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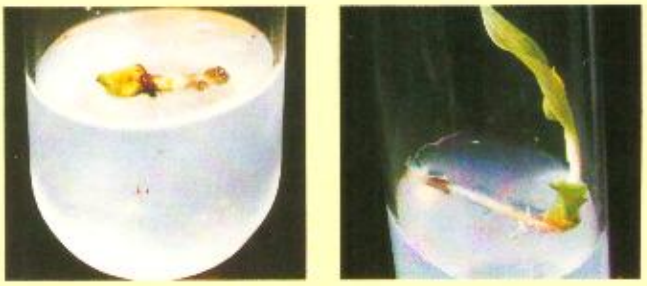
PROMISING TECHNOLOGY

Standardizing Protocol for Plantlet Regeneration from Seedling-Explants of Oilpalm

Callus formation on seedling leaf-explant. Callus formation on the leaf-explants was noticed after 100–120 days in *dura* and 150–180 days in *tenera* oilpalm. About 7% of the cultured explants in *dura* and 10% in *tenera* produced embryogenic calli.

Tissue culture on *dura* (3D × 266D) and *tenera* (333D × 109P) oilpalm (*Elaeis guineensis* Jacq.) seedlings was initiated in September 1994 at the Central Plantation Crops Research Institute, Kasaragod, with the objectives to standardize the best nutrient media and conditions for uniform callus induction and regeneration. Leaf tissues of seedlings were used as explants for reasons of easy availability, sampling and better response. This technique would enable large-scale multiplication of performance-tested *teneras* also. Eighteen-month-old *dura* seedlings and 6-month-old *tenera* seedlings grown in pots were taken for culturing. After surface sterilization of seedlings, 1 cm bits of nonchlorophyllous leaf and leaf bases were cultured on the basal medium of Murashige and Skoog supplemented with 2,4-dichlorophenoxy acetic acid (25mg/litre), adenine sulphate (40 mg/litre) and casein hydrolysate (500mg/litre). Callus induction on leaf-explants was noticed after 100–120 days in *dura* and 150–180 days in *tenera* oilpalm. About 7% of the cultured explants in

Plantlets Obtained from Seedling Leaf-Calli through Somatic Embryogenesis and Organogenesis



Somatic embryos germinate into complete plantlets

Embryogenic calli give rise to a large number of meristemoids

Shoots, 10–12 cm long with 3–4 leaves,are transferred to rhizogenesis medium. On this medium sufficient roots are produced within 3–4 weeks.

Satisfactorily established plantlets. Plantlets with balanced shoot and root system are transferred to pots containing sterile soil and sand.

dura and 10% in *tenera* produced embryogenic calli. They were subsequently transferred to regeneration medium containing zeatin riboside (1mg/litre).

Plantlets from calli were obtained through both somatic embryogenesis and organogenesis. Somatic embryos germinated into complete plantlets. Embryogenic calli gave rise to a large number of meristemoids. Shoots with 3–4 leaves and of 10–12 cm were subsequently transferred to rhizogenesis medium, on which sufficient roots were produced within 3–4 weeks. Plantlets with balanced shoot and root system were transferred to pots containing sterile soil and sand. Initially high humidity was provided. Establishment of plantlets in pots was found satisfactory.

Comparable results were observed on repeating experiments in 3 *dura* and 2 *tenera* seedlings. Further studies are in progress.

Dr M.K. Nair
Director
Central Plantation Crops Research Institute
Kasaragod (Kerala) 671 124

AICRP on Home Science Strengthened

The IXth Annual Workshop on the AICRP on Home Science was held on 13–15 December 1996 at the Punjab Agricultural University, Ludhiana. In this Workshop, strategies for the IX Plan projections for the AICRP on Home Science were deliberated upon and a new AICRP model to suit the changing needs of the rural-families has been evolved.

Two Technical Components Strengthened and 3 New Centres Launched

The critical gaps, as identified during the deliberations of the last Workshop, held at Udaipur, were the serious omissions of the inputs on value-addition in agro-/animal-based fibres and national-level database on rural-women. These have been rectified and included for the appropriate funding by the ICAR in the VIII Five-Year Plan. Under the Clothing and Textile component, value-addition for agro-and animal-based fibres and indigenous dyes are the thrust areas to evolve national profile of availability and trend of agro-and animal-based fibres and dyes, followed by the intervention for improving existing practices in processing them. In this, different techniques for cottage-level adoption are also to be explored. In the Home Science Extension component focus is on the database on the rural-women at the national level, in terms of their involvement and time-use pattern and decision-making pattern in farming and homestead activities. The scientific validation of the indigenous technologies, duly modified through the acceptability trials, for preparing information-technology kits and media packages for dissemination, via linkages with women-developmental agencies for strengthening developmental activities of rural-women, is the major thrust area.

To avoid regional imbalances, 3 more centres have also been added, they are at the Assam Agricultural University, Jorhat; Marathwada Agricultural University, Parbhani; and Himachal Pradesh Krishi Vishwa Vidyalaya, Palampur. Co-ordination Unit of the AICRP at the ICAR Headquarters has been created under the ADG (Home Science) for the proper monitoring; with the decision that the Director of the NRC on Women in Agriculture would also function as a Co-ordinator of this project. Posts of Project Co-ordinator and Technical Officer with computer programming have been added for planning of the project, analysis of project data and writing project-reports.

Besides, the 3 already existing technical components are on Food and Nutrition, Child Development and Family Resource Management.

The technical aspect of the Food and Nutrition component has a mandatory requirement to work on nutritional dimensions of cropping systems. Required attention is paid to the nutritional evaluation of food crops, unconventional/lesser-known foods in various states and physico-chemical and consumer preference characteristics of promising strains. As regard to the Family Resource Management, the

Salient Achievements of the Project

- Nutritional value of new high-yielding varieties of major crops (wheat, rice, ragi, sweet-corn, cowpea, amaranth, legumes) in different regions has been worked out for proximate composition, protein and starch digestibility (*in vitro*), and levels of antinutrients. Physico-chemical and consumer-preferred characteristics of promising strains have been identified
- The unconventional and lesser-known foods for their nutritional values have been explored from various states
- Drudgery reducing technologies at the household level have been introduced, combining with the organization of kitchen. Working on thermal efficiency of smokeless chulahas for conservation of fuel has been explored
- Growth norms for children from birth to six years have been developed along with the psycho-social development of the rural children. Rural farm-creche on community participatory approach has been launched

At the IXth Annual Workshop on the AICRP, held on 13–15 December 1996, three New Centres, HPKVV, Palampur, MAU, Parbhani and AAU, Jorhat, have been launched.

kitchen organizations will pay special attention to develop standard measurements of work surface and standard heights of sitting-kitchens in rural homes. Impact evaluation of the resource utilization and management along with the income-generating activities/technologies has been the focus of research thrust. Under the Child Development component, farm-creche module on the community participatory approach has been worked out along with the growth profile of rural children of age 6-18/20 years and their psycho-social development.

The major emphasis of this interdisciplinary All-India Co-ordinated Research Project is to promote quality of life of rural-families. Concerted efforts are being made to collaborate with other developmental agencies for inter-collaboration in joint ventures to formulate developmental module for farm-families. Based on these targets to be achieved, the ICAR would strengthen this project through additional components on ergonomics management of farm worker's drudgery, mobile farm-creche and nutri-guide for locally available food recipes, and sensitization and empowerment of rural-women of special needs (hill women, coastal women, tribal women, small and marginal farm women).

Dr (Mrs) Tej Verma
Assistant Director-General (Home Science)
Krishi Anusandhan Bhavan
ICAR, Pusa
New Delhi 110 012

Guidelines Developed for Training, Consultancy, Contract Research/Service

Training

Starting from the assessment of the potential of clientele, developing even joint programmes for training based on strengths and weaknesses, modalities for developing and conducting training programmes and going down the line to eligibility for admission, course curriculum, training fee, evaluation not only of the trainees but also by the trainees of the training imparted, impact assessment, feedback, honorarium for the resource personnel and also to the supporting staff are built-in. All details of training for nationals and foreigners have been worked out. The training would be of diverse nature, encompassing basic, strategic, applied and managerial spheres of studies.

Consultancy

There would be 3 types of consultancies—institutional, individual being on duty, and individuals with the kind of leave due to them. The sharing of the intellectual fee would be on 60, 70 and 85% basis, respectively, with 5% going to Staff Welfare Fund and the rest as institutional fund. The Staff Welfare Fund would be shared between the concerned institute and the ICAR headquarters @ 3.5% and 1.5%. In a calendar year, staff may be on consultancy for maximum of 45 days, on being on duty. The consultancy could be in a mandated area of the Council/institute to public/private institutions/organizations/firms within the country or outside.

Contract Research

Starting from defining the scope and purpose of the project as sponsored project, collaborative project, grant-in-aid project and developing the operational mode and modalities, costing, execution, monitoring and management of the project including output, publications, intellectual property claims and its licensing are well elucidated. The incentives for workers is built-in as the employee can earn a sum up to Rs 100,000 or equivalent to his/her annual salary, whichever is less. The contract research is to provide a concrete base, especially to private sector, to have a tie up with concerned institutions to get their scientific problems resolved with lesser investment.

Contract Service

For actual workers an incentive is built-in as up to 10% of the contract service fee could be shared irrespective of the stream of the service it be, scientific, technical, administrative or supporting. This would provide a fillip to growing industries, associations, organizations to have scientific service of class in areas like testing and analysis of soils, water, feed etc; analysis of disease problems and formulation of recommendations; identification of specimen, identification of biological, natural and cultural techniques; feed/prophylactics/therapeutic formulation; fabricating analytical and field equipment, renting of equipment etc.

For smooth operation of rules and guidelines formulated on these schemes, the Governing Body has delegated suitable powers to Directors of the ICAR Institutes and the Director-General, ICAR. The consultancy project involving an outlay not exceeding rupees 10 million with national agencies can be approved at the level of Director of the institute. He can also approve contract research project with an outlay up to Rs 1 million at his own level and up to 2.5 million with the approval of the Management Committee of the institute. The consultancy project involving an outlay not exceeding rupees 10 million, with foreign agencies, can be cleared by the Director-General, ICAR, who will also be competent to approve contract research project above Rs 2.5 million.

The package brought in is believed to transform system in totality with much needed incentive-and-reward system in place. With the detailed guidelines in place, it is hoped that with concerted efforts the provisions put in place would bring a new zeal, devotion and added work-culture in the ICAR system in the years to come and in the process, clients dealing with specialized areas could gain enormously.

Dr Mangala Rai
Assistant Director-General (P)
ICAR, Krishi Bhavan
New Delhi 110 001

Conservation of Nutmeg Germplasm

Nutmeg (*Myristica fragrans* Houtt.), indigenous to Moluccas Islands in Indonesia, is one of the important treespices introduced into India during the eighteenth century by the colonial rulers. This has now become very popular in India. The Indian Institute of Spices Research (IISR), Calicut, has embarked upon a programme for collection, conservation, cataloguing and evaluation of nutmeg, and a total of 452 accessions, including an endangered nutmeg species, have been collected and are being conserved at the National Repository of Nutmeg Germplasm at the IISR, Calicut.

Germplasm conservatory of nutmeg consists of cultivated types and a few wild and related species, viz. *M. andamanensis*, *M. beddomeii*, *M. malabarica*, *M. amygdalina*, *Knema andamanica*, *M. fatua* var. *magnifica* and *M. andamanica*. A preliminary analysis of genetic variability in 28 trees (14 years old) indicated variability only for number of fruits per tree. Correlation analysis has revealed a significant negative correlation between fruits/tree and mace (dried aril surrounding seed of nutmeg) weight; but seed weight has shown a positive significant correlation with mace weight.

The crop-improvement programme in nutmeg aims at selection and breeding of high-yielding trees. Some high-yielding elite trees have been identified in nutmeg-growing areas and their progenies are being evaluated for yield. Ten nutmeg accessions with high fruit set and yield have been located from the germplasm conservatory. A tree bearing 1–4 seeds/fruit is one of the important accessions which could be used in future breeding programmes.

In a systematic study of the progenies from 16 mother-trees of different localities, lack of adequate genetic variability was evident for many of the important attributes. Though significant differences could be observed among the populations for plant height, number of main shoots, number of years for flowering, fruit weight and ratio of mace weight to seed weight. The phenotypic coefficient of variability has been found to be more than the genotypic coefficient of variability, indicating the role of environment in expression of characters. Non-additive genetic factors are attributed for variations, due to comparatively low estimation of heritability and genetic advance for the traits. Ratio of mace weight to seed weight has shown a very high heritability and very good genetic advance. Hence selection for this trait may be very effective. Non-significant variations could be

Endangered nutmeg species—*Myristica fatua* var. *magnifica*. A total of 452 accessions of nutmeg, including this species, have been collected and are being conserved at the National Repository of Nutmeg Germplasm at the IISR, Calicut.

Naturally splitting nutmeg fruit

observed for canopy size, number of erect shoots, girth and number of fruits. This may be due to the narrow genetic pool introduced into India, from which the present-day populations have evolved. Hence, there is an urgent need to introduce genetic variability in this tree.

Identification of sex in nutmeg at the seedling stage is a pressing problem and studies on seedling characters like sprout colour, days for germination, and leaf shape, size and variation have led to the conclusion that none of these traits can be taken as a guide to sex identification.

As a short-time perspective, identification of elite mother-trees, establishment of scion-banks and production and distribution of superior grafts are being carried out at the IISR, Calicut.

Dr B. Krishnamoorthy
Senior Scientist
Indian Institute of Spices Research
Calicut (Kerala) 673 012

Managing finfishes broodstock at the CIBA

Fish broodstock holding facility at the Muttukadu Field Station

Seabass *Lates calcarifer* brooder fish

The Central Institute of Brackishwater Aquaculture (CIBA) has made significant progress in the broodstock-development programme of finfishes, viz. seabass *Lates calcarifer* and grey mullet *Mugil cephalus*. The fishes, being maintained at the institute's broodstock holding facility at Muttukadu field station, have attained maturation up to 3rd stage in captivity. Attempts to further advance maturity conditions are being made by means of hormone-implantation.

Dr K. Alagarswami
Director
Central Institute of Brackishwater Aquaculture
141, Marshalls Road
Egmore (Madras) 600 008

Dr Sukhatme was a great statistician and a true adviser

Prof. Pandurang Vasudeo Sukhatme was born on 27 July 1911 in village Budh, district Satara, 100 miles south of Pune. After completing his school education in Pune, he graduated in 1932 from Fergusson College, with Mathematics as the principal subject. He studied at the University College, London, and was awarded Ph.D. Degree in 1936 and D.Sc. Degree in 1939 for his work on bipartitional functions. This work was published in the 'Philosophical Transactions of the Royal Society of London, Series A' in June 1938.

His two most significant contributions are to Bipartitional Functions and to SamplingTheory entitled'Contributions to the theory of the representative method'. The latter paper laid solid foundations for his subsequent pioneering research in sampling theory of surveys and improvement of agricultural statistics, which ushered in what may be appropriately termed as Sukhatme era in development of agricultural statistics in India and the world.

In 1940, he joined the ICAR as a statistician, and was later appointed as the Statistical Adviser to the ICAR to head its Statistical Unit, which grew to a full-fledged Institute, the Indian Agricultural Statistics Research Institute.

During 1952-70, he headed the Statistics Division of the Food and Agriculture Organization (UN). After retiring from the UN, in 1971 he served as a Regents Professor, University of California at Berkeley, and since then, he had settled in Pune, carrying out valuable work on Nutrition at the Maharashtra Association for the Cultivation of Science. In this field, he is known for the Sukhatme-Margen hypothesis, which implies, "At low levels of calorie intake, energy is used with greater metabolic efficiency, and the efficiency decreases as the intake increases over the homeostatic range". He was awarded Guy Medal by the Royal Statistical Society for his paper on Nutrition, which he presented to the Society in 1963, the B.C. Guha Memorial Lectureship of the Indian Science Congress Association in 1965 and the B.D. Tilak Lectureship of the Indian National Science Academy in 1982. He was also honoured with the Fellowships of the American Statistical Association, National Academy of Sciences, Allahabad, Indian Academy of Sciences, Bangalore, and Indian National Science Academy, New Delhi. **For his outstanding contributions to Science and Human Welfare, he was conferred Padma Bhushan by the President of India in 1973.** He was awarded the Hari Om Ashram Trust award by the University Grants Commission in 1983. For the distinguished service to the cause of statistics and its application in agriculture and allied fields, he was conferred with the honour of Sankhyiki Bhushan in 1989 by the Indian Society of Agricultural Statistics, New Delhi. He also received P.C. Mahalanobis Award at the Jaipur Session of the Indian Science Congress Association.

With the demise of Prof. Sukhatme on 28 January 1997, the scientific community, has lost a great statistician, true adviser, dynamic leader, well-wisher of humanity and a renowned personality of international fame.

Indian Institute of Horticultural Research, Bangalore

Horticultural crops provide nutritional security, and have a great potential to earn foreign exchange

IIHR—main building

The Indian Institute of Horticultural Research was established by the Indian Council of Agricultural Research towards the end of the Fourth Five-Year plan. It started functioning in New Delhi on 5 September 1967, and was subsequently shifted to Bangalore on 1 February 1968 at Hessaraghatta, where a fruit research station was started earlier by the Imperial Council of Agriculture, which in due course was commuted into National Hortorium, located 26 km north of Bangalore on the Bangalore-Bombay line. Initially, 24.7 hectares under the National Hortorium were transferred to the Institute, and later Government of Karnataka handed over 238 hectares of the village Ivarakandapura, opposite to the National Hortorium. Now, the IIHR is a pre-eminent horticultural research Institute of Asia.

Spectrum and Activities

The main experimental farm established at Bangalore has a total of 266 hectares of land, which is divided into 9 functional blocks, working on various horticultural crops, viz. fruits, vegetables, ornamentals, and medicinal and aromatic crops including mushrooms. The work on various aspects of horticultural crops is being carried out in 10 full-fledged divisions and 4 sections, apart from the 2 units of the All-India Co-ordinated Projects on Tropical Fruits and Betelvine. The Institute is also involved in the all-India co-ordinated research work. The work on specific problems is also carried out with international collaborations. The IIHR is also involved in post-graduate

DIRECTOR
(RESEARCH MANAGEMENT AND CO-ORDINATION UNIT)

RESEARCH

Main Campus
(Hessaraghatta, Bangalore)

DIVISIONS

1. Fruit Crops
2. Vegetable Crops
3. Ornamental Crops
4. Post-harvest Technology
5. Plant Pathology
6. Entomology and Nematology
7. Plant Physiology
8. Biotechnology
9. Soil Science
10. Extension

SECTIONS

1. Plant Genetic Resources
2. Medicinal and Aromatic Crops
3. Statistics and Economics
4. Horticultural Engineering

REGIONAL STATIONS

1. Central Horticultural Experiment Station, Chethalli, Kodagu
2. Krishi Vigyan Kendra Gonikoppal, Kodagu
3. Central Horticultural Experiment Station Godhra, Gujarat
4. Central Horticultural Experiment Station Ranchi, Bihar
5. Central Horticultural Experiment Station Bhubaneshwar, Orissa

CO-ORDINATION

1. All-India Co-ordinated Project on Tropical Fruits
2. All-India Co-ordinated Project on Betelvine

POST-GRADUATE EDUCATION

1. Collaboration with the Univ. of Agricultural Sciences

OTHER TECHNICAL UNITS

1. Farm Management
2. Farm Engineering
3. Photography
4. Artists' Cell
5. Library

FINANCE AND ACCOUNTS

ADMINISTRATION

1. Administration
2. Cash and Bill
3. Purchase
4. Stores

education and training, with active collaboration of the University of Agricultural Sciences. Several other universities have also recognized IIHR as the centre for post-graduate research.

Presently, the IIHR has got 4 Central Horticultural Experiment Stations at Chettalli, Godhra, Ranchi and Bhubaneshwar and a Krishi Vigyan Kendra at Gonikoppal, Karnataka.

Chettalli Station concentrates on fruit crops like citrus, sapota, banana, pineapple, papaya, passion-fruit and also on a few vegetables.

The Godhra Station mainly promotes suitable horticultural technologies in the western India for the welfare of tribal populations of Gujarat, Rajasthan, Maharashtra and Madhya Pradesh. It emphasizes to develop dryland horticultural technology, and work is under progress on arid and semi-arid fruits and vegetables.

Ranchi Station serves the tribal areas of the eastern India, and is creating an awareness about the innate potential of the horticulture in the region. It has been working on citrus, papaya, litchi plants and vegetables specific to the region.

Bhubaneshwar Station carries out location-specific research and develops suitable production technology for horticultural crops in tribal belts of Orissa, Madhya Pradesh, West Bengal and coastal Andhra Pradesh.

IIHR Directors

Dr G.S. Randhawa
(5.9.67–26.5.80)

Dr K.L. Chadha
(20.6.80–21.1.86)

Dr R.M. Pandey
(25.11.87–11.11.88),
(21.3.91–31.1.94)

Dr I.S. Yadav
(19.3.94–to-date)

Infrastructure

Over the years, the IIHR has created excellent facilities in terms of buildings, structures, equipments, library and other technical facilities. Many field laboratories and a chain of glasshouses for various disciplines and walk-

in-growth chambers have also been added.

The IIHR has acquired a large number of sophisticated equipments such as HPLC, GLC, UV spectrometer, atomic absorption spectrophotometer, electron microscope, steriozoom microscope, portable leaf-area meter, shrink-film wrapping machine, Instron-texture measuring machine etc. Apart from this, the Institute had installed a desk-model mini computer as early as 1977. Thereafter, a computer centre in central facility with most modern computers has been established. In addition to these, almost all divisions of the IIHR have been provided with personal computers.

The Institute has a well-established library. It has more than 7,000 reference books, 7,500 back volumes of journals, and it subscribes to more than 250 national and international journals. The library is a repository of horticultural literature. It has been designated as the "Information Centre for Horticultural Science" since 1985. The library also brings out a quarterly publication "Rapid Information Service", providing latest information in horticultural sciences.

Liaison and Linkages

The Institute has got a full-fledged Division of Extension, and has a Trainer's Training Centre at its main campus and a Krishi Vigyan Kendra at Gonikoppal (Karnataka). Exhibitions, field-days, video-films and film shows are arranged by the TTC on various occasions.

The Institute works in close liaison with State Horticultural/Agricultural Departments. Representatives of the State Agricultural/Horticultural Departments, State Agricultural Universities, NGOs', involved in horticultural development, are the members of the Management Committee and Research Advisory Committee of the Institute, and TTC Management Committee and Local Management Committee of the KVK. The Institute has research and extension obligations to Karnataka, Andhra Pradesh, Tamil Nadu, Maharashtra, Pondicherry, West Bengal, Orissa, Bihar and Gujarat.

Many collaborating programmes with external funding agencies, like World Bank, USAID, are being carried out.

Electron microscope

Shrink-film wrapping machine

The IIHR is also an active centre for the South Asian Vegetable Research Network and Asian Vegetable Research and Development Centre (AVRDC), Taiwan. Short-term training courses are also conducted for foreign nationals at the Institute.

A World Bank-aided scheme on production of breeder and foundation seeds of vegetable varieties, developed by the IIHR, is under operation at the Institute under the National Seed Project Phase II.

Research Achievements

Genetic Resources. So far more than 19,000 accessions in different fruit, vegetable, ornamental, medicinal and aromatic crops have been collected, both from within the country and abroad, in the genetic-resource base of the IIHR.

Varieties Developed. The Institute has recently released 4 improved varieties of mango, 11 of grape, 3 of papaya, 2 of guava, 1 of litchi and 1 of passion-fruit. The vegetable varieties have been bred for high-yield, improved nutritional content, resistance to biotic and abiotic stresses and suitable for processing and export. In all, 53 vegetable varieties have been developed by the Institute, of which 31 varieties have been released at the national level and 21 at the state level. A major breakthrough has been achieved by the development of okra varieties Arka Anamika and Arka Abhay resistant to yellow vein mosaic virus, brinjal and tomato varieties resistant to bacterial wilt, onion variety Arka Kalyan tolerant to purple blotch and muskmelon variety Arka Rajhans resistant to powdery mildew. Besides, Arka Manik watermelon variety, with triple disease resistance to anthracnose, powdery mildew and downy mildew, has been developed. This has become one of the most popular watermelon varieties in south, and its fruits are available for over 6 months in a year. In medicinal crops two varieties of *Dioscorea* viz., Arka Upkar and FB (C) 1, having high diosgenin content, have been developed. Similarly Arka Sanjivini a less spiny variety and Arka Mahima its tetraploid with high solasodine content of *Solanum viarum* have been developed, and are being commercially grown for production of steroids for family-planning purposes. In jasmine selection Arka Surabhi, having high-oil content, has been identified for release. A total of 74 varieties of gladiolus, bougainvillea, hibiscus, chrysanthemum, China-aster, tuberose and roses have been identified for release at the state and national levels.

Production Technologies. In pine-apple and banana, in which fruit yields were only 20 to 25 tonnes, the Institute has demonstrated that by adopting high-density planting and other production techniques, yield can be increased to several folds; to as much as 80 tonnes in pineapple and 160 tonnes in banana. High-density planting in pine-apple with 63,400 plants/ha and in banana with 4,400 plants/ha has been standardized. Many rootstocks in citrus and grape have also been standardized.

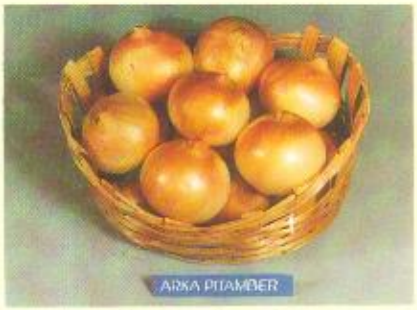
High-density planting in banana increases yield of banana to as high as 160 tonnes/ha. The recommended standard density for banana is 4,400 plants/ha.

COMPUTER-BASED EXPERT SYSTEMS FOR HORTICULTURAL CROPS

Taking into account the fact that in almost every district headquarters computers are available, the Institute has initiated steps to use computers for transfer of technology in horticulture by developing expert systems for various horticultural crops; which can provide all information about production technologies, including propagation, cultivation, plant protection, package of practices and product utilization. Work in this direction has resulted in development of Grape Expert System, Mushroom Expert System, Cabbage Pest Expert System and Personal Computer-based pest information on tomato. Apart from these, a new computer information system, giving recommended guidelines on all aspects of cultivation for 150 horticultural crops (including plantation crops, tuber crops and spices), is in advanced stage, and would give recommended package of practices for each crop in Karnataka, Andhra Pradesh and Tamil Nadu. A data-base programme, giving statewise guidance as to fertilizer and spacing requirements of horticultural crops in India, has also been developed to facilitate the extension worker, planner or cultivator to get within a few seconds the appropriate recommended doses of fertilizers, in whichever state, he resides.

Arka Aruna mango

Arka Manik watermelon, with triple resistance; to anthracnose, powdery mildew and downy mildew



Arka Pitamber onion

SOME OF THE VARIETIES DEVELOPED AT THE IIHR

Arka Navneet brinjal

Violet Cushion China-aster

Red Gold chrysanthemum

Fertilizer schedules for mango, banana, citrus and grape have been worked out. Leaf-nutrient guides for monitoring nutrient status of fruit orchards and for making more precise fertilizer recommendations have also been developed. **The Institute is also running a Leaf Analysis Advisory Service for the benefit of fruit-growers. It carries out root activity and fertilizer-use studies using radioactive and stable isotopes, and works out fertilizer management practices for citrus, banana and grape etc and for a number of vegetables to increase their fertilizer-use efficiency.**

The IIHR has worked out protocols for micropropagation and mass production of banana, gladiolus and difficult to root grape-rootstocks.

ProtectionTechnologies. Success has been achieved in biological control of important pests like mealy-bugs in grape and guava, and terrestrial and aquatic weeds like parthenium and water-hyacinth. The Institute has adopted integrated pest management, and has demonstrated successful control of diamond-back moth of cabbage and fruit-borer of tomato. Safe waiting periods for harvesting and consumption of many fruits and vegetables have been worked out for containing affects of pesticide residues.

Post-harvest Management. In post- harvest technology, maturity standards have been established for many fruits. Methods for uniform ripening of fruits, their handling and storage practices to extend their shelf-life, their packaging and preservation have been worked out for mango, banana, grape, mandarin and also for tomato and onion.

Dr I.S. Yadav
Director
Indian Institute of Horticultural Research
Hessaraghatta Lake Post
Bangalore (Karnataka) 560 089

Central Inland Capture Fisheries Research Institute, Barrackpore

CICFRI—main building

In a memorandum brought out in 1943, the Government of India stressed the need to have a separate central research department for fisheries in the best of interests of the development of the fishery resources of the country. A Fish Sub-Committee of the Central Government's Policy Committee on Agriculture, Forestry and Fisheries endorsed the Memorandum, and a Central Inland Fisheries Research Station was established in Calcutta on 17 March 1947. From a modest beginning as an interim scheme, the organization grew to the status of a premier research establishment in the field of Inland fisheries in the country. By 1959, the Station had acquired the status of an Institute (Central Inland Fisheries Research Institute, CIFRI), and moved to its own building at Barrackpore, West Bengal.

CICFRI laboratory

Since 1967, the Institute has been under the administrative fold of the Indian Council of Agricultural Research (ICAR). The main objective of the Institute then was to conduct investigations for a proper appraisal of the inland fisheries resources of the country and to evolve suitable methods for their conservation and optimum utilization. While fulfilling the above objective, the Institute directed its research efforts towards the understanding of the ecology and production functions of inland waterbodies available in the country, like river systems, lakes, ponds, tanks, reservoirs and ox-bow lakes.

In 1971, the CIFRI initiated All-India Co-ordinated Research Projects on Composite Fish Culture, Riverine Seed Prospecting, Air-breathing Fish Culture and Ecology and Fisheries Manage-

CICFRI laboratory

ment of Reservoirs. One more All-India Co-ordinated Research Project on Brackishwater Fish and Shrimp Farming was initiated in 1973. In 1974, the first two projects were combined as Composite Fish Culture and Fish Seed Production. This project has given the firm support for the development of the freshwater aquaculture in the country.

The CIFRI has the credit of evolving and popularizing technologies for (*i*) fish-seed prospecting from rivers, (*ii*) seed transportation, (*iii*) induced breeding and nursery management of carps, (*iv*) bundh breeding of Chinese carps, (*v*) composite fish culture, (*vi*) aquatic weed control, (*vii*) air-breathing fish culture, (*viii*) fisheries management of small reservoirs, (*ix*) brackishwater fish farming and (*x*) snail farming.

The country has witnessed an increase in inland fish production from a mere 0.25 million tonnes in 1950–51 to 2.096 million tonnes in 1994–95. Fish-seed production also showed a quantum jump, from 409 million in 1973–74 to 14,500 million in 1994–95.

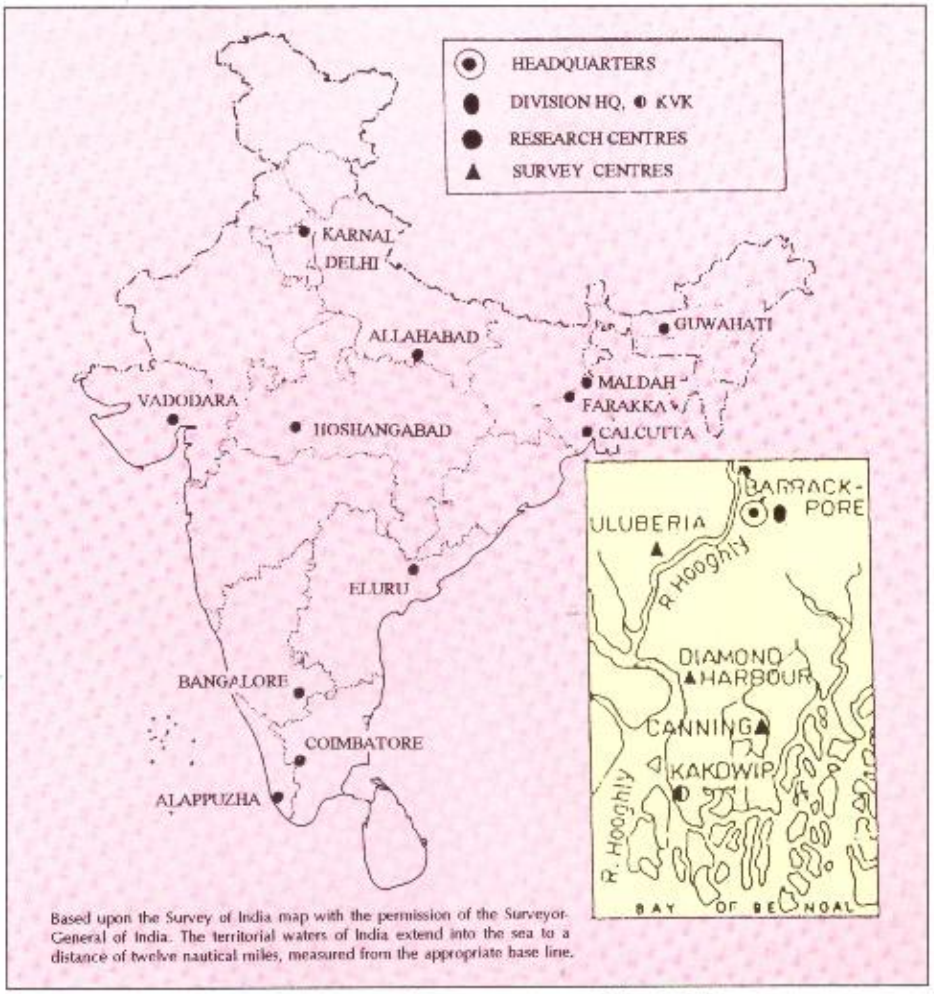
The CIFRI gave birth to 3 major Fisheries Institutions — Central Institute of Freshwater Aquaculture, Central Institute of Brackishwater Aquaculture and National Research Centre of Coldwater Fisheries. Thereafter, keeping in-line with the emerging needs of the research in the country, this Institute concentrated on research activities relating to capture fisheries resources of India. The mandate of the Institute was also modified, giving added emphasis on capture fisheries resources of the country, and the CIFRI was rechristened as the Central Inland Capture Fisheries Research Institute (CICFRI) with effect from 1 April 1987.

Organizational Structure

In order to fulfill its present mandate, the research activities at the CICFRI have been organized under 7 divisions,

Present Mandate

- To study fish population dynamics of exploitable inland open-water ecosystems and to evolve management norms for optimizing fish production
- To investigate causes and effects of pollution in open-water fishery resources and to provide research support to evolve remedial measures for their conservation and management
- To study impact of river-valley projects on the ecology of river-basins and productivity of reservoirs and to evolve strategies for their management
- To act as a national data centre on inland fisheries
- To conduct training and extension education programmes
- To provide consultancy services



Research centres and survey centres of the CICFRI

corresponding to major fishery resources and research needs of the country.

Apart from 7 divisions, the Institute has 8 sections–Economics, Extension, Engineering, Library and Documentation, Technical Cell, Administration, Audit and Hindi Cell–at the Headquarters to provide necessary support.

The Institute's activities are implemented by the Headquarters at Barrackpore, 3 Divisional Centres (Allahabad, Bangalore, Malda), 8 Research Centres (Karnal, Hoshangabad, Vadodara, Alapuzha, Coimbatore, Eluru, Guwahati, Calcutta) and 5 Survey Centres (Lalgola, Canning, Uluberia, Diamond Harbour, Frazergunj), covering 11 states of the country.

Library and Documentation. Apart from catering to the needs of the scientists and technicians of the Institute, the library is also open to research scholars, students, teachers, trainees and scientists from universities and other organizations. The library is affiliated to leading information centres in agriculture and fisheries. It has exchange relationship with many of the leading research organizations both at home and abroad, through which a regular flow of primary, secondary and tertiary informations is maintained from different parts of the world. The current holding of the library is 7,150 books, 4,250 reprints, 937 maps and 3,110 miscellaneous publications. It subscribes to 32 foreign and 58 Indian journals.

An abstracting service, covering the entire gamut of fishery science in India, is rendered by the CICFRI, which is the only one of its kind in the field of inland fisheries in the country. The journal is a quarterly publication entitled *Indian Fisheries Abstract*, giving informative abstracts of all publications on fisheries and related subjects. Similarly, a quarterly Accession List and a monthly Current Contents List are also published.

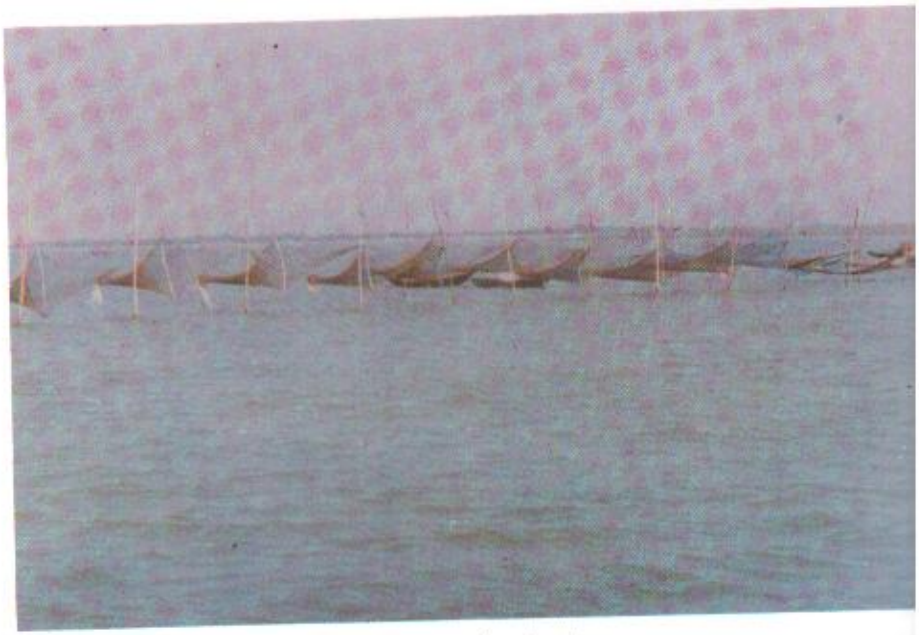
Major Achievements

Resource Assessment Division. Method for collection of inland fisheries statistics has been standardized. Based on this, requisite information for Andhra Pradesh, Maharashtra, Rajasthan and Tripura has been compiled and is under publication.

Riverine Division. Ecology and fisheries of certain stretches of Ganga, Brahmaputra, Godavari, Krishna and Narmada have been studied. Time series fish-catch data of river Ganga showed sharp decline in yield from 26.6 kg ha^{-1} during 1958–61 to 6.07 kg ha^{-1} during 1980–86, due to environmental stresses imposed by the developmental activities● Based on the energy dynamics, the total fish yield potential of river Ganga has been estimated at 74 kg ha^{-1} at Kanpur, 249 kg ha^{-1} at Allahabad and 192 kg ha^{-1} at Patna, compared to present fish harvest of 24.3, 28.7 and 30.1 kg ha^{-1}.

Reservoir Division. Management norms for the small reservoirs have been evolved based on the estimated production potential and trophic characteristics of the ecosystem● Scientific management methodology for medium and large reservoirs based on a 3-pronged strategy, comprising adjustment of mesh-size, optimizing fishing effort and stocking support, has been evolved.

Estuarine Division. The Hooghly estuary has shown marked changes both in respect of environment and fishery due to the construction of Farakka barrage; resulting in increase in freshwater discharge and alteration of salinity regime● Based on C^{14} production values, the potential fish yield from Hooghly-Matlah estuarine system has been estimated at 55,000 tonnes annually against the present average catch of 30,000 tonnes● A seed calendar of Hooghly-Matlah estuary has been prepared, showing availability of prawn and fish seed in time and space● Estimates have been made on quantum o



Riverine seed collection

Stripping of hilsa

Catla injected with hormones

Fertilized eggs

Penaeus monodon seed being presently exploited from estuaries in Sunderbans and the concurrent loss of seed of other prawns and fishes in the process● Likely changes in ecology and fisheries of Narmada estuary due to creation of impoundments (dams) have been identified.

Floodplain Wetlands Division. Management technology for floodplain lakes (*beels* and *mauns*) has been evolved. Fish and prawn production up to 1000 kg ha^{-1} was achieved in a closed *beel* in West Bengal● Technology for culturing freshwater prawn (*Macrobrachium rosenbergii*) in beels has been developed.

Environmental Management and Fish Health Protection Division. Ganga-river system suffers seriously because of effluents discharged from industries, agriculture and municipal wastes. Heavy metal concentrations in Ganga and Yamuna, around industrial towns, have been observed higher than safe limits prescribed for aquatic life● Marked improvement in water quality and primary productivity rate has been recorded in Kanpur since 1987, after implementation of the Ganga Action Plan● Monitoring of pesticide residues in the estuary has revealed presence of DDT and BHC in biotic and abiotic samples● Biomagnification of Zn and DDT in plankton, fish and molluscs has been recorded in samples collected from Hooghly estuary● A large number of diseases of fishes, commonly encountered in fishes and prawns inhabiting open-water fishery resources, and their etiological agents, have been identified, and their control measures have been developed.

Hilsa Division. Tagging experiments conducted by the CICFRI have conclu-

Pen installed in a beel for raising prawns

Microbrachium rosenbergii harvested from the pen

Consultancy Service and Sponsored Schemes

In a major consultancy assignment, the Institute undertook a World Bank-assisted project for reservoir fisheries development in Rajasthan. Based on the studies conducted, recommendations were made to the State Department of Fisheries for development of small reservoirs.

The Institute's studies on the environmental problems relating to aquatic ecosystems have been widely recognized in India and abroad, and consequently it is looked upon as the main consultancy agency for assessing environmental impact of major developmental projects. Following are some of the consultancies and research schemes undertaken by the CICFRI which are in progress.

CONSULTANCIES

NEC, Shillong

Feasibility studies for development of fisheries in Khandong and Umrong reservoirs of the North East.

NTPC, New Delhi

Studies on the impact of hotwater discharge from Singrauli Super Thermal Power Station in Rihand reservoir.

GPD, Govt of India, New Delhi

Water quality monitoring and evaluation in the river Ganga in West Bengal.

Govt of Maharashtra

Fish conservational and hydrobiological perspectives of the river Narmada with reference to Sardar Sarovar Project.

SPONSORED SCHEMES

ICAR, DARE (Agriculture Ministry)

- Biomonitoring of heavy metals in the Hooghly estuary using scales, other hard parts and soft tissues of fishes as possible sites for metal accumulation.
- Biological monitoring of the environmental perturbations in the river Hooghly.
- National Fellow Scheme of the ICAR on the mangroves of the Sunderbans.

DOE (Ministry of Forest and Environment)

Potentialities of tidal mangrove forests of Sundarbans with special reference to estuarine fisheries and forestry.

GPD (Ministry of Forest and Environment)

Investigation on biomonitoring and ecorestoration measures in selected stretches of the river Ganga and Yamuna.

Women trainees at the KVK

sively proved that hilsa is able to negotiate Farakka barrage during flood season● A technology for artificial fecundation of hilsa has been developed and a model hilsa hatchery has been fabricated. These will help in rehabilitating hilsa population at the Farakka barrage.

Krishi Vigyan Kendra, Kakdwip

This conducts training programmes in 5 disciplines i.e. Fisheries, Crop Production, Horticulture, Animal Husbandry and Home Science. A total of 1,384 courses have been organized so far at this Kendra, covering various disciplines for 25,541 farmers, farm-women, farm-youth and school drop-outs.

Dr Maniranjan Sinha
Director
Central Inland Capture Fisheries Research Institute
Barrackpore (West Bengal) 743 101

Vegetative propagation technique developed for jojoba

Jojoba *(Simmondsia chinensis)* is an unisexual plant. In nature, the male/female ratio in randomly harvested seeds is 1:1 and the sex of the plants can be determined only on the appearance of the flowers, after two-and-a-half years. For raising jojoba on a commercial scale, desired male : female ratio is 1:4. Hence, concerted efforts were made to raise plants through vegetative propagation technique to avoid long-gestation period of 2.5 to 3 years.

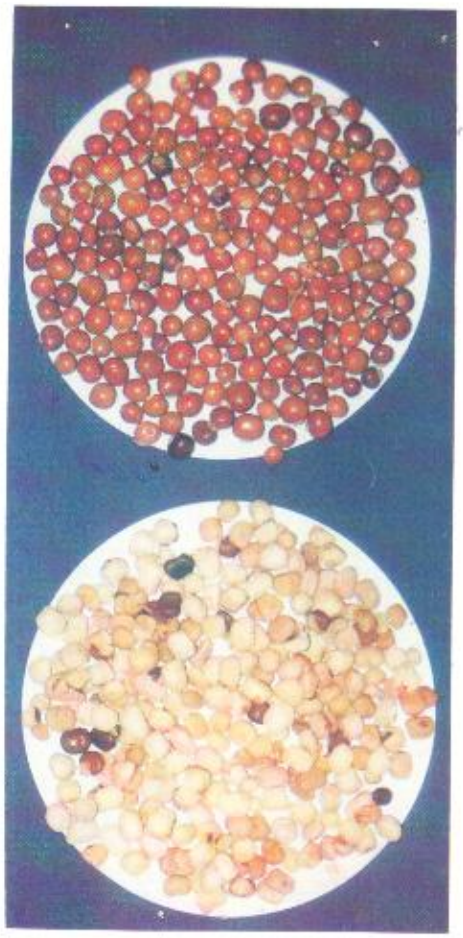
Rooted stem-cutting of jojoba

In stem-cuttings of jojoba, rooting was successfully induced by treating them with 400 ppm IBA. The treated cuttings were placed in a fully automatic mist chamber, where in 90–110 days, root initiation was seen in 40% of the cuttings.

Dr A.S. Faroda
Director
Central Arid Zone Research Institute
Jodhpur (Rajasthan) 342 003

Winged-beans may prove an alternative to pulses

In winged-bean plant, all parts, leaves, succulent shoots, flowers, immature pods, dry seeds and tubers, are edible and rich in nutrients. Winged-bean seeds contain as high as 33% of protein, next only to soybean, with fat content of around 18%. Of the 46 cultivars analysed, the mean protein content was 34.2%. The highest was observed in WAS 26-1 (38.3%). The fat content of the cultivars ranged between 16 and 18%. Mean values for iron and calcium were observed as 119.8 and 215.1 mg/100g seeds. The highest amount of iron (41.9 mg) and of calcium (349 mg/100g) was noticed in WAS 1 and WAS 23-3.



Winged-bean—seeds and *dhal*

Winged-bean seeds with high protein, fat and iron contents need to be exploited as an alternative to pulses, for alleviating malnutrition and hunger.

Dr Meera Rao
Director of Instruction
College of Home Science
University of Agricultural Sciences
Dharwad (Karnataka) 580 005

Ectoparasitic nematodes also found damaging maize

Nematodes, the hidden enemies, are known to cause appreciable losses in several crops. Mostly endoparasitic nematodes like root-knot nematodes and cyst-forming nematodes have been studied and reported to cause economic losses. Perhaps this has been due to the fact that they cause easily identifiable symptoms on plant roots. The ectoparasitic nematodes do not produce distinct, easily observable symptoms on roots, as endoparasitic

Roots of healthy maize-plant (H) and nematode infested maize-plant (I) *(see* bearded-type of roots)

Pots showing stunted growth of maize-seedlings, infested with nematodes (I) and uninoculated healthy maize-seedlings (UNI)

nematodes do. Therefore, their association with damages to crops has been least reported. The external symptoms on plant, caused by ectoparasitic nematodes, were generally mistaken for nutritional deficiency. At the centre of the All-India Co-ordinated Project on Nematodes at the Gujarat Agricultural University, Anand, maize-plants showing symptoms of stunted growth with yellowing of foliage and leaf-top burning were noticed. These symptoms were also observed in maize of Sameri Farm in Panchmahal district. Roots of these plants revealed bearded type of symptoms with reduced root biomass. From the analysis of the soil samples of infected fields, 3,240 stunt-nematodes (*Tylenchorhynchus vulgaris*) per 200 g of soil were recovered. Pots studies further confirmed damaging effect of these nematodes on plant growth even at the earlier stages.

Dr D.J. Patel
Scientist
All-India Co-ordinated Research Project on Nematodes
Gujarat Agricultural University Centre
Anand (Gujarat) 388 110

Unique grape hybrid Pusa Navrang released

Grape hybrid Pusa Navrang

After a rigorous assessment of 2,000 grape hybrids, a unique grape hybrid, named as Pusa Navrang, has recently been released by the Division of Fruits and Horticultural Technology of the Indian Agricultural research Institute, New Delhi.

The teinturier hybrid having colour in berry-skin and pulp is a cross between Madeleine Angevine and Rubired, and is ideally suited for juice and coloured wine-making. Its juice can be used as a colour additive for making fruit beverages and for blending juice of white-grape varieties.

It is an early-ripening, anthracnose-resistant hybrid with a basal bearing. It is highly productive on 'head' system as well as on 'bower' system of training. The bunch is loose and medium in size; berry contains 90% edible portion, 80% juice and 17% total soluble solids.

Drs P.C. Jindal, Kashmir Singh and S.N. Pandey
Division of Fruits and Horticultural Technology
Indian Agricultural Research Institute
New Delhi 110 012

Developing leaf nutrient guide for mandarin

The nutritional problems are one of the prime causes for low productivity of 7-8 tonnes of fruits/ha or less than 300 fruits/tree of Nagpur mandarin *Citrus reticulata* Blanco grown in Central India (Vidarbha region). The massive nutritional surveys of Nagpur mandarin orchards have indicated nitrogen, phosphorus and zinc as the major nutrient constraints in limiting productivity.

The models for working out optimum leaf nutrients in relation to productivity of 178 Nagpur-mandarin orchards have been developed following the application of 20-50 kg of FYM/tree. More intensive studies are in progress to generate leaf nutrients' range, based on the crop-response data, to develop complete leaf nutrient guide for sustained productivity of quality fruits.

Macronutrients and micronutrients in mandarin-leaf

	Optimum level	Critical level
	Leaf macronutrients (%)	
N	2.34	2.00
P	0.08	0.06
K	1.56	1.35
Ca	1.51	1.35
Mg	0.67	0.23
	Leaf micronutrients (ppm)	
Fe	118	104
Mn	43	40
Cu	15	12.5
Zn	29	27.5

Dr R.R. Kohli
Director
National Research Centre for Citrus
Nagpur (Maharashtra) 440 010

Contributors

The scientists of the ICAR system are requested to send information of importance, based on the research-work conducted by them, along with the quality photographs and line-drawings for *ICAR News*. Co-operation in this direction by them would be very much appreciated.

BILAKHANI (*Tephrosia candida*) for eradicating 'Kans grass'

Tephrosia candida DC commonly known as Bilakhani grows wild in almost all parts of the country. It is abundantly available in Assam and other parts of the north-eastern region. It belongs to family Leguminoseae, and possesses a good number of rhizobia-nodules.

The Ramie Research Station, Sorbhog, conducted experiments to test usefulness of this plant in controlling 'kans grass' (*Saccharum spontaneum*) in experimental farm. The studies revealed that this plant can easily eradicate kans grass within two years.

Method of Cultivation

The deep-brown seeds of bilakhani are soaked overnight in water and are broadcast in the field the next day. The average seed rate is 8–10 kg/ha. The seeds are generally sown before the onset of monsoons.

No fertilizer is applied to crop. However, when crop is sown as a sole crop, a dose of P_2O_5 @ 20 kg/ha is applied for better nodulation. In nitrogen-deficient soils, a dose of 15 kg of nitrogen as ammonium sulphate is also recommended.

The plants are ploughed back into the fields after 2 months of crop age, to be utilized as green manure. The leaves can also be used for cattle-feed when they are cut after 6 months or one year. Bilakhani plants are also harvested after they are dry for use as a fuel-wood or for fencing.

Bilakhani-plant

Bilakhani was grown in 4 experimental plots of the farm which were having good population of kans grass. The average of 4 plots for kans grass (41) was utilized for calculating weed-controlling capability of the bilakhani. Besides, the green weight and dry weight of kans grass in g/sq m were calculated for comparing performance of bilakhani. The averages of green and dry weights in g/sq m were also utilized for calculating efficiency of the plant.

The weed-controlling capacity (WCC) of bilakhani in relation to control (when no bilakhani grown) was calculated as follows.

$$\text{WCC of bilakhani} = \left(1 - \frac{\text{Average no. of kans grass plants after growing bilakhani}}{\text{Average no. of kans grass plants before growing bilakhani}}\right) \times 100$$

$$= \left(1 - \frac{41}{185}\right) \times 100 = 77.84$$

(Here 185 is no. of kans grass in control)

This clearly indicates that bilakhani has 77.84% weed-controlling capacity, which is quite high compared with the use of weedicides or herbicides. It is, therefore, evident that bilakhani can be successfully utilized for eradicating kans grass from fields, which is otherwise not easy to control.

Dr Saha and Shri S. Sarkar
Ramie Research Station of the Central Research Institute for Jute and Allied Fibres
Sorbhog (West Bengal) 781 317

Maximizing production on reclaimed ravine lands

The effect of the crown pruning and side-trenching to minimize losses caused by shade and lateral roots of *Eucalyptus* and *Leucaena* on tobacco and summer *bajra* for maximizing production on reclaimed ravine lands was studied at the Central Soil and Water Conservation Research and Training Institute, Research Centre, Vasad.

Management of trees in agroforestry system; 4-year-old coppiced trees of *E. tereticornis* at 2m spacing with 50% crown pruning + side trenching on the border of the irrigated bidi tobacco–summer *bajra* cropping system.

The underground competitive effect of the lateral roots was more than shade of *Leucaena* and *Eucalyptus* trees grown on the field boundary. The yield losses of crops can be minimized by 50% crown pruning and side-trenching. *Eucalyptus* causes more yield losses to tobacco and *bajra* crops than *Leucaena*. Tobacco has been found more sensitive than summer *bajra* in this agroforestry system. A slight increase in tobacco and summer *bajra* yield was recorded when *Leucaena* trees were pruned and leaves were incorporated in the field along with the side-trenching.

The population of *Eucalyptus tereticornis* at the time of harvest ranged from 450 to 662 trees/ha under different treatments; maximum being in where no management practice was applied. The maximum tree biomass was also in the same treatment, with an yield of 937 straight poles/ha, having an average length of 5m. Besides, this gave 12.8 tonnes/ha of air-dry fuel-wood and 14.5 tonnes/ha of lops and tops. The survival and yield obtained in treatment with side-trenching + 50% crown pruning was 612 trees and 850 straight poles of 5.3m average length, in addition to 6.2 tonnes of fuel-wood and 8.8 tonnes of lops and tops per hectare.

Dr J.S. Samra
Central Soil and Water Conservation Research and Training Institute
218, Kaulagarh Road
Dehra Dun (Uttar Pradesh) 248 195

Eco-friendly, traditional technology to cure digestive disorders of bovines

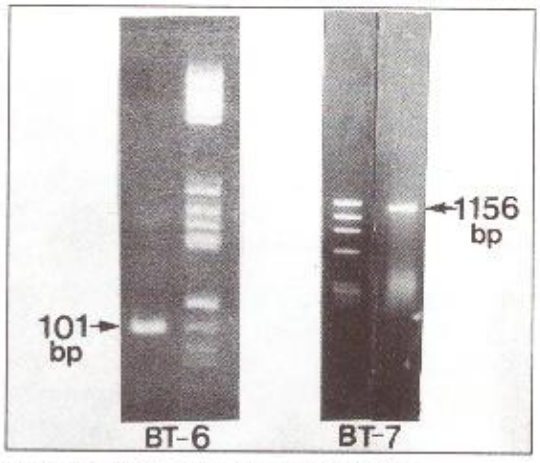
Indian farmers have a rich wealth of traditional knowledge, tested through generations, to solve day-to-day problems in their bovines. Use of decoctions of omum (*Trachyspermum ammi*), black-cumin seeds (*Cuminum cyminum*), pepper (*Piper nigrum*), harra (*Terminalia chebula*), bahera (*Terminalia bellerica*), black cardamom (*Elettaria cardamomum*) and guarpatta (*Cyamopsis tetragonolobus*) is commonly practised, indigenous technology for bovines among the farming communities of Bareilly district. The medicinal properties of these ingredients further confirm their efficacy and use. Spices like harra, omum, cumin seeds and pepper are stomachic, carminative, stimulant, antispasmodic and galactagogue in nature. They expel gas from alimentary canal. Bahera is used as a demulcent and emollient and its oil is used as a laxative and tonic.

These spicy, traditional medicines are not only cheaper and effective but also accessible locally and easily, and thus are ecofriendly and sustainable.

Drs Hema Tripathi and M.K. Mandape
Indian Veterinary Research Institute
Izatnagar (Uttar Pradesh) 243 122

Blue-tongue viral genomic RNA detected

A highly sensitive RT-PCR technique has been standardized at the National Biotechnology Centre of the Indian Veterinary Research Institute for detection of blue-tongue viral RNA in infected BHK_{21} cells. The technique could amplify either a 101 bp sequence within the genome segment 6 (BT-6) or a 1156 bp sequence, comprising whole of the genome segment 7 (BT-7) of the virus. The specificity of the product has been confirmed by restriction enzyme analysis. Since both RNA segments used as a target for amplification are well conserved, the technique could be useful in rapid diagnosis of disease irrespective of the serotype involved. Efforts are on to amplify BT viral genomic RNA directly from infected sheep-blood samples.



BT-6 and BT-7—viral genome segments

Dr S.K. Bandyopadhyay
Indian Veterinary Research Institute
Izatnagar (Uttar Pradesh) 243 122

Coconut-based Mixed Farming System

Coconut is predominantly a smallholder's crop. A sole crop of coconut utilizes only 25% of the land area and 40-45% of the incident light.

In order to utilize the available time of a family-labour effectively and for making the system more self-sustainable, integration of a few more components with coconut is found desirable. One such system was started at the Central Plantation Crops Research Institute, Kasaragod, in 1989 in a coconut-garden of a hectare. The other components in the system were milch cows (5 or 6), fodder grass, poultry birds (100 layers and 100 broilers), Japanese quails (100), rabbits (10 females + 4 males), and fish (in tank of 625 m^2 surface area). A biogas plant of $3m^3$ capacity was also erected as a part of the system. The output of the mixed farming system (average of 1993-95) was as follows: coconuts, 18,765 nuts; milk, 10,074 litres; poultry (live weight), 467 kg; quail birds, 35; hen eggs, 3,098; quail egg, 1,808; rabbits (live weight), 25 kg; and fish, 350 kg; besides 1,000 m^3 biogas.

Coconut-based mixed farming

The pre-experimental coconut production in the plot was 83 nuts per palm, which increased to 97 nuts per palm per year at the end of the fifth year.

Milch cows in the system produced 50-75 kg of cowdung daily which equalled to 15-20 tonnes of farmyard manure. About 400 litres of cow-shed washings and urine produced every day were collected in a tank and recycled to coconut and grass. The saw-dust used as a bedding material for poultry was removed after each batch and was used as a manure. About 1.5 tonnes of poultry-manure could be recycled annually. The poultry droppings, cowdung and grasses were also used as a feed to fish.

The total cost involved for maintaining the system was Rs 153,090 per year. The bulk of the cost consisted of wages and feed-cost. Total receipts from the system were Rs 192,264, and the total returns to the family, including labour-wages were Rs 75,674.

The marginal rate of return (MRR) realised was 38.79% under mixed farming system, 34.39% for coconut + dairy enterprise and 14.78% for coconut + poultry enterprise over coconut monocropping.

To maintain one hectare of coconut-garden in rainfed areas, labour potential of 120 mandays is required and for irrigated areas, labour requirement is of 150 mandays. But, for managing one hectare of coconut-based mixed farming system, nearly 880 mandays are required. Thus, the system provides gainful employment for the entire family labour-force.

The mixed farming in a coconut-garden is one of the viable and profitable systems, which coconut farmer can conveniently adopt. In these days, when farmers are interested in natural farming and want to be self-sustaining, mixed farming is one of the best alternatives which cultivators can think of.

Dr M.K. Nair
Director
Central Plantation Crops Research Institute
Kasaragod (Kerala) 671 124

Absorbable surgical sutures from fish-gut collagen. They are used for opthalmic and other microsurgeries and are comparable to commercial product in all physical properties; are free from abnormal toxicity and tissue reactions; and are an ideal substitute for costly, imported, presently used sutures.

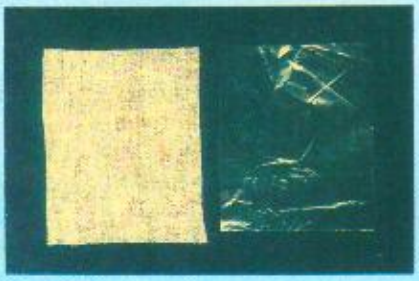
Shark fin-rays. They are valuable for export. The CIFT has developed a simple technique for extracting rays from fins of sharks. These rays are utilized in preparation of soup. There is a good internal demand for shark fin-rays, especially in major hotels.

Rack-dried anchovies. Fishes dried in traditional way on open beaches get contaminated with sand and other extraneous matter. The CIFT has recommended a hygienic method of drying on raised platform, which yields good quality product. The method has been demonstrated in a number of villages and adopted by many fishermen since then.

Fish Products of Commercial Value

Chitosan. It is a valuable chemical substance isolated from prawn- shells as well as shell-wastes of crab and squilla; is a derivative of chitin, and finds varied applications in diverse fields like medicine, pharmaceuticals, food and nutrition, cosmetics, and as an industrial flocculent.

Chitosan impregnated gauze and chitosan film. These are used for treatment of chronic wounds and external ulcers, to minimize bleeding in neurosurgery, and as artificial skin and kidney membrane, in plastic surgery and as contact lens.



Fish fingers. This is a value-added product, prepared from fish-meat free of bones, skin and adipose fat or from minced fish-meat. For consumption, fingers are dipped in a batter prepared with egg, rolled in bread-powder and deep fried.

FISH PRODUCTS OF COMMERCIAL VALUE ... FISH PRODUCTS OF COMMERCIAL VALUE ...

Oesophageal cannula for determining diet composition of sheep

Oesophageal cannula was fabricated and surgically fixed in sheep at the Nutrition Division of the Central Sheep and Wool Research Institute, Avikanagar. The cannula was made up of a high-quality polyethylene material with the following specifications.

Cannula diameter : (i) internal – 17mm
(ii) outer – 18mm
Length of cannula : 40mm
Flange size : length – 40mm
width – 20mm

Conventional methods such as collection of composite biomass and hand-picking and mouth grabe for estimating diet composition and intake on pastures by sheep have limitations. As sheep usually does selective grazing, it is difficult to take representative samples from pastures. Experiments using Oesophageal Cannulated sheep have revealed that sheep is able to select vegetation of a high-crude protein con-

Indigenously fabricated oesophageal cannula

Fish pickle. It is a protein-rich, value-added product, which has a very good market potential both in cities as well as in the interior areas of the country, where fresh fish availability is limited.

The product prepared by the CIFT method can be kept well for 8-10 months compared to 2-3 months storage of the conventional product. Methods have been developed for preparing pickles from fish, prawn, mussel-meat and clam-meat.

Fish wafers, before and after frying. This is a protein-rich food product prepared from miscellaneous fishes, incorporating fish-meat, starch powder, salt etc. This contains 15-20% protein, and is fried for consumption. The product can be stored for 12-18 months at a room temperature.

Fish-paste from jew fish (*Ottolithes argenteus*). It is prepared from fish mince/surimi, incorporating starch, fat, salt, milk, sugar, spices etc. It is rich in protein and is used as a bread-spread. It has a shelf-life of more than 7 months.

Fish-soup powder. It is a protein-rich food; prepared from trash-fish, a rich source of animal proteins, minerals, fat and vitamins. It stores well for 16-18 months at a room temperature; and for consumption, boil one part of the powder in 20 parts of water for 5 minutes.

Fish cutlets. This is one of the many diversified and sophisticated products developed at the CIFT from fish by-catch; for this basic raw material is fish-kheema or cooked fish; for consumption, this needs frying.

Raw fish mince-, fish surimi and surimi-based products. Surimi is a washed, refined fish mince, prepared generally from white fish-meat with low bone content. It is rich in myofibrillar protein fraction, which imparts a particular elastic property to the product—a desirable quality for traditional 'Kamaboko' type product and also for the analogue products.

Dr K. Gopakumar, *Director*
Central Institute of Fisheries Technology
Kochi (Kerala) 682 029

FISH PRODUCTS OF COMMERCIAL VALUE ... FISH PRODUCTS OF COMMERCIAL VALUE ...

Sample of intake-diet of sheep can be collected from oesophagus with the use of cannula

tent even during lean periods. The intake of drymatter, which is over-estimated using composite-sampling method, is realistically estimated using extrusa sample, collected from oesophagus.

Drs S.K. Sankhyan, A.K. Shinde and S.A. Karim
Division of Animal Nutrition
Central Sheep and Wool Research Institute
Avikanagar (Jaipur) 304 501

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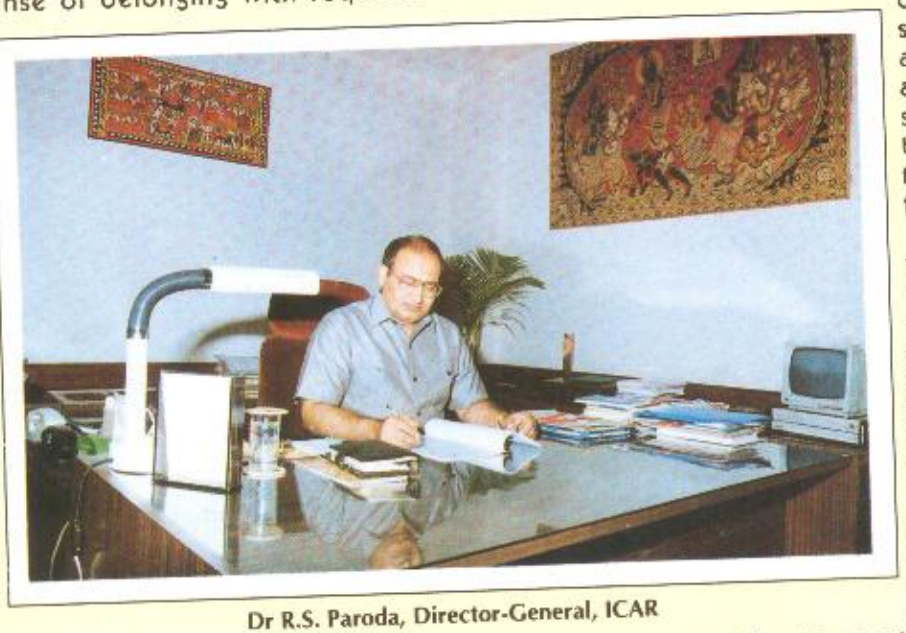
As a sequel to the on-going 'Renewal' process, aiming at the better environment and new work-culture, the ICAR has recently decided to implement recommendations of the Johl Committee on training, consultancy, contract research and contract service. The rules and guidelines for all these schemes will also become operational from 1 April 1997.

The guidelines are expected to promote skill- and knowledge-based interactive mechanisms at the individual as well as at the institutional level, with an in-built system for sharing of incentives among performers within the organization, and are bound to inculcate a sense of belonging with required sincerity and high-order performance. Within the framework of these rules and guidelines, it would now be possible for the ICAR as well as the private sector, where agricultural entrepreneurship is developing at a faster pace, to forge a mutually beneficial partnership and acquire enough strength to compete regionally and globally.



Dr R.S. Paroda, Director-General, ICAR

For their speedy implementation, the steps which are imperative on the part of the ICAR institutes are:

- an assessment of the existing strengths and weaknesses in the mandated areas;
- a continuous dialogue with the Industry, Agriculture Business Organizations, Farmers' Associations, NGOs, etc., who are associated with the functioning of the Institute, in order to assess clearly their needs and to foster required linkages;
- circulation of the provisions to prospective clients;
- an efficient Consultancy Processing Cell (CPC) establishment at each Institute to deal with proposals on training, consultancy, contract research and contract service; and
- establishment of a Staff Welfare Fund at the Institute through the income so generated, and utilization of the same for (i) creating/upgrading staff-canteen facilities; (ii) creating and maintaining recreational facilities; (iii) giving specific help to ailing and poor staff-members; and (iv) for giving some help to families of staff who die in harness.

The provisions on the training provide detailed modalities for conducting training programmes, impact assessment, feedback and for grant of honoraria to resource persons and supporting staff. The clients from both public and private sectors can now be trained in specific areas of their interest. Even the training programmes could now be specifically tailored for foreign students; especially from the developing countries in Asia and Africa.

The provisions on the consultancy would not only enrich research work of scientists with new opportunities learnt and experiences gained through application of their skills, but would also bring in additional resources to create better facilities for scientists and for institutes.

For the first time in the ICAR System, the provisions for the contract research have been brought in. These will benefit equally the private sector, as it can now tie up with the concerned institutes to get their scientific problems suitably addressed.

Contract service would also enable industry, associations, etc. to receive quality technical service in testing and analysis of soils, water, feed, fertilizer; analysis of disease problems and formulation of recommendations; identification of biological, natural and cultural techniques; fabrication of analytical and field equipment; renting of equipment, etc.

It is hoped that all the institutes would take appropriate measures to put various instruments and logistics in place for effective implementation by all. In this direction, an interface between research institutions and other Science Departments, Development Departments, Private Sector, NGOs, Farmers' Associations, etc. is absolutely essential, and which we all must strive for on the priority.

(R.S. PARODA)