

RESEARCH HIGHLIGHTS
1994-95



NATIONAL RESEARCH CENTRE FOR SPICES
(Indian Council of Agricultural Research)
CALICUT 673 012 KERALA

Photographs

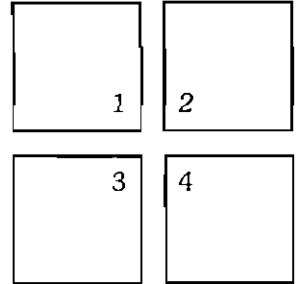
Front cover

The pepper nematode *Trophotylenchulus piperis* larvae emerging out of the case

Inset : *T.piperis* female infesting black pepper roots

Back cover:

1. Ginger variety in pipeline
2. Turmeric variety in pipeline
3. Turmeric *in vitro* tuber formation
4. *Piper nigrum* one year old culture under slow growth



Published by

Dr. K.V. Peter
Director
National Research Centre for Spices
Calicut 673 012

Compiled and edited by

K. Sivaraman
C.K. Thankamani
K. Kandiannan

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DIRECTOR'S REPORT

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The year 1994-95 witnessed allround growth and development in spices research. The Centre organized a group meeting of *Phytophthora* workers in horticultural crops and hosted the First International Symposium on Plantation Crops (PLACROSYM-XI). Dr. R.S. Paroda, Director-General and Dr. K.L. Chadha, Dy. Director-General (Hort.) visited NRCS on 29th November, 1994. Consequent to the recommendations of QRT, and the Report of the Parliamentary Committee on Commerce, the Governing Body of ICAR recommended upgrading of the Research Centre into a full-fledged Institute subject to concurrence of the Planning Commission of India.

The Mini Mission I on Plant Protection operated 16 research projects out of which 3 projects got terminated during the year. The viral etiology of stunted disease of black pepper was proved. Natural "Katte Escapes" and "Rhizome Rot Tolerant Lines" in cardamom were identified as sources of possible resistance / tolerance. Pathogenic potential of the nematode *Trophotylenchulus piperis* needs indepth study. Biocontrol of scale insects and pollu beetle in black pepper and cardamom are being attempted. Use of VAM to nursery of pepper cuttings against *Phytophthora* foot rot is effective.

Mini Mission II on plant production operated 8 projects including 3 projects initiated during the year. cardamom based cropping system is evaluated for economic returns per unit volume of space and time. Experiments on organic spices are in progress. Organic amendments are assessed for better performance in bush pepper.

In Mini Mission III germplasm enrichment continued with vigour in black pepper, ginger,

turmeric, cloves and nutmeg. A dwarf clove was identified during the year. Elite lines of cinnamon, clove and nutmeg are further evaluated. One seedling progeny of turmeric is observed outstanding for curcumin content and dry recovery. Somaclones in ginger resistant to rhizome rot are further evaluated. Protocols have been standardized for micropropagation of *Piper betle*, *Piper chaba*, *Piper colubrinum* and *Ammomum subulatum*. Research on *in vitro* conservation of spices germplasm is in progress.

During 1994-1995, 16 ad-hoc research projects were submitted for funding and 8 projects got approved. The inter-institute collaborative projects are in progress. The study circle of the Research Centre met 17 times, 18 research papers were discussed and 17 were approved for publication. The post graduate committee met 6 times. Five Scientists were deputed for advanced training during the period. The recently constituted Institute Management Committee met on March 16, 1995 and took important decisions. The Institute Joint Council met on April 26, 1994 and November 25, 1994.

The Integrated Programme for Development of Spices (IPDS) made significant strides. Two lakh cuttings of black pepper, 30 tonnes of turmeric seed rhizomes, 23,800 seedlings/ grafts of tree spices and 1800 kg of cardamom seed capsules were distributed among state agriculture departments of Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Madhya Pradesh, Andaman and Nicobar Islands, Maharashtra and Orissa. Four short term trainings were organized on various facets of spices research and development.

During the year, the library subscribed to 58 foreign journals and 90 Indian journals. An amount of Rs.5.5 lakhs was spent on strengthening library. Equipments worth Rs 88 lakhs were purchased during the year. Works costing Rs.244 lakhs are in various stages of construction. The budget of the Centre was Rs.100 lakhs under Non-Plan and Rs.160 lakhs under Plan during the year.

The Research Centre was honoured by many awards during the year. The young Scientist award constituted by Kerala State Committee on Science,

Technology and Environment was given to the research team in the Biotechnology Facility of the Centre. The second best paper presented in PLACROSYM-XI also emanated from this Research Centre. The Research Centre continued as a Centre for Post-Graduate Research of Calicut University and Kerala Agricultural University.

The All India Co-ordinated Research Project on Spices also enlarged its network to cover more states. Number of centres was raised from 16 to 20 during the year. Research on seed spices received due attention during the year.



K.V.PETER
Director

GENETIC RESOURCES

Black pepper

Seventy-six wild *Piper* collections were made from Gorusappa, Akumbe, Kudremkh and Thalakaveri forest areas in Karnataka and Sugandhagiri and other forest areas in Kerala. The most significant among the collections were the bold berried *P. nigrum* and *P. sugandhi* types with a spike length more than 25 cm.

Ginger and Turmeric

Eight new accessions of turmeric (one from Raipur, Madhya Pradesh, two from Himachal Pradesh and five from south Karnataka) and 12 accessions of ginger (eight from Karnataka and three from Kerala) including an exotic collection from Brazil (courtesy: Project Co-ordinator [Spices]) were added to the germplasm.

Tree spices

Eight *Syzygium aromaticum* types, nine *Myristica fragrans* types, one *M. beddomeii* type, four *Cinnamomum verum* types, twelve *C. malabaricum* types and two *Pimenta dioica* types were collected after surveying Ashambo hills, Kanyakumari and Wynad districts. The collections include bushy clove, king clove, small leaved clove variants, elite trees and floral variants in nutmeg.

CROP IMPROVEMENT

Black pepper

Six black pepper hybrids (34, 105, 728, 769, 778 and 813) are performing well at Valparai (1067 m above MSL). Indexing chromosome numbers of 96 accessions of black pepper confirmed the diploid ($2n=52$) condition of all except three accessions wherein variation from the normal ploidy level was noticed. Open pollinated progenies of bold berried cultivars such as 'Vadakkan' showed unique morphological variations in the seedlings.

Ginger and turmeric

A new ginger cultivar is being proposed for release. This selection (accession 64) is a high yielding and low fibre type. Data collected over a period of three years recorded an average yield of 27/ha (provisional) of fresh rhizomes, with a dry recovery of 19.9 per cent, essential oil content of 1.8 per cent, oleoresin content of 6 per cent and crude fibre of 3.95 per cent. It matures in 200 days.

Two turmeric varieties developed through open pollinated progeny selection are being proposed for release. The characteristic features of above two varieties are given below.

Table 1 Salient features of new turmeric varieties proposed for release

Identity	Pedigree	Av. yield (fresh)t/ha*	Maturity (days)	Dry recovery (%)	Curcumin (%)	Curcumin kg/ha*
Acc.360	Open pollinated progeny selection	35.67	200	19	7.2	432.95
Acc.361	Open pollinated progeny selection	38.6	198	18.0	7.0	423.0

* Provisional

Tree spices

In clove progeny evaluation trial (in arecanut plot) B-59 performed better over the rest with maximum plant height (3.13 m) = girth at 45 cm height (9.61 cm) and number of branches (33.75) per plant with a comparatively lower variation among its progenies for these characters. Drenching all spice tree with Paclobutrazol (cultar) 1 g a.i during October induced profuse flowering, but minimum fruit setting. Layering of allspice with a hormonal combination of NAA and IBA aided in the production of adventitious roots. The percentage of immature fruit fall in nutmeg was maximum in accessions No.A11/70 (26.6%), followed by A4/22 (22.2%). The fall was maximum in May (30.5%) followed by April 26.9%.

BIOTECHNOLOGY

Twenty lines of vanilla propagated from seeds through tissue culture have been established in soil medium. Multiple shoots were induced in cinnamon, Cassia. In vitro rooting was induced in clove cultures. Embryo cultures of nutmeg were established. Encapsulation of ginger somatic embryos in vitro shoot buds and immobilization of cells were standardized. Black pepper and three of its related species (*P. longum*, *P. colubrinum* and *P. barberi*) could be stored up to one year under slow growth conditions without subculturing.

Over 265 accessions of spices, including black pepper, cardamom, ginger, turmeric, vanilla, minor spices and their related species have been conserved in in vitro repository for short and medium term conservation. In vitro micro rhizome formation in ginger and in vitro micro root tuber formation in turmeric were achieved.

Protocols have been standardized to regenerate plants from callus in 100 days. Protoplast isolation in black pepper was successful. Crude toxin fraction isolated from culture filtrates of *P. capsici* could reproduce the typical necrosis on black pepper leaves.

NUTRITIONAL REQUIREMENT AND CROP MANAGEMENT

Black pepper

Diagnosis and Recommendation Integrated system (DRIS) was developed in black pepper for assessing nutrients balance and the yield. The leaf nutrients (N, P, K, Ca, Mg, S, Fe, Mn, Zn, and Cu) concentrations and their ratios of 578 pepper vines were used to arrive the range as deficient, low, optimum, high and excess for arriving desirable black pepper yield. Application of burnt lime @ 1.5 tonnes per hectare increased soil pH, available nutrients and yield and reduced concentration of iron, Manganese and Aluminum in the soil. Application of poultry manure was superior to farmyard manure.

Ginger and turmeric

Residual effect of application of organic cakes reduced the bulk density of soil enhancing nutrient uptake and yield of black pepper.

EVALUATION OF SPICES FOR QUALITY

Turmeric

Among the turmeric accessions evaluated for curcumin about 14 accessions have yielded more than 7 per cent curcumin. Accn. 290 and 351 had 8 per cent curcumin. Acc. 360 and 361 performed well at two locations viz., Moovattupuzha and Calicut with 7 per cent curcumin. Both accessions had about 11 per cent oleoresin.

Ginger

Among the accessions cultivated at Moovattupuzha and Calicut which were evaluated for crude fibre Acc. 64, 250, 256 and 106 had comparatively low fibre (about 3%). Accessions 71 had 11 per cent oleoresin with 2.9 per cent oil.

Cardamom

Among the segregants evaluated for oil and quality ASH-A-MR, ASH-A-V-2 and ASH-B-B-1

contained about 9 per cent oil. ASH-A, E-7, ASH-C-MR 39 oil contained more terpinol acetate and low cineole.

Clove

Among the collections evaluated for oil and eugenol tree No.135 had 20 per cent bud oil and tree no. 69 had 88 per cent eugenol. No. 45 and 180 had 19 per cent oil.

CROP PROTECTION

Black pepper

Biocontrol

Field trials conducted in Wynad on the efficacy of Biocontrol agents viz., *Trichoderma* and *Gliocladium* on foot rot suppression showed that *T. hamatum* and *T. harzianum* were more effective in reducing root rot compared to *Gliocladium virens*. *Pseudomonas* isolated from the rhizosphere of black pepper from Eastern Ghats in Andhra Pradesh were found highly inhibitory to *P. capsici*.

Coconut water supported good growth and sporulation of *Trichoderma* and *Gliocladium*. Garlic and mustard extracts were effective in checking both growth and sporulation of *Phytophthora capsici*. These extracts in combination with *T. harzianum* were effective in checking root rot in a pot culture experiment. Field trials with VAM in combination with and without agro-chemicals viz., Akomin and Copper oxychloride, showed that all vines treated with VAM showed higher vegetative growth and early flowering compared to non-VAM plots. Agro-chemicals showed reduction in VAM colonization of roots.

Nine species of *Trichoderma* and *Gliocladium virens* were tested under *in vitro* conditions for their efficacy on root knot nematodes. Second stage juveniles of root knot nematodes showed 100 per cent mortality with 24 hours of exposure to culture filtrates of all the above isolates. Isolates of *T. harzianum*, *T. viridae* and *G. virens* were found to be more effective in suppressing root knot nematode development, even though all isolates

were found to colonize the egg masses. *T. harzianum* isolate from Coorg suppressed root knot nematodes in cardamom seedlings by 59.3 and 54.5 per cent in sterile and native soils, respectively.

A pot culture trial is in progress to assess the effect of *Trichoderma* isolates on suppression of nematodes parasitizing black pepper. Four isolates of *Pseudomonas fluorescens* were screened against root knot nematodes and isolate No.44 gave excellent control of nematodes.

Surveys conducted in Idukki, Wynad and Coorg districts of Kerala and Karnataka indicated that the coleoptera predators *Chilocorus circumdatus*, *Pharoscymnus horni*, *Pseudoscymnus* sp., *Cybocaphalus* sp. and the hymenopteran parasitoid *Encarsia lousburyi* were the important natural enemies of the scale insects *Lepidosaphes piperis* and *Aspidiolus destructor* infesting black pepper.

Natural products

Petroleum ether extracts of *Piper colubrinum* were highly inhibitory to *P. capsici*. Further fractionation of the extract yielded compound with UV absorption maximum at 242, 255, 261 and 278 nm. Similarly the fractionation of the petroleum ether extracts of *Chromolaena odorata* also yielded compound inhibitory to *P. capsici*.

Laboratory bioassays of natural products against 'pollu' beetle *Longitarsus nigripennis* indicated that custard apple seed extract possessed significant antifeedant activity resulting in 50 and 90 per cent feeding deterrence at 0.025% and 0.2% concentrations respectively, 24 h after treatment.

Evaluation of commercial neem products in the field against 'pollu' beetle indicated that spraying of endosulfan (0.05%) during July followed by neem gold (0.3%) during August, September and October was more effective for the control of the pest infestation.

Resistance / tolerance

Field trails with *Phytophthora* tolerant lines at NRCS Peruvannamuzhi during 6th year showed

that P-603, an OP of Valiakaniakadan remained healthy throughout and the yield ranged from 250-1320 g/vine. Similarly HP-780 another promising line showed yield range of 50-4300 g/vine. P-24 continued to perform well at hot spot areas of disease in Sirsi area. Four new field trails at Thamarassery, Kodancherry, Pulpally and Valparai were laid out with *Phytophthora* tolerant trials. Fifty black pepper cultivars screened were found susceptible to *Meloidogyne incognita*.

Agro chemicals

Field trails with different frequencies of fungicidal treatments showed potassium phosphonate (Akomin) application thrice reduced disease. Incidentally Akomin at concentration as high as 1200 ppm was not inhibitory to *Trichoderma* thus implicating its potential in integrated disease management. Comparative efficacy of potassium phosphonate, Dimethomorph and Aureofungin tested in a pot culture study showed that Aureofungin was found superior to dimethomorph and potassium phosphonate in reducing root rot.

Combination of *P.capsici* and nematodes

In the experiment on sequential inoculation of *Phytophthora capsici*, *Radopholus similis* and *Meloidogyne incognita*, mortality of vines was maximum in treatments receiving combination of *P. capsici* and nematodes than either of the pathogen alone. Vesicular arbuscular mycorrhizae isolated from black pepper and found efficient in promoting growth of tissues cultured plants before hardening.

Survey for *T.piperis*

Survey conducted in seven pepper growing districts of Kerala for the incidence of pepper nematodes, *Trophotylenchulus piperis* showed a mean percent infestation of 45.8 with a population range of 24-248 cases/g of root. *Glyricidia sepium* and *Artocarpus heterophyllum* were recorded as new hosts of this nematode. The nematode completed its life cycle on black pepper under room

temperature within 55 days. Population dynamics of *T. piperis* in black pepper gardens is being studied.

Etiology of Stunted disease

The etiology of stunted disease of black pepper caused by cucumber mosaic was further confirmed. The purified virus resolved in SDS-PAGE into 2 bands. Agar gel double diffusion tests indicated that CMV banana and CMV black pepper are antigenically identical.

Ginger and turmeric

Survey for rhizome rot of turmeric in Pathanamthitta, Alleppey, Quilon and Trivandrum showed very low disease incidence. In ginger, the expression of soft rot symptoms due to *Pythium aphanidermatum* got advanced due to root knot nematode infestation, indicating a possible role of nematodes in the rhizome rot disease complex.

First Records

Bacterial wilt of *Kaemferia galanga* caused by *Pseudomonas solanacearum* and clove caused by *Pseudomonas* sp. has been recorded for the first time. Similarly, natural infection of *Piper chaba* caused by *Phytophthora capsici* and cucumber mosaic infection of *Piper longum* have been recorded for the first time.

PRODUCTION OF NUCLEUS PLANTING MATERIALS

Two lakh rooted cuttings of popular high yielding varieties viz. Sreekara, Subhakara, Panchami and Pournami, thirty tonnes of seed rhizomes of high yielding turmeric varieties viz. Suvarna, Suguna, Sudarshana and Alleppey, 23,800 seedlings/grfts of tree spices, 26000 cardamom seedlings and 1800 kg of cardamom seed capsules were distributed as nucleus planting materials to various developmental agencies and progressive farmers for further multiplication and field planting.

TRANSFER OF TECHNOLOGY

Large scale demonstration of foot rot disease management in black pepper in Wynad and Idukki districts jointly organized and implemented by the Directorate of Cocoa Arecanut and Spices Development (DCASD) and the Department of Agriculture further confirmed the efficacy of the package passed on to the extension agencies by NRCS

ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES

The activity of the AICRP on Spices was expanded by sanctioning of four new/additional centres, one each in the State of Maharashtra, Madhya Pradesh, Uttar Pradesh and West Bengal making the total to 20 centres. The Centres of AICRPS represent the major agroclimatic regions of India and are located in 15 states under the 15 Agricultural Universities and an ICAR Institute. In addition to the 20 AICRPS Centres, six voluntary/participating centres also operate under the purview of the project.

Genetic resources

Evaluation of germplasm accession of spices is in progress at all centres. Two cardamom centres viz. Mudigere and Yercaud also assembled black pepper collections. The Yercaud centre collected 3 wild pepper types from Shevroys and Kolli hills. Exploratory survey conducted by the Yercaud centre identified 13 elite mother trees of clove from Courtallam, Nagercoil and Kallar areas and 15 high yielding nutmeg types and 10 accessions of cinnamon and one cassia cinnamon.

In seed spices the Jobner, Jagudan, Coimbatore, Guntur and Hisar centres made exhaustive new collections. In coriander, Jobner made 60 new collections and added 175 from other centres raising the total collection to 683. Collections made in collaboration with NBPGR increased the coriander germplasm from 120 to 230 in Guntur centre; the Coimbatore centre made 243 new

collections making the total to 372. The Hisar and Jagudan centres made a collection of 30 and 37 new lines respectively in coriander. The survey conducted by the Jagudan centre helped to add 460 new entries in cumin taking the Jagudan centre helped to add 460 new entries in cumin taking the total to 566 accessions. The fenugreek collection was increased to 270 at Jobner as a result of 113 indigenous collections received from other seed spices centres, and the collection rose to 179 at Coimbatore as a result of enrichment with 53 new accessions. The Hisar centre also made 80 new fenugreek collections.

Based on genetic diversity, 143 accessions out of 578 in coriander, 106 out of 285 in cumin, 98 out of 283 in fennel and 40 out of 185 in fenugreek accessions having variability were shortlisted and retained and the rest discarded at the Jagudan centre:

Disease resistance

Cumin entries EC-243373, EC-243375 and EC-232684 found to be resistant against Fusarium wilt disease in wilt sick plot in Jagudan. Fenugreek entry EC-257566 (Bulgaria) seems to be resistant against powdery mildew (*Erysiphe polygoni*) under natural conditions at Jagudan centre. In the screening of coriander germplasm at Jobner UD-20 & UD-21 were resistant against root knot nematode (*M. incognita*).

New varieties

The black pepper variety Panniyur-5, cardamom ICRI-3, Fenugreek HM-57 and Coriander DH-5 were recommended for release and among these, Fenugreek (Hisar Sonali) and Coriander (Hisar Anand) have been approved for release by the Central Sub Committee on Crop Standards Notification and Release of varieties of Horticultural Crops, Govt. of India.

Varieties in pipeline

The State variety Release Committee of Karnataka recommended the release of cardamom acc. CL-683

as Mudigere-2. Coriander UD-20 has been released by the State Variety Release Committee for the State of Rajasthan. In Turmeric, PCT-19 and Ginger V2S1-7 and V1S1-2 are under pre-release seed multiplication at the Pottangi centre. The ginger line SG-666 of Solan Centre had been recommended for cultivation in Himachal Pradesh. In cumin, UG-216, UC-217, UC-218, UC-198 are under various stages of release; cumin UC-198 has higher tolerance to wilt and possess maximum volatile oil (4.9%) content.

Crop production

Studies at Panniyur centre revealed that in black pepper increased yield is obtained by irrigation during December to March at IW/CPE of 0.25. In companion cropping systems, the yield of black pepper and arecanut could be increased with the application of 100:40:140 g NPK/year each to arecanut and black pepper. Application of N125, P100, K100 kg/ha recorded the highest yield of 14.35 t/ha in ginger at Pottangi. A seed rate of 25 kg/ha and a fertilizer level of 40 kg N and 40 kg P₂O₅/ha in Fenugreek is recommended for Rajasthan which gave the maximum yield of 11.12 q/ha. The Jobner Centre recommended a three year crop rotation i.e. cluster bean-cumin-cluster bean-wheat-cluster bean-mustard crop sequence to be the best for adoption in Rajasthan for avoiding wilt disease.

Quality evaluation

The promising clones of cardamom viz. CL-683, CL-679 and CL-726 are superior to the released variety Mudigere-1 with respect to oil, alpha terpenyl acetate and 1,8 cineole content. In ginger, SG-673 recorded maximum essential oil (2.1%) and SG-675 maximum oleoresin (8.9%); turmeric PCT-14 recorded 5.67% curcumin and 11.56% oleoresin.

Crop protection

Agrotechniques for the management of Phytophthora foot rot disease were standardized for pepper at Pannityur Centre. Biocontrol studies in pot culture revealed that application of Trichoderma minimized the foot rot incidence in black pepper. Spraying with Monocrotophos (0.0%) combined with thrashing was effective in checking thrips and shoot borer in cardamom. In ginger, pre-sowing rhizome treatment (Indofil M-45 (0.25%) + Bavistin (0.1%) together with soil application of Phorate (10 kg/ha) was effective in checking rhizome rot. Application of Trichoderma viridae with 150 kg neem cake/ha was recommended for the management of root rot disease of fenugreek at Coimbatore centre. Spraying of Carbendazim (0.1%) after 20 days of flowering was very effective against grain mould of coriander. Seed dressing with Bavistin (0.1%) is recommended for cumin wilt control in Rajasthan.

IMPORTANT EVENTS

APRIL 1 1994

MAY 18 - 20 1994

SEPTEMBER 21 - 23 1994

NOV 29

NOV 30 - DEC 3 1994

