also reduced the cost of cultivation and substituted the 2nd and 3rd mulching in turmeric.

KRISHI VIGYAN KENDRA

- Plant and animal health centre was established in July,1995 and arrangements were completed to start an artificial insemination unit at this centre.
- Demonstration units were established in the following disciplines viz.,Vermiculture, Mushrooms, Bee Keeping, Rabbitory, Poultry and Nursery management.
- Fortyfive training programmes were conducted in the disciplines viz.,agriculture, horticulture and home scienee in which 3,500 participants (farmers, farm women, school dropouts and house wives) had attended.
- Ten National Demonstrations on intercropping of coconut with spices were organised in farmers field.
- Problem oriented research was conducted with regard to management of *Phytophthora* foot rot of black pepper and mahali in arecanut.
- The Kendra adopted Pannikottur village in which client oriented programmes and 25 families belonging to scheduled caste category were provided with planting materials, poultry and agri cultural implements with a view to improve their family income.

IISR TRAINING PROGRAMMES

Nursery Management in Spices	7-8 October 1996
Spices Production Technology	18-23 November 1996
Onfarm Processing of Spices	6-7 January 1997



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