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# **All India Coordinated Research Project on Spices**

## **ANNUAL REPORT**

(April 1, 1993 to March 31, 1994)



**NATIONAL RESEARCH CENTRE FOR SPICES**  
(Indian Council of Agricultural Research)  
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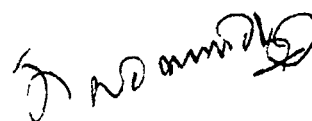
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## About this report

It is with immense pleasure I place before you the Annual Report of the All India Coordinated Research Project on Spices (AICRPS) for the period April 1, 1993 to March 31, 1994. This forms the ninth independent Annual Report of the SPICES PROJECT and covers research activities of 61 projects conducted by 41 Scientists based in 16 AICRPS centres located in 11 States of India during the 12 month period. This report has special significance as it contains the detailed report on the ongoing research projects that has been continued as approved during the VIII Plan with additional experiments that were added to as per decisions taken during XII Workshop (July 26-28, 1993) held at Trichur, Kerala. The present report includes the list of germplasm holdings, the salient features of four new improved varieties one each in black pepper, cardamom, coriander and fenugreek which were released at the Workshop, cost effective strategy to manage Phytophthora foot rot in black pepper which was tested at on farm trials in farmers fields. Intensification of research on biocontrol in the management of diseases and pests of spices, research publications, meteorological data from the Coordinating Centres, budget, staffing pattern, etc. are also furnished.

The AICRPS centres located at the State Agricultural Universities have taken up the assigned technical programmes seriously which helped in timely compilation of this document. The Associate Directors, Professor and Head of Offices as well as the scientific and other staff in all the Centres deserve our appreciation for providing the necessary research data which enabled us in compiling this report in time. We place on record the whole-hearted co-operation and support received from the Director and Staff of NRCS who have rendered all possible assistance in functioning of the Coordinated Project as well as preparation of this Annual Report. The services of Dr. A.K. Johny, Technical Information Officer and Mrs. P.V. Sali, Stenographer, PC's Cell have been appropriately utilised in bringing out this Report.



A.K. SADANANDAN

Project Coordinator

Calicut

December, 1994

## SUMMARY

The AICRP on Spices was initiated in 1971 with the objectives of evolving varieties resistant/tolerant to pests and diseases, standardisation of agro-techniques suited to different agro-climatic regions of India, evolving control measures to manage pests and diseases with minimum residual toxicity and developing linkage between different agencies working on Spices. The 12 mandatory spice crops of AICRPS are Black Pepper, Small and Large Cardamom, Ginger, Turmeric, Nutmeg, Clove, Cinnamon, Coriander, Cumin, Fenugreek and Fennel. Research achievements generated from 61 research projects during 1993-94 in spices improvement, production, protection and quality aspects conducted at 16 AICRPS centres based at 11 Agricultural Universities and one ICAR Research Complex in 11 States of India by 41 Scientists are highlighted.

The important features have been induction of six new centres, Dholi in Bihar, Hisar in Haryana, Nadia in West Bengal, Fisabad in Uttar Pradesh, Raipur in Madhya Pradesh and Dapoli in Maharashtra states. The XII AICRPS Workshop was held at Trichur during July 26-28, 1993 which critically evaluated research results of projects and formulated new programmes. Four varieties in spices viz., Panniyur-5 in black pepper, ICRI-3 in small cardamom, DH-5 in coriander and HM-57 in Fenugreek were recommended for release. Techniques for the management of black pepper, cardamom, ginger and turmeric, multiple cropping system of pepper in arecanut garden, management of the Phytophthora foot rot of black pepper and rhizome rot of ginger and turmeric received priority. To control cumin wilt seed dressing with Bavistin 0.1% followed by crop rotation is recommended for Rajasthan. A coriander variety UD-20 which is consistently giving high yield is recommended for cultivation in drought prone areas of Rajasthan. The planting materials of the released varieties numbering one lakh rooted cuttings in pepper, 100 kg seed capsules of cardamom, 2.5 t of ginger, 10 t of turmeric, 1.9 t of cumin, 100 kg each of coriander and fennel and 1.8 t of fenugreek were supplied during the period. The working of the AICRP on Spices for ten years period 1982-92 was evaluated by Quinquennial Review Team and the report submitted to ICAR. The Annual budget of AICRPS was Rs.80.6 lakhs.

(A.K.Sadanandan)  
Project Coordinator

## सारांश

महामारियों तथा रोगों की विभिन्न प्रकार की सहिष्णुता, भारत में विविध प्रकार के कृषि योग्य मौसमी क्षेत्र के अनुकूल कृषि-तकनीकियों के मानकीकरण, अवशिष्ट न्यूनतम विषाक्ततावाली महामारी तथा रोगों का पबंध करने संबंधी उपायों को निरन्तर करने तथा मसालों पर काम कर रहे भिन्न-भिन्न अभिकरणों के बीच बढ़ते अनुबंध पर 1971 में मसालों पर ए.आइ.सी.आर.पी.एस. प्रारंभ की गयी। ए.आइ.सी.आर.पी.एस. के मसालों की 12 अनिवार्य आदेशात्मक फसलें हैं - कालीमिर्च, छोटी तथा बड़ी इलायची, अदरक, हल्दी, गिरी(जातिफल), लौंग(लवङ्ग), बाज्रघोनी, धनिया, जीरा, मेथी और सौंफ। भारत के 11 राज्यों में वर्ष 1993-94 के अंतराल 61 अनुसंधान परियोजनाओं के माध्यम से मसालों के सुधार, उत्पादन, सुरक्षा तथा गुणवत्ता आदि विषयों में 11 कृषि विश्वविद्यालयों पर आधारित 16 ए.आइ.सी.आर.पी.एस. केन्द्रों पर तथा एक आइ.सी.ए.आर. अनुसंधान परिसर में 41 वैज्ञानिकों ने अनुसंधान के लक्ष्यों की जो प्राप्ति की है उसपर प्रकाश डाला गया है।

2. छः नए केन्द्रों; यथा- बिहार में ढोली, हरियाणा में हिसार, पश्चिम बंगाल में नदिया, उत्तर प्रदेश में फैजाबाद, मध्यप्रदेश में रायपुर तथा महाराष्ट्र राज्य में दापोली आदि का विलय (समावेश) मुख्य लक्षण (कार्यक्रम/क्रियाकलाप) रहे हैं। ए.आइ.सी.आर.पी.एस. की 12 कार्यशालाएँ 26-28 जुलाई 1993 के दौरान त्रिशूर में आयोजित की गयी थीं; जिनके माध्यम से परियोजनाओं की अनुसंधान की परिणति का मूल्यांकन कठिनाई से किया जा सका। मसालों के चार प्रकार; यथा - कालीमिर्च में ढब्रीयूर - 5, छोटी इलायची में आइ.सी.आर.आइ-3, धनिया में डी.एच-5 तथा मेथी में एच.एम.-57 को वंटन के लिए संस्तुत किया गया। कालीमिर्च, इलायची (छोटी/बड़ी), अदरक तथा हल्दी सुपारीवाटिका में कालीमिर्च की अधिक फसल प्रणाली, कालीमिर्च के फिटीफ्योरा तथा अदरक और हल्दी के रिज़ोम के अघोभाग की सड़न की व्यवस्था करने की तकनीकी को प्राथमिकता दी गयी। राजस्थान में फसल के घूर्णन से उत्पन्न जीरा के बीज की मूर्च्छा का नियंत्रण करने के लिए 0.1% बैविस्टिन से प्रतिसारण की संस्तुति दी गयी है। यू.डी. - 20 धनियाँ का एक क्रिस्म (प्रकार) जो निरंतर अच्छा उत्पादन देता रहा है; को राजस्थान के सुखे क्षेत्रों में कृषि के लिए संस्तुति दी गयी है। आवंटित प्रकार (क्रिस्म) की रोपण - सामग्रियों में कालीमिर्च की जड़ें एक लाख की संख्या में काटकर लगायी गयीं, इलायची के बीज 100 किलो, अदरक 2.5 टन, हल्दी 10 टन, जीरा 1.9 टन, धनियाँ तथा सौंफ में से प्रत्येक 100 किलो एवं मेथी के 1.8 टन अवधि के दौरान आपूर्ति किये गये। 1982-92 की दश वर्षों की अवधि तक मसालों पर ए.आइ.सी.आर.पी. के कार्यों का मूल्यांकन पंचवर्षीय समीक्षा दल द्वारा किया गया तथा आइ.सी.ए.आर. को प्रतिवेदन संस्तुत किया गया। ए.आइ.सी.आर.पी.एस. का वार्षिक आय-व्यय 80.6 लाख टन रुपये का था।

ए. के. सदानंदन  
परियोजना समन्वेता

## INTRODUCTION

The All India Coordinated Research Project on Spices was initiated as a combined Project on Spices and Cashewnut in 1971 with its headquarters at CPCRI, Kasaragod. In order to bestow undivided attention to research on spices ICAR bifurcated the combined project into two independent projects on Spices and Cashewnut in 1986. The headquarters of AICRPS is NRCS, Calicut.

The AICRP on Spices initiated in 1971 (IV Plan) with four Centres and four crops was expanded to 14 centres and 12 spice crops during the V, VI and VII Plan periods. The activities of AICRPS was further increased during VIII Plan by adding two new centres, viz., Dholi in Bihar and Hisar in Haryana states. The spectrum of AICRPS activities was further increased by ICAR by sanctioning four more centres during the current VIII Five Year Plan period. These four centres would be based at the SAUs one each in the states of Maharashtra, West Bengal, Madhya Pradesh and Uttar Pradesh. These four centres would concentrate on tree and seed spices research. The AICRP started during IV Plan with four centres and four crop would now have 20 centres and 12 crops during the current Plan period. The 12 crops dealt are black pepper, small and large cardamom, ginger, turmeric, tree spices - clove, nutmeg and cinnamon and seed spices - coriander, cumin, fennel and fenugreek.

### Mandate

The objectives of AICRPS are :

- \* evolving high yielding varieties resistant/tolerant to diseases and pests;
- \* standardisation of agro-techniques for the crops under different agro-climatic conditions;
- \* evolving control measures for major pests and diseases; and
- \* working as inter-face and feed-back between SAUs, National Research Centre for Spices and ICAR.

## History and activities

The first Workshop on AICRPS was held at CPCRI, Kasaragod in Dec. 1971 wherein the research problems to be tackled under AICRPS were identified and technical programmes drawn and implemented. Since then the performance of various research programmes under the AICRP was reviewed at the Annual/Biennial Workshops held during the years 1972, '75, '78, '81, '83, '85, '87, '88, '89, '91 and '93. The working of AICRPS for ten years (1982-92) was reviewed by the Quinquennial Review Team and report submitted to ICAR.

Dr. M.C. Nambiar was the first Project Coordinator of the combined Project on Spices and Cashewnut from its inception in 1971 till his retirement in April 1985. Dr. M.K. Nair, Director, CPCRI, Kasaragod held additional charge as Project Coordinator during 1985-86. Dr.S.Edison took over as Project Coordinator (Spices) during March 1986 and continued up to January 12, 1993.

I place on record the great vision and service rendered by Dr.K.V.A. Bavappa, Retd. Director of CPCRI, Kasaragod who has been instrumental in initiating and establishing the host Institute of AICRP on Spices. His interest in the development of spices projects is duly acknowledged. The guidance and support rendered by Dr. M.K. Nair, Director, CPCRI in the activities of AICRPS is gratefully appreciated. The significant contributions made by Dr.S.Edison, Project Coordinator in streamlining the activities of AICRPS is duly acknowledged. The help and assistance rendered by Dr.K.V.Peter, Director, NRCS and my colleagues at the Institute in the smooth running of the Project during the period under report is also acknowledged with thanks.



## PROJECT COORDINATOR'S REPORT

The All India Coordinated Research Project (AICRP) on Spices is vested with a mandate to carry out scientific research to develop location specific technology to augment spices productivity in the country. Problem oriented research has been envisaged in black pepper, small and large cardamom, ginger and turmeric, tree spices (clove, nutmeg and cinnamon) and seed spices (coriander, cumin, fennel and fenugreek). Scientific research of these 12 spice crops are carried out in 16 centres of AICRPS based in eleven Agricultural Universities and one ICAR centre at Gangtok. The research programmes are carried out under four broad heads, Genetic Resources, Crop Improvement, Crop Production including quality and Crop Protection. The Project Coordinator is based at the National Research Centre for Spices, Calicut.

### History

The AICRP on Spices was formulated during IV Five Year Plan (1971) as a combined AICRP on Spices and Cashewnut. The first combined Workshop was held at Kasaragod in 1971 and research programmes initiated in four spice crops (pepper, cardamom, ginger and turmeric) at four centres (Panniyur, Pampadumpara, Mudigere and Solan). During V Plan, Research on seed spices was initiated and intensified work on ginger by adding five more centres (Jobner, Jagudan, Guntur, Coimbatore and Pottangi). During VI Plan four new centres were added (Sirsi, Vellanikkara, Chintapalli and Yercaud) to further intensify work on pepper, ginger and turmeric. During VII Plan two more centres were added (Gangtok and Jagtial) one for turmeric and the other for large cardamom in Gangtok. During VIII Plan, two new centres one at Hisar (Haryana) and another at Dholi (Bihar) were added to intensify work on seed spices and turmeric thus making the total to 16 Research Centres under AICRPS which are based in 11 Agricultural Universities and the Gangtok centre under ICAR Research Complex in 11 states of India. Workshops were held at Goa (1978), Trichur (1981), Calicut (1983), Trivandrum (1985), Guntur (1987), Solan (1988), Coimbatore (1989), Trivandrum (1991) and Trichur (1993). The Workshop reviewed the

progress of research and depending upon the needs of the country, formulated new technical programmes.

### **Staff and budget**

The staff strength of AICRP on Spices consists of 41 Scientists supported by technical (21) and auxiliary (3) making the total 65 staff. The annual budget was increased from Rs.15.6 lakhs in 1985-1986 to Rs.81 lakhs in 1993-94.

### **Research activities**

The AICRP on Spices is vested with a mandate to develop location specific agrotechniques for sustainable spices production. A multiprong approach is envisaged and research projects formulated to tackle pests and diseases. There are 61 projects and discipline wise distributions are 31 in Crop Improvement (including Genetic resources), 11 in Crop Production, 5 in Quality Improvements and 14 in Crop Protection. The crop wise distribution of projects are pepper 8, small cardamom 6, large cardamom 3, ginger 7, turmeric 5, tree spices 6, seed spices 24 (coriander 7, cumin 6, fennel 6 and fenugreek 5).

#### **1. Genetic Resources**

The germplasm accessions including wild and exotic types maintained in 16 Coordinating Centres as on March 31, 1994 are given elsewhere.

**1.1 Black pepper :** The Panniyur centre shifted 117 wild accessions in black pepper to Ambalavayal (KAU) for want of ideal climatic conditions. Out of the 76 cultivated types evaluated at Panniyur, Karimunda-I (PRS-20), Karimunda-III (PRS-22) and Sullia (PRS-49) have shown high yield potential. The Yercaud and Mudigere centres also assembled black pepper germplasm as per the decision that all cardamom centres to initiate work on black pepper. Three wild types from Shevroys and Kolli hills were collected during the year by Yercaud centre.

- 1.2 Cardamom : The germplasm evaluation at Pampadumpara identified Cardamom types PS-21, PS-22 and Clone-57 for the bold capsules. The CL-692 (638 kg/ha) and P-20 (556 kg/ha) were promising collections with regard to yield. The entries CL-802 and CL-683 recorded higher values for most of the yield attributes in the germplasm collection at Mudigere.
- 1.3 Ginger : One new accession was added making the progressive total to 147 at Pottangi and out of the 140 accessions of ginger, Z0-17 was the top yielder. Out of the 132 collections maintained at Solan, collections BDTR-1267, PGS-10, Kerala Local and SG-603 recorded maximum yield.
- 1.4 Turmeric : Jagtial centre made 46 new collections and increased the accessions to 188 while Pottangi centre added one new collection making to 187. Among these cv. Roma gave highest yield in the evaluation of 143 Curcuma longa types; Haridaguda and CAM-3 among C. aromatica and C. amda respectively at Pottangi. In the evaluation at Jagtial, Ethamukkula gave highest yield in long duration type, CLI-317 among intermediate and PCT-13 among short duration type. At Solan, maximum yield per plot was obtained in CLS-9, ST-41, BDJR-1156 and BDJR-1276.
- 1.5 Tree Spices : The exploratory survey conducted for tree spices (clove, nutmeg and cinnamon) germplasm by the Yercaud centre identified 13 elite mother trees of clove from Courtallam, Nagarcoil and Kallar areas and 15 high yielding nutmeg types from Kallar, Burliar and Courtallam. In cinnamon 10 accessions, along with one cassia cinnamon, are also maintained.
- 1.6 Coriander : The existing 578 (468 indigenous and 50 exotic) collections available at Jagudan centre were critically examined and based on the genetic diversity, 143 accessions having variability were shortlisted. Extensive survey work also carried out by Jagudan centre during 1993-94 in the state of Gujarat and collected 37 new coriander accessions. Jobner centre made 60 new collections and also received 175 (137 indigenous and 38 exotic) collections from

other centres makes the total collection to 683. Hundred and ten germplasm accessions were collected in collaboration with NBPGR and increased the collection to 230 in Guntur centre. Coimbatore centre made 243 new collections making the total to 372. The new centre Hisar, made a collection of 30 lines in coriander.

Thirty seven exotic germplasm in Coriandrum sativum received through NBPGR (1990-91) have been distributed to Jobner and Jagudan centres. Another seven Coriandrum sativum (six from Germany and one from Japan) and medicinal plants Carum carvi (4), Anethum graveleus (3), A. beishei, A. anoonals, A. decursevia, Ammi visnaga (one each), Anethum graveleous (2), Apium sp. (39) received from NBPGR also forwarded to Jobner.

Jobner centre tested 45 entries against root knot nematode (M. incognita). Out of the 45 entries tested UD-20 and UD-21 were resistant.

- 1.7 Cumin : The existing collections 285 (278 indigenous and 7 exotic) maintained at Jagudan were critically examined and based on diversity 106 entries having variability were retained. With a view to collect diverse genotype of cumin, the major growing area was surveyed and 460 new entries collected on the basis of diversity by Jagudan during 1993-94 makes the total collection to 566 accessions.

A total of 224 (214 indigenous and 10 exotic) are maintained at Jobner.

In the screening of 9 germplasm entries E C 243373, EC 243375 and EC 232684 accessions found to be resistant against fusarium wilt disease in wilt sick plot at Jagudan.

- 1.8 Fennel : At Jagudan the available 283 entries (262 indigenous and 21 exotic) were critically examined and screened diversity. Based on the genetic diversity 98 entries having variability were retained. Jobner centre maintained 139 collections in fennel. Two fennel

germplasm (Germany and Japan) received from NBPGR (93-94) also forwarded to Jobner.

- 1.9 Fenugreek : The germplasm collection was increased to 270 (258 indigenous and 12 exotic) at Jobner centre as a result of 113 indigenous collections received from other centres during 1993-94. The germplasm collection rose to 179 at Coimbatore Centre as a result of enrichment of 53 new accessions during 1993-94. Out of the 53 accessions (received from the Coimbatore) evaluated, none was better than RMT-1 with respect to yield, however, 19 accessions showed lower incidence of powdery mildew and 7 accessions showed lower incidence of root rot.

The Hisar made 80 new collections. Seventy accessions were evaluated at Guntur. Among the accessions UM-117 (1100 kg/ha) followed by Lam Sel.1 (1092 g/ha) gave highest yields. Jagudan centre holds 135 accessions including two exotic accessions. During the year, the entries were evaluated for morphological and yield diversity. None was found superior in yield over control. Based on genetic diversity, 40 entries having variability retained and other discarded.

In the screening of three exotic entries at Jagudan under natural condition EC-257566 (Bulgaria) was found resistant against powdery mildew disease.

## 2. Crop improvement

In black pepper, variety Panniyur-5 from Panniyur (KAU), cardamom ICRI-3 (SKP-14) from Indian Cardamom Research Institute; Sakleshpur (Spices Board) and Coriander DH-5 and fenugreek HM-57 from Hisar (HAU) were recommended for release.

Several MLT's are in progress viz., five MLT's in Black pepper (at Panniyur, Sirsi, Chintapalli, Yercaud and Pampadumpara) one in Cardamom (Pampadumpara), one in Clove (Yercaud) two in turmeric (Jagtial & Pottangi) and one in ginger (Pottangi). In seed spices MLT's

are under operation in Coriander (Jobner, Jagudan) Cumin (Jobner, Jagudan) Fennel (Jobner & Jagudan) and Fenugreek (Jobner & Jagudan).

2.1 **Black pepper** : Panniyur-5 (Culture 239) was evolved from the Pepper Research Station (KAU) Panniyur, Kerala. It is a selection from the OP progeny of the local cultivar Perumkodi, recommended for growing in Kerala. The MLTs to evaluate the performance of released varieties including promising selections from NRCS and Panniyur were laid out at Panniyur, Pampadumpara and Yercaud centres. In the evaluation of seven black pepper cultures, culture-331 (Panniyur-3), Culture-239 (Panniyur-5) and Culture-54 were found to be performing well in the MLT at Panniyur. In the intervarietal hybridisation at Panniyur, 1134 open pollinated/hybrid progenies are maintained. The top yielders for the season were Culture-5834, Culture-6766 and Culture-6988. Among varieties, Panniyur-1 is performing well at Chintapalli and therefore recommended to grow in that high altitude. Among the pepper cultivars under MLT at Panniyur centre Kalluvally stood first followed by Kuthiravally and Neelamundi in terms of green berry per vine.

2.2 **Cardamom** : ICRI-3 (SKP-14) from Indian Cardamom Research Institute, Regional Station, Sakleshpur, Karnataka is a Malabar type with long and bold capsules, more than 73% of the capsules are above 7.5 mm diameter. It is an early maturing type recommended for growing in hills zones of Karnataka state which gives an yield of 439 kg/ha more under rainfed and 599 kg/ha under irrigated condition (118% more than the local check) and is capable of giving potential yield of 790 kg/ha. It contains 6.6% essential oil and 54% 1,8 Cineole content. At Mudigere among the three promising clones (in farm trials), Clone-683 was superior with respect to boldness, weight, essential oil besides higher yields. Several promising lines have been identified from seedling progeny viz., Cl-692 (636 kg/ha), P-20 (556 kg/ha) which are most promising collections from productivity point. The yield from suckers was 70% higher as compared to yield from seedlings in the case of cv. Mudigere-1. Tissue cultured cardamom selection (TC-6) appeared promising at Mudigere.

- 2.3 **Ginger** : A line SG-666 of Solan centre has been recommended for cultivation in the state of Himachal Pradesh. In the MLT maximum yield was recorded by Rajgarh local, SG-646, SG-666 and SG-547. At Pottangi SG-547 was the highest yielder (16.05 T/ha) closely followed by  $V_2S_1-7$  (14.43 T/ha).
- 2.4 **Turmeric** : PTS-19 was the top yielder (22.28 t/ha) at Pottangi among the 13 high yielding cultivars tested under MLT. Among the short duration types, PTS-15 (19.27t fresh rhizome/ha), and PTS-19 (18.84t fresh rhizome/ha) among long duration type were the highest yielders at Pottangi. At Jagtial, in the MLT with 12 entries, Duggirala (7.9 kg/3sq.m.) recorded highest yield. And in the evaluation of promising long, intermediate and short duration turmeric cultures, higher yields were obtained by Ethamukkala (5.1 kg/3 sq.m), CLI-317 (7.4 kg/3 sq.m) and PCT-13 (4.2 kg/3 sq.m) respectively. Pooled analysis gave maximum yield in ST-510 followed by ST-365 and VK-70 in the MLT at Solan.
- 2.5 **Tree spices** : The MLTs in clove with six entries and cinnamon with five entries were laid out at Yercaud.
- 2.6 **Coriander** : DH-5 was proposed by Department of Vegetable Crops, HAU, Haryana. A selection from the indigenous material collection from Karnal district (Haryana). It is a dual purpose and high yielding variety (135 days duration) with wider adaptability, gives an average yield of 1400-1600 kg/ha. Recommended from Haryana and Andhra Pradesh where long duration varieties are grown.
- 2.7 **Fenugreek** : HM-57 was proposed by Department of Vegetable Crops, HAU, Haryana, selected from the germplasm collected from Kurukshetra district of Haryana. It is a quick growing dual purpose and high yielding variety. Average yield under normal condition ranges from 1600-1800 kg/ha.

### 3. Crop production

- 3.1 Black pepper : In black pepper highest yield was obtained at Panniyur by irrigation at IW/CPE of 0.25. Studies at Sirsi confirmed that in companion cropping system the yield of black pepper and arecanut could be increased with the application of 100:40:140g NPK/year each to arecanut and pepper.
- 3.2 Cardamom : At Mudigere, studies indicated that in cardamom, the number of suckers per panicles and yield could be significantly increased with increase in N and P levels under uniform shaded conditions. Similarly cardamom yield under irrigated situation was 75 per cent higher compared to yield in rainfed situation at Mudigere. The average yield from suckers was 48% higher (500 kg/ha) as compared to that from seedlings (337 kg/ha) in case of variety Mudigere-1.
- 3.3 Ginger : In ginger application of  $N_{125} P_{100} K_{100}$  kg/ha recorded the highest yield of 14.35 t/ha with a maximum benefit at Pottangi.
- 3.4 Tree spices : Research on Tree Spices (clove, nutmeg and cinnamon) was initiated at Yercaud centre. Standardisation of vegetative propagation in nutmeg by different grafting methods is under progress. A considerable increase in the population dynamics of Azospirillum and Phosphobacteria in the root zone was observed in cloves and nutmeg plantations by the application of these organisms to the soils.
- 3.4 Seed spices : For cumin the Jobner centre recommended a three years crop rotation i.e., cluster bean - cumin - cluster bean - wheat - cluster bean - mustard crop sequence to be the best for adoption in Rajasthan. A seed rate of 25 kg/ha in fenugreek standardised at Jobner gave the maximum yield of 11.12 q/ha. At Coimbatore, coriander sown in first week of November by adopting a spacing of 15 x 15 cm gave high yield.



#### 4. Quality evaluation

The promising clones of cardamom viz., CL-683, CL-679 and CL-726 were superior to Mudigere-1 with respect to essential oil and Alpha terpenyl acetate and 1,8 Cineole content. In ginger SG-673 recorded maximum essential oil and SG-675 maximum oleoresin. And in turmeric PCT-14 followed by PCT-13 recorded maximum curcumin and oleoresin contents.

In seed spices quality is judged by the presence of aroma which is due to volatile oil content of the grains. Quality studies at Jobner recorded maximum volatile oil content in coriander JCo-126 (0.4%) followed by JCo-81 (0.32%), cumin UC-198 (4.9%) and in fennel by HM-39 (1.51%).

#### 5. Crop protection

- 5.1 Black pepper : In the studies on the Phytophthora foot rot and nematode disease management in black pepper at Panniyur minimum defoliation was noticed in the treatment receiving all cultural practices + 1 kg neem cake/vine + 3g a.i. Phorate/vine + 1% Bordeaux mixture + two drenching with 0.2% Copper oxychloride. At Sirsi Phytophthora foot rot incidence was lowest by adopting cultural practices, combined with application of one kg neem cake/vine, 3g a.i. Phorate/vine, Bordeaux mixture spraying @ 3 l/vine and drenching copper oxychloride (0.2%), 5 l/vine, before the onset of monsoon. This was followed by spraying and drenching of Akomin (0.4%) during second week of July and spraying and drenching Ridomil MZ-72 WP (100 ppm) in second week of September. Bordeaux mixture spraying + pasting or pasting Bordeaux mixture + Blitox (2%) drenching recorded only 14% disease incidence compared to 35% in control at Chintapalli.

On farm trial in farmers' plot by Panniyur centre on Phytophthora disease management revealed that combined treatment of Bordeaux mixture spray, pasting and drenching combined with application of neem cake (2 kg/vine) and lime one kg/vine was

effective. Studies at Panniyur centre showed application of neem cake @ 2 kg/vine, Phorate 3g ai/vine and Copper oxychloride (0.3%) drenching was effective in checking slow wilt of pepper.

Biological control studies of Phytophthora foot rot of black pepper at Sirsi using four antagonistic organisms showed that Trichoderma harzianum minimised the foot-rot incidence. Studies at Chintapalli revealed that percentage of Phytophthora disease incidence was less with application of T. harzianum and T. viride.

Nursery diseases : In the trial on control of nursery diseases of pepper, at Panniyur centre minimum infection was noticed in vines treated with Validacin 0.2% under medium shade condition. Spraying and drenching of Difolatan (0.1%) reduced the mortality of pepper cutting in the nursery as compared to check under medium light intensity at Sirsi.

- 5.2 Cardamom : At Mudigere no shoot borer damage was noticed in 10 cardamom germplasm entries viz., C1-1228, C-57, C-154, C-10, P-9, PV-2, C-126, C-2, Ang. cap. and Nel.12. Studies on the effect of shoot borer at Mudigere in the three types of cardamom on yield, sucker and panicle production showed a significant yield reduction in damaged shoots. But no difference between healthy and damaged shoots in the production of new suckers and panicles. The thrips control studies at Pampadumpara showed that six spraying of monocrotophos (0.05%) combined with thrashing was effective in checking shoot borer.
- 5.3 Ginger : In ginger, pre-sowing seed treatment in combination of Indofil M-45 (0.25%) + Bavistin (0.1%) plus soil application of Phorate (10 kg ha<sup>-1</sup>) was effective in managing rhizome-rot.
- 5.4 Seed spices : For control of grain mould of coriander spraying of Carbendazim 0.1% after 20 days of flowering was effective. Application of neem cake @ 150 kg/ha was most effective for the management of wilt (4.8% disease incidence) in coriander followed by seed treatment and soil drenching with 0.1% Bavistin gave 5.2% wilt

incidence at Coimbatore during Kharif. The incidence of wilt disease has brought down to 8.1% from 32.3% by the use of Trichoderma viride as a means of biological management and this has been recommended for wilt management in coriander by the Coimbatore centre. The yield was also high in plots applied with Trichoderma (515 kg/ha) compared to control (260 kg/ha). The effect of T. viride either alone or with neem cake in the management of root rot disease of fenugreek was assessed by Coimbatore. The centre recommended application of T. viride along with 150 kg neem cake per hectare which reduced the incidence of root rot of fenugreek. Seed dressing with Bavistin (0.1%) consistently reduced the cumin wilt incidence and is recommended for adoption in Rajasthan.

## TECHNICAL PROGRAMME

| Crop / Technical programme   | Research Centres   |
|--|--|
| <b>1. BLACK PEPPER</b>   |  |
| 1.1 Germplasm collection, description and evaluation   | Panniyur<br>Chintapalli<br>Sirsi &<br>Yercaud                    |
| 1.2 Multilocation trials (MLTs)  |  |
| a) MLT of promising cultures<br>MLT 1984 - Series I  | Panniyur &<br>Chintapalli  |
| b) Multilocation trial of pepper cultivars<br>MLT 1984 - Series II                           | Panniyur &<br>Chintapalli  |
| c) Multilocation trial<br>MLT 1987 - Series III  | Panniyur<br>Sirsi &<br>Chintapalli                               |
| d) Multilocation trial<br>MLT 1991 - Series IV   | Mudigere<br>Panniyur<br>Pampadumpara<br>Yercaud &<br>Ambalavayal |
| 1.3 Inter varietal hybridisation to evolve high yielding varieties                           | Panniyur   |
| 1.4 Irrigation-cum-fertilizer requirements on pepper and arecanut in a mixed cropping system | Sirsi &<br>Panniyur  |
| 1.5 <u>Phytophthora</u> - foot rot (quick wilt) and nematode disease management              | Panniyur<br>Sirsi &<br>Chintapalli                               |
| 1.6 Biological control of foot rot of black pepper   | Sirsi<br>Panniyur<br>Chintapalli                                 |
| 1.7 Field trial for the control of slow wilt disease of pepper                               | Panniyur   |

- |     |   |   |
|-----|---|---|
| 1.8 | Management of <u>Phytophthora</u> foot rot in pepper  |   |
| a)  | Observational trial for the control of foot rot of pepper in farmers' field   | Panniyur  |
| b)  | Studies on the control of nursery diseases of black pepper (solarisation studies for the control of plant diseases) | Sirsi & Panniyur                                      |
| 1.9 | Survey for insect pests of black pepper in high altitudes/chemical control of insect pests                          | Mudigere  |
| 2.  | CARDAMOM  |   |
| 2.1 | Germplasm collection, description and evaluation  | Mudigere<br>Pampadumpara                              |
| 2.2 | Multilocation trial (MLTs)  |   |
| a)  | MLT Series II - 1988  | Mudigere<br>Pampadumpara                              |
| b)  | MLT Series III - 1991 with Mysore type  | Mudigere<br>Appangala<br>Sakleshpur & Myladumpara     |
| c)  | MLT Series III - 1991 with Malabar type   | Mudigere<br>Appangala<br>Sakleshpur & Thadiyankudisai |
| 2.3 | Hybridisation and selection in cardamom   | Mudigere  |
| 2.4 | Manurial experiment (NPK trial)   | Mudigere & Pampadumpara                               |
| 2.5 | Micronutrient requirement studies   | Mudigere & Pampadumpara                               |
| 2.6 | Pest management in cardamom   |   |
| a)  | Screening of cardamom germplasm for shoot borer   | Mudigere  |
| b)  | Cultural and chemical control of thrips and capsule borer   | Mudigere & Pampadumpara                               |
| c)  | Determination of number of sprays for thrips control  | Mudigere  |

|     |  |                  |
|-----|--|------------------|
| d)  | Estimation of loss due to cardamom shoot borer   | Mudigere         |
| e)  | Effect of neem and pongamia cake application on thrips control                             | Mudigere         |
| f)  | Bioecology of natural enemies of major pests of cardamom                                   | Mudigere         |
| 2.7 | Screening for <u>katte</u> disease resistance, evolving control measures against clump rot | Mudigere         |
| 2.8 | Control of nursery diseases in cardamom  | Mudigere         |
| 3.  | <b>LARGE CARDAMOM</b>  |                  |
| 3.1 | Germplasm collection, description and evaluation   | Gangtok          |
| 3.2 | Identifying tolerant types to the two virus diseases and evolving control measures         | Gangtok          |
| 4.  | <b>GINGER</b>  |                  |
| 4.1 | Germplasm collection, description and evaluation   | Solan & Pottangi |
| 4.2 | Initial evaluation trial (IET)   | Pottangi & Solan |
| 4.3 | Comparative yield trial (CYT)  | Pottangi Solan   |
| 4.4 | Multilocation trial (MLT series III 1991)  | Pottangi & Solan |
| 4.5 | NPK trial in ginger  | Pottangi         |
| 4.6 | Evolving control measures including seed treatment against rhizome-rot disease             | Solan            |
| 4.7 | Evaluation of germplasm for quality characters   | Solan            |

## 5. TURMERIC

- |     |  |  |
|-----|--|--|
| 5.1 | Germplasm collection, description and evaluation     | Solan<br>Pottangi &<br>Jagtial           |
| 5.2 | Initial evaluation trial (IET)                       | Pottangi<br>Jagtial &<br>Solan           |
| 5.3 | Comparative yield trial (CYT)                        | Pottangi &<br>Solan                      |
| 5.4 | Multilocation trial - MLT-1991 Series III            | Pottangi<br>Jagtial<br>Guntur &<br>Solan |
| 5.5 | Quality evaluation of germplasm collection/varieties | Solan                                    |

## 6. TREE SPICES

- |     |  |   |
|-----|--|---|
| 6.1 | Germplasm collection, conservation and cataloguing of tree spices (clove, nutmeg and cinnamon) | Yercaud<br>Pechiparai<br>Ambalavayal &<br>Thadiyankudisai |
| 6.2 | Multilocation trial of elite cloves  | Yercaud<br>Pechiparai &<br>Ambalavayal                    |
| 6.3 | Multilocation trial of elite cinnamon  | Yercaud<br>Ambalavayal<br>Thadiyankudisai &<br>Pechiparai |
| 6.4 | Vegetative propagation in nutmeg and clove   | Yercaud<br>Thadiyankudisai &<br>Pechiparai                |
| 6.5 | Drip irrigation in clove & nutmeg  | Yercaud   |
| 6.6 | Biofertilizer trial in clove & nutmeg  | Yercaud   |

## 7. CORIANDER

- |     |  |  |
|-----|--|--|
| 7.1 | Germplasm collection, maintenance and evaluation | Jobner<br>Jagudan<br>Guntur<br>Coimbatore<br>Hisar & Dholi |
|-----|--|--|

|     |   |  |
|-----|---|--|
| 7.2 | Initial evaluation trial  | Jagudan<br>Guntur<br>Coimbatore<br>Hisar & Dholi           |
| 7.3 | Multilocation trials<br><br>MLT-1989 Series I<br>MLT-1993 Series II                               | Jobner<br>Jagudan<br>Coimbatore<br>Guntur<br>Hisar & Dholi |
| 7.4 | Mutation breeding in coriander<br>to evolve varieties with earliness<br>and resistance to disease | Jobner &<br>Coimbatore                                     |
| 7.5 | Studies on wilt disease<br>management of coriander  | Coimbatore   |
| 7.6 | Response of coriander to weed management  | Jobner   |
| 7.7 | Quality evaluation  | Jobner   |
| 8.  | CUMIN   |  |
| 8.1 | Germplasm collection, description<br>evaluation and screening against diseases                    | Jobner &<br>Jagudan  |
| 8.2 | Initial evaluation trial  | Jagudan  |
| 8.3 | Multilocation varietal trial<br>MLT 1989 Series I   | Jobner<br>Jagudan &<br>Hisar                               |
| 8.4 | Mutation studies and hybridisation<br>programmes in cumin   | Jagudan  |
| 8.5 | Evolving control measures against<br>wilt disease including crop rotation                         | Jobner   |
| 8.6 | Quality evaluation in cumin   | Jobner   |
| 9.  | FENNEL  |  |
| 9.1 | Germplasm collection, description<br>evaluation and screening against<br>diseases                 | Jobner &<br>Jagudan  |
| 9.2 | Initial evaluation trial  | Jagudan  |



|                 |  |  |
|-----------------|--|--|
| 9.3             | Multilocation trial<br>MLT - 1989 series I   | Jagudan<br>Jobner &<br>Hisar                                 |
| 9.4             | Mutation studies and crossing-<br>programmes in fennel   | Jagudan  |
| 9.5             | Response of fennel to weed management  | Jobner &<br>Hisar  |
| 9.6             | Quality evaluation studies   | Jobner   |
| 10.             | FENUGREEK  |  |
| 10.1            | Germplasm collection, maintenance,<br>evaluation and screening against<br>diseases   | Jobner<br>Jagudan<br>Coimbatore &<br>Guntur                  |
| 10.2            | Multilocation varietal trials<br><br>a) MLT 1989 - Series I<br>b) MLT 1993 - Series II   | <br><br>Guntur<br>Coimbatore<br>Jobner<br>Jagudan &<br>Hisar |
| 10.3            | Evolving varieties resistant to<br>powdery mildew through mutation<br>breeding and crossing programme                                    | Jagudan &<br>Jobner  |
| CLOSED PROJECTS |  |  |
| 1.              | Maunial experiments on black pepper<br>and arecanut  | Sirsi  |
| 2.              | Field trial for the control of slow<br>wilt disease of black pepper  | Panniyur   |
| 3.              | Effect of fertilizer and seed rate<br>on yield of fenugreek  | Jobner   |
| 4.              | Response of fenugreek to weed management   | Jobner   |
| 5.              | Evolving control measures against wilt<br>disease including crop rotation  | Jobner &<br>Jagudan  |
| 6.              | Studies on the control of root rot of<br>fenugreek with the use of soil<br>amendments, antagonistic fungi and<br>drenching of fungicides | Coimbatore   |

|    |   |            |
|----|---|------------|
| 7. | Fungicidal trial on grain mould control<br>in coriander | Coimbatore |
| 8. | MLT (1991) series IV on black pepper                    | Mudigere   |
|    | CYT of coriander  | Jobner     |
|    | CYT of fenugreek  | Jobner     |

Discipline/crop wise distribution of technical programme of AICRPS in 1993

| Crops          | Crop<br>improvement | Crop<br>production | Quality<br>evaluation | Crop<br>protection | Total<br>Projects |
|----------------|---------------------|--------------------|-----------------------|--------------------|-------------------|
| Black pepper   | 3                   | 1                  | -                     | 4                  | 8                 |
| Cardamom       | 3                   | 2                  | -                     | 1                  | 6                 |
| Large Cardamom | 2                   | -                  | -                     | 1                  | 3                 |
| Ginger         | 4                   | 1                  | 1                     | 1                  | 7                 |
| Turmeric       | 4                   | -                  | 1                     | -                  | 5                 |
| Coriander      | 4                   | 1                  | 1                     | 1                  | 7                 |
| Cumin          | 4                   | -                  | 1                     | 1                  | 6                 |
| Fennel         | 4                   | 1                  | 1                     | -                  | 6                 |
| Fenugreek      | 3                   | 1                  | -                     | 1                  | 5                 |
| Tree Spices    | 4                   | 2                  | -                     | -                  | 6                 |
| Total projects | 35                  | 9                  | 5                     | 10                 | 59                |

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## BLACK PEPPER

### 1.1 Germplasm collection, description and evaluation (Panniyur, Chintapalli, Sirsi & Yercaud)

Seventy five cultivated and 120 wild types were collected and maintained at Pepper Research Station, Panniyur. The entire wild germplasm were later transferred to RARS, Ambalavayal (1992) considering the severe drought condition at Panniyur centre. The yield, yield contributing characters and incidence of pests and diseases in the 66 accessions (cultivated types) were observed at Panniyur Centre. The TMB IV recorded maximum yield of 10.92 kg green berries/vine followed by Karimunda III (6.53 kg) and Kalluvally IV (4.65 kg) during 1993-94. The pooled data over the years indicated superiority of cultures viz., Karimunda I, Karimunda III, PRS 22 and Sullia (PRS 49) with respect to yield. The cultivar TMB VI (PRS 56) consistently giving heaviest and bold berries could be used in the breeding programme.

The Chintapalli centre holds 27 cultivated and 19 wild accessions of pepper germplasm. In the evaluation of yield and yield attributes of 9 cultivated types (1992-93), Panniyur-1 recorded significantly higher yield (3.55 kg fresh berries/vine) followed by Kalluvally (3.01 kg fresh berries/vine). Among the wild germplasm evaluated Madem Acc. No.9 recorded maximum yield (2.150 kg/vine).

At Sirsi 50 cultivated and 15 wild accessions are being maintained. Yercaud centre maintained 99 cultivated and 3 wild accessions.

### 1.2 Multilocational trials (MLTs)

#### a) Multilocation trial of promising cultures (MLT 1984 - Series I) (Panniyur & Chintapalli)

The trial aims to evaluate the performance of promising cultures viz., Cultures-54, 211, 239, 331, 406, 1171, 1199 (selections from the breeding programmes at Panniyur) along with

Panniyur-1 and Karimunda as checks. As recorded in previous years, cultures 239, 331 and 54 ranked the first three positions, in terms of yield (green berries) at Panniyur centre.

At Chintapalli, the trial laid out in 1986 with nine varieties (with border rows of Panniyur-1 and Kottanadan) trailed on silver oak standards continued and maintained as germplasm trial.

- b) Multilocation trial of pepper cultivars  
(MLT 1984 - Series II)  
(Panniyur & Chintapalli)

The trial laid out at Panniyur in 1984 with 9 cultivars viz., Neelamundi, Kalluvally, Aimpirian, Kottanadan, Narayakodi, Kuthiravally, Arakulamunda with Panniyur-1 and Karimunda as checks. Among the 9 cultivars Kalluvally stood first with 2.58 kg green berries/vine followed by Kuthiravally (1.96 kg) and Neelamundi (1.78 kg). There was large variation in cultivars and hence it is not possible to ascertain whether these differences were genetic.

The trial at Chintapalli is converted as germplasm trial.

- c) Multilocation trial (MLT 1987-Series III)  
(Panniyur, Sirsi & Chintapalli)

To compare the performance of released varieties a trial of promising cultures was laid out in 1990 at Panniyur with the cultures 141, 239, 331, 1558, 5128 (from KAU) and KS-14, KS-27, KS-88 (from NRCS) along with Karimunda and Panniyur-1 as checks. The vines have started yielding. Among the varieties KS-14 recorded highest yield.

The trial laid out at Sirsi in 1991-92 with eleven cultures viz., KS-14, KS-27, Cultures 141, 239, 331, 812, 856, Panniyur-1, Karimalligesara and Uddarkare and are under evaluation

At Chintapalli, the trial was laid out in 1993-94 with Acc. 2426, 2445, KS-14, KS-27, Ottaplackal, Panniyur-1, Panniyur-2, Panniyur-3, Panniyur-4, Pournami, Panchami, Kottanadan & Aimpiriyen.

d) Multilocation trial (MLT 1991-Series IV)

(Mudigere, Panniyur, Pampadumpara, Yercaud & Ambalavayal)

A new MLT, with the objective to evaluate the performance of released varieties of pepper, at different locations with promising selections laid out in 1992-93 at Panniyur, Mudigere, Pampadumpara, Yercaud and Ambalavayal with 14 varieties/cultures viz., Sreekara, Subhakara, Panchami, Ottaplackal, Kottanadan (Acc. 2426), Kottanadan (Acc. 2445), Panniyur-1, Panniyur-2, Panniyur-3, Panniyur-4, Cul. 1558, Cul. 5128, Panniyur-5 and Karimunda as control. The vines are coming up well. The observation on the percentage of establishment of vine, plant height etc. were recorded. Mudigere centre has closed the trial for want of adequate funds.

1.3 Intervarietal hybridisation to evolve high yielding varieties  
(Panniyur)

At Panniyur, about 8000 open pollinated and hybrid progenies were evaluated till this year. At present, 795 progenies are maintained age varies from one to ten years. Based on the performance of past four years, cultures 1558, 5128, 5186, 5308, 5834, 5381, 4834, 6367, 5293, and 4032 are identified as promising. Variation in yield is observed in almost all the above mentioned cultures over the years, however culture 5293 gave consistently higher yields. During the current year (1993-94) cultures 5834, 6766 and 6988 are the top yielders, out of which Culture 5834 yielded above 2 kg dry pepper.

1.4 Irrigation-cum-fertilizer requirements on pepper and arecanut mixed cropping system  
(Panniyur and Sirsi)

The irrigation-cum-fertilizer experiment laid out in 1988 at Panniyur in split plot design using Panniyur-1 and Karimunda

varieties with three levels of irrigation (No irrigation, irrigation @ IW/CPE ratio 0.125, 0.250) with main plot, and three levels of fertilizers (No fertilizers, NPK @ 50:50:150, 75:75:225 g/vine) as subplot treatments. During 1991-92 and 1992-93, irrigation at IW/CPE ratio of 0.25 recorded maximum number of spikes. During the period under report, no significant influence for irrigation and fertilizer level was noticed. Cultivar Karimunda produced significantly higher number of spikes (765) than Panniyur-1 (343) during 1993-94.

The experiment was laid out with two varieties of pepper (Karimalligessara and Panniyur-1) at Sirsi (1991-92) using arecanut palm as standard to trail pepper in a split plot design with three levels of irrigation (IW/CPE ratio @ 1.0, 0.66, 0.33) and three levels of fertilizer (control, NPK @ 50:20:70, 100:40:140, 150:60:210 g/vine<sup>-1</sup> year<sup>-1</sup>). The recommended dose of fertilizers and irrigation were given uniformly to all the treatments. Both the varieties are coming up well. However, Panniyur-1 vines are growing vigorously than Karimalligessara. Treatments will be super imposed during the ensuing season.

#### 1.5 Phytophthora foot rot (quick wilt) and nematode disease management in black pepper (Panniyur, Sirsi & Chintapalli)

Studies were carried out at Panniyur with newer fungicides (9 treatments) for management of wilt disease. The treatments were applied thrice, first just before the onset of monsoon, second during the third week of July, third in the second week of September. The observations viz., defoliation, foliar yellowing and death of vines showed significant difference at Panniyur (Table 1). Minimum defoliation was noticed in the treatment receiving all cultural practices + 1 kg neemcake/vine + 3g a.i. Phorate/vine + 1% Bordeaux mixture + two drenching with 0.2% copper oxychloride.

At Sirsi, the trial was laid out with 8 treatments for the third year and treatments imposed as per the schedule. The disease incidence was lowest (10%) when compared to control (50% disease incidence) in the experiment consisting of following cultural practices combined with application of one kg neem cake per vine,

Table Phytophthora foot rot and nematode disease management in black pepper (1993)  
at Panniyur (Disease incidence %)

| Treatments   | Mean of     |                  |               |                        |
|--|-------------|------------------|---------------|------------------------|
|  | Defoliation | Foliar yellowing | Death of vine | Fungal pollu incidence |
| T1 - Control (without cultural practices)  | 17.90       | 8.77             | 2.33          | 4.40                   |
| T2 - Cultural practices + 1kg neemcake + 3g a.i. Phorate/vine (30g/vine)   | 14.63       | 6.29             | 0             | 3.30                   |
| T3 - Cultural practices + Bordeaux mixture spraying, drenching with Copperoxychloride (0.2%) first Ridomil MZ 72 WP (100 ppm as metalaxyl) as second round | 5.38        | 4.43             | 0             | 4.30                   |
| T4 - T2+Ridomil MZ first+Bordeaux mixture second round   | 11.63       | 4.14             | 1.00          | 2.56                   |
| T5 - T2+Akomin first (spray & soil drench) + Bordeaux mixture second round   | 6.14        | 3.40             | 0.67          | 5.89                   |
| T6 - T2+Bordeaux mixture first + Akomin second round   | 5.44        | 3.14             | 0             | 3.14                   |
| T7 - T2+Bordeaux mixture spraying + Copperoxychloride (0.2%) drench) second rounds   | 4.20        | 2.69             | 0             | 2.00                   |
| T8 - T2+first round Bordeaux mixture second round Akomin and 3rd round Ridomil MZ 78 WP  | 5.73        | 3.12             | 0             | 5.13                   |
| T9 - Kavach 0.2% drenching and spraying three rounds   | 10.50       | 4.66             | 1.33          | 3.64                   |
| CD at 5% level   | 2.60        | 1.80             | --            | NS                     |

3g a.i. Phorate per vine, spraying (@ 3 litre/vine) and drenching (@ 5 l/vine) bordeaux mixture, pasting of 10% bordeaux paste up to one meter height from collar region before onset of monsoon, followed by spraying & drenching of Ridomil MZ-72 W.P. (100 ppm) during second week of September.

The trial initiated at Chintapalli centre in 1990 with 8 treatments showed the least disease incidence of foliar yellowing and defoliation in the treatments - adopting cultural practices + 1kg neem cake + 3g a.i. Phorate (soil application) + Bordeaux mixture spray followed by second round spraying of Akomin as best.

#### 1.6 Biological control of foot rot of black pepper - (Sirsi, Panniyur & Chintapalli)

Studies using biocontrol agents against Phytophthora capsici was conducted in pot culture at Sirsi, Panniyur and Chintapalli centres. Antagonistic organism like Trichoderma harzianum, T. viride, Lactesesia arvalis, B. subtilis were used against Phytophthora capsici. Studies at Sirsi and Chintapalli indicated the beneficial effect of using biocontrol agents in checking the incidence of Phytophthora capsici.

#### 1.7 Field trial for control of slow wilt disease of pepper (Panniyur)

An experiment to identify suitable chemicals and soil amendments for the management of slow decline (slow wilt) of pepper is progressing in the farmers' fields at Panniyur centre since 1987. The treatments were applied in two rounds, the first during first week of June and next during the last week of September. Treatment effect were found significant. The combined application of neem cake with nematicide and fungicide was found effective in managing the disease (Table 2).



Table 2 Incidence of slow decline (slow wilt) disease of pepper at Panniyur 1993

| Sl. No.   | Treatments                               | Mean infection (%) |
|-----------|--|--------------------|
| 1.        | Application of Thimet % 3g a.i. per vine | 6.24               |
| 2.        | Bavistin 0.1%                            | 10.97              |
| 3.        | Copper oxychloride 0.3%                  | 9.68               |
| 4.        | T1 + T2                                  | 10.22              |
| 5.        | T1 + T3                                  | 6.33               |
| 6.        | T1 + T2 + T3                             | 4.83               |
| 7.        | Application of Neemcake @ 2kg/vine       | 5.30               |
| 8.        | Application of T1+T2+T3+T7               | 3.35               |
| 9.        | Control                                  | 12.14              |
| C.D. @ 5% |  | 3.63               |

### 1.8 Management of foot-rot (Phytophthora) in pepper

- a) Observational trial for the control of foot-rot of pepper in farmers' field  
(Panniyur)

The experiment was laid out in 1987 in two locations\* by Panniyur centre. The treatments are pre-monsoon pasting, spraying and drenching with bordeaux mixture and application of lime and neemcake. Second and third spraying with Bordeaux mixture during last week of July and September respectively. The results showed that significant difference between treatments in respect of leaf infection and yield in both locations, wherein treatment effects were found significant for branch infection in one location (Table 3). In general, combined application of fungicides with soil amendments were effective in checking infection, and increasing the yield of vine.

Table 3 Trial for the control of quick wilt disease of pepper in Farmers' plots at Panniyur (Mean infection %)

|   | Location I |        |      |              |                 | Location II |        |      |              |                 |
|---|------------|--------|------|--------------|-----------------|-------------|--------|------|--------------|-----------------|
|   | Leaf       | Branch | Stem | Fungal pollu | Yield (kg/vine) | Leaf        | Branch | Stem | Fungal pollu | Yield (kg/vine) |
| T1 - Spraying, drenching and pasting Bordeaux mixture | 5.3        | 4.5    | 2.5  | 4.2          | 9.8             | 5.9         | 5.50   | 6.2  | 5.8          | 13.1            |
| T2 - T1+application of neemcake @ 2kg/vine            | 4.9        | 3.3    | 2.5  | 3.2          | 8.2             | 6.0         | 5.68   | 3.7  | 6.6          | 11.8            |
| T3 - T1+application of lime @ 1kg/vine                | 4.3        | 2.8    | 5.0  | 3.8          | 10.5            | 3.8         | 4.53   | 2.5  | 4.7          | 13.3            |
| T4 - T1+T2+T3   | 4.2        | 3.1    | 1.2  | 3.2          | 12.1            | 4.1         | 2.68   | 1.2  | 3.3          | 16.6            |
| T5 - Control  | 8.6        | 6.8    | 8.8  | 5.7          | 6.5             | 14.6        | 8.08   | 12.5 | 7.9          | 7.5             |
| CD at (5%)  | 2.6        | 2.6    | NS   | NS           | 3.0             | 5.1         | NS     | NS   | NS           | 4.5             |

- b) Studies on the control of nursery diseases / solarisation studies for the control of plant diseases - Management of Phytophthora foot rot disease  
(Sirsi & Panniyur)

The trial was laid out at Sirsi under three light intensities (7.1 K.Lux - high, 3.6 K.Lux - medium, 0.7 K.Lux - low) with 8 treatments viz., Bordeaux mixture spraying, Foltaf spraying, Bordeaux mixture spraying + drenching, Foltaf spraying + drenching, Kavach spraying, Chestnut compound drenching, Kavach spraying + drenching. Pepper cutting planted in medium light intensity showed vigorous growth. Spraying and drenching of difoltan (0.1%) reduced the mortality of seedlings (33.33%) as compared to 76.66% in control under medium light intensity.

An experiment to find out efficient control measures for the management of nursery disease of pepper, started in Panniyur centre in 1987-88 was modified in 1991-92 by addition of certain treatments. The trial was laid out in three light intensities. The treatments effect were found significant under high shade, spraying and drenching of Validacin (0.2%) was effective and was on par with the treatment involving spraying and drenching with Difolitan 0.1%. However, minimum infection was noticed when vines were treated with Validacin (0.2%) under medium shade. In general, infection was low under low shade.

- 1.9 Survey for insect pest of black pepper in high altitudes/chemical control of insect pests  
(Mudigere)

The survey was conducted at Chickmagalur, Hassan, Coorg & Shimoga districts for pepper pests. All pests encountered were minor and therefore loss appeared insignificant.

## CLOSED PROJECT

Manurial experiment in black pepper/arecanut  
(Sirsi)

The experiment was conducted for three years (1990-91 to 1992-93) in farmers' garden at Sirsi using Panniyur-1 pepper vines trained on local Arecanut palms with following 5 treatments.

- T<sub>1</sub> - Control (No fertilizers)  
 T<sub>2</sub> - Recommended fertilizer dose (RFD) for main crop  
           recommended fertilizer dose for inter crop  
 T<sub>3</sub> - 75% of recommended dose for main crop + inter crop  
 T<sub>4</sub> - 50% of RFD for main inter crop  
 T<sub>5</sub> - 75% of RFD for main crop and 50% of RFD for intercrop

The fertilizers were applied twice i.e., first on the onset of monsoon (May) and second dose at the end of Monsoon (Sept.) as equal doses. The yield of arecanut and black pepper during all the three years differed significantly among the treatments (Table 4). The three years data indicated that application of NPK @ 200 : 80 : 280 gm for both arecanut and pepper increased the yield. The net return of Rs.38,000/ha was obtained due to increase in crop yield.

Table 4 Fresh yield of Arecanut and Pepper (kg/palm/vine)

| Treatments                 | Arecanut |         |         |       | Black Pepper |         |         |       |
|----------------------------|----------|---------|---------|-------|--------------|---------|---------|-------|
|                            | 1990-91  | 1991-92 | 1992-93 | Mean  | 1990-91      | 1991-92 | 1992-93 | Mean  |
| T <sub>1</sub> Control     | 6.100    | 7.06    | 8.09    | 7.08  | 0.470        | 0.450   | 0.500   | 0.473 |
| T <sub>2</sub> 200:80:280g | 17.430   | 12.25   | 15.13   | 14.94 | 1.820        | 1.743   | 2.050   | 1.871 |
| T <sub>3</sub> 150:60:200g | 12.040   | 11.69   | 12.68   | 12.14 | 1.060        | 1.005   | 1.425   | 1.163 |
| T <sub>4</sub> 100:40:140g | 10.330   | 10.87   | 10.78   | 10.66 | 0.670        | 0.685   | 0.950   | 0.768 |
| T <sub>5</sub> 125:50:185g | 11.080   | 8.16    | 10.48   | 9.91  | 0.890        | 0.871   | 0.925   | 0.895 |
| SEM ±                      | 0.48     | 1.12    | 0.93    |       | 0.07         | 0.06    | 0.12    |       |
| CD 5%                      | 1.48     | 3.44    | 2.86    |       | 0.02         | 0.18    | 0.37    |       |

## CARDAMOM

### 2.1 Germplasm collection, description and evaluation (Mudigere & Pampadumpara)

At Mudigere, out of 245 collections maintained, 195 collections were evaluated and 50 accessions planted in 1990. The yield and yield attributes of 195 collections (1991-94) in the pooled analysis showed high degree of variability for morphological characters and yield attributes. Estimated yield varied from 240 to 636 kg/ha and the top ranking entries have been listed in Table 5. The CL-692 was top most, followed by P-20 and CL-683. The CL-802 and CL-683 have recorded higher value for most of the yield and yield attributes. They are earmarked for using in breeding programme.

Table 5 Top ranking entries for green capsule yield in the cardamom germplasm collections (Pooled data 1991-94)

| Entry     | Average green yield/clump (gm) | Estimated dry capsule yield (kg/ha) | High value for yield attributes  |
|-----------|--------------------------------|-------------------------------------|--|
| CL-692    | 824                            | 636                                 | Panicle length, No. of capsules/clump                                      |
| P-20      | 721                            | 556                                 | Pseudostem height, Panicles + No. of capsules/clump                        |
| CL-683    | 467                            | 360                                 | Panicle length, Nodes/panicle + No. of capsules/clump+weight/green capsule |
| P-10      | 452                            | 349                                 | No. of capsules/clump  |
| CL-722    | 434                            | 335                                 | No. of capsules/clump  |
| EB 1271-4 | 427                            | 329                                 | Panicle length, Nodes/panicle  |
| P-15      | 415                            | 320                                 | Panicle length, Nodes/panicle  |
| EB-1277-7 | 365                            | 281                                 | No. of capsules/clump  |
| P3A       | 345                            | 266                                 | No. of capsules/clump  |
| RC(pb)    | 321                            | 248                                 | No. of capsules/clump  |

|        |     |      |  |
|--------|-----|------|--|
| CL-802 | 319 | 246  | Pseudostem height, Panicles/<br>clump, Panicle length<br>Nodes/panicle + weight/green<br>capsule |
| P-11   | 311 | 240. | No. of capsules/clump  |

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The regression coefficient and yield contributing characters (mean value of three years observations) indicated that excluding capsules/clump, it is difficult to advance yield through selection of any characters or a combination of characters since the coefficient of determination are less than 80 per cent. The results call for a more careful study of other yield attributes of importance in cardamom.

The evaluation of germplasm collections at Pampadumpara (72 cultivated and 15 wild types) showed that accessions PS-21, PS-22 and Clone-57 are continue to give bold capsules.

## 2.2 Multilocation trials on cardamom

### a) MLT series II - 1988

(Mudigere and Pampadumpara)

At Mudigere, the MLT series-II (1988) with 10 promising entries were relaid out in 1990. The clones differed significantly with respect to pseudostem height, suckers/clump, panicle length and yield/ clump. The yield level was low because of the flood which damaged the plants in 1991-92. However, from the preliminary data obtained, sel.800 gave maximum yield (146g) which was significantly higher than all other clones. Considering the performance over the years (1991-94), sel.112, sel.800, M-1 and CL-683 are considered promising. Sel.112 was low in suckering ability, Sel.800 was better than M-1 in yield but M-1 was good in suckers/clump and panicle length. For CL-683, mean weight and volume for 100 capsule were higher (0.87g/163 cc). Similarly the capsule are bolder in size for CL-683 and SKP-14. The MLT with full replication will be laid out during the current year (1994-95) at Pampadumpara.

- b) MLT Series-III 1991 with Mysore type  
(Mudigere, NRCS CRS-Appangala, ICRI RS-Saklespur and ICRI-Myriadumpara)

The MLT Series-III (1991) with Mysore type consisting of five entries viz., SKP-51 (Saklespur), MCC-12, MCC-21, MCC-85 (ICRI Myriadumpara) and MCC-61 (Myriadumpara) as control, was laid out at ICRI Myriadumpara during 1991, at Mudigere, ICRI RS - Saklespur and NRCS-Appangala during 1992 (with additional controls). Replanting was done at ICRI RS Saklespur during 1993 due to wind damage. Observations on biometrical characters were recorded. Results indicated that MCC-61 is superior with regard to number of tillar per clump and MCC,12 with characters viz., vegetative buds per clump and leaf area.

- c) MLT Series-III 1991 with Malabar types  
(Mudigere, NRCS, CRS-Appangala, ICRI, RS-Saklespur and Thadiyankudisai)

As per the XI AICRPS Workshop's decision, the MLT-III (1991) with Malabar types consisting of 13 entries were laid out during 1992 at Mudigere, ICRI RS-Saklespur and NRCS CRS-Appangala. The morphological data were recorded. The damaged plants were replanted in June 1993 at Saklespur.

## 2.3 Hybridization and selection in cardamom (Mudigere)

The studies were initiated in 1989. The seedling progenies were evaluated. Positive significant correlation was observed between yield and all the characters studied. In general it may be tentatively concluded that characters like pseudostem height and suckers/clump can be used for culling out inferior ones.

## 2.4 Manurial experiments (NPK trials) (Mudigere, Pampadumpara)

The experiment was laid out at Mudigere (1987) with uniform monoclinal Mudigere-1, to study the response of NPK on yield of cardamom under uniform coir mat shade. The treatments

(27 treatment combinations of NPK) were imposed during 1988 and the crop started yielding from 1989 onwards. The data indicated significant response for N and P on the sucker and panicle production but not with K levels. In the case of capsule yield, response of N, P and K was significant and the response to fertilizers, was more promising to high levels of fertilizers. The interactions between N, P and K were however, not significant. The fertilizer level of 100:100:200 kg NPK/ha gave the highest yield (315 kg/ha).

The Xth AICRPS Workshop suggested to start new NPK trials with 6 treatments at Mudigere and Pampadumpara. Accordingly the trial was laid out at Mudigere with graded levels of fertilizers under natural shade using variety Mudigere-1. At Pampadumpara, the experiment was laid out with seedlings and observations were made on biometric characters and yield. Statistical analysis showed that there was no significant difference among the treatments. The trial will be relaid out during 1994-95 at Pampadumpara using clones of PV-1 as suggested by XIIth Workshop.

## 2.5 Micronutrient requirement studies (Mudigere and Pampadumpara)

The experiment was relaid out at Mudigere during 1992 using Mudigere-1 suckers with seven treatments and four replications in an RBD. In the treatment (micronutrients-Boron and Molybdenum) were applied one month before panicle initiation. The crop stand is satisfactory. This trial was also laid out in 1994 at Pampadumpara centre.

## 2.6 Pest management in cardamom

### a) Screening of cardamom germplasm for shoot borer (Mudigere 1991)

So far 200 accessions, in the cardamom germplasm collections, were screened for shoot borer damage, out of which 10 entries recorded zero damage and four entries less than 5 per cent damage.



- b) Cultural and chemical control of thrips and capsule borer  
(Mudigere and Pampadumpara).

Experiment was conducted at Mudigere (1992 & 1993) to study the effect of thrashing alone and thrashing combined with insecticidal sprays (consisting of 10 treatments in 3 replications) for control of thrips. Insecticidal spraying was done with monocrotophos (0.05%) and thrashing was done in Feb. and May followed by insecticidal application. The results showed that the insecticide application as well as combination of insecticides and thrashing were superior to control.

A similar trial was laid out at Pampadumpara with 10 treatments (selective thrashing and insecticidal application at different intervals). Spraying of 0.05% monocrotophos (seven sprays) thrashing + sprayings were effective in controlling shoot borer infection. Capsule borer infestation was not very severe and did not vary among the treatments. In control and selective thrashing treatments, 60 per cent of the capsules were infected by thrips.

- c) Determination of number of sprays for thrips control  
(Mudigere - 1991)

Another trial was conducted to develop suitable spraying schedule for thrips and capsule borer of cardamom. The experiment consisted of five treatments and four replications consisting of four spraying schedules comprising of six, three and two sprays compared with control. In all treatments the first spraying was done with monocrotophos and subsequent with Phosalone (0.05%). The data revealed no significant difference between six sprays (monthly once) commencing from April at monthly intervals and three sprays (April, June and August), suggesting the latter as better and economical.

- d) Estimation of loss due to cardamom shoot borer  
(Mudigere 1991)

Studies on the incidence of shoot borer (in all the three types of cardamom, viz., Mysore, Malabar and Vazhukka) on yield,

sucker and panicle production revealed significant yield reduction in damaged shoots. However, there was no difference between healthy and damaged shoots with regard to production of new suckers and panicles.

e) Effect of neem and pongamia cake application on thrips control (Mudigere)

Preliminary studies on the effect of neem, pongamia oil cakes in comparison with insecticides, for their usefulness in controlling thrips and capsule borer, revealed non-significant difference between oil cakes and insecticides. Neem cake applied clump observed numerically lower thrips damage but next only to Monocrotophos. However, there was no statistical difference between the two.

f) Bio-ecology of natural enemies of major pests of cardamom (Mudigere)

Documentation of natural enemies of cardamom thrips and shoot and capsule borer initiated in 1992 is under progress at Mudigere.

2.7 Screening for katte disease resistance, evolving control measures against clump rot (Mudigere)

Suspected katte tolerant/escape clumps have been marked and are under scrutiny and evaluation.

2.8 Nursery disease control in cardamom

- a) Clonal control of leaf spot in cardamom nursery
- b) Biological control of damping off disease of cardamom
- c) Nematode disease management in nursery

The experiment will be taken up during 1994-95 at Mudigere.

## LARGE CARDAMOM

### 3.1 Germplasm collection, description and evaluation (Gangtok)

Thirty four germplasm collections in Large Cardamom are maintained and evaluated at the Centre.

### 3.2 Identifying tolerant types to the two virus diseases and evolving control measures (Gangtok)

The commercial cultivars/varieties viz., Golsey, Ramsey, Ramla and Sawney planted (500 seedlings each) in 1988 at ICAR Farm, Tadong were evaluated. The seedlings were screened against the two virus diseases viz., "Foorkey" and Chirkey under natural conditions. The disease incidence and the number of clumps affected in each year (1988-93) are presented in Table 6. In 1993 out of the 350 clump of Golsey seven clumps were affected with Chirkey and 8 with Foorkey. In Ramsey out of 85 clumps 10 clumps were affected with Chirkey and 6 with Foorkey. In Sawney out of 348 clumps 60 were affected with Chirkey and 38 with Foorkey. In Ramla out of 390 clumps 46 were affected with Chirkey and 33 with Foorkey. In general an increase in the incidence of both the diseases are observed. Among the varieties Golsey may be preferred to grow in endemic areas.

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Table 6 Status of Foorkey & Chirkey diseases in the screening trial 1988-93

| Variety | No. of clumps |      |      |      |      |      |      |      |      |      | Chirkey |      |      |      |      | Foorkey |      |      |      |      |
|---------|---------------|------|------|------|------|------|------|------|------|------|---------|------|------|------|------|---------|------|------|------|------|
|         | 1988          | 1989 | 1990 | 1991 | 1992 | 1993 | 1988 | 1989 | 1990 | 1991 | 1992    | 1993 | 1988 | 1989 | 1990 | 1991    | 1992 | 1993 | 1988 | 1993 |
| Colsey  | 37            | 57   | 357  | 357  | 351  | 350  | -    | -    | -    | 2    | 5       | 7    | -    | -    | 3    | 5       | 7    | 8    | -    | -    |
| Ramsay  | 10            | 93   | 93   | 90   | 87   | 85   | -    | -    | -    | 2    | 7       | 10   | -    | -    | 1    | 2       | 4    | 6    | -    | -    |
| Sawrey  | 37            | 355  | 355  | 355  | 349  | 348  | -    | 11   | 25   | 46   | 52      | 60   | -    | 8    | 25   | 31      | 35   | 38   | -    | -    |
| Ramsay  | 409           | 399  | 398  | 395  | 391  | 390  | -    | 16   | 22   | 30   | 39      | 46   | -    | 14   | 22   | 27      | 30   | 33   | -    | -    |

Note : No. of seedlings planted = 500 in each case in May 1988.

## GINGER

### 4.1 Germplasm collection, description and evaluation (Pottangi & Solan)

At Pottangi, out of the 147 accessions collected so far, 140 were evaluated. During 1993-94 Ac.No.20-17 was the top yielder (8.025 kg/3M<sup>2</sup>). The 132 collection made at Solan centre were evaluated, and maximum yield was obtained with BDJR-1267 (4.90 kg/3M<sup>2</sup> plot).

Hundred and thirty two germplasm accessions were screened against rhizome rot at Solan. The incidence of rhizome rot varied from 4 to 32%.

### 4.2 Initial evaluation trial (IET) (Pottangi & Solan)

Sixteen promising entries were evaluated under IET at Pottangi. Highest fresh rhizome yield was obtained from V<sub>1</sub>E<sub>8</sub>-2 (21.70 t/ha) followed by V<sub>1</sub>S<sub>1</sub>-8 (21.05 t/ha) in the second year of the trial.

On the basis of the performance of germplasm evaluation, 14 top yielding collections at Solan were evaluated in IET. None gave significant difference for yield. However, SG-710, SKR and W. Local were comparatively high yielders.

### 4.3 Comparative yield trial (CYT) (Pottangi & Solan)

Six cultures were evaluated in the CYT at Pottangi. Highest fresh rhizome yield was recorded in V<sub>1</sub>E<sub>8</sub>-2 (15.65 t/ha) followed by Jugijan (14.20 t/ha).

At Solan six collections were studied under CYT. None recorded significant difference for yield. However SG-696 and SG-689 showed comparatively higher yield.

#### 4.4 Multilocation trial (MLT Series-III 1991) (Pottangi & Solan)

Ten promising cultures were evaluated in the MLT 1991 Series-III for the third year at Pottangi. Maximum fresh yields were recorded in SG-574 followed by  $V_1S_1-7$  (Table 7).

Table 7 Fresh rhizome yield of ginger cultivars in MLT (for 3 years)

| Sl. No.  | Cultivars     | 1991-92 | 1992-93 | 1993-94 | Mean yield<br>(kg/3M <sup>2</sup> ) | Projected<br>(t/ha) |
|----------|---------------|---------|---------|---------|-------------------------------------|---------------------|
| 1.       | Suravi        | 1.743   | 4.945   | 7.357   | 4.68                                | 11.7                |
| 2.       | $V_2S_1-7$    | 1.966   | 6.135   | 9.212   | 5.77                                | 14.4                |
| 3.       | $V_1E_4-4$    | 2.346   | 4.441   | 8.972   | 5.25                                | 13.1                |
| 4.       | $V_1S_1-2$    | 1.735   | 8.054   | 7.282   | 5.69                                | 14.2                |
| 5.       | Suprabha      | 1.638   | 6.430   | 6.456   | 4.84                                | 12.1                |
| 6.       | S-547         | 2.235   | 9.382   | 7.638   | 6.42                                | 16.0                |
| 7.       | Maran         | 1.491   | 5.890   | 6.109   | 4.50                                | 11.2                |
| 8.       | Rajgarh local | 2.424   | 7.010   | 7.606   | 5.68                                | 14.2                |
| 9.       | S-566         | 2.305   | 6.244   | 7.752   | 5.44                                | 13.6                |
| 10.      | S-646         | 3.113   | 5.078   | 7.998   | 5.40                                | 13.5                |
| CD at 5% |               | N.S     | N.S     | N.S     |                                     |                     |

The MLT 1991 was continued at Solan with 10 entries. The entries from Solan centre showed comparatively high yield than Maran and other varieties from Pottangi.

#### 4.5 NPK trial in ginger (Pottangi)

The NPK trial was conducted for the 4th year in a RBD with six treatments. It was found from the pooled data that

application of  $N_{125}$ ,  $P_{100}$ ,  $K_{100}$  kg/ha recorded highest yield (14.35 t/ha) followed by  $N_{75}$   $P_{50}$   $K_{50}$  kg/ha (13.34 t/ha): Maximum benefit was obtained by these treatments.

#### 4.6 Evolving control measures (including seed treatment) against rhizome rot disease (Solan)

This trial was started in 1987 to evaluate the effect of seed treatment with five different fungicides and their combinations (9 treatments) plus Phorate as soil application in reducing the incidence of rhizome rot. Seed rhizomes were treated with fungicide as pre-sowing seed dip treatment for 60 min., Phorate was applied to soil @  $10 \text{ kg ha}^{-1}$  at the time of bed preparation. The data presented in Table 8 confirmed that ginger seed treatment before sowing in a combination of Indofil M-45 (0.25%) and Bavistin (0.1%) plus Phorate as soil application ( $10 \text{ kg ha}^{-1}$ ) was the best and superior over other treatments in managing rhizome rot.

Table 8 Effect of seed treatments on the control of rhizome rot (1993)

| Treatment                                     | Conc.  | Germination (%) | Disease incidence (%) | Yield (kg/3M <sup>2</sup> ) |
|---|--|-----------------|-----------------------|-----------------------------|
| Bavistin                                      | (0.1%)   | 84.0            | 11.0                  | 5.55                        |
| Indofil M-45                                  | (0.25%)  | 84.6            | 12.0                  | 4.75                        |
| Indofil M-45<br>+<br>Bavistin                 | (0.25%)<br>(0.1%)  | 84.3            | 5.3                   | 6.00                        |
| Blitox-50                                     | (0.3%)   | 73.6            | 14.3                  | 4.47                        |
| Captan  | (0.25%)  | 91.6            | 8.0                   | 5.50                        |
| Ridomil MZ                                    | (0.4%)   | 72.3            | 12.6                  | 5.40                        |
| Phorate                                       | ( $10 \text{ kg ha}^{-1}$ )                                | 71.6            | 13.3                  | 3.50                        |
| Phorate<br>+<br>Indofil M-45<br>+<br>Bavistin | ( $10 \text{ kg ha}^{-1}$ )<br>+<br>(0.25%)<br>+<br>(0.1%) | 89.0            | 2.3                   | 6.50                        |
| Control                                       |  | 62.3            | 20.0                  | 3.40                        |

#### 4.7 Evaluation of germplasm for quality characters (Solan)

Thirty collections of ginger were analysed for different quality characters. The essential oil, oleoresin and dry matter content were maximum in SG-673 (2.5%), SG-675 (8.9%) and Bhoisnshi (22.0 %) respectively.

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## TURMERIC

### 5.1 Germplasm collection, description and evaluation (Pottangi, Solan & Jagtial)

At Pottangi, out of 187 accessions, 163 were evaluated. These include 143 types of Curcuma longa, 17 of C. aromatica and three of C. amada. During the year 1993, Roma gave the highest yield ( $14 \text{ kg/3m}^2$ ), among C. longa, Paridaguda ( $7.88 \text{ kg/3m}^2$ ) among C. aromatica and CAH-3 ( $12.73 \text{ kg/m}^2$ ) among C. amada.

At Solan out of 186 collections maintained observations on various characters were recorded and studied the performance of 164 collections. The promising collections were identified with respect to different characters studied.

The germplasm collection at Jagtial was increased to 188. The collections evaluated showed wide variation for growth and other characters.

### 5.2 Initial evaluation trial (IET) (Pottangi, Solan & Jagtial)

Fifteen each of promising entries of long duration types (maturity period more than 200 days) and short duration group (less than 200 days) were screened at Pottangi showed significant yield difference. Significantly highest fresh rhizome yield was observed repeatedly by PTS-43 ( $27.46 \text{ t/ha}$ ) followed by PTS-22 ( $24.63 \text{ t/ha}$ ) during the current year under the long duration group and PTS-15 ( $19.27 \text{ t/ha}$ ) under short duration group.

Fifteen high yielding collections were short listed from the germplasm (1992) and were tested under IET in 1993 at Solan. Two collections viz., Mandel Local and ST-77 significantly out yielded the check (ST-3).

At Jagtial, seven each of long and short duration types and intermediate types, were evaluated for growth and yield characters to identify high yielding types suitable for North Telengana zone.

During 1993 highest yield under long duration was obtained in Ethamukkula ( $5.1 \text{ kg/3m}^2$ ) followed by Armoor and Duggirala ( $3.7 \text{ kg/3m}^2$ ). Among intermediate type CLI-317 ( $7.4 \text{ kg/3m}^2$ ) followed by CLI-390 ( $6.8 \text{ kg/3m}^2$ ) and under short duration type PCT-13 ( $4.2 \text{ kg/m}^2$ ) followed by PCT-14 & PCT-10 ( $3.3 \text{ kg/3m}^2$ ) were superior.

### 5.3 Comparative yield trial (CYT) (Pottangi & Solan)

Six promising cultivars (with Roma as check) were laid out under CYT at Pottangi. PTS-19 ( $13.84 \text{ t/ha}$ ) followed by PTS-62 ( $18.62 \text{ t/ha}$ ) gave highest fresh rhizome yield during the period under report.

The CYT laid out at Solan (1993), with six top yielding collections from IET, four collections viz., ST-154, ST-831, ST-247 and ST-148 gave significantly higher yield of  $6699 \text{ kg/ha}$ ,  $7653 \text{ kg/ha}$ ,  $7308 \text{ kg/ha}$ ,  $6618 \text{ kg/ha}$  respectively over the check ST-3 ( $4567 \text{ kg/ha}$ ).

### 5.4 Multilocation trial (MLT-1991 Series III) (Pottangi, Solan, Jagtial & Guntur)

The MLT 1991 Series III with 13 high yielding cultivars was started at Pottangi and Solan during 1991-92. The three years results at Pottangi showed significance for yield in all the three years. It is evident from the pooled data (three years) presented in Table 9 that PTS-19 is promising which gave a projected yield of  $23.28 \text{ t/ha}$ .

Table 9 Yield performance of Turmeric under MLT\* at Pottangi

| Sl. No. | Cultivars | 1991-92 | 1992-93 | 1993-94 | Mean yield ( $\text{kg/3m}^2$ ) | Projected yield ( $\text{t/ha}$ ) |
|---------|-----------|---------|---------|---------|---------------------------------|-----------------------------------|
| 1.      | PTS-19    | 8.285   | 9.874   | 9.774   | 9.31                            | 23.28                             |
| 2.      | PTS-38    | 8.158   | 9.486   | 9.226   | 9.19                            | 22.97                             |
| 3.      | Armoor    | 7.626   | 8.471   | 5.105   | 7.07                            | 17.67                             |

|       |          |       |       |        |      |       |
|-------|----------|-------|-------|--------|------|-------|
| 4.    | TC-2     | 7.456 | 8.613 | 8.397  | 8.16 | 20.39 |
| 5.    | BSR-1    | 7.288 | 8.194 | 9.974  | 8.49 | 21.21 |
| 6.    | PTS-9    | 6.801 | 9.386 | 10.817 | 9.00 | 22.50 |
| 7.    | ROMA     | 6.580 | 8.313 | 7.320  | 7.40 | 18.51 |
| 8.    | SURAMA   | 6.576 | 6.750 | 9.658  | 7.66 | 19.15 |
| 9.    | TC-4     | 6.170 | 9.881 | 7.772  | 7.94 | 19.85 |
| 10.   | ST-510   | 3.345 | 5.050 | 9.609  | 6.00 | 15.00 |
| 11.   | VK-70    | 2.320 | 3.996 | 7.931  | 4.75 | 11.87 |
| 12.   | ST-365   | 2.149 | 4.032 | 7.638  | 4.61 | 11.52 |
| 13.   | Dugirala | -     | 3.905 | 8.558  | 6.23 | 15.58 |
| <hr/> |          |       |       |        |      |       |
|       | CD at 5% | 1.680 | 3.484 | 2.457  | 2.54 | 6.35  |

\*MLT Series III 1991

At Solan from the three years pooled data, none of the varieties showed significant difference for yield/plant over the check (ST-3). However, ST-510, ST-365, PTS-9, PTS-38, VK-70 and ST-3 performed better than the check (Roma). This MLT is closed as per the decision of AICRPS Workshop (Trichur).

At Jagtial, the MLT (1991) was laid out with 12 cultures for the second year. During 1993 the highest yield was in Duggirala ( $7.9 \text{ kg/3m}^2$ ) followed by PTS-19 ( $7.3 \text{ kg/3m}^2$ ) and PTS-24 ( $6.87 \text{ kg/3m}^2$ ). The new MLT will be laid out at Guntur.

#### 5.5 Quality evaluation of germplasm collection/varieties (Solan)

The samples of 64 collections of Turmeric (1992-93) were analysed for quality attributes. The highest amount of curcumin was recorded in PCT-14 (whole rhizomes) with a value 5.67% followed by PCT-13 (5.35%). The comparative study revealed the maximum curcumin in mother rhizomes and the secondary fingers accumulated the lowest amount of curcumin. Maximum oleoresin content was found in PCT-13 (11.80%) followed by PCT-14 (11.56) and ST-330 (10.80%). ST-345 recorded the highest amount of essential oil (6.13%) while the dry matter yield was maximum in ST-365 (24.26%).

## TREE SPICES

### 6.1 Germplasm collection, conservation and cataloguing of Tree Spices - Clove, Nutmeg & Cinnamon (Yercaud & Pechiparai)

The survey undertaken by the Yercaud centre identified 13 elite clove trees from clove growing tracts of Tamil Nadu. The selected elite lines were multiplied and seedlings kept ready for planting. In nutmeg, 15 elite high yielding trees have been identified. Grafting was adopted to get the true progenies for further evaluation. Two cinnamon cv. viz., Cinnamon verum and C. cassia are maintained at Yercaud.

The Pechiparai centre collected 18 high yielding clove accessions (11 types from NRCS Calicut and seven types from Kanyakumari district) and are under observation. In nutmeg four elite types were collected from NRCS, one from Horticulture farm, Courtallam and seven from adjoining estates. Twelve high yielding desirable type of cinnamon are under evaluation which include nine types from NRCS and remaining collected from Kanyakumari district.

### 6.2 Multilocation trial in Clove (Yercaud & Pechiparai)

An MLT with five elite selections with Kallar local as check laid out in 1992 (with eight plants per treatment) is maintained at Yercaud. The plants are under vegetative growth phase and observation on growth parameters viz., plant height, number of branches are recorded at monthly intervals. The trial with five elite lines laid out in 1991 at Pechiparai is maintained. Observations on growth performance are continued.

### 6.3 Multilocation trial in Cinnamon (Yercaud, Amlalavayal, Thadiyankudisai & Pechiparai)

The MLT with five elite lines in cinnamon laid out at all the four centres with 12 plants per treatment during 1992 is maintained. The entries are under vegetative phase, and growth

parameters viz., height, number of branches and leaves length, stem girth etc. are recorded at monthly intervals.

#### 6.4 Vegetative propagation in Nutmeg & Clove (Yercaud & Pechiparai)

The experiment using non-precured orthotrophic and semi hard wood scions of nutmeg are in progress at Yercaud. The root stocks at different stages of growth viz., epicotyl stage, two, four and six leaved stages were used for grafting work. The percentage of success is above 50% in two leaved stage. Seeds of clove & nutmeg were sown and observations are progressing at Pechiparai and preparation for the propagation trial is over. Experiment will be taken up shortly.

#### 6.5 Drip irrigation in clove & nutmeg (Yercaud)

Clove seedlings and grafts of nutmeg planted in July 1992 was installed with drip irrigation system during March, 1993. The treatments fixed (for the pre-bearing age) was imposed as follows

##### Phase - I (prebearing age up to 8th year)

- T<sub>1</sub> - Dripping of 2 lt water/day/plant during dry months
- T<sub>2</sub> - Dripping of 4 lt water/day/plant during dry months
- T<sub>3</sub> - Dripping of 6 lt water/day/plant during dry months
- T<sub>4</sub> - Dripping of 8 lt water/day/plant during dry months
- T<sub>5</sub> - Providing 8 lt of water by watering once in a week/plant during dry months (control)

The treatment for Phase-II bearing age (after 8th year) will be fixed based on the growth and response to the above drip irrigation.

The first year observation on vegetative growth parameters after installation of drip system was recorded in clove and nutmeg. New flushes was observed especially in clove and nutmeg. Sprouting of new branches has been initiated.

#### 6.6 Biofertilizer trial in tree spices - Clove & Nutmeg (Yercaud)

A biofertilizer trial with the following five treatments was laid out in clove & nutmeg at Yercaud centre.

- T<sub>1</sub> - Control (50 kg FYM + 5 kg Bonemeal)
- T<sub>2</sub> - 100 kg FYM + 400g N, 350g P and 1200g K per tree/year
- T<sub>3</sub> - T<sub>2</sub> + 50g in each of Azospirillum and Phosphobacteria
- T<sub>4</sub> - 75% of T<sub>2</sub> + 50g each of Azospirillum and Phosphobacteria per tree per year
- T<sub>5</sub> - 50% of T<sub>2</sub> + 50g each of Azospirillum and Phosphobacteria

The observation on growth attributes of the respective crops showed that treatment T<sub>5</sub> with biofertilizers viz., Azospirillum and Phosphobacteria gave maximum increase in stem girth.

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## CORIANDER

### 7.1 Germplasm collection, maintenance and evaluation

(Jobner, Jagudan, Guntur, Coimbatore, Hisar & Dholi)

The Jobner centre made 60 new collections during 1993-94. The Centre also received one hundred and seventy five collection (137 indigenous and 38 exotic) from other centres and Project Coordinator, thus making the total collection to 683 (578 indigenous and 105 exotic). In the evaluation of 97 accessions, UD-118, UD-158, UD-174 and UD-262 were better in yield compared to both the checks viz., RCr-41 and UD-20. Thirty three coriander germplasm entries were screened at Jobner against stem gall disease caused by Protomyces macrosporus. Screening was undertaken at farmers' field but disease did not appear and hence data was not be recorded. Out of 45 entries screened against root knot nematode (M. incognita) in pots, variety UD-20 & UD-21 were found resistant whereas others were found moderately resistant to highly susceptible.

Hundred and ten germplasm accessions were collected by Guntur centre in collaboration with NBPGR thus increasing the collection to 230 in coriander. The existing 120 accessions were evaluated for vegetative growth, yield and yield attributes. Among the accessions, Uppalapadu-2 gave the highest yield of 1050 kg/ha followed by P-2, ATP-77, UD-370 and ATP-120 which gave yield of 1025, 1017, 975 and 976 kg/ha respectively.

The Coimbatore centre made 243 new additions during 1993-94 making the total accessions to 372. The entries in the IET and CYT were screened under field conditions for the incidence of wilt. Acc.S.496, 406 and 806 in IET and DH-20, DH-5 of CYT showed lesser incidence of wilt.

The Jagudan centre holds a total of 518 (468 indigenous and 50 exotic) germplasm collection. Based on genetic diversity 143 accessions having variability was identified and maintained. Thirteen new exotic entries were screened against powdery mildew at Jagudan. The data revealed that PDI value (per cent disease

incidence) varied from 42 to 85 per cent. None of the entry was found resistant or tolerant to powdery mildew.

The 30 existing collections are being maintained by the Hisar centre.

## 7.2 Initial Evaluation Trial

(Jagudan, Guntur, Hisar, Dhali & Coimbatore)

The IET, with 10 promising selections from germplasm, was conducted at Guntur with Sadhana as check. Among the entries ATP-77 recorded significantly highest yield during 1993-94.

Nine entries, selected from germplasm, were tested for the first year at Jagudan with Gujarat Coriander-2 as a check. The yield difference were significant among the entries and entry JCo-58 gave maximum yield (15.74 Q/ha).

Eleven entries were tested at Coimbatore in comparison with Co-2 (check). All entries except line 745 registered the same yield of Co-2 (203.3 kg/plot).

Nine entries including local check is under IET at Hisar.

## 7.3 Multilocation trials

a) MLT 1989 Series I

(Jobner, Jagudan & Hisar)

The MLT 1989 Series-I with 13 entries viz., UD-435, UD-436 (from Rajasthan), CS-695, CS-287 and CS-335 (from Tamil Nadu), JCo-81, JCo-126 and JCo-147 (from Gujarat), DH-5 & DH-26 (from Haryana), CS-45 and ATP-82 (from Andhra Pradesh) was laid out under irrigated condition at Jobner along with local check RCr-41. Observations were recorded for morphological yield and yield contributing characters. The data from the entries tested at Jobner indicated wide range of variability for all characters studied except umbels/plant and volatile oil content during the year 1992-93. DH-5 recorded maximum grain yield of 8.67 Q/ha, closely followed by RCr-41 (7.91 Q/ha), UD-435 (7.84 Q/ha), DH-26 (7.55 Q/ha) and J.Co-147 (7.01 Q/ha). The mean performance of



varieties evaluated (10 entries) over 1990-91 to 92-93 revealed superiority of RCr-41 (8.59 Q/ha), closely followed by DH-26 (8.06 Q/ha), DH-5 (8.5 Q/ha), J.Co-147 (7.85 Q/ha) and UD-435 (7.03 Q/ha).

In the MLT 1989 Series-I, the pooled analysis of the entries evaluated at Jagudan for four years (1989-90 to 1992-93) showed significant difference among the entries for yield, but none of the entry gave significantly higher yield than the control. However, entry J.Co-126 recorded 12.11% increased yield (1324 kg/ha) than the control Guj. Cori-2 (1182 kg/ha).

The MLT 1989 Series-I with 13 entries from different centres laid out at Hisar for four years (1989-90 to 92-93). On the basis of average yield of four years, DH-5 recorded the highest yield of 21.3 Q/ha which was 35.7% increase over check followed by UD-435 and GC-2.

The 'State Varietal Trial' were conducted at two locations viz., Digg-Tonk and Berkhera-Kota under irrigated as well as rainfed conditions by Jobner Centre. In the trial, conducted with six entries, under irrigated condition, UD-1 recorded maximum grain yield of 18.46 Q/ha, closely followed by UD-21 (15.95 Q/ha), UD-435 (13.94 Q/ha) and local check (11.96 Q/ha) while RCr-41 recorded the lowest yield (11.18 Q/ha). Mean performance of entries evaluated over 1991-92 and 92-93 under irrigated conditions indicated the superior performance of UD-21 producing 11.98 Q/ha followed by UD-435 (9.68 Q/ha) while RCr-1 recorded lowest grain yield of 8.27 Q/ha. The trial comprised of seven entries under rainfed conditions (limited moisture) including CS-6, CS-4 and CS-2 from Rajasthan. CS-6 produced maximum grain yield of 10.06 Q/ha, closely followed by CS-4 (9.10 Q/ha), CS-2 (8.19 Q/ha) and UD-20 (7.49 Q/ha). In the mean performance of over 1991-92 and '92-93, CS-6 maintained the superiority producing 12.10 Q/ha followed by CS-2 (10.28 Q/ha), CS-4 (9.18 Q/ha) and UD-436 (8.26 Q/ha) while local check recorded lowest yield of 6.52 Q/ha.

b) MLT 1993 - Series II

(Jagudan, Jobner, Coimbatore, Guntur, Hisar & Dholi)

The MLT-1993 series-II was laid out at Jagudan with 11 entries viz., Co-462 and Co-964 (Tamil Nadu), ATP-77 and ATP-102 (Andhra Pradesh), DH-36 and DH-38 (Haryana), JCo-64 and JCo-123 (Gujarat), UD-446 and UD-447 (Rajasthan) along with JCo-1 as check. The yield and yield contributing characters recorded. Entry JCo-123 and Co-964 gave significantly higher yield (16.53 Q/ha) which is 18.58% higher than the control.

In the MLT, 11 entries were tested at Coimbatore. The entries differed significantly for yield potential and two entries viz., Co-462 and Co-964 have proved to be on par with the check Co-3 in their yield.

At Guntur, in the MLT with 11 entries, from different Coordinating Centres, ATP-77 recorded highest yield of 969 kg/ha (during 1993-94), which is significantly superior over check Sadhana (767 kg/ha).

The trial has to be laid out at Jobner, Hisar and Dholi centres during 1993-94.

7.4 Mutation breeding in coriander  
(Jobner and Coimbatore)

Nine selected mutant lines, advanced from gamma induced populations, was tested at Coimbatore with Co-2 as check for yield and yield attributes. The mutant line 29/1 recorded more yield than check however, statistical analysis indicated that mutants did not differ significantly for any of the traits studies.

At Jobner thirty eight (twenty seven  $M_3$ , eight  $M_4$  and three  $M_5$ ) progenies derived from different doses of gama radiations (5, 10, 15, 20 kr), when evaluated revealed that three progenies had earliness in flowering and 21 progenies produced higher grain yield as compared to untreated control (UD-20). Promising progenies with high yield potential identified were 5 kr-1, 5 kr-10, 20 kr-5 whereas 20 kr-28-4, 5kr-9 and 5 kr-17 gave earliness

in flowering. Mean performance over the years 1991-92 and 92-93 indicated that progeny 5kr-1, 20 kr-5 and 10 kr-15 were superior with respect to yield potential as well as earliness, while 5 kr-9 was early in flowering.

#### 7.5 Studies on wilt disease management of coriander (Coimbatore)

Studies with the use of organic amendments in the management of coriander wilt disease at Coimbatore revealed that application of neem cake @ 150 kg/ha the most effective which gave only 4.8% wilt incidence. Seed treatment plus soil drenching with 0.1% Bavistin was found to be the next best (5.2% incidence) during the studies in Kharif and Rabi seasons of 1992 and 93 (Table 10).

Table 10 Effect of organic amendments on control of wilt in Coriander at Coimbatore

| Treatment  | Wilt incidence (%) |              |                |              | Yield (kg/ha)  |              |              |
|--|--------------------|--------------|----------------|--------------|----------------|--------------|--------------|
|  | Kharif<br>1992     | Rabi<br>1992 | Kharif<br>1993 | Rabi<br>1993 | Kharif<br>1992 | Rabi<br>1992 | Rabi<br>1993 |
| Seed treatment +<br>soil drenching<br>with Carbendazim | 5.2                | 4.1          | 5.2            | 5.6          | 424            | 380          | 380          |
| FYM  | 14.4               | 12.8         | 16.8           | 10.2         | 385            | 327          | 418          |
| Poultry manure   | 10.6               | 9.4          | 10.7           | 8.4          | 424            | 300          | 395          |
| Neem cake  | 4.8                | 3.2          | 4.8            | 4.8          | 438            | 292          | 482          |
| Leaf mulch   | 18.2               | 12.3         | 14.6           | 14.8         | 318            | 280          | 360          |
| Soil drenching<br>with<br>Carbendazim                  | 17.8               | 8.2          | 9.8            | 16.9         | 364            | 260          | 410          |
| Control  | 36.8               | 25.4         | 32.8           | 24.3         | 152            | 132          | 200          |
| CD (5%)  | 4.2                | 4.8          | NS             | 8.6          | 31.8           | 24.3         | 57.6         |

Four biocontrol agents were tested for the control of Coriander wilt disease at Coimbatore. The use of *T. viride*, as a means of biological management of wilt disease, has brought down

the incidence of wilt and increased the yield which is evident from the table 11. The studies recommended 'application of T. viride for the management of wilt in coriander'.

Table 11 Effect of seed treatment on wilt incidence in coriander at Coimbatore (1992-93 and 1993-94)

| Treatment  | Wilt incidence(%) |           | Yield (kg/ha) |           |
|--|-------------------|-----------|---------------|-----------|
|  | Rabi 1992         | Rabi 1993 | Rabi 1992     | Rabi 1993 |
| Seed treatment + soil drenching with Carbendazim | 11.4              | 13.4      | 307           | 485       |
| Seed pelleting in <u>T. viride</u>               | 6.3               | 8.1       | 356           | 525       |
| Seed pelleting with <u>T. harzianum</u>          | 12.3              | 10.2      | 300           | 527       |
| Seed pelleting with <u>B. subtilis</u>           | 14.8              | 18.4      | 290           | 380       |
| Seed pelleting with <u>P. flourescens</u>        | 29.5              | 19.5      | 172           | 375       |
| Seed pelleting with Carbendazim 0.1%             | 14.2              | 16.3      | 285           | 490       |
| Control  | 28.9              | 32.2      | 168           | 260       |
| CD at 5%   | 5.8               | 3.8       | 26.4          | 22.0      |

#### 7.6 Response of coriander to weed management (Jobner)

The coriander weed management experiment using four herbicides viz., pre-emergent oxyfluorfen, metolachlor and pendimethalin and preplant fluchloralin, each at two rates - and the lower dose of herbicide was supplemented with hand weeding once at 50 DAS, unweeded control, hand weeding once (25 DAS) and twice (25 and 50 DAS) and weed free (kept through out the crop season) comprising of 16 treatments conducted for two years (1991-92 and 1992-93) at Jobner. The trial was conducted with UD-20 at a seed rate of 12 kg/ha in lines spaced at 30 cm apart following the recommended package of practice. The second years experimental data revealed that all the weed control measures significantly reduced the weed (dry matter production) at all the

four stages of crop growth, compared to the unweeded control. Among the herbicidal treatments, minimum weed dry matter of 0.6 and 1.84 Q/ha was recorded under pendimethalin @ 1.5 kg/ha @ 25 and 50 DAS and 0.40 and 1.42 Q/ha under pendimethalin @ 1.0 kg/ha, supplemented with hand weeding once at 75 DAS and at harvest respectively. The data further recorded that weed control treatments had significant effect on crop growth, yield and yield attributes viz., umbellets/umbel and harvest index. Significant increase in biological yield under all the weed control measures adopted except application of metolachlor alone. Hand weeding twice and Pendimethalin @ 1.0 kg/ha recorded maximum biological yield (37.5 Q/ha) and straw yield (27.36 Q/ha) respectively. The weed free plots gave significantly higher seed yield (11.74 Q/ha) over other treatments except Oxyfluorfen and Pendimethalin both supplemented with hand weeding once. The highest net profit of Rs.17,172/ha with B:C ratio of 4.34 was recorded for weed free treatment.

#### 7.7 Quality evaluation in Coriander (Jobner)

The volatile oil content of 13 entries of coriander under MLT were evaluated at Jobner. There was not much variation in the volatile oil contents of coriander seeds of different entries and it ranged from 0.2 to 0.4%, the maximum recorded in JCo-126 (0.4%) next by JCo-31 (0.33%). The mean volatile oil content of different entries (1990-91 to 1992-93) indicated the maximum of 0.4% in JCo-126 followed by 0.35% in CS-45. The total yield of volatile oil depends upon the total grain yield/ha which was highest in DH-5 followed by RCr-41.

At Jobner no difference in oil content was observed in different entries of coriander from Jobner or Jagudan centre. The coriander seeds were having very low volatile oil content and it ranged from 0.2 to 0.4%. The total yield of volatile oil was affected as the total grain yield when affected. Thus the weed control measures significantly increased the volatile oil yield over weedy check in the experiment comprised of four herbicides treatments. Pendimethalin at 1 kg/ha supplemented with one hand weeding recorded maximum volatile oil yield.

## CUMIN

### 8.1 Germplasm collection, description, evaluation and screening against diseases (Jobner and Jagudan)

During 1993-94, the entire cumin growing areas were surveyed by Jagudan centre with a view to collect diverse type of entries which includes the two hundred and eighty five accessions (278 indigenous and 7 exotic) maintained at Jagudan centre were critically examined and screened for morphological characters and yield diversity. Based on the diversity, 106 entries having variability, were shortlisted and made the total entries to 566. The entry JC-24 gave maximum yield but was at par with the check. Three wilt resistant exotic entries were at par with the check.

total of 224 (214 indigenous and 10 exotic) accessions  
ned at Jobner.

The germplasm entries were screened under field condition at Jobner. Out of the nine entries evaluated, the mortality due to disease incidence was lowest in UC-218 (44.66%) and UC-217 (45.33%). The grain yields were 1.01 Q/ha and 0.93 Q/ha respectively.

At Jagudan seven exotic entries were tested against powdery mildew, wilt and blight diseases along with Guj. Cumin-1 and Guj. Cumin-2. The recording of powdery mildew resistance could not be made because of unseasonal rainfall at the time of flowering. The blight disease appeared and therefore the estimation of intensity of powdery mildew could not be recorded. Out of the nine entries (including GC-1 and GC-2) three exotic entries EC-243375, EC-243373 and EC-232684 showed resistant against fusarium wilt in sick plot and all the 8 entries showed 100% blight disease incidence at maturity. The disease free cumin plant (10 nos.) selected from the diseased plot, was further evaluated in diseased plot, but none of the lines was found resistant against blight.

## 8.2 Initial evaluation trial (Jagudan)

Ten cumin entries (seven exotic and two indigenous) tested for the first year (keeping Guj. Cumin-2 as check) gave significant difference among entries for yield. But none of the entries gave superior yield than Guj. Cumin-2 (6.11 Q/ha) which was at par with all the entries except EC-243373 and EC-243375.

## 8.3 Multilocation varietal trial MLT-1989 Series-I (Jobner, Jagudan & Hisar)

The MLT 1989-Series-I, consisted of 8 entries including 3 from Rajasthan (UC-216, UC-217 and UC-218) and four from Gujarat (JC-9, JC-11, JC-15, JC-147) was tested along with RZ-19 and Guj. Cumin-1 as checks for the third year at Jobner and second year at Jagudan centres. During the year 1992-93 significant differences was observed for characters like days to flowering, umbels/plant, grains/umbel, test weight and grain yield, and entry JC-11 recorded higher yield than the check (RZ-19) at Jobner. The mean performance of three years (1990-91 to 1992-93) indicated that none of the entries is significantly superior over the check (RZ-19). The entry RZ-19 gave maximum grain yield of 2.99 Q/ha closely followed by JC-147 (2.79 Q/ha), JC-15 (2.38 Q/ha), UC-216 (2.33 Q/ha) while lowest yield of 2.21 Q/ha was recorded in JC-11.

The data on yield and yield attributing characters recorded significant difference among the entries for grain yield at Jagudan. The maximum yield of 6.87 Q/ha was recorded by an entry JC-147 (13.74% higher than the control) which was at par with JC-9, Guj. Cumin-1, UC-216, JC-11 and JC-15. Based on the average of performance of two years, JC-147 gave maximum yield of 6.04 Q/ha which was 11.65% higher than the control.

The eight entries were tested in the MLT at Hisar. Due to wilt and blight the plants died and no data could be recorded.

#### 8.4 Mutation studies and hybridization programmes in cumin (Jagudan)

Mutation studies was initiated in cumin by the Jagudan centre. Seeds of cumin were treated with different doses (30, 40, 50 and 60 kr) of gamma rays, but none of the M-1 seeds germinated even in lower doses.

Attempts were also made to hybridise wilt resistant entries with Gujarat Cumin-1 for earliness and dwarfness. Flowers were pollinated and studies are in progress.

#### 8.5 Evolving control measures against wilt disease including crop rotation (Jobner)

An experiment consisting of six treatments viz., soil solarisation, seed dressing with fungicides like Captan (0.3%), Bavistin (0.1%), Thiram (0.3%) biocontrol agents Trichoderma (0.4%) was conducted at Jobner under irrigated condition. The percentage of infection was recorded plot wise as percentage of plants wilted till maturity of the crop. The studies revealed that Trichoderma reduced disease incidence (27.85%) resulting in maximum grain yield of 2.3 Q/ha followed by Bavistin (34.21%) giving an yield of 2.0 Q/ha. The previous years study revealed that seed dressing with Bavistin 0.1% consistently reduced the cumin wilt incidence and hence has been recommended for general adoption.

An experiment was conducted to study the effect of crop rotation on yield and wilt infection of cumin at Jobner centre. The 9 years crop rotation experimental data at Jobner revealed that, three years crop rotation i.e., cluster bean - cumin - cluster bean - wheat - cluster bean - mustard proved to be the best crop sequence for cumin with the lowest percentage of wilt (38.60%) with the highest yield of 248.26 kg/ha and the same has been recommended for adoption. The next best is four year crop rotation i.e., cluster bean - cumin - cluster bean - wheat - cluster bean - gram - cluster bean - mustard giving 229.40 kg/ha yield and 38.84% wilt incidence.



## 8.6 Quality evaluation in cumin (Jobner)

The volatile oil content of eight entries of cumin seed, tested under MLT were estimated at Jobner. The oil content ranged from 3.2 to 4.2%, the highest percent of volatile oil of 4.2 obtained in JC-15 followed by 3.8 in JC-9. The promising entries with respect to volatile oil content are JC-9, JC-15, JC-147 and UC-218. The production of volatile oil was calculated and was found to be maximum in JC-147 (10.51 L/ha) followed by RZ-19 (9.17 L/ha) and JC-15 (8.97 L/ha). The entries from Jagudan centre were estimated at Jobner for the content of volatile oil. The content was found to be higher in all the samples of Jobner compared to samples obtained from Jagudan. The oil content ranged from 3.4 to 4.2 percent in Jobner samples, while it ranged from 3.0 to 3.5% in samples obtained from Jagudan.

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## FENNEL

### 9.1 Germplasm collection, description, evaluation and screening against diseases

(Jobner & Jagudan)

Jobner centre holds a total of 139 collections (131 indigenous and 8 exotic) in fennel. At Jagudan the available 283 entries (262 indigenous and 21 exotic) were screened for morphological and yield diversity. Based on the genetic diversity 98 entries having variability were shortlisted. A survey was conducted by the Jagudan centre with a view to collect diverse genotype of fennel during 1993-94 and another 98 entries were collected.

Exotic fennel entries (19 entries) under natural condition at Jagudan were screened against Ramularia blight disease, along with Guj. Fennel, but the disease had not recorded at all.

### 9.2 Initial evaluation trial

(Jagudan)

Nine exotic entries were tested at Jagudan with Guj. Fennel-1 as check during 1993-94. The yield differences among entries were significant, but none gave higher yield than the check during the first year of the trial.

### 9.3 Multilocation trial

MLT-1989 Series-I

(Jagudan, Jobner & Hisar)

The MLT 1989-Series-I with 13 entries viz., 5 entries from Rajasthan, 4 from Gujarat and 3 from Haryana keeping Guj. fennel-1 as check was laid out for the third year at Jagudan. The results showed significant difference among the entries, though none of the entries recorded higher yield than the check in 1993-94. However the pooled data of three years (1991-92 to 1993-94) showed that entry JF-66 had higher yield than the control (5.48% higher yield than control) which was at par with Guj. Fennel-1, JF-71, JF-127, UF-131 and JF-132.

The trial was laid out during 1992-93 at Jobner for the third year (with the 13 entries including a local check). Observations were recorded for yield and yield attributing characters. The results indicated significant difference among entries for umbels per plant, grain/umbel, test weight and grain yield per plot. Out of 13 entries evaluated, entry JF-66 recorded maximum grain yield of 10.43 Q/ha closely followed by UF-131 (9.53 Q/ha), UF(M)-1 (8.89 Q/ha), UF-90 (8.85 Q/ha) and UF-101 (8.83 Q/ha) while JF-132 produced lowest grain yield of 5.58 Q/ha. The mean performance of 10 entries evaluated during 1990-91 to 1992-93 indicated significant difference among the entries evaluated. The maximum grain yield is obtained in UF-90 (18.26 Q/ha).

The trial with 13 entries laid out for the second year at Hisar. The observations recorded gave significant difference for all parameters except plant height. The maximum grain yield (24.6 Q/ha) was recorded in entry HF-33 followed by JF-132. The mean performance of two years also showed the superiority of HF-33 with regard to yield (43.9% increase over local check).

#### 9.4 Mutation studies and crossing programmes in fennel (Jagudan)

Besides mutation studies, crossing programmes was also initiated at Jagudan in fennel. Seeds, treated with gamma rays, did not germinate irrespective of the doses of treatments. Hybridisation studies were also carried out between Guj. Fennel-1 with three exotic collections viz., EC-241499, EC-323056 and EC-279042 and the  $F_1$  seed collected for the evaluation.

#### 9.5 Response of fennel to weed management (Jobner & Hisar)

The weed control trial comprising 16 treatments consisting of 4 herbicides - Fluchloralin, Pendimethalin, Metolachlar and Oxyfluorfen (each at two concentrations and the lower dose supplemented with hand weeding once at 50 DAS) at Jobner revealed that all weed control measures reduced the weed dry matter production, recorded at 25, 50, 75 DAS and at harvest compared to

unweeded control in all the two years of study. Among the herbicidal treatment, minimum weed dry matter production of 1.09 and 2.29 Q/ha at 25 and 50 DAS was recorded with Pendimethalin applied at 1.5 kg/ha and 0.4 and 1.67 Q/ha at 75 DAS at harvest under Pendimethalin @ 1.0 kg/ha supplemented with hand weeding once, which was significantly different when compared with unweeded control at Jobner. The data further revealed that weed control treatment significantly influenced yield and yield contributing characters. Maximum net profit of Rs.9847/ha and B:C ratio of 2.14 was recorded under weed free treatment using Pendimethalin @ 1.0 kg/ha, supplemented with hand weeding once recording net profit of Rs.8608/ha and B:C ratio of 1.90.

The experiment at Hisar comprised of four herbicides viz., Fluchloralin, Pendimethalin, Isoproturon, Oxyfluorfen each at two concentrations. The lower dose of herbicide was supplemented with one hand weeding at 45 days after sowing along with one hand weeding, two hand weeding alone, weed free and weedy check consisting of 16 treatments. The studies indicated that all treatments significantly reduced the weed population and dry weight of weed compared to weedy check. In case of weed free treatment, the plots were kept weed free throughout the crop season. Among the other weed control treatments, minimum dry wt. of weed was found in pendimethalin treated plot.

#### 9.6 Quality evaluation studies (Jobner)

The estimation of volatile oil content of 13 entries of fennel tested under CYT ranged from 1.2 to 2.1% at Jobner. The maximum volatile oil of 2.1% was found in HF-33 followed by 1.95% in HF-39, 1.9% in JF-66 and JF-71. In the pooled analysis (1990-91 to 1992-93) the maximum content was recorded as 1.5% (HM-39) followed by 1.43% (local check), 1.37% (UF-90) and 1.23% (UF-131, UF-112 and JF-127). The data also revealed that there was not much difference in total volatile oil yield in fennel.

The volatile oil content of fennel samples obtained from Jagudan centre and Jobner centre were estimated. The oil content was higher in Jobner entries compared to Jagudan samples. It

ranged from 1.2 to 2.1% for Jobner while the content ranged from 1.1 to 1.8 from Jagudan samples.

The effect of weedicide application and weed control on the volatile oil content of fennel in the experiment comprising four herbicides were estimated at Jobner. Some of the weedicides like Metalochlor and Pendimethalin had not affected the volatile oil percentage. However, fluchloralin and oxyfluorfen had affected volatile oil content to some extent. The weed control measures significantly increased the grain yield over unweeded check. The total yield of volatile oil depends on the grain yield which was increased by eliminating the weeds whether it was eliminated by hand weeding and or by using weedicides. Weed free fennel produced maximum volatile oil yield of 14.44 L/ha which was at par with Pendimethalin applied @ 1.0 kg/ha supplemented with one hand weeding (12.48 L/ha) and two hand weeding (10.83 L/ha).

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## FENUGREEK

### 10.1 Germplasm collection, maintenance, evaluation and screening against diseases

(Jobner, Jagudan, Coimbatore & Guntur)

At Jobner centre the germplasm collection was increased to 270 (258 indigenous & 12 exotic collections) as a result of 20 new collections from Chittogarh district of Rajasthan and 113 indigenous collections received from other centres during 1993-94. Out of fifty three accessions received from Coimbatore, none was better than RMT-1 with respect to yield. However, 19 accessions showed lower incidence of powdery mildew and seven accessions showed low incidence of root-rot.

The germplasm collection rose to 179 at Coimbatore centre as a result of enrichment of 53 new accessions during 1993-94.

Seventy accessions were evaluated at Guntur. Among the accessions, UM-117 (1100 kg/ha) followed by Lam Sel.1 (1092 kg/ha) gave highest yields during 1993-94.

Jagudan centre holds a total of 185 accessions including two exotic accessions. During the year, the entries were evaluated and critically examined and screened for morphological and yield diversity but none was found superior in yield over the control. Based on the genetic diversity, 40 entries having variability were retained and others were discarded.

The entries under IET and CYT were screened at Coimbatore against powdery mildew disease. Acc. 464, 113 and 2310 recorded only below 5% incidence under CYT and acc. HM-57 showed a minimum incidence of 2.8%.

Exotic entry EC-257566 (Bulgarian) was found resistant against powdery mildew disease in the screening of three entries at Jagudan under natural condition (Methi EC-257566, Fenugreek Australian, Methi local).

At Jobner 28 entries of fenugreek were tested against root knot nematode (M. incognita) in pots, variety UM-9, UM-17, UM-18, UM-23, UM-26, UM-27, UM-32, UM-33, UM-34, UM-35, UM-52, UM-70, UM-79, UM-84, UM-113, UM-127, UM-128 & RMT-1 were moderately resistant.

## 10.2 Multilocation varietal trials

### a) MLT 1989-Series-I

(Jobner, Jagudan, Guntur, Coimbatore & Hisar)

The MLT with 13 entries (four from Rajasthan, three each from Gujarat, Tamil Nadu, and Haryana and local check) was conducted at Jobner, Jagudan, Guntur, Coimbatore and Hisar centres. At Jobner during 1992-93 rabi, entry UM-127 recorded maximum grain yield of 11.92 Q/ha followed by UM-128 (10.31 Q/ha), PRT-4 (9.79 Q/ha), HM-57 (9.72 Q/ha) which were higher than the check variety RMT-1 (8.96 Q/ha). The performance of varieties, evaluated over four years (1989-90 to 92-93), revealed that entries did not differ significantly. However, maximum grain yield of 10.60 Q/ha was recorded in HM-57, closely followed by RMT-1 (10.44 Q/ha), PRT-4 (10.40 Q/ha), TG-947 (9.68 Q/ha).

The trial has completed four years at Hisar. The mean performance of the entries evaluated in MLT over four years are presented in table 12. HM-57 recorded 45% increase yield over check which was followed by HM-46 J.Fenu-10 and J.Fen-53.

The trial running for four years at Jagudan, Coimbatore and Guntur Centres (1989-90 to 92-93 was concluded).

A State Varietal trial, was running at Jobner with 10 entries in fenugreek. These entries were tested, along with two local check at Mandor - Jodhpur. RMT-2 (local check of Mandor) produced maximum grain yield of 9.35 Q/ha, closely followed by UM-117 (9.16 Q/ha), UM-32 (8.80 Q/ha), RMT-1 (8.36 Q/ha), UM-116 and UM-118 (8.31 Q/ha). The performance of entries was evaluated for two years (1990-91 & 1991-92). Data showed superior performance of RMM-2 (12.18 Q/ha) followed by UM-128 (11.17 Q/ha), UM-117 (10.78 Q/ha) and RMM-1 (10.73 Q/ha).

Table 12 Yield performance of fenugreek in the MLT 1989  
at Hisar over four years (1989-90 to 92-93)

| Sl.<br>No. | Name of the entry | Seed yield (q/ha) |         |         |         |      |
|------------|-------------------|-------------------|---------|---------|---------|------|
|            |                   | 1989-90           | 1990-91 | 1991-92 | 1992-93 | Mean |
| 1.         | UM-127            | -                 | 17.4    | 23.0    | 18.3    | 19.6 |
| 2.         | UM-128            | -                 | 16.1    | 19.2    | 20.0    | 18.4 |
| 3.         | UM-129            | -                 | 19.5    | 24.1    | 19.3    | 21.0 |
| 4.         | TG-194            | 24.7              | 18.6    | 19.5    | 14.9    | 19.4 |
| 5.         | TG-208            | 22.3              | 19.4    | 21.9    | 17.7    | 20.3 |
| 6.         | TG-947            | 21.7              | 17.8    | 18.9    | 21.9    | 20.1 |
| 7.         | P.Fc-1            | 20.5              | 14.3    | 19.8    | 20.2    | 18.7 |
| 8.         | J.Fcnu-10         | 24.4              | 21.0    | 22.8    | 23.4    | 22.9 |
| 9.         | J.Fcnu-53         | 23.2              | 20.1    | 22.5    | 20.9    | 21.7 |
| 10.        | HM-46             | 29.5              | 19.5    | 23.2    | 21.7    | 23.5 |
| 11.        | HM-57             | 30.4              | 21.8    | 28.1    | 25.3    | 26.4 |
| 12.        | PRT-4             | 20.1              | 19.2    | 21.7    | 19.7    | 20.2 |
| 13.        | PEB (Check)       | 18.5              | 16.5    | 19.7    | 18.0    | 18.2 |
| CD at 5%   |                   | 6.7               | 2.5     | 3.1     | 5.0     |      |
| CV %       |                   | 17.0              | 4.8     | 8.6     | 17.8    |      |

b) MLT 1993 - Series-II

(Guntur, Coimbatore, Jobner & Jagudan)

The new MLT 1993 with the following nine entries (8 + check) from different Coordinating centres are under trial in RBD at Guntur, Coimbatore, Jobner and Jagudan centres during 1993-94.

CF-168 and CF-390 (Tamil Nadu)

HM-103 and HM-141 (Haryana)

J.Fenu-145 and J.Fenu-148 (Gujarat)

UM-142 and UM-144 (Rajasthan)

Keeping one local variety as check



The data on yield and yield related characters were recorded for the first year of the experiment. Among the nine entries none recorded significantly higher yield over check at Guntur and Jagudan centres.

#### 10.3 Evolving varieties resistant to powdery mildew through mutation breeding and crossing programme (Jagudan & Jobner)

Mutation studies with gamma irradiation was initiated (1988-89) in fenugreek (RMT-1) at Jobner. Forty four progenies (31  $M_4$  and 13  $M_5$  progenies) derived from 20, 30 and 40 kr doses of gamma irradiation evaluated (1992-93) resulted in isolation of seven progenies having low incidence of powdery mildew. And 19 progenies were better in yield performance as compared to untreated control (RMT-1). The promising progenies with high yield potential combining with low incidence of powdery mildew were 40 kr-1-4, 40 kr-100-5, 30-kr-2-15, 20 kr-3, 40 kr-3-4 and 40 kr-3-12.

Mutation studies was initiated at Jagudan and the seeds were treated with different doses (30, 40, 50 and 60 kr) of gamma rays to create genetic variability in fenugreek. Forty four progenies were evaluated in the  $M_1$  generation. The seeds germinated in all treatments but survived up to maturity in 30 kr and 40 kr treatments. Plants showing morphological differences in  $M_1$  generation were selected.

Attempts were made to hybridise fenugreek to create variability and evolving resistance to powdery mildew disease. Reciprocal crosses were made between methi local and Kasuri at Jagudan and 59  $F_1$  seeds were harvested.

#### 10.4 Effect of time of sowing and spacing in fenugreek (Coimbatore)

A trial was laid out (1993-94) with eighteen treatments involving combination of six sowing dates and three spacing levels. The plant growth and yield and yield characters showed difference, the yield was high (283.3g) when the crop was sown in 5th November adopting a spacing of 15 x 10 cm.

### 10.5 Response of fenugreek to weed management (Jobner)

The experiment was conducted for two years using four herbicides viz., Oxyfluorfen, metolachlor / pendimethalin (pre-emergent) and pre-plant fluchloralin each at two levels and the lower level was supplemented with one hand weeding once at 50 DAS unweeded control, hand weeding one (25 DAS) and twice (25 and 50 DAS) and weed free control (16 treatments). The dominant weed species observed in the experimental plot included Chenopodium album L., C. murale L. and others being Melilotus alba, Brassica Kaber and Heliotropium ellipticum. All the weed control measures significantly reduced the weed dry matter production at all stages of crop growth and at harvest. Results further revealed that weed control treatment significantly increased the number of branches and pod per plant, harvest index and biological straw and seed yield of fenugreek. Weed free fenugreek produced maximum biological yield of 51.07 Q/ha closely followed by hand weeding twice (50.93 Q/ha) and pendimethalin @ 1.0 kg/ha supplemented with hand weeding once (48.66 Q/ha) during the second year of the trial. Weed free plots gave maximum seed yield of 17.87 Q/ha which was statistically at par with fluchloralin 0.75 kg/ha and Oxyfluorfen 0.15 kg/ha both supplemented with hand weeding once (17.13 and 17.04 Q/ha respectively) and hand weeding twice treatment (16.62 Q/ha). Maximum net profit of Rs.17,138/ha with B:C ratio of 4.27 was obtained under weed free condition followed by hand weeding twice and fluchloralin 0.75 kg/ha supplemented with hand weeding once treatments recorded net profit of Rs.16,365 and 16,130/ha with B:C ratio of 4.44 and 4.22 respectively.

### Closed projects

#### 1. Effect of fertilizer and seed rate on yield of fenugreek (Jobner)

The experiment consisted of twenty four treatment combinations comprising four seed rates (15, 20, 25 & 30 kg/ha) and six combination of N and P (0+0, 20+20, 20+40, 20+60, 40+40, 40+60) (N and P<sub>2</sub>O<sub>5</sub>/ha respectively). Observation on plant height,

branches/plant, pods/plant, pod length, seeds/pod, test weight and biological, straw and seed yield were recorded for three years. Data revealed that seed rate significantly affect the pods/plant, biological straw and seed yield of fenugreek. The seed rate of 25 kg/ha gave the highest yield of 11.12 Q/ha of yield. This has been recommended for general adoption in the State of Rajasthan. Maximum net profit of Rs.7980/ha and B:C ratio of 2.25 was also observed under 25 kg/ha seed rate.

Similarly, the levels of fertilizer also significantly affected the production of branches/plant, pods/plant, test weight and biological straw and seed yield over control at 40 kg N plus 40 kg  $P_2O_5$ /ha. The average seed yield of 11.47 Q/ha recorded under this treatment was significantly higher over rest of the fertilizer combinations. Maximum net profit of Rs.8197/ha and B:C ratio of 2.25 was also recorded under this treatment. Based on the three years data on seed rate and fertilizer experiment it was recommended :

- \* that the seed rate of 25 kg/ha recommended against the current rate of 20 kg/ha
- \*\* the dose of nitrogen is to be increased to 40 kg N/ha over the present recommended dose of 20 kg N/ha. The  $P_2O_5$  dose remains the same.

2. Studies on the control of root-rot of fenugreek with the use of soil amendments, antagonistic fungi and drenching of fungicides (Coimbatore)

The experiment was conducted to evolve suitable bioagents/ organic amendments/fungicides to the control of root-rot of fenugreek. The effect of Trichoderma viride either alone or with neem cake in the management of root rot-disease was assessed. Application of T. viride either alone or in combination with neem cake @ 150 kg/ha reduced the incidence of wilt to 3.8 and 4.4% respectively and a higher yield of 492 and 480 kg/ha respectively. Similarly during rabi 1993-94 also application of T. viride reduced the incidence to 3.2% (Table 13).

Table 13 Biocontrol studies against root rot disease in Fenugreek  
at Coimbatore (1992-93 and 1993-94)

| Treatment   | Root rot incidence (%) |              |                |              | Yield(Kg/ha)   |              |              |
|---|------------------------|--------------|----------------|--------------|----------------|--------------|--------------|
|   | Kharif<br>1992         | Rabi<br>1992 | Kharif<br>1993 | Rabi<br>1993 | Kharif<br>1992 | Rabi<br>1992 | Rabi<br>1993 |
| Seed treatment +<br>soil drenching<br>with Carbendazim(T <sub>1</sub> )             | 14.8                   | 10.8         | 12.8           | 7.8          | 422            | 315          | 390          |
| Seed treatment<br>with <u>T. viride</u> (T <sub>2</sub> )                           | 4.8                    | 4.4          | 3.4            | 3.8          | 384            | 365          | 492          |
| Seed dressing<br>with <u>T.viride</u><br>20 days before<br>sowing (T <sub>3</sub> ) | 26.3                   | 20.4         | 24.2           | 12.3         | 288            | 285          | 346          |
| Neem cake<br>150 kg/ha(T <sub>4</sub> )   | 3.9                    | 3.2          | 3.2            | 5.2          | 427            | 385          | 424          |
| T <sub>4</sub> + T <sub>2</sub>   | 3.2                    | 3.4          | 4.8            | 4.4          | 424            | 360          | 480          |
| T <sub>4</sub> + T <sub>3</sub>   | 5.4                    | 12.4         | 14.6           | 15.8         | 288            | 325          | 330          |
| T <sub>4</sub> + T <sub>1</sub>   | 12.8                   | 14.3         | 26.2           | 20.8         | 345            | 340          | 298          |
| Seed dressing<br>with Carbendazim   | 27.9                   | 24.5         | 28.2           | 24.4         | 294            | 265          | 264          |
| Control   | 36.2                   | 32.8         | 38.4           | 32.4         | 163            | 184          | 152          |
| CD (P 0.05)   | 5.7                    | 4.3          | NS             | 6.3          | 52.4           | 27.8         | 64.8         |

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**GERMPLASM HOLDINGS OF DIFFERENT SPICES  
AT THE COORDINATING CENTRES**

|                          |     |                     |     |
|--------------------------|-----|---------------------|-----|
| <b>A. BLACK PEPPER</b>   |     | <b>I. CORIANDER</b> |     |
| Panniyur                 | 195 | Jobner              | 683 |
| Sirsi                    | 65  | Jagudan             | 143 |
| Chintapelli              | 46  | Guntur              | 230 |
| Yercaud                  | 102 | Coimbatore          | 372 |
|                          |     | Hisar               | 30  |
| <b>B. CARDAMOM</b>       |     | <b>J. CUMIN</b>     |     |
| Pampadumpara             | 87  | Jobner              | 224 |
| Mudigere                 | 243 | Jagudan             | 566 |
| <b>C. LARGE CARDAMOM</b> |     | <b>K. FENNEL</b>    |     |
| Gangtok                  | 34  | Jobner              | 139 |
|                          |     | Jagudan             | 98  |
| <b>D. GINGER</b>         |     | <b>L. FENUGREEK</b> |     |
| Pottangi                 | 147 | Jobner              | 270 |
| Solan                    | 132 | Jagudan             | 40  |
|                          |     | Guntur              | 70  |
| <b>E. TURMERIC</b>       |     | Coimbatore          | 179 |
| Pottangi                 | 187 | Hisar               | 80  |
| Solan                    | 164 |                     |     |
| Jagtial                  | 188 |                     |     |
| <b>F. CLOVE</b>          |     |                     |     |
| Yercaud                  | 13  |                     |     |
| <b>G. NUTMEG</b>         |     |                     |     |
| Yercaud                  | 15  |                     |     |
| <b>H. CINNAMON</b>       |     |                     |     |
| Yercaud                  | 11  |                     |     |

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## FUNCTIONING OF THE COORDINATED PROJECT

Area and production of Spices (pepper, small and large cardamom, ginger, turmeric, chillies, cumin, coriander, fennel, fenugreek, clove, nutmeg, cinnamon, saffron, garlic etc. in India are about 2.30 million ha and 2.12 million tonnes respectively. The value of these spices is around Rs.52,000 million. The major states accounting for spices are Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Rajasthan, Gujarat, Orissa, Maharashtra, West Bengal, Uttar Pradesh, Madhya Pradesh and N.E. Region.

During 1993-94 about 1,75,532 tonnes of spices were exported from India resulted in an earning of Rs.5401.24 million (US \$ 180 million) in foreign exchange. There is good scope to step up the export earnings through increasing the exports of black pepper, cardamom, ginger, turmeric and seed spices. Realising importance of spices in our foreign trade, Government of India has initiated actions for a targeted export of spices from India during 1994-95 as 1.6 lakh tonnes valued Rs.6000 (US \$ 200 million). The money spent on Research of Spices, has so far been only marginal and efforts are made by Government of India/ICAR to increase the budget and provide more thrust for Research to augment production, productivity and upgradation of quality to suit International standards.

The network of centres under the AICRPS was increased from 16 to 20 during the VIII Plan. The four new centres came into existence from December 1994 are Nadia (West Bengal), Fasiabad (Uttar Pradesh), Jaghalpur (Madhya Pradesh) and Dapoli (Maharashtra). The mandatory crops of AICRPS are :

- |                     |               |
|---------------------|---------------|
| 1. Black pepper     | 7. Nutmeg     |
| 2. Cardamom (small) | 8. Cinnamon   |
| 3. Large Cardamom   | 9. Cumin      |
| 4. Ginger           | 10. Coriander |
| 5. Turmeric         | 11. Fennel    |
| 6. Clove            | 12. Fenugreek |



The Voluntary / participating centres reporting to the AICRPS are the Indian Cardamom Research Institute (ICRI) at Myladumpara and its two centres at Sakleshpur and Thadiyankudisai under the Spices Board. In addition to that four participating centres currently reporting under the AICRPS on Spices are Thadiyankudisai, Bhavanisagar and Pechiparai under TNAU and Ambalavayal under KAU. On the whole there are 20 Coordinating Centres and seven Voluntary centre. This report deals only the work of 16 Coordinating Centres and all the Voluntary Centres.

The sanctioned budget of AICRPS was 81.6 lakhs during 1993-94 and the funds are disbursed through the different SKUs who implementing the Spice Projects at State level. In the light of detailed discussions of XII Workshop new areas have been identified keeping in view the specific requirement of the country and export needs of spices.

Yet another important activity during the year under report has been the evaluation of working of AICRP on Spices by Quinquennial Review Team constituted by ICAR. The QRT reviewed working of AICRPS for ten years (1982-92) and report submitted.

Significant feature of the Workshops of the AICRP on Spices 1993 has been the release of four varieties on Spices, one each in black pepper, cardamom, coriander and fenugreek. The Workshop was also used as the platform to take stock of the earlier work and recommended improved technology for adoption. So far 53 spices varieties have been released in different spices viz., black pepper, cardamom, ginger, turmeric, coriander, cumin, coriander, fennel and fenugreek.

## PERFORMANCE OF THE CENTRES

### Black pepper centres

The research on biological control of Phytophthora foot-rot disease was initiated at Panniyur, Sirsi and Chintapalli centres, as a new thrust area. The multilocation trials on pepper have also been laid out as decided at Trichur Workshop. There has been a very heavy demand for the planting materials of the released varieties of black pepper and to meet this requirement, propagation sheds have been

provided at Chintapalli, Sirsi and Panniyur centres. There has been dislocation of breeding works at the Panniyur centre. The post of breeder is vacant at Panniyur. The authorities in the respective Universities have already been advised on this deficiency. Panniyur centre has distributed over one lakh rooted cutting of released varieties viz., Panniyur-1, 2, 3, 4 and 5. Barring the above weakness, the centres have performed satisfactorily.

#### Cardamom Centres

The Pampadumpara centre has further improved its function subsequent to the posting of scientists and staff. Experiments on multilocation trial have been laid out. The work on azhukal disease has not been taken up for two years in succession at Pampadumpara and therefore the post of Pathologist was shifted to Hisar centre. The Yercaud and Mudigere centres have fulfilled their programmes excepting that the Mudigere centre did not fill post Jr. Plant Pathologist who went on study leave. The work on katte disease have suffered at Mudigere centre. The multilocation trials, as decided during the Trichur Workshop, were laid out in all the Cardamom Centres. Excepting those mentioned at Mudigere, the Centres made satisfactory progress. Mudigere centre had distributed about 190 kg seed capsule of cv. Mudigere-I. Less priority was given for cardamom research at Yercaud centre as the area does not represent major cardamom tract. All the cardamom centres have initiated work on Black pepper. The Centres have purchased all equipments identified except Spectrophotometer at Mudigere. QRT has suggested to take up studies on cropping system at all cardamom centres.

#### Ginger & Turmeric centres

Pottangi, Solan and Jagtial are the centres carrying out the work. The production and distribution of seed rhizome of released varieties of ginger and turmeric have been a major activity at Pottangi centre. During 1993-94, 23 quintals of ginger and 65 quintals of turmeric seed materials were distributed by Pottangi centre. The trials on biological control of rhizome-rot, screening for resistance against diseases are progressing satisfactorily at Solan centre. The trials on intercropping and their cost benefit analysis has yielded significant

results in Pottangi. The Jagtial centre in Andhra Pradesh is meeting the great demand for the seed rhizomes of turmeric varieties - Suguna and Sudarshana. However, the work in Plant Pathology at Jagtial centre improved after Plant Pathologist joined. Dholi centre started working on turmeric from 1993 onwards.

### Tree Spices Centres

Research on tree spices (clove, nutmeg and cinnamon) has already been initiated as per the decisions of the group meeting held at TNAU, Coimbatore on May 15, 1992. Yercaud is the lone tree spices centre. The centre has purchased all equipments allotted. The construction of propagation shed is progressing. The QRT has suggested to take up vegetative propagation of tree spices. The Pechiparai and Thadiyankudisai (TNAU) and Ambalavayal (KAU) are participating centres.

### Seed Spices Centre

Subsequent to the group meeting on seed spices held at Coimbatore on Nov. 23-24, 1992 research programmes were intensified. The six centres viz., Jobner, Jagudan, Guntur, Coimbatore, Hisar and Dholi have made steady progress in their research accomplishments. Hisar released Coriander DH-5 and Fenugreek HP-57 at the XII Workshop held at Trichur. New CYTs/MLTs have been taken up in all the centres. All these centres have taken up large scale production of seeds of released varieties and participated in the Centrally sponsored scheme on Seed Production. The control measures against grain mould of coriander, root-rot of fenugreek and powdery mildew of the seed spices have already been recommended in the package of practices. The cumin wilt control is gaining popularity in Rajasthan and Gujarat. The Hisar centre has become a regular centre since March 1993 and makes steady progress. Dholi centre reported that hail storm destroyed spice crops. Guntur and Jobner centres have distributed 410 kg and 545 kg of coriander seed respectively for cultivation. On the whole performance of the centres are satisfactory.

**ACTION TAKEN ON THE RECOMMENDATIONS OF THE XII WORKSHOP ON SPICES  
HELD AT TRICHUR DURING JULY 1993 AND ACTION TAKEN ON EARLIER DECISIONS**

| Decisions  | Action taken/remarks   |
|--|--|
| 1. GENERAL   |  |
| 1. One batch of improved varieties of Black pepper from Panniyur (KAU), Cardamom from ICRI, Sakleshpur, Coriander & Fenugreek from Hesar (KAU) were recommended for release  | The concerned Centres have taken up actions for release of varieties. Varieties released are Panniyur-5 in pepper, ICRI-3 in cardamom DH-5 in coriander and HM-57 in fenugreek |
| 2. Propagating cultures under NLT should be evaluated in farmers' field besides being evaluated at the Research Station  | The directions will be followed by all centres.  |
| 3. In all the experiments the cost benefit C/E ratios are to be invariably worked out to assess the economic implication of adoption of the various technologies   | The C/E ratio are being worked out to assess the economic implications   |
| 4. It is also necessary to review all the present experimental programmes thoroughly to decide upon the future experiments strategy for various centres  | The CRT has reviewed all programmes of the centres. Recommendations are being implemented.   |
| 5. Experiments on fertilizer use efficiency and slow release fertilizers are suggested for important spice crops, and organic farming trial on important spices have been suggested under AICRPS. Integrated nutrient management trial including biofertilizers have been suggested under AICRPS. Crop rotation system trial including pepper, tree spices & other crops are suggested under AICRPS. | This will be taken in to consideration while formulating new technical programmes  |

6. In view of great concern for reducing the pesticide residues in spices, a coordinating centre of the AICRP on Pesticide Residue may be established at NRCS, Kozhikode.

7. Infrastructure for pesticide residue assay may be established at least in selected centres and facilities for microbiology may be developed.

8. Collaborative programmes on the post harvest technology with reference to storage pests and diseases may be initiated.

9. The Chairman of the Flonary Session (XI AICRP Workshop) underlined the necessity for initiating seed technology research on seed spices especially on the aspects like seed storage, seed health and viability.

10. The germ plasma survey and collection in Cardamom and black pepper from the evergreen forests of Western Ghats will be a collaborative programme among NRCS and KAU. A group meeting may be organised.

11. The NRCS will establish a National gene bank for cardamom, ginger, turmeric and tree spices. Fanniyur, Appangale, Aratalavayal will be the reference centres for black pepper, cardamom and white pepper respectively and Ettangi for turmeric and ginger.

This will be taken up with the concerned Project Coordinator. Project proposal submitted to ICAR.

The above project will cover this aspect.

CRT recommended to initiate the work at Coimbatore Centre. The programmes will be worked out in the next seed spices group meeting.

The PC (Spices) has already taken up the matter with the Head, Department of Seed Technology, TNLU and work out further details in the light of group discussion on seed spices.

Under the chairmanship of Dr. N. Aravindakshan, Director of Research, KAU a group meeting was held on February 4, 1992 at NRCS and the proceedings communicated to all participants. Survey already initiated in all centres.

NRCS has already initiated action for maintenance of gene bank for the important spices. Aratalavayal and Fanniyur have initiated work.

12. When varieties being released from the germplasm collections obtained from other centres, due credit should be given to the original collection centre
  13. The Project Coordinator may ensure that exchange of planting material is completed sufficiently early so that the multiplication trials will not suffer due to non-availability of planting material
  14. For all concluding experiment cost benefit ratio should be worked out and results should be tested in "on farm trials" in farmers-holdings before it is recommended for adoption. The funds allocated for the respective centres will have to be utilised for this.
  15. The use of biofertilizers in spice crops was emphasised. The centres may consult the Professor & Head, Department of Microbiology for taking up observational trials. The cultures required will be supplied by the Department of Microbiology, Tamil Nadu Agricultural University (TNAU). IC (Spices) will interact with TNAU, in formulating suitable programmes in seed spices and pepper
  16. Biological control of Phytophthora foot rot of black pepper and rhizome rot of cardamom may be taken up by use of antagonists
  17. All the Entomology Projects have to be discussed thoroughly and new technical programmes formulated
- The direction will be followed by all centres
- Coordinating centres have been asked to expedite action
- The centres have been advised accordingly. For pepper, Panniyur is conducting on farm trials
- At TNAU, Coimbatore a training programme was conducted at the Departments of Plant Pathology & Microbiology with participation from Coimbatore, Panniyur & Sirsi Centres. Necessary stock cultures of biofertilizers and biocontrol agents were supplied to the participants. Pot culture studies have already been initiated. Yercaud started trial in 1990
- On pepper biocontrol work has been initiated at Chintapalli, Panniyur & Sirsi Centres. The Mudigere Centre has also started similar work on rhizome rot of cardamom
- Four experiments in Entomology at Mudigere & Pampadumpara centres technical programmes were discussed in a Sub group meeting the last workshop and the revised programme

approved in the Workshop. It has been decided to take up work on black pepper also at Mudigere and Pampadumpara centres. The programmes were further discussed at the Group Meeting of Entomologists at Lucknow during August 12-13, 1992 and technical programme approved.

The Biochemist at Jobner has already initiated biochemical analysis

18. The Jobner centre will also analyse the coriander samples of Jagudan & Guntur centres

## II. SPECIFIC ITEMS, CROP-WISE

### A. BLACK PEPPER

1. MLT-IV (1991) will be laid out at all the centres

MLT-IV (1991) was not laid out by Chintapalli. However MLT series (1993) was initiated at Chintapalli. The trial will be laid out at Sirsi after collecting planting material from NRCS

2. The MLT of promising cultures of black pepper from Panniyur and NRCS may be used in laying trial at Sirsi and Yercaud also

The promising cultures from Pepper Research Station, Panniyur and NRCS, Calicut have been identified and the trial laid out

3. Chintapalli centre will collect planting material from NRCS for MLT gap filling

Planting material was lifted from NRCS for gap filling by Chintapalli

4. In view of the large scale deforestation in Kerala, survey for wild germplasm for black pepper may be intensified

The Panniyur Centre has taken up survey for wild germplasm of black pepper in Karnataka & Kerala and new entries added

One Associate Professor (Breeder) has been deployed at Ambalavayal centre and multifocation trials on Black pepper has been laid out.

The wild pepper collection are maintained at NRCS Centre, Appangala. NRCS has established a Gene bank at Appangala and collections from various centres are planted.

Scientists from NRCS, Calicut and NBPGR visited Chintapalli centre and made wild germplasm collection of Black pepper

New MLT's have been made out at Panniyur, Ambalavayal and other co-ordinated centres

Is being followed by pepper centres

Difficulty is being experienced to record yield data by Chintapalli since trial is being laid out at far off plantations of other organisations

The decisions are followed

Work on biocontrol with Trichoderma sp. is carrying out at Sirsi & Chintapalli

5. The ARS Ambalavayal of KAU will be a Voluntary centre of AICRP on Spices and a Breeder from Pampadumpara centre may be redeployed to look after the MLT of pepper at Ambalavayal

6. The wild pepper collections made by different centres may be utilised by NRCS and will be established at Appangala centre under "National Gene Bank for wild pepper"

7. A joint team of Scientists from KAU, UAS & NRCS Calicut will visit all the centres for collection of wild germplasm of black pepper

8. The IC (Spices) will suggest new MLT for Panniyur. A new MLT with the released varieties from NRCS and Panniyur may be laid out at Ambalavayal and also in all cardamom centres viz., Mudigere, Yercaud, Pampadumpara and Aralam Farm

9. Approved nomenclature to describe the diseases will have to be used while reporting the results

10. In fungicide/insecticide evaluation trials, yield data is to be provided wherever needed. The C/B ratio are to be worked out to the extend possible

11. Experiment of Phytophthora foot rot and nematode management will continue for two more years in all the Coordinating Centres

12. Experiment on the biocontrol of foot rot using Trichoderma sp. is to be intensified and pursued actively with a view to develop control strategies



13. MLT 1993 should be started at Chintapalli and Thadiyankudissai centre.
  14. Sirsi centre should start the experiment on nursery diseases in the coming nursery season
  15. The field trial for the control of slow wilt disease will be concluded after collecting 1992-94 data
  16. In fact, a disease management review, the available data may be reviewed and appropriate decision taken. A group meeting of Phytophthora workers is to be convened to review the present disease management strategy and to formulate a new programme to develop low cost disease management technology
  17. A well knit group management for pepper diseases is to be formed by integrating crop intensive programme in view of various developmental agencies taking up the programme viz., DCA/SD/Dir. of Agriculture/Horticulture, Spices Board and NABARD.
  18. The studies on the control of nursery diseases may be continued for one more year at Panniyur. Sirsi centre should start the experiment in the coming nursery season.
  19. In the post infestation survey, the incidence of post infestation is to be quantified properly by adopting grading scale
  20. The soil and leaf analysis is to be done in pepper in fertilizer experiments at Panniyur centre.
- Chintapalli has started MLT IV series Thadiyankudissai has been asked to send the proposal for required numbers of planting material.
- Chemical control of nursery diseases of black pepper is in progress at Sirsi
- The trials were concluded at Panniyur and Chintapalli centres
- This aspect was discussed at the Phytophthora meeting on Sept. 21-23, 1994. The pasting (10% Bordeaux mixture) is not economical for giving a blanket recommendation.
- Leaf-let on Phytophthora management was brought out by NRCS which is being followed by developmental agencies.
- The decisions are followed by Panniyur and Sirsi Centres.
- The Mudigere & Pampadumpara have adapted the norms
- Work has been initiated at Panniyur.

21. In the irrigation-cum-fertilizer experiment involving arecanut and pepper at Sirsi centre, incidence of pests and diseases should be recorded

This is being recorded.

## B. CARDAMOM

1. MLT in cardamom should be laid out in 1993-94 as full fledged experiment
2. MLT Series-III (1991) with Malabar types will be taken up at ICRI and RRS Thadiyankudisai in the current season
3. Five suckers each of four superior lines will be given to NRCS by Mudigere for micropropagation
4. Micronutrient trial in cardamom should be laid out during 1993-94 with vegetative propagation of PV-1
5. Breeding for katte tolerance : Work on katte disease tolerance with special emphasis on natural katte escapes has to be intensified
6. The trial Effect of fertilizer levels on the yield of cardamom under natural shade should be laid out with vegetatively propagated PV-1 plants
7. In cardamom, breeding for yield has achieved the expected level. Efforts are to be made to breed varieties for tolerance to katte disease
8. Cardamom germplasm would be further enriched by natural katte escapes

The trial is laid out during June 1994 at Pampadumpara

Work has been initiated at ICRI

Materials will be spared during May 1995

The trial has been laid out during June 1994 at Pampadumpara

The Centres at Saklespur, Mudigere, Appangala assembled katte tolerant lines collected from endemic areas.

The trial laid out at Pampadumpara accordingly

Some suspected katte tolerant/escape clumps have been marked at Mudigere and are under scrutiny

Attempts have been made to spot out the escapes and multiply them by Mudigere.

9. Some amount of resistance to the thrips and shoot borer have been identified in few clones viz., D-163, P-547, D-446 & D-514 at Mudigere. The work is to be pursued actively and extended to Pampadumpara also.
10. Cultures identified as tolerant/resistant to pests will be further tested. Pest survey is to be intensified
11. Predatory fauna associated with Sciothrips cardamomi identified, where the predatory potential are to be studied at Mudigere. Survey for natural enemies as well as thrips is to be taken up at Pampadumpara.
12. The screening of cardamom for katte resistance should be tested in sick-plots
13. The NRCS may take up mutation breeding programme on cardamom
14. The experiments using irradiation, mutagenesis breeding ability in cardamom etc. may be de-linked from the coordinated project. These may be taken as a University Project
15. The observational trials with the use of natural products like Digitalin and Alitin to induce resistance may be tested in cardamom
16. To induce somoclonal variants through tissue culture, against 'katte' resistance may be intensified by NRCS and ICRI
17. For assessing the performance of individual clones, annual sucker production per plant may also be used as one of the criteria

Identified clones are being multiplied and the same will be further screened at Mudigere and thereafter transferred to Pampadumpara

Work on biocontrol/integrate pest management have been intensified at Mudigere.

Work has been initiated at both the Centres

The Mudigere centre has taken up the study

The work will again be initiated at NRCS

All the cardamom centres have been informed accordingly

The Mudigere centre has taken up this programme under glass house conditions

The NRCS, Calicut/Appangala and at ICRI Myladumpara have taken up the investigation

Directions are being followed by the concerned centres

### C. LARGE CARDAMOM

1. A group meeting will be conducted preferably at Gangtok during 1994 to chalk out the detailed technical programme
2. ICRI, Myledumpara may also establish a gene bank on large cardamom

Department of Agriculture, Gangtok has already been contacted for hosting the meeting

ICRI centre has initiated action in these lines

### D. GINGER

1. The Solan centre will supply the low fibre varieties to all the Coordinating Centres. Import of exotic germplasm from Indonesia may be arranged through NBPGR
2. Ginger, germplasm would be evaluated for low fibre content, high oleoresin and resistance to soft rot at Pottangi
3. In the JET at Solan, the fibre content and dry recovery should be evaluated
4. At Pottangi 10-15 promising accessions may be evaluated having low fibre and high oleoresin content. Promising 10 lines of NRCS may be tested at Pottangi
5. The NPK experiment on ginger at Pottangi will be continued for one more year. The soil and plant analysis data are to be presented during the next group meeting
6. The possibility of fixing threshold value for the inoculum in the field may be explored

The NBPGR has been requested again to obtain the material from exotic sources. The matter will be further pursued with the NBPGR

Pottangi centre has initiated the work.

The information is being generated.

Experiment is being laid out at Pottangi accordingly

Pottangi centre has been instructed accordingly

Studies have already been initiated in fixing threshold value for soft-rot of ginger

## E. TURMERIC

1. A survey for wild germplasm at Andhra Pradesh centre for turmeric may be expedited
2. The coordinating centres may send samples to the Director, NRCS with adequate basic information through the Project Coordinator
3. Turmeric samples of IET at Pottangi will be sent to Solan for estimation of curcumin
4. Turmeric dry recovery will also be recorded at Pottangi
5. High curcumin varieties will be tested at Jagtial and Pottangi centres
6. There is a need to develop varieties preferred by importers
7. High curcumin lines in turmeric with higher drilage would be further collected
8. The crop rotation experiment is to continue for one more year at Jagtial

## F. TREE SPICES

1. Research on tree spices may be included in the AICRPS Yercaud & Pampadumpara may be a voluntary centre for black pepper and tree spices

The Jagtial Centre has initiated action on wild germplasm of turmeric and added five entries

Procedure for sending of turmeric samples for analysis have been communicated to all the Centres. Analysis for curcumin and oleoresin have been done at NRCS

Dried samples of 31 cultivars of IET have been sent to Solan for curcumin analysis

Already recorded at Pottangi

Action is being taken accordingly

Action has already been initiated

Collection is being made at Pottangi

This will be done

Work on tree spices and pepper has been initiated at Yercaud as regular centre and Pampadumpara on voluntary basis

2. Discussion may be held with the tree spices breeder at NRCS, Calicut regarding elite tree identification.
3. The required scion and root stock materials of mother trees available at State Horticulture Farms, Kallar-Burlier and Courtallam may be used for vegetative propagation.
3. For the trials on drip irrigation and use of biofertilizers at Yercaud nutmeg grafts only has to be used

**CORIANDER**

1. A new MLT (MLT-1993) with entries UD-446 & UD-447 from Jobner, JCC-64 & JCo-123 from Jagudan, DH-36 & DH-38 from Hiser, ATP-77 & ATP-102 from Andhra Pradesh, CC-462-CC-964 from Tamil Nadu finalised at XII AICRPS Workshop
2. CYT for green (leaf) type will be laid out at Coimbatore, Iholi & Euntur centres with 12 entries
3. Samples of IET & MLT (1989) will be sent to TNAU Coimbatore for evaluation of varieties for oil content
4. Oil content may be estimated from germplasm accessions for identifying quality accessions. The centres will send samples to Coimbatore
5. The experimental procedure for screening coriander varieties against Meloidogyne incognita has to be adopted in the Jobner, Jagudan and Coimbatore centres uniformly

Discussion made regarding the identification procedures for elite tree spices

Necessary arrangement have been made for collection of scions of nutmeg for elite mother trees for establishing scion bank

This is being adopted

The MLT is being conducted in the current season at Jobner and in all the coriander centres

The CYT for green leafy type of coriander will be laid out in the current season

The directions will be followed

The oil content of germplasm will be estimated after harvest of crop in rabi 1993-94 at Jobner

The proper experimental procedure for screening of coriander varieties against Meloidogyne incognita is being adopted at Jobner.

6. The treatment in weed control, experiment may be modified
7. Mutation breeding in coriander will be undertaken at Coimbatore & Jobner centres
8. The weed control experiments at Jobner will continue for one more year

#### H. CUMIN

1. The ML1-I (1989) will be continued for one more year and performance evaluated (Jobner & Jagudan centres)
2. The wilt resistant lines (four Nos.) identified at Jagudan may be tested at Jobner. The materials will be supplied by Jagudan centre

#### I. FENNEL

1. The MLF-1991 will be continued for one more year and performance evaluated (Jobner, Jagudan & Hisar)
2. Weed control experiment in fennel at Jobner & Hisar may be modified

#### J. FENUGREEK

1. From the four years yield data of MLT I - 1989 at Jobner, yield during the poor season should be deleted and reanalysed to see if any worthwhile information can be derived

The treatment in weed control experiment were modified and data regarding weed flora are being recorded at Jobner.

The work has already been initiated

The decisions will be followed

The decision will be followed

Resistant lines received from Jagudan are being tested in sick plot in the year 1993-94 at Jobner

The directions are followed

Modifications were made in the experiment

The yield data of MLT 1989 were reanalysed by Jobner after deleting 1990-91 data

- |    |  |  |
|----|--|--|
| 2. | New MLT with entries viz., UM-143, UM-144 (Jobner) J.Fenu.149, J.Fenu.145 (Jagudan), HM-103 & HM-141 (Hisar), CF-169 & CF-390 (Tamil Nadu) was finalised and will be laid out at all Fenugreek centres | The new MLT is being conducted                     |
| 3. | The CYT for green leafy type of fenugreek will be laid out at Coimbatore   | The CYT for green leafy type of Fenugreek laid out |
| 4. | The IET will be continued for one more year at Coimbatore  | The directions are followed.                       |
| 5. | Mutation breeding should be initiated at Jobner and Coimbatore centres   | The studies will be intensified                    |
| 6. | In fenugreek Guntur and Coimbatore centres will work on vegetable type of fenugreek.   | The decisions were being followed.                 |

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ALL INDIA COORDINATED RESEARCH PROJECT ON SPICES

Centre wise and Head wise Annual Plan Allocation & Expenditure 1993-94

(Rs. in lakhs)

| Centre               | SALARY       |              |             | T.A.        |             |             | R.C.         |              |              | N.R.C.       |              |              | TOTAL  |      |
|----------------------|--------------|--------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------|------|
|                      | Alloc.       | Exp.         | Alloc.      | Exp.        | Alloc.      | Exp.        | Alloc.       | Exp.         | Alloc.       | Exp.         | Alloc.       | Exp.         | Alloc. | Exp. |
| Pampadumpore         | 2.15         | 2.94         | 0.20        | 0.07        | 0.45        | 0.25        | 0.05         | 0.05         | 0.05         | 0.05         | 3.25         | 3.31         |        |      |
| Mucigere             | 4.90         | 3.86         | 0.32        | 0.07        | 0.80        | 0.80        | 4.52         | 0.50         | 4.52         | 0.50         | 10.54        | 5.23         |        |      |
| Yercaud              | 1.70         | 1.30         | 0.12        | 0.07        | 0.40        | 0.40        | 5.07         | 4.93         | 5.07         | 4.93         | 7.29         | 6.70         |        |      |
| Panniyur             | 4.66         | 2.66         | 0.26        | 0.22        | 0.80        | 0.75        | 5.20         | 3.87         | 5.20         | 3.87         | 10.92        | 7.50         |        |      |
| Chintampalli         | 1.94         | 2.40         | 0.16        | 0.10        | 0.40        | 0.40        | 1.00         | --           | 1.00         | --           | 3.50         | 2.90         |        |      |
| Sirsi                | 1.58         | 1.13         | 0.14        | 0.10        | 0.40        | 0.35        | 2.20         | 1.46         | 2.20         | 1.46         | 4.32         | 3.04         |        |      |
| Solan                | 2.57         | 2.83         | 0.24        | 0.22        | 0.60        | 0.70        | 0.45         | 0.45         | 0.45         | 0.45         | 3.86         | 4.20         |        |      |
| Pottangi             | 1.94         | 1.78         | 0.18        | 0.18        | 0.40        | 0.40        | 6.55         | 5.00         | 6.55         | 5.00         | 9.07         | 7.36         |        |      |
| Jobner               | 5.16         | 4.90         | 0.40        | 0.40        | 1.0         | 0.99        | 5.00         | 5.00         | 5.00         | 5.00         | 11.56        | 11.29        |        |      |
| Guntur               | 1.94         | 1.47         | 0.10        | 0.03        | 0.40        | 0.35        | 0.11         | --           | 0.11         | --           | 2.55         | 1.85         |        |      |
| Vasudan              | 1.94         | 1.08         | 0.15        | 0.05        | 0.40        | 0.38        | 0.60         | 0.17         | 0.60         | 0.17         | 3.09         | 1.68         |        |      |
| Orinlatore           | 2.72         | 3.31         | 0.06        | 0.04        | 0.40        | 0.40        | --           | --           | --           | --           | 3.18         | 3.75         |        |      |
| Jogthel              | 1.58         | 1.48         | 0.04        | 0.04        | 0.40        | 0.40        | 0.65         | 0.23         | 0.65         | 0.23         | 2.67         | 2.15         |        |      |
| Hisser               | 0.82         | 0.16         | 0.08        | 0.08        | 0.20        | 0.19        | --           | --           | --           | --           | 1.10         | 0.43         |        |      |
| Dhoni                | 0.58         | NA           | 0.10        | NA          | 0.20        | NA          | --           | --           | --           | --           | 1.28         | NA           |        |      |
| <b>TOTAL</b>         | <b>36.98</b> | <b>31.30</b> | <b>2.55</b> | <b>1.67</b> | <b>7.25</b> | <b>6.76</b> | <b>31.40</b> | <b>21.66</b> | <b>31.40</b> | <b>21.66</b> | <b>78.18</b> | <b>61.39</b> |        |      |
| ICAR share (75%)     | 27.74        | 23.48        | 1.91        | 1.25        | 5.44        | 5.07        | 23.55        | 16.25        | 23.55        | 16.25        | 58.64        | 46.05        |        |      |
| Gangotri (100% ICAR) |              |              |             |             |             |             |              |              |              |              |              |              |        |      |
| Not communicated     |              |              |             |             |             |             |              |              |              |              |              |              |        |      |
| Govt share (25%)     | 9.24         | 7.82         | 0.64        | 0.42        | 1.81        | 1.69        | 7.85         | 5.41         | 7.85         | 5.41         | 19.54        | 15.34        |        |      |
| <b>Grand Total</b>   | <b>46.22</b> | <b>39.12</b> | <b>3.19</b> | <b>2.09</b> | <b>9.06</b> | <b>8.45</b> | <b>39.25</b> | <b>27.07</b> | <b>39.25</b> | <b>27.07</b> | <b>98.12</b> | <b>76.40</b> |        |      |

**STAFF STRENGTH**  
(as on 31-3-94)

**PROJECT COORDINATOR'S CELL  
NATIONAL RESEARCH CENTRE FOR SPICES  
CALICUT - KERALA**

|                               |   |                        |
|-------------------------------|---|------------------------|
| Project Coordinator           | : | AK Sadanandan          |
| Technical Information Officer | : | Johny A. Kallapurackal |
| Stenographer                  | : | P.V. Sali              |
| Supporting Staff              | : | K. Keeran              |

**COORDINATING CENTRES**

**1. CARDAMOM RESEARCH STATION, KAU, PAMPADUMPARA**

|                           |   |  |
|---------------------------|---|--|
| Entomologist              | : | Dr. Arthur Jacob J.                      |
| Soil Scientist/Agrocnmist | : | Mr. M. Murugan                           |
| Breeder                   | : | Smt. Maya Devi<br>(based at Ambalavayal) |
| Lab. Asst. Gr. I          | : | Vacant                                   |
| Farm Assistant            | : | C.G. Pradeep                             |
| Peon                      | : | Vacant                                   |

**2. REGIONAL RESEARCH STATION, UAS(B), MUDIGERE**

|                     |   |                            |
|---------------------|---|----------------------------|
| Breeder             | : | H.M. Chandrappa            |
| Agrocnmist (Hort.)  | : | S.M. Shanthaveerabhadraiah |
| Pathologist         | : | Vacant (from 15-5-93)      |
| Jr. Entomologist    | : | C. Parvathy                |
| Jr. Tech. Assistant | : | Narayana                   |
| Jr. Tech. Assistant | : | Mruthunjaya                |
| Messenger           | : | G. Venkatesh               |

**3. HORTICULTURAL RESEARCH STATION, TNAU, YERCAUD**

|                         |   |               |
|-------------------------|---|---------------|
| Asst. Professor (Hort.) | : | L. Pugalendhi |
| Jr. Breeder (Hort.)     | : | K. Manivannan |
| Lab. Assistant          | : | Vacant        |

**4. PEPPER RESEARCH STATION, KAU, PANNIYUR**

|                              |   |                     |
|------------------------------|---|---------------------|
| Assoc. Professor (Pl. Path.) | : | K.P. Mammooty       |
| Assoc. Professor (Pl. Path.) | : | Vacant              |
| Asst. Professor (Breeding)   | : | Vacant              |
| Asst. Professor (Agro.)      | : | Sri K.N. Satheeshan |
| Farm Asst. Gr. II            | : | K. Lakshmanan       |
| Farm Asst. Gr. I             | : | T. Muhammed Hameeda |
| Lab. Assistant               | : | Vacant              |
| Peon                         | : | M.P. Narayanan      |

5. REGIONAL AGRICULTURAL RESEARCH STATION, APAU, CHINTAPALLI

Horticulturist : M. Padma  
Plant Pathologist : V. Chiranjeevi  
Tech. Assistant : Vacant

6. AGRICULTURAL RESEARCH STATION, UAS(D), SIRSI

Jr. Horticulturist : P.M. Gangadharappa  
Jr. Pathologist : M.S. Lokesh  
Research Assistant : Nagesh Naik

7. DEPARTMENT OF VEGETABLE CROPS, YSPUHF, SOLAN

Breeder (Olericulturist) : B.N. Kerla  
Jr. Plant Pathologist : M.P. Dohra  
Jr. Biochemist : R.K. Goyal  
Jr. Tech. Assistant : S.L. Shankar Lal

8. HIGH ALTITUDE RESEARCH STATION, OUAT, POTTANGI

Breeder (Olericulturist) : D.C. Mohanty  
Jr. Breeder : D.K. Dash  
Sr. Tech. Assistant : Vacant  
Jr. Tech. Assistant : R.C. Dash

9. DEPARTMENT OF PLANT BREEDING, SKN COLLEGE OF AGRICULTURE, RAJAU, JOBNER

Sr. Breeder (Prof.) : R.K. Sharma  
Breeder : S.L. Dashra  
Asst. Agronomist (Hort.) : H.R. Agrawal  
Asst. Plant Pathologist : M.P. Jain  
Asst. Biochemist : S. Agarwal  
Sr. Tech. Asst. : Dharendra Singh  
Jr. Tech. Asst. : S.R. Kumawat

10. REGIONAL AGRICULTURAL RESEARCH STATION, APAU, GUNTUR

Jr. Breeder (Hort.) : N. Hariprasad Rao  
Horticulturist : Vacant  
Sub-Assistant : M. Sivakumar

11. SPICES RESEARCH STATION, GAU, JAGUDAN

Jr. Breeder (Hort.) : G.M. Patel  
Sr. Plant Pathologist : Vacant  
Jr. Tech. Assistant : B.G. Vaghela

12. DEPARTMENT OF SPICES & PLANTATION CROPS, TNAU, COIMBATORE

Breeder (Assoc. Professor) : R.S. Azhakiyamanavalan  
Jr. Pathologist : F. Salal Rajan  
Agriculture Assistant : V. Marimuthu

13. REGIONAL AGRICULTURAL RESEARCH STATION, APAU, JAGTIAL

Jr. Pathologist : M.A. Rahman  
Asst. Horticulturist : On study leave  
Tech.Asst/Sub-Asst. : Vacant

14. ICAR RESEARCH COMPLEX FOR NEH REGION, GANGTOK

Scientist S2 (Pl.Path.) : L.S. Srivastava  
Scientist S1 (Hort.) : On study leave

15. DEPT. OF VEGETABLE CROPS (CCS-HAU), HISAR

Olericulturist/Horticulturist : Nanda Kishore Sharma  
Asst. Scientist (VC) : Vacant

16. SPICES RESEARCH SCHEME (RAU), DHOLI

Horticulturist :  
Jr. Pathologist : Bimla Rai  
Tech. Assistant :

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## LIST OF PUBLICATIONS 1993-94

### POTTANGI

- Mohanty, D.C. and Panda, B.S. 1993 : Genetic resources in ginger. *Advances in Horticulture* No.9. Plantation Crops (1993) Eds. K.L.Chadha and P.Rethinam, Malhotra Publishing House, New Delhi
- Mohanty, D.C. 1994 : Adaeka Arthakari Phasela - Oriya - Ginger - A profitable cultivation, *Annapurna* Feb-Mar 1994. pp. 4-5.

### YERCAUD

- Kumar, N., Thamburaj, S. and Manivannan, K. 1993 : Clove requires initial training, *Spice India* V. 6(2) : 5.
- Kumar, N., Abdul Khader, J.B.M., Rangaswamy, P. and Irulappan, I. 1993 : Introduction of Spices, Plantation Crops, medicinal and aromatic plants, Rajalakshmi publications, Nagercoil.

### MUDIGERE

- Parvathi, C., Shadakshari, Y.C., Belavadi, V.V. and Chandrappa, H.M. 1993. Foraging behaviour of honey bees on cardamom (Elettaria cardamomum Maton). In. Pollination in Tropics (1993) Eds. G.K. Veeresh, R. Muashankar and K.N. Ganeshaiah, IUSSI, Indian Chapter, Bangalore pp. 241-243.
- Belavadi, V.V. and Parvathi, C., 1993. Landing and departure decisions used by honeybees on cardamom (Elettaria cardamomum Maton). In. Pollination in Tropics (1993) Eds. G.K. Veeresh, R. Umashankar and K.N. Ganeshaiah, IUSSI Indian Chapter, Bangalore pp. 73-76.

Belavadi, V.V. Chandrappa, H.M. Shadakshari, Y.C. and Parvathi, C. 1993 : Isolation distance for seed gardens of Cardamom (Elettaria cardamomum Maton.) In : Pollination in Tropics (1993). Eds. G. K. Veeresh, R. Umashankar and K.N. Ganeshaiah, IUSSI, Indian Chapter, Bangalore pp. 241-243.

Parvathi, C. and Belavadi, V.V. 1994. Seasonal incidence of Anarsia achrasella (Lepidoptera gelechiidae) and the significance of its damage to Sapota. International Journal of Pest Management (In press).

#### Bock

Shanthaveerabhadraiah, S.M. and Chandrappa, H.M. 1994. Elakki (Cardamom) (in Kannada) pp. 60.

#### SOLAN

Dohroo, N.P. 1994. Ginger Biocontrol of rhizome rot. The Tribune, April 7.

Goyal, R.K. and Korla, B.N. 1993 : Changes in the quality and quantity of ginger rhizomes during development. Nat. Semi. on Post Harvest Technology of Spices 13-14 May, 1993, Trivandrum

Korla, B.N. and Goyal, R.K. 1993. Evaluation of ginger germplasm for quality attributes under mid hill conditions of H.P. Nat. Sem. on Post Harvest Technology of Spices, 13-14 May, 1993, Trivandrum

Korla, B.N., Rattan, R.S. and Dohroo, N.P. 1992. Performance of ginger cultivars under mid-hill conditions of H.P. J. Hill Res. 5(2) 136-138.

PAMPADUMPARA

Abraham, C.T., Salin, N.B. and Jain, M. 1993. Application of Biotechnology for weed management, Proc. Int. Symp. on Integrated Weed Management for Sustainable Agriculture 18-20 November, 1993. HAU, Hisar pp. 209-220.

JOBNER

Agrawal, S. and Gour H.N. 1993: Antifungal substances in the essential oil of cumin (Cuminum cyminum L.). In Proc. of Nat. Semi. on exploration of indigenous raw materials for essential oil industry (edited by D.V. Singh et. al.) CIMAP Lucknow pp. 102-106.

Chaudhary, G.R. and Gupta, O.P. 1994 : Effect of sowing methods, nitrogen application and weed control on nutrient uptake by cumin crop. Haryana J. Agron. (under print).

Chaudhary, G.R. and Sharma, R.K. 1994 : Some aspects of improvemental strategies and productivity of seed spices. Plant Productivity under Environmental Stresses (under print).

Rajendra Singh and Chaudhary, G.R. 1992. Effect of weed control and Phosphorus on yield and yield attributes of green gram (Phaseolus radiatus). Indian J. Agron. 37(2) : 373-374.

Sharma, R.K. 1992 : Collection, evaluation and maintenance of germplasm in annual spices. Recent Advances in Medicinal & Aromatic and Spices Crops : 2 : 355-360.

Sharma, R.K. 1993 : Genetic resources of seed spices 'Spices in India' Edited by K.L.Chadha & S. Retinam (In press).

Singh, B., S.L. Dashora, R.K. Sharma & E.V.D.Sastry. 1992 :  
Gamma rays induced variation in coriander (Coriandrum  
sativum) Ind. Cocoa Arecanut & Spices J. 16 : 60-62.

SIRSI

Lokesh, M.S. 1994 : Phytophthora foot rot and nematode disease  
management. In : Nat. Seminar on diseases of Spices.  
7 April, 1994, Calicut.

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# WEATHER DATA 1993

Centre : Coimbatore

Latitude : 11°N  
Longitude : 77°E  
Altitude : 427m MSL  
Soil type : Black clay loam

| Month | Monthly rainfall (mm) | Rainy days (No.) | Mean temp (°C) |      | Mean RH(%) |
|-------|-----------------------|------------------|----------------|------|------------|
|       |                       |                  | Max.           | Min. |            |
| Jan   | Nil                   | Nil              | 31.0           | 13.6 | 80         |
| Feb   | Nil                   | Nil              | 32.2           | 14.3 | 70         |
| Mar   | 14.0                  | 3                | 35.2           | 19.5 | 65         |
| Apr   | 10.0                  | 1                | 36.3           | 23.1 | 82         |
| May   | 55.6                  | 4                | 35.8           | 23.8 | 82         |
| Jun   | 21.9                  | 4                | 32.8           | 23.8 | 75         |
| Jul   | 30.5                  | 2                | 31.1           | 23.2 | 71         |
| Aug   | 28.9                  | 4                | 31.9           | 22.8 | 78         |
| Sep   | 24.3                  | 3                | 32.5           | 21.0 | 83         |
| Oct   | 154.5                 | 12               | 30.5           | 22.3 | 89         |
| Nov   | 248.7                 | 11               | 28.5           | 21.1 | 89         |
| Dec   | 29.1                  | 5                | 27.7           | 19.5 | 88         |
| Total | 617.5                 | 49               |                |      |            |

Centre : Mudigere

Latitude : 13°50'N  
Longitude : 75°39'E  
Altitude : 1175m MSL  
Soil type : Sandy loam

| Month | Monthly rainfall (mm) | Rainy days (No.) | Mean temp (°C) |      | Mean RH(%) |
|-------|-----------------------|------------------|----------------|------|------------|
|       |                       |                  | Max.           | Min. |            |
| Jan   | Nil                   | Nil              | 29.2           | 13.2 | 93         |
| Feb   | Nil                   | Nil              | 30.0           | 14.0 | 91         |
| Mar   | 5.4                   | Nil              | 31.0           | 16.6 | 92         |
| Apr   | 36.8                  | 5                | 31.6           | 17.3 | 94         |
| May   | 128.2                 | 9                | 31.0           | 18.3 | 94         |
| Jun   | 558.0                 | 17               | 25.6           | 19.1 | 98         |
| Jul   | 584.2                 | 27               | 23.9           | 18.5 | 95         |
| Aug   | 386.2                 | 19               | 24.0           | 18.3 | 96         |
| Sep   | 114.8                 | 10               | 25.2           | 17.9 | 96         |
| Oct   | 244.2                 | 18               | 26.4           | 18.3 | 95         |
| Nov   | 7.8                   | 1                | 27.5           | 17.4 | 92         |
| Dec   | 26.4                  | 3                | 27.3           | 13.4 | 90         |
| Total | 2092.2                | 109              |                |      |            |

## Centre . Yercaud

Latitude- 11.4°N  
 Longitude 78.5°E  
 Altitude- 1450m MSL  
 Soil-type Clay-loam

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | Nil                         | Nil                    | 21.8           | 10.4 | 49            |
| Feb   | Nil                         | Nil                    | 24.0           | 13.9 | 56            |
| Mar   | Nil                         | Nil                    | 27.6           | 16.5 | 48            |
| Apr   | 13.6                        | 2                      | 28.3           | 17.1 | 61            |
| May   | 127.0                       | 8                      | 21.9           | 16.9 | 66            |
| Jun   | 215.4                       | 8                      | 26.1           | 16.4 | 65            |
| Jul   | 160.5                       | 8                      | 25.5           | 16.1 | 65            |
| Aug   | 221.9                       | 9                      | 25.8           | 15.9 | 65            |
| Sep   | 248.6                       | 11                     | 25.2           | 16.0 | 62            |
| Oct   | 258.5                       | 15                     | 24.2           | 15.5 | 69            |
| Nov   | 422.4                       | 10                     | 23.6           | 13.5 | 70            |
| Dec   | 229.9                       | 7                      | 23.1           | 11.2 | 64            |
| Total | 1897.8                      | 78                     |                |      |               |

## Centre : Panniyur.

Latitude : 12.5°N  
 Longitude : 74.55°E  
 Altitude : 95m MSL  
 Soil type : Laterite

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean-temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min  |               |
| Jan   | Nil                         | Nil                    | 34.9           | 18.6 | 76            |
| Feb   | Nil                         | Nil                    | 35.9           | 19.9 | 73            |
| Mar   | Nil                         | Nil                    | 36.4           | 22.5 | 75            |
| Apr   | 109.2                       | 10                     | 37.6           | 24.1 | 74            |
| May   | 754.6                       | 23                     | 37.8           | 24.0 | 77            |
| Jun   | 1260.2                      | 29                     | 31.3           | 23.6 | 91            |
| Jul   | 555.8                       | 26                     | 29.2           | 22.6 | 93            |
| Aug   | 64.6                        | 12                     | 31.1           | 22.7 | 90            |
| Sep   | 255.8                       | 19                     | 31.2           | 22.4 | 88            |
| Oct   | 204.8                       | 10                     | 33.2           | 22.6 | 90            |
| Nov   | 62.4                        | 4                      | 33.4           | 22.2 | 87            |
| Dec   | Nil                         | Nil                    | 33.5           | 20.7 | 84            |
| Total | 3267.4                      | 133                    |                |      |               |

## Centre : Sirsi

Latitude : 14°36'N  
 Longitude : 74°50'E  
 Altitude : 619m MSL  
 Soil type : Laterite

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | Nil                         | Nil                    | NA             | NA   | NA            |
| Feb   | Nil                         | Nil                    |                |      |               |
| Mar   | 4.3                         | 1                      |                |      |               |
| Apr   | 11.3                        | 1                      |                |      |               |
| May   | 52.0                        | 3                      |                |      |               |
| Jun   | 309.5                       | 20                     |                |      |               |
| Jul   | 974.1                       | 25                     |                |      |               |
| Aug   | 511.6                       | 22                     |                |      |               |
| Sep   | 77.7                        | 9                      |                |      |               |
| Oct   | 302.2                       | 16                     |                |      |               |
| Nov   | 42.8                        | 2                      |                |      |               |
| Dec   | 67.5                        | 1                      |                |      |               |
| Total | 2353.0                      | 100                    |                |      |               |

## Centre : Chintapalli

Latitude : 17°52'N  
 Longitude : 82°14'E  
 Altitude : 818m MSL  
 Soil type : Clay loam

| Months | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|--------|-----------------------------|------------------------|----------------|------|---------------|
|        |                             |                        | Max.           | Min. |               |
| Jan    | Nil                         | Nil                    | 26.3           | 9.8  | 96            |
| Feb    | Nil                         | Nil                    | 27.5           | 11.5 | 93            |
| Mar    | 21.2                        | 2                      | 29.9           | 11.0 | 87            |
| Apr    | 62.4                        | 4                      | 32.0           | 18.1 | 90            |
| May    | 127.6                       | 8                      | 33.6           | 21.6 | 86            |
| Jun    | 79.2                        | 10                     | 29.3           | 22.6 | 83            |
| Jul    | 79.2                        | 18                     | 26.0           | 21.0 | 83            |
| Aug    | 245.5                       | 13                     | 25.3           | 21.7 | 86            |
| Sep    | 200.7                       | 13                     | 26.3           | 20.2 | 92            |
| Oct    | 94.1                        | 9                      | 26.3           | 19.2 | 92            |
| Nov    | 5.0                         | 1                      | 25.6           | 13.0 | 89            |
| Dec    | Nil                         | Nil                    | 24.6           | 9.6  | 87            |
| Total  | 1036.8                      | 78                     |                |      |               |

Centre : Solan

Latitude : 30.5°N  
 Longitude : 77.8°E  
 Altitude : 1000m MSL  
 Soil type : Loam

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | 117.6                       | 7                      | 15.7           | 2.1  | 69            |
| Feb   | 66.4                        | 6                      | 20.6           | 5.8  | 59            |
| Mar   | 100.4                       | 7                      | 20.2           | 6.2  | 59            |
| Apr   | 5.2                         | 1                      | 27.7           | 11.3 | 45            |
| May   | 24.5                        | 4                      | 32.7           | 16.3 | 43            |
| Jun   | 130.0                       | 10                     | 31.5           | 19.5 | 63            |
| Jul   | 305.8                       | 10                     | 27.5           | 19.9 | 83            |
| Aug   | 45.0                        | 6                      | 29.1           | 19.5 | 78            |
| Sep   | 183.4                       | 11                     | 26.5           | 17.3 | 84            |
| Oct   | Nil                         | Nil                    | 26.4           | 10.1 | 52            |
| Nov   | 9.3                         | 1                      | 23.9           | 7.3  | 58            |
| Dec   | Nil                         | Nil                    | 20.8           | 3.6  | 59            |
| Total | 987.6                       | 63                     |                |      |               |

Centre : Pottangi

Latitude : 18°34'N  
 Longitude : 82°52'E  
 Altitude : 917m MSL  
 Soil type : Sandy loam

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | Nil                         | Nil                    | 24.3           | 20.3 | 66            |
| Feb   | Nil                         | Nil                    | 23.2           | 22.6 | 61            |
| Mar   | 38.0                        | 3                      | 26.7           | 23.0 | 65            |
| Apr   | 77.1                        | 8                      | 27.4           | 24.9 | 63            |
| May   | 99.5                        | 9                      | 31.8           | 27.4 | 60            |
| Jun   | 57.9                        | 6                      | 29.2           | 26.7 | 71            |
| Jul   | 312.2                       | 19                     | 26.6           | 25.8 | 80            |
| Aug   | 224.5                       | 16                     | 26.0           | 24.2 | 82            |
| Sep   | 312.5                       | 18                     | 26.6           | 24.8 | 82            |
| Oct   | 185.5                       | 15                     | 26.0           | 24.2 | 81            |
| Nov   | 1.6                         | 1                      | 26.6           | 23.1 | 68            |
| Dec   | Nil                         | Nil                    | 25.5           | 23.0 | 62            |
| Total | 1308.8                      | 95                     |                |      |               |

Centre : Pampadumpara

Latitude : 9°45'N  
 Longitude : 7°10'E  
 Altitude : 1100m MSL  
 Soil type : Forest loam

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | Nil                         | Nil                    | 25.0           | 13.0 | NA            |
| Feb   | 84.2                        | 4                      | 28.0           | 15.0 |               |
| Mar   | 32.0                        | 3                      | 30.0           | 16.0 |               |
| Apr   | 22.0                        | 2                      | 31.0           | 17.0 |               |
| May   | 98.2                        | 6                      | 32.0           | 16.0 |               |
| Jun   | 242.0                       | 22                     | 27.5           | 18.0 |               |
| Jul   | 348.1                       | 28                     | 23.0           | 16.0 |               |
| Aug   | 214.2                       | 24                     | 25.0           | 17.0 |               |
| Sep   | 67.2                        | 14                     | 28.0           | 17.0 |               |
| Oct   | 215.2                       | 16                     | 27.0           | 16.0 |               |
| Nov   | 323.0                       | 16                     | 24.0           | 16.0 |               |
| Dec   | 49.4                        | 8                      | 24.0           | 14.0 |               |
| Total | 1695.5                      | 143                    |                |      |               |

Centre : Jagtial

Latitude : 18°49'N  
 Longitude : 78°56'E  
 Altitude : 243m MSL  
 Soil type : Clay loam

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | Nil                         | Nil                    | 31.0           | 13.6 | 80            |
| Feb   | Nil                         | Nil                    | 32.2           | 14.3 | 70            |
| Mar   | 14.4                        | 3                      | 35.2           | 19.5 | 65            |
| Apr   |                             |                        |                |      |               |
| May   |                             |                        |                |      |               |
| Jun   |                             |                        |                |      |               |
| Jul   | NA                          |                        |                |      |               |
| Aug   |                             |                        |                |      |               |
| Sep   |                             |                        |                |      |               |
| Oct   |                             |                        |                |      |               |
| Nov   |                             |                        |                |      |               |
| Dec   |                             |                        |                |      |               |
| Total |                             |                        |                |      |               |

Centre : Jobner

Latitude : 26°5'N  
 Longitude : 75°E  
 Altitude : 427  
 Soil type : Sandy loam

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | Nil                         | Nil                    | 22.5           | 5.0  | 86            |
| Feb   | Nil                         | Nil                    | 26.8           | 7.3  | 51            |
| Mar   | Nil                         | Nil                    | 37.3           | 12.8 | 73            |
| Apr   | 6.5                         | 2                      | 35.5           | 19.9 | 18            |
| May   | Nil                         | Nil                    | 40.6           | 25.9 | 28            |
| Jun   | 91.0                        | 8                      | 39.4           | 27.1 | 34            |
| Jul   | 335.8                       | 16                     | 33.1           | 24.7 | 64            |
| Aug   | 30.3                        | 3                      | 34.3           | 24.5 | 59            |
| Sep   | Nil                         | Nil                    | 33.4           | 22.8 | 50            |
| Oct   | 12.5                        | 1                      | 33.8           | 12.5 | 28            |
| Nov   | Nil                         | Nil                    | 29.6           | 9.8  | 26            |
| Dec   | Nil                         | Nil                    | 25.4           | 4.2  | 34            |
| Total | 476.1                       | 30                     |                |      |               |

Centre : Jagudan

Latitude : 23.52°N  
 Longitude : 72.3°E  
 Altitude : 91m MSL  
 Soil type : Sandy loam

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | Nil                         | Nil                    | 23.3           | 15.4 | NA            |
| Feb   | 1.6                         | 1                      | 26.1           | 16.3 | NA            |
| Mar   | Nil                         | Nil                    | 34.2           | 21.6 | NA            |
| Apr   | Nil                         | Nil                    | 38.5           | 25.6 | NA            |
| May   | Nil                         | Nil                    | 41.8           | 28.7 | NA            |
| Jun   | 100.0                       | 1                      | 40.5           | 27.7 | NA            |
| Jul   | 493.7                       | 9                      | 34.8           | 28.2 | NA            |
| Aug   | 32.0                        | 1                      | 35.4           | 37.1 | NA            |
| Sep   | 82.7                        | 3                      | 35.4           | 27.6 | NA            |
| Oct   | 166.5                       | 4                      | 34.5           | 27.4 | NA            |
| Nov   | Nil                         | Nil                    | 32.6           | 23.1 | NA            |
| Dec   | Nil                         | Nil                    | 28.1           | 25.6 | NA            |
| Total | 894.5                       | 19                     |                |      |               |

Centre : Guntur

Latitude : 16.18°N  
 Longitude : 80.29°E  
 Altitude : 32m MSL  
 Soil type : Black clayey

| Month | Monthly<br>rainfall<br>(mm) | Rainy<br>days<br>(No.) | Mean temp (°C) |      | Mean<br>RH(%) |
|-------|-----------------------------|------------------------|----------------|------|---------------|
|       |                             |                        | Max.           | Min. |               |
| Jan   | Nil                         | Nil                    | 31.2           | 15.1 | 95            |
| Feb   | Nil                         | Nil                    | 32.9           | 17.6 | 90            |
| Mar   | 2.6                         | 1                      | 36.1           | 21.6 | 92            |
| Apr   | 2.8                         | 1                      | 38.7           | 24.4 | 81            |
| May   | 83.7                        | 3                      | 40.1           | 26.0 | 71            |
| Jun   | 67.7                        | 5                      | 39.8           | 25.4 | 75            |
| Jul   | 186.9                       | 12                     | 34.8           | 25.1 | 81            |
| Aug   | 50.1                        | 4                      | 35.7           | 25.6 | 77            |
| Sep   | 67.1                        | 7                      | 34.8           | 23.6 | 86            |
| Oct   | 267.4                       | 12                     | 33.0           | 22.9 | 91            |
| Nov   | 4.1                         | 1                      | 31.9           | 16.7 | 91            |
| Dec   | 28.8                        | 4                      | 29.3           | 15.9 | 89            |
| Total | 791.2                       | 49                     |                |      |               |

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