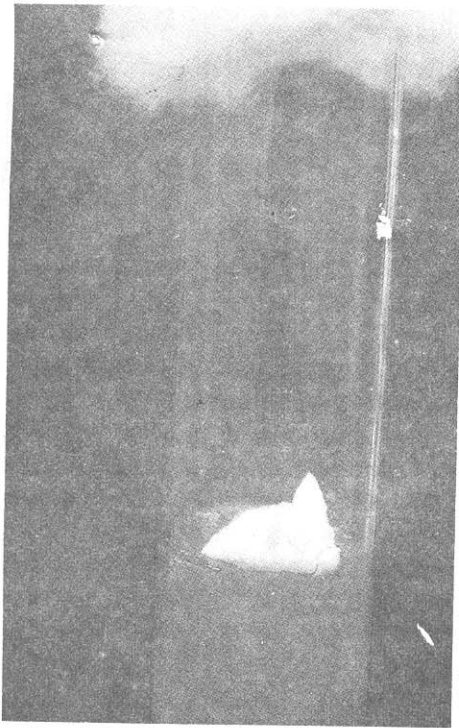


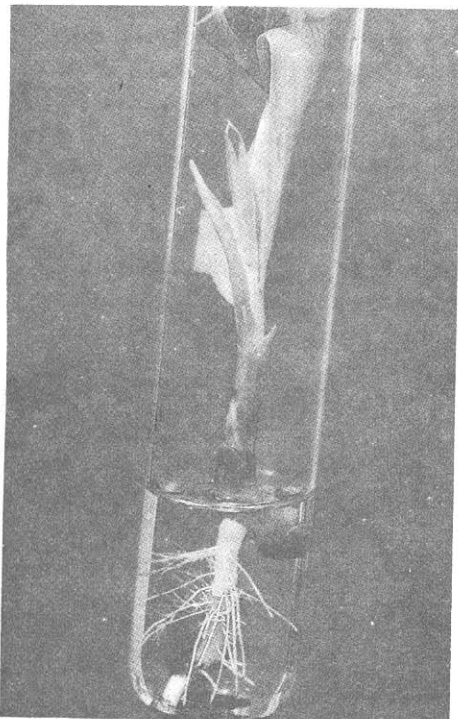
M.K. NAIR and ANITHA KARUN

Vistas of biotechnology for Palms, Cocoa and Cashew

Tissue culture of woody perennials including palms, cocoa and cashew are not commercially successful so far. Research programmes of different laboratories around the world however provide some hope for a breakthrough in these crops.



'Tough as Coconut'. Indeed biotechnological successes at being able to multiply the coconut have been little the world over. As it is the coconut has a low multiplication rate through seed propagation. Above. The scientists at the CPCRI, Kasaragod, observe *in vitro* the emergence of shoot and root in the embryos extracted from coconuts, 8 months or older. Below. An embryo-cultured plantlet.



BIOTECHNOLOGY has become a promising tool in the field of plant breeding, and together with the conventional breeding techniques it helps in producing novel and improved plants. Micropropagation of desired plants (disease-free or resistant), induction and selection of mutants, production of haploids through anther culture, wide hybridization through embryo and ovule culture, somatic hybrids and cybrids through protoplast fusion, transformation through uptake of foreign genome, nitrogen fixation, improvement of photosynthetic efficiency and cryopreservation of genetic variability are the important areas of biotechnology. Tissue culture of woody perennials including palms, cocoa and cashew are not commercially successful so far. Research programmes of different laboratories around the world however provide some hope for a breakthrough in these crops.

Coconut

Low multiplication rate of coconut through seed propagation and lack of reproducible clonal propagation are the major constraints in popularization of high-yielding selections and hybrids. While the country's annual requirement of coconut planting material is about 15 million seedlings, hardly two million elite seedlings of

the 9 hybrids and 2 selections released could be supplied. Micropropagation seems the only permanent solution to bridge this gap between demand and supply.

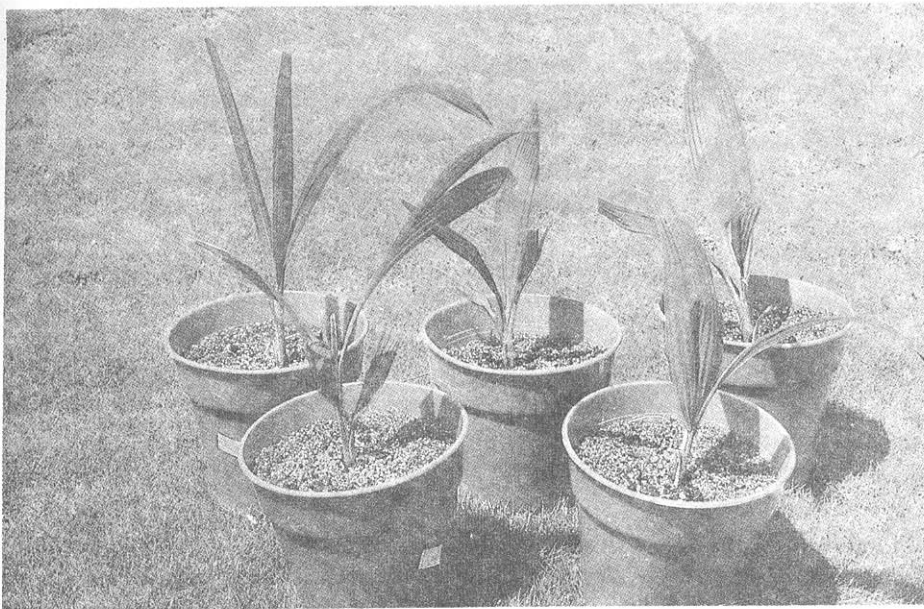
The first attempt in the country to culture immature rachillae explants excised from the leaf axil was made at the Central Plantation Crops Research Institute, Kasaragod, during 1980 by Kuruvinashetty and Iyer, which failed to regenerate any viable plantlet. From tender leaf tissues of 'West Coast Tall', Raju *et al.* succeeded in obtaining embryoids during 1984 at the CPCRI. They also developed a non-destructive method for extraction of tender spindle tissue from mature palm 4 years later. However, regeneration of such mature explants is yet to be achieved.

Explants of coconut in different media have also been tissue cultured at the Jawaharlal Nehru University, New Delhi (by Guha-Mukherjee and associates), the National Chemical Laboratories, Pune (by Mascarenhas and associates) and Hindustan Levers Ltd, Bombay (by Bhaskaran). The results so far are inconsistent.

The work at the Wye College, United Kingdom, and the IRHO, France, although yielded a few plantlets from leaf and inflorescence explants, a repeatable and commercial protocol is yet to be achieved.



The performance of embryo-cultured coconut plantlets in a humidity chamber (above). These plantlets have established in pots (below).



Collection and conservation of germplasm is fundamental to its commercial exploitation through biotechnology. Large nut size, short-duration dormancy and phytosanitary regulations pose problems in germplasm exploration of coconuts. It is therefore now an accepted practice that coconut germplasm is exchanged through embryo cultures. The embryo culture in coconut was first attempted by Abraham and Thomas at the Kerala

Agricultural University in 1962, who obtained plantlets from rudimentary roots. Collection of coconut embryos aseptically from the field and their *in-vitro* germination was initiated at the CPCRI, Kasaragod, during 1987 (Raju and Bavappa). Anitha Karun and associates of the same laboratory evolved a simple procedure of field collection and direct inoculation of embryos using a portable inoculation hood. They found that embryos ex-

tracted from coconuts, 8 months old and above, could be germinated *in vitro*. The standardization of *ex vitro* establishment of plantlets and methods for short-term storage of coconut embryos are in progress at the CPCRI.

Guha-Mukherjee from the Delhi University, D'Souza from the Mangalore University, Padmanabhan from the Madurai Kamaraj University and Gupta and Mascarenhas from the National Chemical Laboratories, Pune; Bajaj from the Punjab Agricultural University, Ludhiana; Kalamani and Rangaswamy from the Tamil Nadu Agricultural University, Coimbatore, have reported limited success in coconut embryo culture.

In the Philippines, de Guzman and associates took to embryo culture in 'Macapuno' embryos during 1971, the fact coconut 'Macapuno' does not germinate in nature. Embryo culture has been succeeded with at the IRHO, France, and Sri Lanka.

Oil palm

Oil palm, the richest source of vegetable oil, is increasingly being grown in India. Only 0.3 million plantings are available annually, the rest imported. Clonal propagation in addition to fulfilling the demand for planting material will facilitate propagation of *dura* and *pisifera* parents to produce desirable *tenera* combinations.

The success in vegetative propagation of oil palm through tissue culture using explants from matured palms have been reported in the United Kingdom, Ivory Coast, France and Malaysia. France and Malaysia are commercially supplying tissue cultured seedlings of oil palm. Thomas and Rao at the Bhabha Atomic Research Centre, Bombay, were the first to obtain a few plantlets of oil palm from tender leaf explants through somatic embryogenesis. At the CPCRI, Kasaragod, Raju and associates produced somatic embryoids from leaf explants of seedlings, which were hardened and transplanted in the field



Oil palm. The seedling explant is at-home in the field.



Cocoa. The cotyledon callus differentiates profusely into somatic embryos.

in 1989. A protocol for culturing of explants from adult palms is still to be standardized.

Cocoa

Tissue culture would be of immense use in clonal propagation of the cocoa and the genetic improvement of the crop through production of homozygous diploids, interspecific hybridization and biosynthesis of cocoa flavours. At the CPCRI, Kasaragod, mature cotyledon segments could be made to produce somatic embryoids profusely through callogenesis. At the Kerala Agricultural University too plantlets could be regenerated from cotyledon explants after somatic embryogenesis. However there was only callus formation in

leaf and stem explants. Somatic embryogenesis in cocoa using cotyledon and zygotic embryonic axis as explants has also been reported in many laboratories abroad.

Cashew

During 1993-94, more than Rs 10,000 million were earned from export of the cashew. *In vitro* clonal propagation if standardized will supplement the conventional vegetative propagation methods in meeting the requirement of planting material in the crop. Mature trees are recalcitrant and their *in vitro* culture difficult. At the Calicut University, Philip and Unni found that cotyledonary segments could produce more shoot buds and regenerate into plantlets com-

pared with the hypocotyl segments. At the CPCRI, Kasaragod, Nambiar and Iyer obtained multiple shoots using auxiliary buds but without rooting. Callus formation and different embryoids were obtained from seedling explants by Lakshmi Sita and Sreenatha at the Indian Institute of Science, Bangalore. Fr. D'Souza and associates of the Mangalore University have reported embryoids and multiple buds from cotyledonary explants of the cashew.

For clarification please write to:
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Above Coffee 'Cauvery' a hybrid between 'Caturra' x 'HDT' is an arabica selection. The plants are semi-dwarf, vigorous and compact, early-bearing, yielding 786 kg/ha of the berries. Although there is vertical resistance to leaf-rust, it tends to breakdown owing to the appearance of new races of rust. Below. In flowering, *Coffea canephora*, the robusta coffee much preferred internationally.



In coffee, the concentration of research has been to evolve varieties resistant to leaf-rust combined with high productivity, improved quality and better adaptability. Despite a narrow genetic base, 12 arabica and 3 robusta strains have been developed for commercial cultivation. Variation in ploidy level among the commercially grown arabica and other wild species, and the self-incompatible alleles present in diploid species pose problems in breeding for improvement. Molecular approaches offer a greater scope.

Domestic preference for arabica coffee is in contrast to the world-wide palate for the robusta coffees. Our export share is 2.5 per cent but the returns from the trade account for 8 per cent earned through agro-exports.

Of the 0.24 million hectare covered by the minor cash crop coffee, 68 per cent is in Karnataka, the balance in Kerala and Tamil Nadu. The country produced 0.24 million tonnes of coffee and exported 0.15 million tonnes of it in 1993-94. Today coffee trades are negotiated directly with growers, cooperatives, curing units and auctions; the past 50 years marked controlled marketing through the statutory Coffee Board.

We grow more of arabica coffee than robusta, the more popular coffee in international trade. Coffee is not an ideal crop for round-the-year marketing. Besides, if the trade sways from the primary market to roasted beans or its ground form, the 16 grades for export will lose identity to 'Brand' names.