

**RESEARCH
HIGHLIGHTS
1990-91**

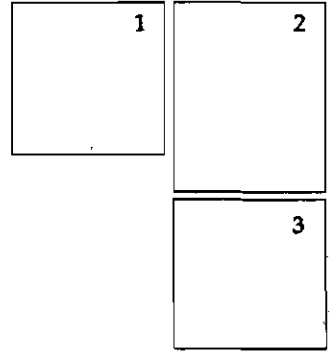


ISSRRH-4.

NATIONAL RESEARCH CENTRE FOR SPICES
CALICUT - 673 012, KERALA, INDIA

Cover Photo :

1. Nutmeg - Elite Tree
2. Subhakara - A black pepper selection released by NRCS in 1990
3. *In vitro* embryogenesis in Ginger.



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INTRODUCTION

The National Research Centre for Spices completed five years of its existence this year. In keeping with the requirements of the farming community, the Research Centre has strived its best this year also in fulfilling certain important objectives in its mandate.

The year saw launching of technologies for increasing the productivity and production of black pepper and cardamom. These technologies, successfully tested in the cultivators field, can help narrowing the yield gap between the national average and the yield potential.

The release of Subhakara, a high yielding selection of black pepper heralds a new era since this release will soon be followed by release of several high yielding lines in the coming years. In turmeric, the release of Suguna and Sudarshana with high curcumin and high production potential has raised the possibility of giving adequate support to industries engaged in the export of curcumin.

A major constraint in increasing the production of black pepper continues to be the foot rot disease caused by *Phytophthora*. This Centre through its demonstration plots, although in small scale, has demonstrated that through a well tested disease management technology the disease incidence could be checked to significantly low levels. While this management technology which includes phytosanitation and chemical control will help to minimise the risk, the Centre is hopeful of finding a lasting solution soon by releasing disease tolerant black pepper lines.

As in the previous years, this year also the Centre has continued to produce and distribute planting materials of high yielding varieties.

The highlights of this years findings are briefly dealt with in the following pages.



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GENETIC RESOURCES

Extensive germplasm collection surveys were conducted in the states of Meghalaya, Tripura, Kerala, Andhra Pradesh and Tamil Nadu to collect and conserve the fast depleting genetic resources of spice crops especially from the forests. During the year 148 black pepper, 76 ginger, 91 turmeric, 10 cinnamon, 18 clove and 3 nutmeg accessions including their related species were collected and added to the germplasm.

A 'mutant' type of clove with extra bold clove buds, a dwarf clove with bushy habit, 'tejpat' — a related species of cinnamon (*Cinnamomum tamala*) grown in the north-eastern India for its spicy leaves were the most valuable additions to the tree spices germplasm.

Piper hapnium, a species similar to long pepper was collected for the first time. A very distinct, rare and endangered species of *Piper* collected in 1989 was characterised and identified as the female plant of *P. barberi*, a species established by G.S. Gamble in 1924 based on the male plant but could not be collected ever since.

CROP IMPROVEMENT

Black Pepper :

Subhakara, a high yielding selection of black pepper was released for cultivation in Kerala and Southern Karnataka. This variety gives at 5th year an estimated mean yield of 2,352 kg (@ 1600 vines/ha at 2.5 x 2.5 m spacing) and has an yield potential of 4,487 kg of dry pepper per hectare.

Cultivar Aimpiriyan (Coll. 856) has recorded the highest mean yield of 5.2 kg of green berries per vine followed by Coll. 812, a nematode tolerant line with 4.7 kg/vine, in the

Comparative Yield Trial (CYT) of five promising cultivars at 5th year. These two lines are being proposed for release.

In the CYT involving Karimunda Selections, KS-105 gave the highest mean yield of 4.7 kg/vine at 5th year.

A study on the breeding behaviour of 3 black pepper varieties viz., Karimunda, Aimpiriyan and Panniyur-1 revealed 86-95% of autogamy. It was found that rain water was not essential for pollination.

A preliminary study on the shoot tip colour of black pepper indicated that two pairs of genes with complementary action control the inheritance of this character.

Cardamom :

Cardamom selection No. 872 with a cumulative mean yield of 409 kg of dry capsules per hectare was the best among the selections of CL. 37 after 4 years of yield evaluation. This high yielding selection with 8.7% essential oil is being proposed for release.

Turmeric & Ginger :

Two high yielding selections of turmeric Suguna and Sudarshana with mean fresh rhizome yield of 29.2 and 28.8 t/ha, and yield potential of 60.3 and 54.8 t/ha respectively were released for cultivation in the states of Kerala and Andhra Pradesh. Suguna has a curcumin content of 4.9% while Sudarshana has 7.9% of curcumin.

Estimation of genetic parameters for 14 characters in 108 accessions of turmeric revealed significant variability for yield and yield attributes. Moderate to high heritability coupled with good genetic gain was observed

for characters like weight of mother, primary and secondary rhizomes as well as for number of secondary rhizomes.

Turmeric progeny 5(c) with a mean yield of 15.9 kg fresh rhizomes per 3 sq.m. bed was the most promising among the 15 seedling progenies evaluated for yield.

Tree Spices :

Six nutmeg accessions with high fruit set were identified as promising from the germplasm conservatory.

Approach grafting of clove on its own root stock is successful. However, grafting clove on *Eugenia cumini* root stock is difficult.

Studies on vegetative propagation of elite lines of cinnamon, by rooted cuttings, indicated that the genotypes differed significantly in their rooting capacity.

BREEDING FOR RESISTANCE

One line of black pepper tolerant to *Phytophthora* viz., P-24 continued to show robust growth and good yield at 5th year in the yield evaluation trial at Sirsi. It has recorded a maximum yield of 4.8 kg/vine when planted as a mixed crop with arecanut and cocoa.

Twenty lines of cardamom were found promising in the field screening trial of katte escapes in sick plot.

BIOTECHNOLOGY

Successful regeneration of plantlets was achieved from the callus cultures of cardamom on the modified Murashige and Skoog's medium.

In the yield evaluation trial of cardamom involving tissue cultured plants, seedlings, and suckers, no significant differences were found between the treatments with regard to yield.

Protocol for somatic embryogenesis and plant regeneration from the ovary derived callus of ginger was standardised. This technique with large number of tiny embryoids available per culture is ideally suited for *in vitro* mutagenesis.

Micropropagation of ginger by the conversion of floral buds into vegetative buds and their subsequent development into plantlets was achieved in inflorescence cultures. Complete plantlets were also developed directly from the ovular tissues when individual flowers were cultured *in vitro*.

In vitro rooting and multiple shoot formation were induced in shoot tip cultures of black pepper in modified B₅ and MS media respectively.

Protocol for callus induction from leaf as well as stem explants was standardised and adventitious bud formation was induced in some leaf derived callus cultures.

EVALUATION OF SPICES FOR QUALITY

Sixty seven accessions of black pepper germplasm were analysed for their quality and among them Coll. 1060 has highest oil (5.3%) and piperine (5.7%) contents, while Coll. 893 has highest oleoresin (14.5%).

APG-57 which gave 9.8% oil (with 55.6% alpha terpinyl acetate) and APG-106 with 10.3% oil were the best among the 29 accessions of cardamom indexed for quality. From the selections of CL-37, selection No. 800 was the best with 10.5% of oil



In cinnamon, Sri Lankan line-5 has recorded the maximum eugenol content of 82% in its leaf oil.

CHARACTERISATION OF DROUGHT TOLERANCE IN BLACK PEPPER

Black pepper cultivars subjected to moisture stress did not differ significantly in the rate of leaf expansion. The leaves ceased to expand when the soil moisture level was reduced to 18.55%. Karimunda Selection-69 is promising in field evaluation under moisture stress condition.

NUTRITIONAL REQUIREMENT AND CROP MANAGEMENT

Studies on the interrelationships of phosphorus content in the leaf and the yield of black pepper showed significant correlation between leaf P index $\left(\frac{P}{N + P + K + Ca}\right)$ and yield of pepper ($r = 0.81^{**}$) underlining the importance of phosphate nutrition in pepper productivity.

Investigations on different categories of potash (K) in cardamom growing soils, and their interrelationships showed that ammonium acetate extractable K is significantly correlated with nitric acid extractable K ($r = 0.646^{**}$), and sodium acetate extractable K ($r = 0.694^{**}$) emphasising the importance of soil K in the dynamics of K availability in soil. Significant correlation was also found between exchangeable K and cardamom yield ($r = 0.47^{**}$) demonstrating the importance of soil K in cardamom productivity.

Studies carried out to assess the nutritional requirement of three released turmeric varieties (Suvarna, Suguna and Sudarshana) have indicated that the nutrients applied have directly reflected more in the rhizome than in the leaf tissue.

Cumulative yield data for six years indicated that closer spacing of 2 x 1 m (5000 vines/ha) was found to be the best when RCC posts were used as standards of black pepper. Cultivar Karimunda gave the highest yield at this spacing when compared with Panniyur-1 and Aimpriyan.

PLANT PROTECTION

Systemic fungicides viz., Ridomil ZM, Ridomil MZ and Akomin in combination with Phorate has reduced the incidence of root rot in black pepper.

Based on the residue analysis for metalaxyl, Ridomil MZ 72 at the rate of 100 ppm metalaxyl can be safely used upto 3 rounds. The last round has to be completed at least 120 days before harvest. If the concentration of metalaxyl is increased to 200 ppm the last spray must be completed 180 days before harvest.

Root infection of ginger by *Pythium aphanidermatum* also leads to rhizome rot of ginger.

Incidence of rhizome rot of ginger caused by *Pythium aphanidermatum* could be minimized by seed treatment and infesting soil with *Trichoderma viridae* and *T. harzianum*. *T. viridae* is more effective compared to *T. harzianum*.

Rhizoctonia solani was found to infect cardamom panicles and capsules in addition to rhizomes.

** Significant at 1% level

Infection of cardamom by *Meloidogyne incognita* resulted in the reduction of yield upto 38.6%.

Entomophagus mites and nematodes were recorded for the first time as natural enemies of black pepper top shoot borer at larval stage.

The insecticides (monocrotophos and dimethoate) recommended for the control of leaf gall thrips of black pepper were found toxic to the anthocorid predator upto 3 days after application.

Effect of VAM on biotic and abiotic stresses :

Incorporation of VAM (*Aculospora laevis*, *Glomus mosseae*, *G. fasciculatum* and *Gigaspora margarita*) was found effective in suppressing root-knot nematode (*Meloidogyne incognita*) infection in black pepper.

VAM (*Glomus fasciculatum*) inoculated black pepper plants showed stability in the activities of enzymes viz., nitrate reductase, peroxidase and acid phosphatase when subjected to moisture stress. The wilting of these plants was also delayed significantly.

Incorporation of VAM, *G. fasciculatum* in the rooting medium enhanced the rooting percentage of black pepper and their subsequent growth.

PRODUCTION OF NUCLEUS PLANTING MATERIALS

Multiplication of planting materials of released varieties as well as promising selections of black pepper, cardamom, turmeric and tree spices was given high priority during the year. A

total number of 14,000 rooted single noded cuttings of high yielding black pepper varieties (Subhakara, KS-14, Panniyur-1 and Kottandan), 850 kg of seed capsules of CL-37 of cardamom, 2000 kg of seed rhizomes of turmeric varieties Suguna and Sudarshana, 500 epicotyl grafts of nutmeg, 2000 each of clove and cinnamon seedlings were produced and distributed to various developmental agencies as well as farmers as nucleus planting material.

A simple method for multiplication of planting material of black pepper from single noded cuttings of field grown vines have been developed with a success rate of 85%.

A quick method for proliferation of suckers in cardamom was developed to generate more number of planting materials in a short time at the same time getting good yield of cardamom capsules. A high density planting (9259 plants/ha) in trenches with a spacing of 1.8 x 0.6 m under controlled overhead shade gave an average of 32-42 tillers per plant after 12 months of planting, thus giving a very high rate of planting units.

TRANSFER OF TECHNOLOGY

Six training courses were conducted on spices production technology during the year. Officials from departments of Agriculture and Horticulture from various states participated. Off campus training programmes were also conducted at Quilandy (Kerala), Sirsi and Hulagola (Karnataka) to educate the farmers on various aspects of cultivation of spices and production of planting material. Scientists of this institute participated in seminars and growers meetings held at Sagar, Santhaly, Makkandoor and the planters were educated on different aspects of cardamom production technology and katta disease management

A folder on bush pepper was published during the year.

ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES

The Project has completed 2 decades of its existence and has now 14 Coordinating Centres viz., Panniyur, Sirsi and Chintapalli for black pepper; Mudigere, Yercaud and Pampadumpara for small cardamom; Gangtok for large cardamom; Solan and Pottangi for ginger; Pottangi, Jagtial and Solan for turmeric; Jagudan and Jobner for cumin & fennel; Coimbatore, Guntur, Jobner and Jagudan for coriander & fenugreek.

Genetic Resources :

Panniyur centre improved its black pepper collection by addition of 8 collections from Karnataka, bringing the total to 200; Sirsi has 75 including 15 wild accessions added during the year. Pottangi centre maintains 155 accessions in turmeric and 124 accessions in ginger. Solan centre added 59 new accessions to the ginger germplasm, though a NBPGR-AICRP joint survey. In large cardamom, additional germplasm was brought from Arunachal Pradesh and parts of Sikkim. There is exchange of ginger & cardamom germplasm between NRCS and Coordinating Centres.

Crop Improvement :

Varieties Panniyur 2, Panniyur 3 and Panniyur 4 were released with average dry pepper yield of 1954 kg/ha, 1749 kg/ha and 975 kg/ha respectively. About 30000 rooted cuttings of these varieties were distributed. Cardamom selection PV-1 from KAU is in advanced stage of release. Twenty five kg of seed capsules of M1 cardamom variety were distributed, from Mudigere (UAS). In large cardamom cultivar 'Pink Golsey' and Clone-4 (green cardamom) were identified as superior and are being promoted for release. In ginger Pottangi centre

has released a new variety Suruchi and another selection "Surabhi" with low fibre content (4%) is under consideration for release. This centre has distributed 6.3 t. of seed rhizomes of ginger (Suprabha & Suruchi) and 16 t. of seed rhizomes of turmeric (Roma & Suroma) during the last 5 years.

In coriander, varieties Sadhana and Swathi have been released by the APAU. These two varieties have an average yield, essential oil and fixed oil of 1025 kg/ha, 0.2% & 9.2% and 885 kg/ha, 0.3% & 9.6% respectively. Coimbatore centre has released coriander variety Co-3 with an yield of 644 kg/ha, 0.4% seed oil content and less incidence of wilt and grain mould. At Guntur, coriander ATP 82 recorded the highest yield of 692 kg/ha.

Crop production :

Most economical dose of NPK for black pepper has been recommended as 50 : 50 : 150 kg NPK (per ha). Among the live standards for black pepper those grown on *Ailanthus malabaricum* gave the maximum yield. High density planting of cardamom var. Malabar with a closer spacing of 1 m x 1 m was found superior at Yercaud.

In coriander application of N @ 60 kg/ha in 3 equal splits, applied as basal, 30 and 60 days after sowing, under irrigated conditions, gave higher yields at Jobner. Leaf plucking up to 50% if done 75 days after sowing, did not affect grain yield of coriander. In Guntur sowing coriander in kharif gave 658 kg/ha when sown in 15th September. Cumin when broadcast and applied with 30 kg N/ha in single dose gave higher yields. In Fennel, application of N @ 90 kg/ha in 3 equal splits given as basal, 30 and 60 days after sowing gave higher production in Jobner. For producing the "Chewing type" fennel can be harvested when the grains are of "half length size" around 30 days after

anthesis. At Jobner, it was found that when the IW/CPE ratio is kept at 1.0, the fenugreek crop gives the highest seed yield of 1400 kg/ha.

Crop Protection :

Metalaxyl and A1-fosetyl compounds are superior to Bordeaux Mixture (BM) in performance at Sirsi but on par with BM at Panniyur. At Mudigere, the cardamom cultivar "Pink Pseudostem" was identified as tolerant to leaf spot disease. The *Pestalotiopsis* leaf spot of large cardamom is controlled by spraying Blitox 50 @ 0.3%.

In cardamom, the azhukal disease was controlled by spraying 1% BM as well as soil

drenching. Nematode infestation in cardamom nurseries was controlled by application of Temik granules and the root grub has been effectively checked by Carbofuran 3% G @ 8 - 10 g/clump, applied during June-July & November-December. Leaf diseases in cardamom nurseries have been controlled by spraying with Dithane M-45 (0.25%).

Weed control in cumin has been achieved with Terbutryn @ 0.5 kg a.i./ha. Cumin blight caused by *Alternaria burnsii* was controlled by spraying Dithane M45 or Cupramar @ 0.8 to 1.0 kg/ha, the first spray to be given at the time of flowering, followed by fortnightly intervals. Grain mould of coriander has been controlled by spraying Carbendazim 0.1% applied 20 days after grain set.