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Research Highlights 1981

CENTRAL PLANTATION CROPS RESEARCH INSTITUTE
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RESEARCH HIGHLIGHTS 1981

Central Plantation Crops Research Institute
Kasaragod 670 124, Kerala, India

Published by

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INTRODUCTION

Central Plantation Crops Research Institute is one of the thirty eight institutes under the Indian Council of Agricultural Research, established in 1970, reorganising the research activities of the erstwhile Central Coconut Research Stations at Kasaragod and Kayangulam and the Central Arecanut Research Station at Vittal as well as its sub-stations. Though the crops researched originally were coconut and arecanut, in subsequent years, research on cashew, cacao, oil palm, and spices like pepper, cardamom, ginger, turmeric, nutmeg, clove and cinnamon were added on. At present the Institute conducts crop improvement research on 12 plantation crops and spices. The Institute is also responsible for co-ordinating the research work on plantation crops conducted by other institutes, universities and state departments of agriculture and servicing the All India Co-ordinated Crop Improvement Projects on Coconut and Arecanut and Spices and Cashewnut. The production and distribution of foundation stocks of quality planting materials in all these crops as well as serving as a centre of information and centre of excellence pertaining to all matters related to these crops are the other functions of the Institute.

India produces 16.7% of world's coconut, 94.5% of arecanut, 25.5% of cashew, 16.8% of pepper, 66.3% of cardamom, 66.5% of ginger and 88.5% of turmeric. However, the unit area production of all these crops in the country is one of the lowest. As such, CPCRI's task is to develop suitable production technology for plantation crops so as to enhance the per unit area productivity of the crops in the farmer's field and thereby the overall production in the country.

This publication summarises the salient features of the research findings of CPCRI during 1981.

K. V. Ahamed Bavappa
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Kasaragod,
15—5—1982.

COCONUT

Establishing a World Coconut Germplasm Centre

Survey and collection of coconut germplasm in Polynesia, Micronesia and Melanesia group of islands were undertaken during the year with the financial assistance received from the IBPGR. The survey team visited Solomon Islands, Fiji, American Samoa, Western Samoa, Tonga and French Polynesia and collected about 2,500 nuts belonging to 21 Tall and three Dwarf types. These include collections such as Rennel Tall, Solomon Tall, Fiji Tall, Samoan Tall, Tahiti Tall, Rangiroa Tall, Dwarf Yellow (American Samoa), Dwarf Orange (Rangiroa–also known as Hari-Papua) and Niuleka (Dwarf : Fiji). Two tall types Niu Bulendrau (Fiji) and Takove (Tonga) having large number of small nuts (comparable to Laccadive Micro) were also collected. The nuts were sown in Andamans at the World Coconut Germplasm Centre being established by the Institute.

Heritabilities and correlation studies in coconut

Path coefficient analysis for cumulative yield of nuts in coconut revealed that the average number of female flowers, number of functioning leaves and internodal distance at the fixed mark have high direct effect with the yield of nuts once the yield stabilises (21-24 years). Time taken for flowering and total leaf production during the first three years showed a high heritability, thereby suggesting the importance of these characters, for the selection programme in coconut.

An index for evaluating the coconut germplasm in the nursery based on the mean values and the CV for growth characters was developed. This index is also useful in selecting palms for *inter se*, depending upon the selection pressure to be applied.

Fertiliser requirements of coconut under rainfed conditions

West Coast Tall (WCT) palms growing in sandy loam soil under rainfed condition did not respond favourably to fertiliser dose higher than 500g N + 500g P_2O_5 + 1500g K_2O/palm/year. There was no improvement in productivity of the CDO (Chowghat Dwarf orange) × WCT hybrid, when the fertiliser dosage was increased above 500 g N + 500 g P_2O_5 + 1000g K_2O/palm/year. However, the yield of the reciprocal hybrid WCT × CDO increased from 50 to 58 nuts and that of high yielding WCT from 50 to 62 nuts when the fertiliser dosage was doubled.

Effect of moisture stress on copra content

Copra content of nuts collected in October from palms receiving both irrigation and fertilisers was 167g/nut whereas it was only 114g/nut in those receiving fertilisers without irrigation. Field experiments on irrigation schedule for young coconut during the early years under different soil types have established that irrigation with 45 l of water once in 4 days was the best.

Beneficial effect of organic manures

Continuous addition of organic manures with NPK fertilisers had a

definite additive effect on growth characters like plant height and leaf production of coconut over NPK application alone. The addition of organic manures also helped in early and enhanced flowering and reduced the mortality rate.

Available N status in soil was not influenced until sixth year of treatment in spite of increase in organic matter content. From the seventh year onwards significant differences were observed in available N also. The organic carbon level of soil was raised from 0.07 to 0.22 per cent. A build up of available P and K was also noticed in organic blended treatments. The initial water holding capacity significantly increased from an average value of 20.4% to 25.7%, 26%, 26.2% and 27.5% in plots treated with coconut sheddings, forest leaves, cattle manure and coir dust respectively. Moisture retention curves for treatments revealed increased retention and availability of water in plots treated with organic sources. The bulk density value of the surface soil showed a decreasing trend with the increasing values of organic carbon in organic matter treated plots.

The information available from the present investigation suggests that the organic sources could efficiently be utilised for effective establishment of coconut gardens in coastal areas. Of the organic sources compared, forest leaves and cattle manure seemed to be the best and coir dust and coconut sheddings could also profitably be utilized for successful establishment and better performance of coconut in coastal sands.

Production physiology in coconut

In palms, the leaf area and leaf area index were found significantly correlated with annual yield of nuts ($r=0.7$). A palm yielding about 50 nuts annually produced about 68 kg of dry matter annually, excluding the trunk.

The rate of apparent photosynthesis (which had been found significantly related to annual yield of nuts) was more directly related to chlorophyll-a than to the total chlorophyll content. The T×D hybrids showed 15% increased rate of apparent photosynthesis over the WCT and the Dwarf parents. A study on the contribution of nut for its own development indicated that the photosynthetic pigments on the husk of the developing nuts contributed, though in a small measure, to the nut development. When developing nuts were covered with black cloth, there was a 12% reduction in the dry weight of husk, 6% in the shell dry weight and about 11% in the kernel dry weight. The chlorophyll pigments were reduced by about 65%.

Northward spread of root (wilt) disease in Kerala

A rapid survey of coconut gardens in Trichur District between the Karuvannoor river and the Bharathapuzha river particularly along the waterways and low lying areas indicated further northward spread of the root (wilt) disease from the Northern border of disease affected tract identified earlier. The disease was located in nine villages at distances varying from 15 to 45 km away

from the earlier border, and its frequency ranged from a single palm to 18 palm per garden.

Coconut situation in India

Area under coconut in India has increased from 0.6 million hectares in 1949-50 to 1.1 million hectares in 1979-80 and its production increased from 3,448 million nuts to 5,830 million nuts during the same period. The increase in production (69%) has been mainly attributed to almost 100 per cent increase in area under coconut during the last three decades. The yield per hectare showed a gradual increase from 5,785 nuts in 1949-50 to 7,012 nuts in 1953-54 and then came down to the all time low level of 5,121 nuts in 1977-78. However since then, the yield/ha has steadily increased to 5,127 nuts in 1978-79 and 5,438 nuts in 1979-80.

A manually operated coconut dehusker

A manually operated coconut dehusker has been developed. An out-turn of 500, 1,600 and 3,000 nuts can be obtained by one, two and three operators, respectively. The operation with two or three workers is easy and efficient as compared to a single worker.

Tissue culture for clonal multiplication of coconut

Tissue culture for clonal multiplication of coconut has been initiated. Rachilla explants taken from the immature spathe of the first open leaf axil of an adult WCT palm showed the formation of shoot-like structures in 50% of the flower primordia. Slow growing callus were obtained from tender leaf bases, inner spathe of spadix and parts of apical meristems, though sub-culturing of this callus has not given continuous growth so far. By rapid transfer of sprouted embryos of WCT in liquid media using filter paper supports, it has been possible to obtain adequate root growth. However, attempts to transplant the seedlings to the soil have not so far been successful.

ARECANUT

Changes in soil composition due to application of organic manures

In the study on the composition changes in soil and plant by continuous use of fertilisers, manures and cultural practices, soil from treatments receiving organic manures was found to contain significantly higher organic carbon (upto 1.29%) and soil pH (upto 7.25) than in soil receiving inorganic fertilisers alone (upto 0.8% organic carbon and 5.5 pH).

Indexing yellow leaf disease

A formula for indexing the intensity of the yellow leaf disease of arecanut was evolved, *i. e.*,

$$I = \left(\frac{Y + N}{L/2} + R \right)^{10}$$

Where I = index; Y = scoring for yellowing of leaves; N = scoring for necrosis of leaves; R = scoring for reduction in size of crown and L = total number of leaves.

Arecanut garden slug – a predisposing agent for inflorescence caterpillar attack

The arecanut garden slug whose damage is a predisposing factor for

infection by the inflorescence caterpillar *Thirathaba mundella* Walk. was identified as *Mariaella dussumieri*. Correlation study between the slug damage and caterpillar incidence revealed significantly positive correlation ($r = 0.56^{**}$).

Arecoline content of some cultivars

Nine varieties of *Areca catechu* and three related species were evaluated for their arecoline content.

Maximum amount of arecoline was found in VTL-14 (0.38 mg), VTL-3 and VTL-22 (0.31 mg each) (all *A. catechu*) and in exotic species like *Areca macrocalyx* (0.89 mg), *Areca triandra* (0.68 mg) and *Areca normanbii* (0.61 mg) per 100g dry weight.

CASHEW

Vegetative propagation

Studies on the vegetative propagation methods in cashew have been concluded. The success percentage and optimum period to adopt different propagation techniques are presented in Table 1.

Of late, the technique of epicotyl grafting has been perfected for cashew and is found a far superior technique with high percentage of 'take' (50%) and cent per cent field establishment.

Forecasting yield

A study carried out for three years on cashew for standardising the technique for prediction of yield, showed that with a single observation of seven biometrical characters, during the peak flowering period, yield forecast can be made with an $R^2 = 0.64$. The number of variables could be brought down to two, *viz.*, count of tender nuts in the tree and the condition of flowering; without substantially affecting the accuracy of the estimate.

CACAO

Biology of mealy bug

The nymphal stage of mealy bug (*Planococcus lilacinus* Ckll.) lasted for 20-25 days in females and 17-20 days in males. Males had a pupal period of 4-5 days. A rearing technique was standardised for culturing the mealy bug in laboratory using ripe pumpkin and sprouted potato tubers. Studies on the population dynamics showed that the lowest mealy bug population existed during June to August (3.01-10.88%) and the peak levels during April to May (48.12-60.48%). Highly significant positive correlation existed between temperature and mealy bug population ($r = 0.79^{**}$), and significant negative correlation ($r = 0.51$) between rainfall and bug population.

SPICES

Black pepper

A crossing technique for pepper

A crossing technique using rooted lateral branches of pepper and planting them in the pots to establish a clonal crossing block of dwarfed plants, has been standardised. For rooting, the laterals were separated, kept in 500 ppm IBA overnight and planted in a rooting medium. These laterals started

Table 1. *Success percentage and optimum period for adopting vegetative propagation in cashew*

Months	Techniques				
	A	B	C	D	E
August	32.0	17.5	7.0	1.0	41.0
September	28.0	17.5	19.0	9.5	55.0
October	40.0	19.0	15.0	4.5	54.0
November	24.0	13.0	54.0	8.0	60.0
December	16.0	5.5	50.0	5.0	66.0
January	15.5	5.0	12.5	18.0	72.0
February	9.0	3.5	15.0	25.0	80.0
March	0.5	1.5	13.5	39.0	86.0
April	5.0	7.5	60.0	41.0	80 0
May	22.0	18.0	75.0	40.0	86.0
June	41.0	16.5	52.0	40.0	35.0
July	51.0	20.0	55.0	16.0	13.0
Mean	26.62	12.04	34.83	20.58	60.66
CD (5%)	6.72 (months)			4.26 (technique)	

A = Veneer grafting in polybags
B = Side grafting *in situ*
C = Patch budding *in situ*
D = Patch budding in polybags
E = Air layering

flowering after 2-3 months of establishing in pots and produced number of spikes in the ensuing flowering season. For artificial pollination, protogyny was made use of wherever possible. The spikes were bagged and when the stigma became receptive, pollination was carried out by applying a pollen suspension (prepared by crushing a few fully mature anthers in water) on to the mature receptive stigma, using a soft brush. In cultivars whose male and female flowers open simultaneously, the emasculation was carried out by fine pointed needles before the emergence of anthers. This technique facilitates crossing work in pepper under controlled conditions throughout the year.

Screening technique to assess the resistance of pepper cultivars to Phytophthora

Among the stem, root and leaf inoculation techniques compared to assess the relative tolerance/susceptibility of pepper cultivars to *Phytophthora palmivora,* stem inoculation technique was found to be more efficient.

Out of 4,247 seedlings from eight cultivars screened so far by the root inoculation technique, none was found resistant to the pathogen. In addition, 42 cultivars and 73 *Piper* accessions were also found susceptible. Some degrees of tolerance has been found in Narayakodi, Kalluvally and Uthirankotta cultivars.

Epidemiology of collar infection of Phytophthora

From a study of the soil particles sticking on to the pepper vines at the basal portions at different heights, it was found that the amount of soil sticking was maximum at 25 cm height and it

gradually reduced as the height increased. The percentages of infection of castor baits by the pathogen *(Phytophthora palmivora)* were 27.5 and 12.5 from the soil particles collected at 25 cm and 50 cm heights of vines respectively. No infection of castor baits occurred from soil particles collected at 75 cm and above. This observation shows that the basal portions of the vines upto 75 cm are to be protected well for preventing infection by *P. palmivora,* since the collar infection is generally fatal to the vine.

Endosulfan to control 'pollu' beetle

Among nine insecticides used against 'pollu' beetle *(Longitarsus nigripennis)* and top shoot borer *Cydia (Laspeyresia) hemidoxa,* endosulfan 0.05% could reduce the incidence of 'pollu' beetle by 90.0% and top shoot borer by 67.0% over control.

A screening technique for assessing tolerance of pepper cultivars to root-knot nematode

A screening technique in pepper cultivars/accessions for assessing resistance/tolerance to root-knot nematodes *Meloidogyne incognita* has been standardised. Cuttings of black pepper hybrid Panniyur-1 were raised in sterilized soil in polythene bags. They were inoculated with freshly hatched second stage larvae of *M. incognita* @ 100, 250, 500, 1000 and 2000 second stage juveniles/cutting. At 2, 3, 4, 5 and 6 months after inoculation the root-knot index was recorded. The results showed that the root-knot index at four months after inoculation with an inoculum of 1000 second stage juveniles/cutting was four, and was considered optimum for rating the cultivars/accessions.

A total of 45 pepper cultivars/accessions were screened for their reaction to root-knot nematode. Accessions VTP 531, VTP 238, VTP 663, and VTP 431 (all wild types) had root-knot index of 3 or less and were considered tolerant to the root-knot nematode. All other cultivars/accessions had index of more than 3 and considered susceptible.

Quality evaluation of pepper cultivars

Mature and dry berries from 29 cultivars of black pepper were analysed for their quality components, *viz.,* oleoresin, piperine, volatile oil and starch contents. Results indicated that volatile oil ranged from 0.40 to 5.5% (v/W). Most of the cultivars had 3-5% volatile oil content. The maximum oil content was in Nilgiris (5.5%), followed by Balankotta (5.1%), Arakulam and Arikottanadan (4.8%) each. Oleoresin content ranged from 5.5 to 17.8% W/W among the cultivars. The maximum oleoresin content was in Kottanadan (17.8%) followed by Nilgiris (15.5%), Kumbhakodi and Kuthiravally (14.9%). Piperine content ranged from 2.9% (W/W) in Doddigya to 7.6% in Kumbhakodi and Ceylon. Starch content ranged from 12.4% (W/W) in Kaniakkadan to 46.6% in Chumala. A negative correlation was noted between starch and piperine content.

Cardamom

'Katte' disease of cardamom–survey

The survey carried out in the states of Kerala, Karnataka and Tamilnadu revealed that the 'katte' disease is prevalent in all the main cardamom growing tracts comprising Cardamom

hills, Bodi hills, Anamalai hills, Lower Pulneys, Nilgiri hills, Nelliampathy, Shabari hills, Mekkarai area (Shenkottai), Shevoray hills and cardamom growing areas in Karnataka, with intensities ranging from 0.01 to 99%. Results also indicated that plants at all stages are prone to natural infection.

The disease incidence recorded in the plantations with regular rogueing practice was 1.7% as against 3.6 and 34.7% in the plantations with irregular and no rogueing respectively.

Nymphs of all instars of the aphid *Pentalonia nigronervosa* f. *caladii* were found to transmit 'katte' virus. The efficiency of transmission varied from 60–76%; efficiency increasing with the age of nymphs. The adult apterate and alate forms were highly potent in transmission of the disease (92–94%) as compared to nymphs.

A study on the virus vector relationship showed that 'katte' virus is non-persistent (stylet borne) though earlier reports mentioned it as a semipersistent virus.

Quinalphos to control cardamom thrips

Efficacy of eleven insecticides was tested in the field to control the cardamom thrips (*Sciothrips cardamomi* Ramak). Based on the performance for three years, quinalphos 0.025% was found to be the best followed by dimethoate and phenthoate each at 0.025%. It was also found that only 4-5 rounds of spraying were necessary for controlling the thrips.

Studies on the seasonal fluctuations of the thrips on cardamom indicated that the population reaches its maximum during March and April and starts declining with the onset of monsoon from June onwards. Therefore one round of spray at monthly intervals during March, April and May was found to reduce the pest population considerably. The spraying operations could be suspended during the period of monsoon and could be resumed again during September and October.

Estimating leaf area in cardamom

A regression equation using the length and breadth of the median leaf has been proposed for correctly estimating the area of any leaf in one year old cardamom plants. The area of all the leaves in a tiller (Y) can be estimated using the relationship $Y = -3.05_n + 7.119\ x$, ($R^2 = 0.994$) where x is the product of length and breadth measurements of the median leaf and n is the number of leaves in the tiller. A similar equation was suggested for getting the leaf area of a whole clump, using the measurements of the median leaf of the biggest tiller and the count of the total number of leaves in the whole plant.

Ginger and Turmeric

Yield prediction in ginger

Multiple regression analysis in ginger using morphological characters recorded on 90th and 120th day after planting showed that the final yield could be fairly accurately estimated based on height of pseudostem, number of leaves, and breadth and length of last fully opened leaf. The improvement in prediction value was noticed with the advancement in the age of plants.

Path co-efficient analysis revealed that phenotypic correlation between yield of rhizome and height of pseudostem in ginger was quite high, and also the direct effect of height towards the correlation was very high.

Rapid multiplication of turmeric through tissue culture

In turmeric, a tissue culture technique has been standardised, for the rapid multiplication of improved clones. Buds collected from sprouting rhizomes of clone 15 B were individually planted on MS nutrient media containing 6-benzylaminopurine (BAP 2 mg/l), Kinetin (1 mg/l) and coconut water (10%). An average of 8 shoots were produced from each meristem bud culture in 60 days. These shoots when subcultured individually again multiplied in the same fashion. Thus from every established single bud culture, 8^6 (2, 62,144) plantlets could be produced in one year's time, if every plantlet produced *in vitro* was subjected to further multiplications. Two hundred and fifty tissue cultured plants were transplanted in polybags and grown to maturity, to give a reasonable quantity of rhizome for further multiplication.

Malathion to control ginger shoot borer

Among seven insecticides tried to control ginger shoot borer *Dichocrocis punctiferalis*, malathion (Cythion) was found to be significantly superior to all others in controlling the pest.

Biology and ecology of Dichocrocis punctiferalis

The biology and ecology of the polyphagous *Dichocrocis punctiferalis* Guen. infesting ginger, turmeric, cardamom etc. and causing withered and dry shoots, have been worked out on turmeric. Twelve species of parasites and predators associated with the pest were identified.

Control of rhizome scale of ginger and turmeric

Dipping of rhizomes in 0.1% quinalphos for 5 minutes at the time of harvest and planting can ensure scale free rhizomes.

Quality evaluation of turmeric cultivars

Quality evaluation of 88 turmeric cultivars indicated that the recovery of dry turmeric was maximum in 'Karimala' (27.0%) followed by 'Cll 321 Ethamukula' (26.2%). A maximum oil content of 9.5% was found in 'Kahikuchi' followed by 9.0% each in 'Kongpong', 'C/S No. 57' and 'Mundakkayam'. Oleoresin percentage was maximum in 'Rajpuri' (13.8%) followed by 'Nandyal' type (13.2%) and 'Valra Falls' (13.0%).

Tree spices

Vegetative propagation in nutmeg

An epicotyl grafting technique in nutmeg has been standardised using *Myristica beddomei* and *M. malabarica* as root stocks. Cleft grafting using leafy scion gave 'take' upto 48% when *M. beddomei* was used as root stock and 40% 'take' with *M. malabarica* as root stock.

OIL PALM

Identification of pisifera *palms*

Twenty two *pisifera* palms (11 sterile and 11 fertile) have been identified from a *tenera* × *tenera* population at Oil

palm Research Station, Thodupuzha. Cumulative yield data of a *dura* plantation at the same farm showed that about 10% of the palms are high yielders. It is therefore now possible to produce the commercial oil palm hybrid indigenously.

Fertiliser requirements of oil palm

The nutritional experiment on oil palm showed that application of 800g N, 400g P_2O_5 and 1800g K_2O gave significantly higher yield of fresh fruit bunches. Application of Ca and Mg had no beneficial effect to the palms.

OTHER HIGHLIGHTS

Rice cultivars and crop rotation for Goa

The following cultivars of rice are recommended for the Territory: Upland: DR-92, CC-39 (upto 90 days); Short duration (100-115 days): Annapoorna, Rohini, IET-2222. Medium duration (115-130 days): Bhavani; Gall midge resistant types.

For rice fallows, the following crop rotations have been found to be suitable: (a) Rice-Pulses (cowpea, pigeon pea); (b) Rice-Jowar (fodder) - Ratoon Jowar (for feed); (c) Rice-Oilseeds (ground nut, sunflower); (d) Rice-vegetables.

The following are the recommended cultivars for rotation :

Cowpea: S-288 (vegetable type), S-488 (grain type); *Brinjal:* Pusa purple Long, Pusa Purple Round, Selection 1; *Pigeon pea:* Pakhanjore; *Raddish:* Japanese White; *Jowar:* CSH-5.

Distribution of elite seeds from Kidu farm

During the year over 50,000 selected Mangala seeds were distributed to the areca growers of Karnataka and Kerala States.

During the year 670 Dwarf Orange and 186 D×T coconut seedlings were also distributed to the farmers.

Crop varieties selected for Lakshadweep

Pusa Kranti and Pusa Purple Long varieties of brinjal, Co-1 and Pusa Ruby varieties of tomato, Chaman variety of chillies, Coimbatore Long variety of bitter gourd, PSP Long bottle gourd, Co-1 snake gourd, Co-1 and Co-2 varieties of papaya, Mannan variety of banana, Sugar Baby watermelon, Deccan Hybrid maize, CSH-5 sorghum and C-152 cowpea could successfully be grown as inter crops in coconut gardens.

Identification of distinct Laccadive varieties of coconut

Important and distinct germplasm types of Lakshadweep coconuts *viz.*, Laccadive ordinary, Micro and Dwarf were identified after a thorough survey of the Minicoy island.

Causes of infertility in cattle in Goa

Infertility conditions in cattle was found to be as high as 49% (Normal : below 10%). The major causes of infertility were genetic (29%), anaestrum (25%), and repeaters (17%). Effective treatments have been developed for these.

HH 260-a strain of White Leghorn for Goa

Under local conditions, the HH 260 (a strain of White Leghorn) poultry

birds performed better. A 10% saving in feed has been effected in the Govt. Poultry Farm, Ela, where this strain is being maintained, and the average egg production in the Farm has increased by 15%.

In poultry, infectious coryza is the most serious disease in Goa. A cheap and effective method for its treatment has been developed.

Brewery waste as a cattle feed

The Union Territory of Goa produces about 1200 tonnes of brewery waste every year. It has been found that feeding it to milch cattle (2.5 kg/day/animal) reduces the cost of milk production (by about 20 paise/litre).

TRANSFER OF TECHNOLOGY

Training activities

Training courses on cultivation of coconut, arecanut, cacao, cashew and spices were organised for the Agricultural and Extension Officers, and Field Investigators of the Agricultural Departments of various states as well as officers belonging to the private sector establishments. The improved crop production technology developed at the Institute is transferred to the extension workers and farmers primarily in four ways: (1) training extension workers and farmers, (2) operational research projects, (3) lab-to-land programme, and (4) distribution of quality planting materials. Training programmes on plantation crops production were conducted for about 500 farmers also during the year.

One official each sponsored by Zambia, Sri Lanka and France was trained in the management of cashew and coconut plantations.

Operational Research Project

The Operational Research Project of the Institute for integrated land use and garden management is in operation at Muttathody village near Kasaragod. The project staff made frequent farm visits and gave technical advice to prepare and implement farm plans for increasing crop and livestock production. The staff also assisted the farmers in the project area in securing institutional credit to the tune of Rs. 44,190/- and procuring quality planting materials, fertilisers, pesticides, livestock and poultry.

Lab-to-Land Programme

The Lab-to-Land programme is being implemented in nine centres of the Institute and the total number of families adopted were 381. The Institute scientists visited each of these families at an average of 16 times during the year and educated the members of the adopted farm families about the improved technologies in crop, livestock, poultry and fisheries production. The families were also provided with additional farm inputs free of cost (not exceeding Rs. 500/- per family per year). A four day Kisan Mela was also held at the Institute headquarters under the Lab-to-Land programme, in which 302 farmers participated. The exhibition put up in connection with the Kisan Mela was largely attended by farmers.

Distribution of quality planting materials

During the year 12,474 coconut seedlings of different cultivars and hybrids were produced and sold to the farmers of different states.

ALL INDIA CO-ORDINATED PROJECTS

Coconut and Arecanut

Evaluation of coconut germplasm

Evaluation of the earlier batch of germplasm collections available at Kasaragod showed that the coconut cultivars San Ramon, Philippines Ordinary and SS Green from overseas and Laccadive Ordinary, Laccadive Micro, Kappadam and Andaman Ordinary from India are comparatively superior to other cultivars with respect to yield of nuts and copra content. Laccadive Ordinary has been recommended for large scale distribution in Kerala.

Spacing and fertiliser requirement of coconut in the East Coast

At Veppankulam (Tamil Nadu), the highest yield of 103 nuts/palm was obtained at a spacing of 9.1 × 9.1 m and under the fertiliser dosage of 610 g N, 454 g P_2O_5 and 608 g K_2O compared to palms spaced at 6.1 × 6.1 m (68.3 nuts/palm). However, the yield per hectare (18,304 nuts/ha) was higher at 6.1 × 6.1 m spacing than under 9.1 × 9.1 m spacing (12,336 nuts/ha). A similar trend has been observed at Arsikere (Karnataka) also.

At Veppankulam a very high yield of 181 nuts/palm could be obtained when higher doses of fertilisers (900g N, 320g P_2O_5 and 1800g K_2O) were given under irrigated conditions.

Intercropping in coconut garden

At Pilicode (Kerala) planting cacao in coconut gardens gave an average yield of 63 nuts/palm and 14,000 cacao pods/ha with double hedge planting and 66 nuts/palm and 63,000 cacao pods/ha under single hedge system. At Arsikere (Karnataka) a double cropping sequence of potato followed by wheat gave the maximum net return of Rs. 12,110/ha under irrigated conditions. At Ambajipet (Andhra Pradesh) elephant foot yam was found to be the most suitable intercrop followed by banana.

Spices and Cashewnut

Release of varieties

a) Cashew : Two Cashew Research Stations implementing the programme under the Project, *viz.*, Vengurla and Vridhachalam released three promising cashew varieties through the respective State Variety Release Committees during the year under report. The salient features of the varieties, *viz.*, Vengurla-1 and Vengurla-2 from Cashew Research Station, Vengurla and Vridhachalam-1 from Vridhachalam are given in Table 2.

b) Condiments

Coriander : UD-41, a coriander selection from Jobner with an yield potential of 11-14q/ha has been released by the State Variety Release Committee, Rajasthan. It is an erect type with small seeds, developed through recurrent selection based on progeny testing from local collection. It has also shown

Table 2. *Characters of the new cashew varieties released from Vengurla and Vridhachalam*

Centre	Selection	Parentage	% of perfect flowers	Weight of 100 nuts (g)	Yield (av. for 5 years in kg/tree)	Shelling %
Cashew Research Station, Vengurla	Vengurla–1	Ansur–1 (Sel. from Ansur)	8.0	525	10.4	32.0
	Vengurla–2	West Bengal Deepal collections–6 (Vengurla 37/3)	11.1	478	27.2	34.0
Cashew Research Station, Vridhachalam	Vridhachalam–1	M 10/4 (seedling progeny – Cuddalem block)	14.6	500	7.6	26.0

comparatively more field tolerance to wilt disease. The duration of the crop is 140–146 days and yield ranged from 11-14q/ha with an essential oil content of 0.25%.

Another improved coriander selection (AC No. 270), better than the existing Co. 1 has been released as variety Co. 2 by the Tamil Nadu Variety Release Committee. The new type recorded a mean yield of 794 kg/ha as against 648 kg/ha for Co. 1.

Fenugreek : The fenugreek selection NL(M) developed at Jobner with an yield potential of 12-14q/ha has been released for cultivation in Rajasthan by the State Variety Release Committee. This bold seeded selection has been developed through pure line selection. Time taken for flowering is 58-62 days and the duration of the crop is 140-150 days.

Fertiliser requirements for pepper, Panniyur–1

A fertiliser trial carried out at Panniyur in a pure pepper plantation since 1974 showed that application of 60g nitrogen / vine / year is optimum for hybrid Panniyur-1, instead of the hitherto recommended dose of 100g nitrogen / vine / year. Higher level of nitrogen had a detrimental effect on the pepper yield in pure pepper plantations under Panniyur conditions (Table 3).

Table 3. *Effect of nitrogen on the yield of Panniyur–1.*

N (g/plant/year)	Yield of pepper for five years – kg/plant					
	1975–76	1976–77	1977–78	1978–79	1979–80	Mean
N_1 (60)	5.12	6.47	7.36	6.47	5.07	6.10
N_2 (120)	3.62	5.99	6.50	4.67	4.26	5.01
N_3 (180)	3.28	5.19	5.50	4.63	3.17	4.35
Mean	4.01	5.89	6.46	5.26	4.17	5.15
	(CD for year : 0.84)					