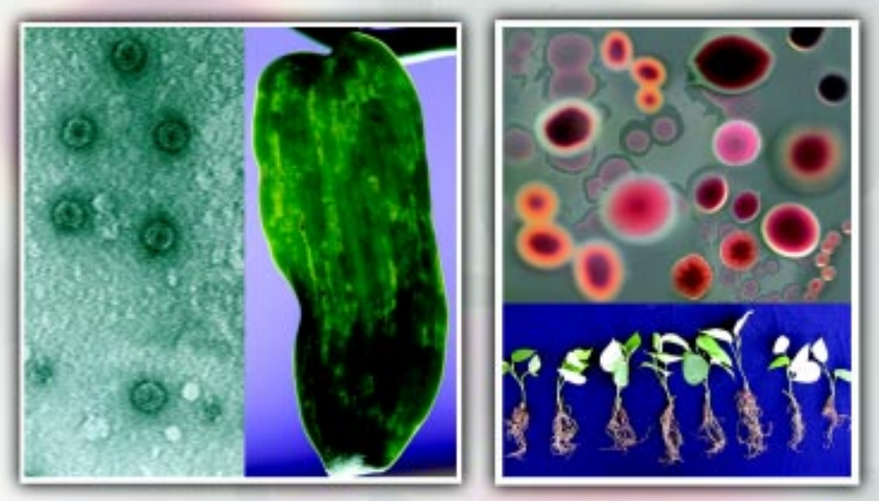
Research Highlights
2004-05



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Indian Institute of Spices Research
Calicut

Research Highlights

2004–05

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Front cover pictures: 1. Vanilla leaf infected by Cucumber mosaic virus *and Viral particles (p. 10) (From left)*

2. Colonies of endophytic bacteria from black pepper and their effect on growth of black pepper rooted cuttings. (p. 14)

Bottom : Field training programme by KVK (p. 15)

Back cover picture: Agricultural Technology Information Centre of IISR, Calicut

PREFACE

I am happy to present the Research Highlights for the year 2004-05. The research activities of the institute were fine tuned with the recommendations of the Research Advisory Committee (RAC) and Quinquennial Review Team (QRT). Seventy five of the 81 recommendations by QRT were approved in the Governing Body of ICAR and action has been initiated in almost all the recommendations. The new RAC under the Chairmanship of Dr. S Kannaiyan, Chairman, National Biodiversity Board was constituted. The RAC reviewed the entire work during 2004-05 under the light of recommendations of the earlier RAC and QRT. During the year, the institute conducted all the regular meetings as per the schedule. The institute also received six new externally funded projects during the year. Under the Scientific front, the identification of Phytoplasma causing Phyllody disease of black pepper, identification of promising bacterial strains to develop endobacterial consortium for disease management in spice crops, and enrichment of germplasm of various spices crops through explorations were the hallmark of research achievements during the year besides many others presented the report.

I thank the Editorial Committee consisting of Dr. A Kumar, Scientist & Secretary, Staff Research Council, Dr. A Ishwara Bhat, Senior Scientist, Dr. R Dinesh, Senior Scientist, and Dr. Utpala Parthasarathy, Technical Officer for bringing out the Research Highlights in an excellent manner.

Calicut
June 2005

V.A. Parthasarathy
Director

CONTENTS

GENETIC RESOURCES

Black Pepper, Cardamom, Ginger, Turmeric, Paprika and Tree spices

About 97 *Piper* accessions including *Piper nigrum* with bold berries, *P. argyrophyllum* with long spikes and *Piper hymenophyllum* with profuse hairiness were collected from the forests of Kakkayam, Tusharagiri (Calicut district) and Tirunelly / Brahmagiri / Pakshipathalam (Wayanad district). Large assembly of cardamom selections made from different cardamom growing regions of country is being maintained in CRC, Appangala. The present *in-vivo* cardamom clonal gene bank comprises collection, variants, hybrids and disease resistant selections. During 2004-05 five accessions (precocious yielder- 3 and high yielder-2) were collected from Kodagu District, Karnataka. A total of nine accessions of *Zingiber* spp. and 11 accessions of *Curcuma* spp. were collected from farmer's fields of Wyanad and Arunachal Pradesh. Twenty five accessions of *Garcinia* species such as *G. gummigutta, G.indica, G. hombroniana, G. imbertii, G. morella* (Fig 1) and *G. wightii*, six accessions of *Cinnamomum* species such as *C. filipedicillate, C. citriodora, C. gracile, C. malabatrum and C. verum* and two accessions of *Myristica beddomeii* from Palode, Calicut, Wyanad (Kerala) and South Kanara (Karnataka) were collected. Eleven accessions of indigenous and five accessions of exotic germplasm of paprika-alike-chillies and paprika were collected from Jorhat (Assam) and Dharwad (Karnataka).

Fig 1. Garcinia morella

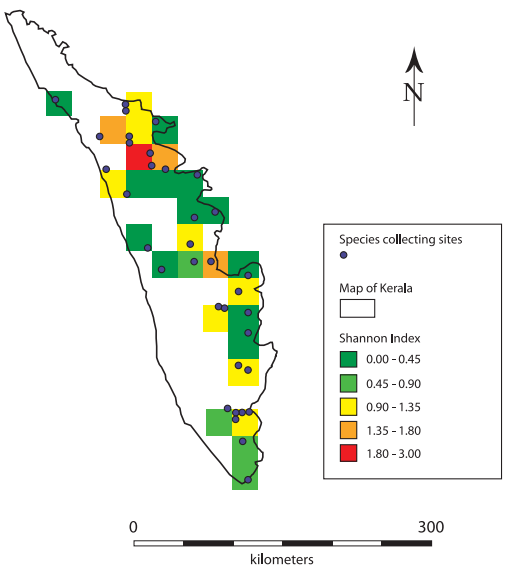
Present status of spice germplasm at IISR, Calicut

Spice Crop	No. of germplasm
Black Pepper	2257
Cardamom	408
Ginger	756
Turmeric	936
Garcinia	86
Cinnamon	408
Nutmeg	484
Clove	233
Allspice	2
Paprika	63
Vanilla	82

GIS and Shannon Diversity Index in Pepper

In order to study the species richness and diversity of pepper in Kerala, the distribution data were plotted in the Kerala administrative map with the help of DIVA GIS software. Shannon's diversity index was studied which indicates that the Wayanad district is having the highest diversity followed by Palakkad district. The DOMAIN model was used to predict the distribution of *Piper* species in other parts of India. Northeast India, coastal Andhra Pradesh, Orissa and West Bengal are likely to have many *Piper* species. The chances of availability of wild species of *Piper* in other parts of the country are remote. The ideal annual rainfall is between 2200mm to 2700mm and the frequency of the distribution of *Piper* species is very high in these ranges even though *Piper* species do occur in areas receiving rainfall from 1500 to 3500mm.The distribution of *Piper* species at different altitudes was also studied. It shows that Silent valley of Western Ghats is having very high richness of the pepper species. The analysed map with species collection show that climate and soil has impact on the distribution of wild *Piper*. The present study is the first report on *Piper* species using GIS.

Shannon diversity index of *Piper* species



Characterization of germplasm

Black pepper

About 50 cultivar accessions were characterized and evaluated based on IPGRI descriptor. One *Piper nigrum* collected from the natural forests of Nelliampathy (Palaghat district) has been registered as a unique germplasm for its high oleoresin content (28.15%) and bold berries (INGR. 04111, IC-370011).

Identification of hybrids in black pepper using ISSR markers

Inter Short Sequence Repeat (ISSR) Markers were found to discriminate *Piper* species,

Piper hybrids HP 780x *P.nigrum* (wild), IISR4176 x IISR 430, Panniyur1 x Karimunda and their parents.

Cardamom

Molecular profiling using RAPD, ISSR and PCR-RFLP revealed two major divergent clusters viz., "Kerala collections" and "Karnataka collections." *Amomum subulatum* and *A. microstephanum* were found clustered with *Elettaria cardamomum* indicating that *Amomum* is closest to cultivated cardamom.

Turmeric

Cytological analysis of true turmeric seedlings of the mother line Ac. 126 revealed a somatic chromosome number of 84 or 78.

Vanilla

Cytological analysis of the *V. andamanica* revealed 2n = 40 as most frequent chromosome number

Paprika

The capsaicin content (pungency) of selected paprika accessions ranged from 0.006 (EC-490) to 0.13% (ICBD-14).

Crop Improvement

Black pepper

Evaluation of nine promising black pepper lines at Peruvannamuzhi indicated superiority of OPKm, HP1411 and Coll. 1041, yielding 4.05, 3.87 and 4.14 kg (fresh berries) / vine respectively as compared to Sreekara (control) which yielded 2.94 kg / vine.

Cardamom

Field reaction of 42 entries against leaf blight (*Colletotrichum gloeosporioides*) was recorded. While the glabrous selections of Malabar type MA-15, MA-18 and MA-20 were moderately resistant, the compound panicle types, CP-9 and CP-2 were resistant. The land race Green Gold (Neljiani Gold) also showed resistant reaction.

Ginger and turmeric

Among the ginger accession evaluated, Acc. 578- an exotic ginger collection from Nepal recorded the highest yield (15.25 kg / 3 m^2) with a dry recovery of 23.5% and fibre content of 1.5%. An Acc. 162 was superior to the rest in terms of oil content (2.3 %).

Cassia

Among the elite lines of Cassia, C_5 was found to be superior with a yield of 475 g and quality parameters such as bark oil (5.0 %), leaf oil (3.09%) and bark oleoresin (10.70%).

Nutmeg

Among the 106 accessions evaluated during 2004-2005, A9 / 18 with 933 fruits per tree was found to be superior.

Garcinia

Soft wood grafting of *Garcinia xanthochymus* was standardized on nine months old *G. xanthochymus* rootstocks with 90% success. Grafts have a compact plant type and bear fruits at an early age. Preliminary field evaluation revealed that grafted plants flowered within two to three years after grafting, while seedling trees did not flower even seven years after planting.

Vanilla

Pollination studies indicated that white and pink flowered varieties of *Vanilla andamanica*

were self and cross compatible besides showing compatibility with *V. planifolia*.

Quality evaluation in spices

Black Pepper

Among the black pepper accessions evaluated, Acc. 1637, 1566 and 1493 contained 4% oil, Acc. 1602 contained 19% oleoresin followed by KS-127, 4073 and KS 147 with over 16%. W-3001 contained 5.6% piperine followed by HP-1523 with 4.3% and Acc. 836, 1261 and KS-139 with more than 3.6% piperine.

Cardamom

Three cardamom accessions (CP, HY-2 and NHY-2) had high levels of essential oil (7.8, 6.8 and 6.4% respectively).

Ginger and Turmeric

Accessions 694, 695, 633, 632 and 630 contained high oil and oleoresin. Evaluation of turmeric accessions showed higher levels of oleoresin in accessions 773, 715, 772, 781, 727, 445 and 126. Except for accession 126, all others yielded <5% curcumin.

Cassia

High oil and oleoresin in bark (8% oil and 14% oleoresin) were recorded in the cassia accessions 57 and 60.

Clove

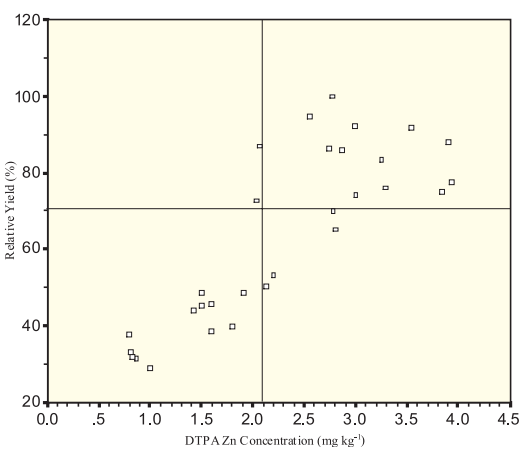
Among the clove samples evaluated, B-2, B-95, K-9 and K-7 contained more than 20% bud oil. In immature clove the eugenol content in bud oil was low (58%) while the oil in pedicel contained 70% eugenol.

Production of planting materials

Growing rooted black pepper cuttings in potting mixture applied with *Trichoderma* and application of *Pseudomonas fluorescens* strain IISR 6 at the time of planting, first and second months after planting (thrice) in polythene bags was found to produce healthy black pepper rooted cuttings. Twenty three thousand rooted black pepper cuttings, 8047 cardamom seedlings, 1000 cardamom suckers, 20 kg cardamom capsules, four tonnes of ginger seed rhizomes, 11 tonnes of turmeric seed rhizomes and 6498 nutmeg grafts were produced and distributed to farmers during 2004-05.

Critical limits of zinc for ginger

To obtain profitable yield in ginger, critical concentrations for soil and foliar zinc levels were calculated by the graphical method of Cate and Nelson (1965). The critical levels of Zn were found to be 2.1 mg kg^{-1} for soil and 27 mg kg^{-1} for foliar concentrations.



Scatter diagram for critical soil Zn concentration in ginger

Organic farming in ginger and turmeric

Ginger and turmeric were cultivated organically by applying FYM, vermi compost, ash rock phosphate as nutrient source and *Pseudomonas* sp. & *Trichoderma* sp. as biocontrol agent for rhizome rot control. The mean yield recorded in ginger (var. Varada) was 7.5 kg / 3 m^2 with a reduction of 26% and 22.8% rhizome yield as compared to chemical and integrated farming, respectively. Turmeric (var. Alleppey) recorded a mean yield of 15.5 kg / 3 m^2 under organic cultivation with a reduction of 15.3% rhizome yield as compared to the conventional system.

Biometeorological Investigations and Modelling in Black pepper

Correlation between black pepper yield and weather parameters (weekly rainfall, maximum temperature and maximum relative humidity) was established with multiple regression models. Weekly rainfall during crop period (June to January) had a positive association with yield (R^2=0.834) whereas weekly maximum temperature during crop period had negative relationship with yield (R^2=0.6113). Maximum relative humidity showed negative relationship during initial 18 weeks with subsequent positive association (R^2=0.9997).

Physiological and biochemical basis of productivity in black pepper

Metabolite partitioning studies in five each of high and low yielding black pepper accessions revealed that during juvenile stage, stem had higher reducing sugars and lower total carbohydrates as compared to leaves. High yielding accessions had higher starch levels compared to low yielder. In general, high yielder had higher photosynthetic rate and higher transpiration compared to low yielder.

Purification of curcuminoids from turmeric oleoresin

Three different curcuminoids (Curcumin, Demethoxy curcumin and Bisdemethoxy curcumin) could be separated from oleoresin of turmeric rhizomes by employing chromatographic techniques. Purity was confirmed based on UV absorption maxima, which were identical to authentic values.

Drought management

Black pepper

Chlorophyll fluorescence characteristics of drought tolerant and susceptible black pepper accessions did not indicate any difference in the fluorescence yield, which ranged from 0.76 to 0.60 under controlled conditions. However, in susceptible accessions, the value started declining on increasing the stress intensity, while tolerant accessions showed relatively stable values.

Cardamom

Four collections of cardamom viz., CP1, *Katte* resistant line 19, RR1 and NHY-15 with bold capsule size recorded high biomass characters and low relative water content.

Irrigation management

Cardamom

Drip irrigation and sprinkler irrigation once in 12 days recorded significantly higher number of tillers / clump, more number of leaves per tiller and more number of panicles per plant. In spite of early initiation of panicle and poor setting during early stages, drip irrigation @ 8 litre / plant / day recorded higher yield (575kg / ha) followed by sprinkler irrigation once in 12 days (395 kg / ha) and sprinkler irrigation once in 15 days (378.8 kg / ha). Control recorded lower yield (224.1 kg / ha). Thus irrigating cardamom with drip (8 litre / clump), daily or sprinkler irrigation once in 12 days leads to higher yield.

Soil and moisture conservation

Cardamom

Cardamom plot with contour staggered trenches (2m x 0.45m x 0.30m) in alternate rows recorded less runoff (43.8mm) and soil loss (148.09 kg / ha) compared to unplanted treatment (fallow), which recorded maximum runoff (216.0 mm) and soil loss (944.12 kg / ha). Trials with trench system of planting recorded less runoff (10.8 mm) and soil loss (66.34 kg / ha).

GIS studies on stunted disease

The survey record of percentage of stunted disease in the districts of Kerala was plotted with the help of DIVA–GIS. The incidences were correlated with environmental factors such as altitude, rainfall and temperature. It was found that high altitude and low rainfall favoured multiplication of virus as well as vectors.

Disease management in spice crops

Black pepper

Phytoplasma associated with phyllody disease of black pepper

Phytoplasma was detected in black pepper with phyllody symptoms using Polymerase Chain Reaction (PCR). A 1.20 kb DNA fragment encoding the portion of Phytoplasma 16S rDNA consistently amplified by nested PCR was cloned and sequenced. The sequenced region contained 1230 nucleotides. Sequence analyses showed that the gene was most closely related to members of aster yellows group (16Sr I) of phytoplasma.

Cucumber mosaic virus in vanilla

Cucumber mosaic virus (CMV) of vanilla (*Vanilla planifolia* Andrews) was characterized on the basis of biological and coat protein (CP) nucleotide sequence properties. The virus was found to infect members of Chenopodiaceae, Cucurbitaceae, Fabaceae and Solanaceae. DAS ELISA method was standardized for the detection of CMV infection in vanilla plants. CP gene of the virus was amplified using RT-PCR, cloned and sequenced. Sequenced region contained a single open reading frame of 657 nucleotides potentially coding for 218 amino acids. Sequence analyses with other CMV isolates revealed the greatest identity with black pepper isolate of CMV (99%) and the phylogram clearly showed that CMV infecting vanilla belongs to subgroup IB.

Citrus mealy bug- a vector of Badnavirus

Citrus mealybug (*Planococcus citri* Risso), commonly found associated with black pepper (*Piper nigrum* L.) was shown to transmit the Badnavirus associated with stunted disease. The transmission of the virus was confirmed by symptomatology and PCR using *Badnavirus* specific primers.

Ginger and Turmeric

Pathogen collection and characterization

Pythium spp. was frequently isolated from rhizome rot affected samples of ginger collected from Wyanad & Calicut (Kerala), Coorg and Dharwad (Karnataka), Raigarh (Chattisgarh), Pottangi (Orissa), Kumaraganj (UP), Sikkim and Gudalur (Tamil Nadu). *Pythium* spp and *Fusarium* spp were isolated from rhizome rot affected turmeric collected from Kumaraganj (UP), Medak (Andhra Pradesh) Sikkim and Gudalur (Tamil Nadu). The pathogen causing soft rot of ginger was identified as *Pythium myriotylum*.

Bacterial wilt of turmeric

Turmeric was identified as one of the hosts of ginger strain of *Ralstonia solanacearum* Yabuuchi (Smith) (Fig. 2a & 2b).

Screening procedure for bacterial wilt resistance

A reliable screening methodology based on soil inoculation of the pathogen was developed for large scale screening of ginger germplasm for bacterial wilt resistance. The 'disease escape' was due to failure of the pathogen to sustain its threshold population. This necessitated three rounds of inoculation with the pathogen during initial stages of screening. A *Ralstonia* specific PCR confirmed the absence of the bacterial wilt pathogen in the escaped accession, which succumbed to wilt after the second and third round of pathogen inoculation.

Isolation and evaluation of endophytic bacteria

Among the 93 putative endophytic bacteria isolated from ginger and turmeric rhizome, 19 isolates were found to inhibit rhizome rot pathogens such as *Fusarium oxysporum*, *Pythium myriotylum*, *P. ultimum*, *Rhizoctonia solani* and *Ralstonia solanacearum*.

Diversity of rhizobacteria

In the highly discriminatory Rep-PCR, the

Fig 2a . Bacterial wilt of turmeric

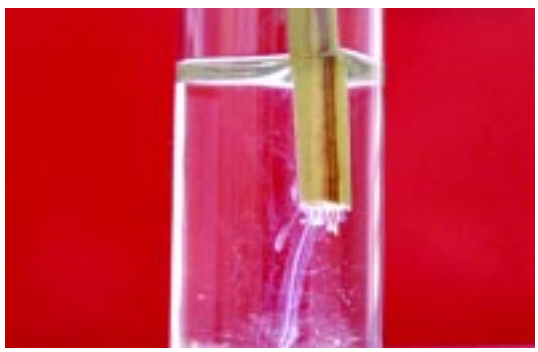


Fig 2b . Bacterial ooze from turmeric pseudostem

39 strains of rhizobacteria isolated from different spice crops were grouped in to 33 clusters at 70% similarity coefficient indicating high diversity of rhizobacteria isolated from spice crops.

Large-scale treatment of rhizomes using solarization

For large-scale rhizome disinfection, the rhizome solarization methodology was modified wherein the bulk of the rhizome material was spread on to a polythene sheet (100-200kg) directly under sunlight. The rhizomes were covered with another sheet of polythene and the borders were sealed with wet soil. The lethal temperature for *Ralstonia solanacearum* (48°C) was achieved within 60 minutes when the rhizomes were exposed from 12:00 noon onwards. This methodology can accommodate large volume of rhizome material for heat treatment.

Vanilla

A new disease of vanilla caused by a fungal pathogen (*Cylindrocladium quinqueseptatum* Boedijn & Reitsma) was identified. The cross infectivity of the pathogen was confirmed by inoculating to clove (*Syzygium aromaticum*), rubber (*Haevea brasiliensis*) and Allspice (*Pimenta dioica*). The symptom of brown spot appeared in 48-72h. This is the first report of *C. quinqueseptatum* infection on vanilla from India (Fig 3).

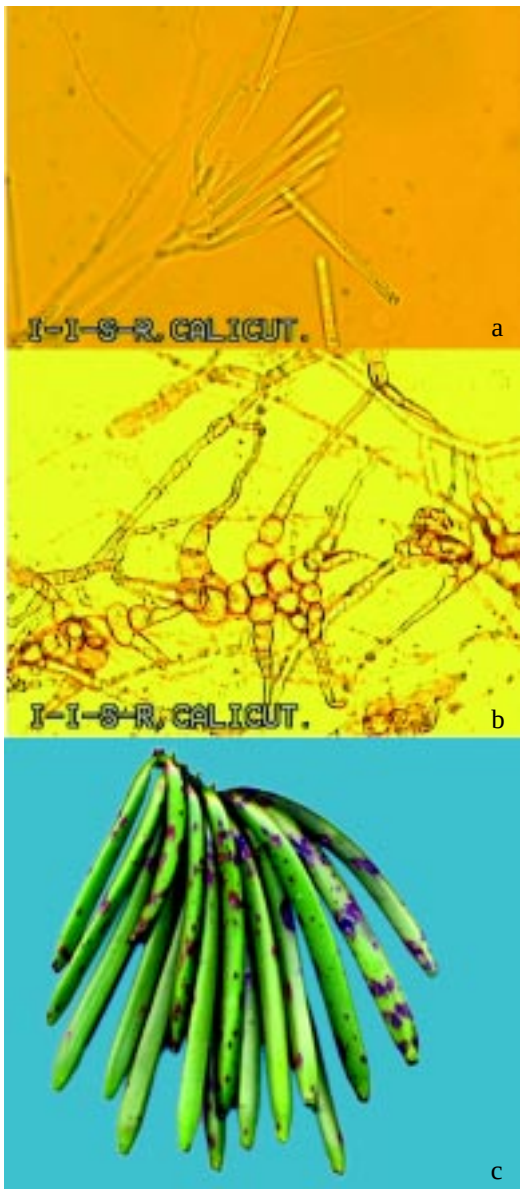


Fig 3. C. quinqueseptatum infection on vanilla
a. Conidia of C. quinqueseptatum
b. Chlamydospores of C. quinqueseptatum
c. Brown spot symptoms on beans of vanilla

Fig. 4. Planococcus spp. recorded from roots of black pepper vines

Insect Pest Management

Black pepper

Investigations on Root mealy bug

Surveys conducted in Wyanad and Calicut districts in Kerala indicated that in addition to an undescribed species of *Planococcus*, (Fig. 4) *P. citri* also infested basal portions of stems and roots of black pepper. Colonies of root mealy bug were observed on banana & turmeric rhizomes, basal stems of coffee & *Erythrina* sp. and on roots of 14 weed plants belonging to the families Amaranthaceae, Araceae, Asteraceae, Cyperaceae, Euphorbiaceae, Fabaceae, Graminae, Malvaceae, Nephrolepidaceae, Scrophulariaceae, Verbanaceae and Zingiberaceae in black pepper gardens severely infested with the pest thus confirming the polyphagous nature of the pest. The investigation further revealed the existence of natural enemy (*Spalgis epius*, Lycaenidae). Besides generating information on life history, method of culturing mealy bug using squash (*Cucurbita moschata*) was also standardized.

Ginger and Turmeric

Shoot borer

Host resistance

Screening of 555 germplasm accessions of ginger for the incidence of shoot borer (*Conognethes punctiferalis*) showed that the pest infestation ranged from 3.1 to 35.3 % in various accessions. However, Accession number 41 was found free of pest infestation.

Rhizome scale

Management

Dried leaves of *Strychnos nux vomica* & *Glycosmis pentaphylla* and sawdust were evaluated as storage materials in various proportions for the management of rhizome scale (*Aspidiella hartii*) after dipping

the rhizomes in quinalphos 0.075%. For obtaining higher number of sprouts and lesser incidence of rhizome scale, storage of rhizomes in dried leaves of *S. nux-vomica* alone, *G. pentaphylla* alone, *S. nux-vomica* + saw dust (1:1) and *G. pentaphylla* + saw dust (1:1) were as promising as storage in sawdust alone.

Nematode management in spice crops

Black pepper

Nematode Resistance

Two wild accessions (Acc. 3283 and 3290) and one hybrid (HP 125) were found to be resistant to *R. similis*. Field evaluation of promising accessions confirmed the resistance of Acc. 820 (IC No. 316481), Acc. 1090 (IC No. 316635) and HP 39 to *R. similis* infestation during two years of planting.

Biological control of nematodes

Studies on Endophytic Bacteria

Seventy-three endophytic bacteria from black pepper were isolated, morphologically characterized and preserved in the repository of endophytes. Roots of black pepper plants harbour maximum endophytes compared to leaf and stem. Out of the 11 black pepper improved varieties tested, HP 813 possessed the maximum population of endophytic bacteria (cfu 8.5 x 10^3) while the lowest was found in Panniyur 4. *In vitro* screening of endophytic bacteria for nematicidal activity indicated that the mortality of root knot nematodes (*Meloidogyne incognita*) ranged from 0 to 31.03%.

Ginger and Turmeric

Nematode Resistance

Among the root knot resistant turmeric and ginger accessions, Acc. 43, 56 and Acc.57 in turmeric and Acc. 36 in ginger were found to be superior in yield.

Impact assessment of biocontrol technology

A study on the assessment of level of adoption, diffusion and the impact of integrated disease management of foot rot disease of black pepper in Kerala clearly indicated that 73% of farmers were applying chemical fungicides prior to biocontrol intervention by IISR. About 27% of the farmers were managing the diseases through cultural practices and 75% of farmers used biocontrol agents and other integrated management practices recommended by IISR, Calicut. The mean adoption index score of the sample for the total package of integrated disease management methods was only 0.61 indicative of only partial adoption. The farmers experienced a mean yield loss of 37.4% prior to the adoption of the technology, which was 32.9% after adopting the technology, a marginal difference of 4.5%. Interestingly, the crop loss due to diseases reduced by 8.4% when biocontrol technology was adopted, whereas the loss ranged from 40.7 to 52.3% when the technology was discontinued or not adopted.

Economic evaluation of transferred technology

Investment on the technological package recommended for soil-water conservation in cardamom based cropping system in Kodagu district of Karnataka yielded a net

return of Rs.111593/ ha as against Rs.56186/ ha in non-adopted farms.

The *Trichoderma* mass production venture with 10 years life period resulted in a Net Present Value of Rs.242618 with less than 2 years of pay back period, 121% internal rate of return and 1.84 B: C ratio.

Estimating the returns to research investment

An investment of Rs.14.2 lakhs over a period of five years for developing and commercialisation of a mass multiplication technique for *Trichoderma harzianum* for control of *Phytophthora* foot rot disease in black pepper generated a net economic surplus of 11.39 lakhs after six years of adoption with a maximum adoption level of 5%. The investment has returned an internal rate of return (IRR) of 19% and B:C ratio of 3.2:1.

Research investment of Rs.13.27 lakhs over a period of three years to develop soil and water conservation measures for cardamom based cropping systems in Kodagu district returned a net economic surplus of Rs.34.57 lakhs with IRR of 33% and B: C ratio of 2.9 after seven years of introduction.

New software and database

New softwares and database developed during 2004-05 were SPICEPAT- a data base on patents granted for discoveries related to spices and spice related products, SOILLAB- a software for classifying soil into low, medium and high for major, secondary and micronutrient status and PAYROLL, IMPRESTSOFT and ADVANCESOFT- soft wares developed as tools for Management of accounts in the office.

Bioinformatics Centre

A database 'Piper base' was developed and brought out.

Krishi Vigyan Kendra

Krishi Vigyan Kendra, Peruvannamuzhi conducted 82 training programmes for practicing farmers, unemployed youth, school drop outs and extension functionaries of the line departments in the disciplines of agronomy, horticulture, animal sciences, home science, fisheries and allied fields. A total of 2823 trainees including 1242 women were benefited. The Kendra has conducted Frontline Demonstrations on tissue culture banana, drought management in coconut garden and hybrid layer chicken in backyard in 3, 5 and 10 farmer's fields respectively. Onfarm Testing trials were also conducted in disease management in Vanilla and induction of flowering in clove.

KVK conducted 2 Kisan Melas cum exhibitions, six seminars, broadcasted five radio talks and published three popular articles disseminating agricultural technologies. Five study tours for farmers to various research institutions/ farms were also organised by the Kendra during the period. The Animal Clinic has taken up 520 consultancy/advisory service/home service treatments, and 263 artificial insemination services and generated an income of Rs.18, 426/- through Registration, consultation and home service treatments. Several rural youth started self-employment avocations in agri-nurseries, vermicomposting, apiculture, and goatery with the help of KVK. Many Vikas Volunteer Vahini clubs and members of over 150 Self Help Groups sought the services of KVK

in dissemination of agricultural knowledge and to enhance self-employment and income generation.

The Kendra has generated an income of Rs.2.08 lakhs through sale of planting materials of spices, fruits, plantation crops, ornamentals etc., and Revolving Fund has presently a net balance of Rs.2.2 lakhs.

Research Highlights of All India Coordinated Research Project on Spices

The All India Coordinated Research Project on Spices (AICRPS) is the largest network in the country to conduct and coordinate research the spices research in 19 coordinating and eight voluntary centres.

In ginger, maximum fresh rhizome yield (23.2t / ha) was recorded with the application of inorganic N 100% + *Azospirillum* 50g + FYM 5kg per 3m^2 bed at Pundibari centre. In coriander, UD-797 (998.95 kg / ha); in cumin, UC-310 (385.5 kg / ha); in fennel, UF-178 (1677 kg / ha); in fenugreek, UM-351 (1944.67 kg / ha) was found superior in performance under CVT at Jobner centre. Maximum volatile oil content was recorded with the entries, DH-234 and ND-2 (0.55% each) in coriander, UC-310 (5.0%) in cumin and HF-116 (2.50%) in fennel at Jobner conditions. Application of 100% inorganic N (60 kg / ha) + *Azospirillum* (5kg / ha as seed treatment) + FYM (5t / ha) gave maximum seed yield in seed spices at various centres.

Spraying and drenching with Metalaxyl-Mancozeb 72 WP (1.25 g / l) @ 5 litres / vine alone and in combination with *Trichoderma harzianum* (50g) along with one kg neem cake per vine during the first week of June and September was found effective against *Phytophthora* disease in black pepper at Mudigere centre. In coriander, minimum wilt incidence (8.39%) with maximum seed yield (819 kg / ha) was recorded with the application of *Trichoderma harzianum* through seed treatment and soil application at Jobner centre. In a screening test against root rot, downy mildew and powdery mildew diseases in fenugreek, the entries, UM-351 and UM-3852 were recorded minimum incidences with maximum seed yield of 1944 and 1797 kg / ha, respectively.

In the recently concluded Workshop of AICRPS, six entries / varieties namely, DH-246 in coriander; RZ-223 in cumin, HF-33 (Hisar), GF-11 (Jagudan) and RF-143 (Jobner) in fennel and Rmt-305 (Jobner) of AICRPS-centres; six varieties namely, IISR-Thevam, IISR-Malabar Excel, IISR-Girimunda and IISR-Shakthi in black pepper and IISR-Kedaram and IISR-Alleppey Supreme in turmeric of IISR, Calicut; five entries namely, AN-01-1 in nigella, AD-01-43 and AD-01-6 in dill, and AA-01-61 and AA-01-19 in ajowan of NRC Seed Spices, Ajmer were identified and recommended for state release.