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Coconut Research and Development

N. M. NAYAR

Central Plantation Crops Research Institute, Vittal 574 243, Karnataka State, India.

The palm family (Arecaceae), more commonly known as Palmae, is one of the largest in the plant kingdom, though it is mostly restricted to the tropics. Among the palms, the coconut (*Cocos nucifera*) is the most widely distributed. Most economic botanists agree that the coconut palm is the most useful tree to man because every part of this palm finds an active economic use. Further, this palm means much to the people of certain tropical countries because of its greater concentration there. The Philippines, Indonesia, India, and Sri Lanka are the principal coconut-growing countries of the world. Coconut also occurs as a cultivated or naturalized plant in several tropical countries of the New World.

The coconut palm is best known for the oil that its endosperm gives. Until about four decades ago, coconut oil was the most widely traded of all vegetable oils. Today, it ranks sixth in the world in terms of production and fourth in international trade following soya bean oil, palm oil, and safflower oil. It is also now one of the most expensive edible vegetable oils. The reason for this has been the more organized and aggressive research and development methods that have gone into the utilization and improvement of other oil-yielding plants and in their oil technology while those of the coconut palm have remained at best stagnant. Though the FAO has been organizing some working party meetings on coconut production, processing, and utilization, its impact on research and development efforts in the coconut has been possibly only marginal.

It is against this background that the Indian Society for Plantation Crops and the Indian Council of Agricultural Research organized an International Symposium on Coconut Research and Development, the first of its kind on this palm, at Kasaragod (Kerala State, India) from 27–31 December 1976 to mark the diamond jubilee year of coconut research in India. Coconut research was first begun in India (and for elsewhere in the world) in 1917 at Kasaragod, Nileshwar, and Pilicode by the Madras Agriculture Department. The symposium attracted over 320 scientists from India and several important coconut-growing countries of the world. The mark the occasion, the Indian Posts and Telegraphs Department issued a commemorative stamp depicting an early-bearing, heavy-yielding, hybrid coconut palm symbolizing the most notable research achievement of the last six decades (Fig. 1). A philatelic competition and exhibition on two themes "Coconuts on Stamps" and "Plants on Stamps" was also organized at this time, possibly for the first time, along with a scientific program of this nature.

Dr. M. S. Swaminathan (Director General, Indian Council of Agricultural Research, New Delhi) inaugurated the symposium with a keynote address "Coconut research—the next phase." He identified the major research problem in coconut as breaking the yield barrier which has remained consistently sta-

1. Facsimile of the commemorative stamp issued by the Indian Posts and Telegraphs Department on 27 December 1976 to mark the Diamond Jubilee Year of Coconut Research in India.

tionary with 30–40 nuts annually in cultivators' plots while some "super" palms have been observed that are capable of yielding over 600 nuts annually. He made a gap analysis of the problems involved in breaking this yield barrier. He also called for finding a solution to the root (wilt) disease of Kerala State, which is responsible for an annual loss of Rs.300 million (about US $35 million).

The symposium was organized in nine sessions in which 80 papers were presented. In the session on Genetics and Plant Breeding, 10 papers were presented. Of these, seven related to selection and breeding, and one each on cytogenetics, seed production, and sampling. Coconut has a long juvenile phase. It takes about 10 years under ordinary management conditions to come to stabilized yield. Several papers related to developing methods for identifying high-yielding and prepotent palms at the seedling stage or from seedling characters of the progeny. Satyabalan and Jacob Mathew (CPCRI, Kasaragod) presented data which showed some possibilities for identifying potentially high-yielding palms in the fifth month based on leaf number and girth at collar.

Ninan (Kerala University, Trivandrum) and Bavappa and Sukumaran (CPCRI, Kasaragod) called for intensifying research on utilizing "dwarf" palms and their hybrids with "tall" palms. Rognon and de Nuce de Lamothe (IRHO, Paris and Port Bouet) presented data on xenia and combining ability in the coconut palms. Balingasa and Carpio (Philippine Coconut Authority, Davao City) discussed the prevalence of wide variability occurring in the natural populations in the Philippine Islands. This is understandable as the Philippines possesses the largest area under coconuts in the world and is also considered by some authors as its center of origin.

The session on Agronomy and Soil Science transacted 10 papers. In a paper on the effect of moisture stress and irrigation on yield, Abeywardena (Coconut Research Institute of Sri Lanka, Lunuwila) attempted to establish a quantitative relationship of high predictability between drought index and coconut yield. Relevance of soil and leaf analysis in relation to the nutrition of high-yielding coconut genotypes was brought out by Kamala Devi et al. (CPCRI, Kasaragod) by using data on changes in both total and available nutrition. Several reasons, as the long juvenile phase, the wide planting distance of 7.5 m^2, the almost stagnating yield, and the ever-increasing pressure on land, have made it imperative to develop methods to increase the productivity of coconut gardens. Two pa-

pers dealt with this aspect (Ramadasan et al., MARDI, Kuala Lumpur; Sahasranamam et al., CPCRI, Krishnapuram), the former relating to intercropping coconut gardens with cacao, and the latter to a mixed farming program consisting of fodder grasses and legumes planted in interspaces of coconut, maintaining milk cattle, and recycling cattle wastes. These and such other systems are already being practised by the coconut farmers from time immemorial, but more as a way of life rather than as an efficient economic activity as was sought to be presented here.

Nine papers were presented in the session on Biochemistry and Physiology. Three dealt with chemical properties of coconut products like toddy, coconut water, and copra. Samarajeewa et al. (Coconut Research Institute of Sri Lanka, Lunuwila) presented a practical and easily workable method for efficient fermentation of toddy. In a paper that was read in absentia, Milburn (University of Glasgow) discussed the vascular physiology of this palm. More than anything else, it showed how little was known about the basic physiology of the coconut palm despite its considerable economic importance. Milburn proposed that sap concentration in this palm was maintained homeostatistically to a considerable extent as in other plants, and sap was driven through the sieve tubes by pressure.

The session on Technology saw the presentation of eight papers. The underlying current of most of them was stressing the need for making concentrated efforts to improve the yield and quality of oil by developing efficient and cheap methods for drying coconut kernel into copra and for reducing spoilage of both copra and oil during storage. This session called for developing a technique for extracting part of the oil from fresh endosperm. This would permit both recovery of some oil and also use the partially "spent" endosperm for culinary purposes. Timmins (Tropical Products Institute, Culham) gave an account of the traditional and modern methods of wet-milling fresh coconut kernel. Nambiar (Chemical Construction Company, Madras) presented the economics of the "Solvol" process. The other papers presented in this session related to the industrial utilization of coconut husk for manufacture of coir and coir products as foot mats, mat filters, upholstery, carpets, etc. (Prabhu, Central Coir Research Institute, Alleppey), the microbiological processes involved in the retting of coconut husk (Bhat, Kasturba Medical College, Manipal), and production of activated carbons from fiber pith (Aslam Ali, Karnataka Carbons, Bangalore), and prestressed building materials from coconut husk and by-products (George, Indian Plywood Industries Research Institute, Bangalore).

In the session on Basic Studies, seven papers were presented. Two related to efforts being made for the vegetative propagation of coconut palm (Schwabe, Wye College, Kent) and the characteristics of bearing palms raised by embryo culture (de Guzman, University of Philippines, Los Banos). Tissue culture offers considerable potentiality in a tree like the coconut palm with its long juvenile phase and obligate sexual reproduction. There was a consensus that work on this aspect should be intensified, especially in view of the recent success obtained in oil palm by the Unilever Laboratories in Sharnbrook, UK. In a paper on the association of coconut foliar asymmetry with latitude, Davis (Indian Statistical Institute, Calcutta) presented data on the spirality of over 60,000 palms recorded from 38

countries in both hemispheres, which were found to be 52% left-spiralled. Asymmetry was also shown to increase with increasing latitude in both hemispheres.

Origin of the coconut palm is a highly controversial point and considerable arguments have been put forward in support of both Old World and New World origins. Nayar (CPCRI, Vittal) argued that there was no need to assume the existence of a truly wild coconut palm either now, or in the immediate past, since, as with many other tropical plants used by man, the present-day coconut palm does not also appear to have made any significant evolutionary advancement as a result of deliberate cultivation by man. The germ plasm collections made from around the world, including the numerous islands in the South Pacific and Indian Oceans, do not show the presence or prevalence of genuinely primitive and advanced characters for even the economic attributes.

The highlights of the symposium were the two sessions on Diseases and Diseases of Uncertain Etiology. Unlike most other economic plants, the coconut palm is affected by a number of diseases of uncertain etiology like the cadang-cadang disease of the Philippines, the thattipaka and root (wilt) diseases of India, kaïnkopé disease of tropical West Africa, and lethal yellowing of the West Indies. There are also other maladies like the red ring, bud rot, stem bleeding, and hartrot diseases for some of which etiology has been only "vaguely" determined if at all. The 14 papers presented in these two sessions, however, brought out the feeling that the intensive, often international, cooperative research efforts underway on many of these diseases are beginning to bear fruit and that the workers are "closing in," as was termed by Swaminathan, on determining the etiology of some of them. For instance, Giannotti (Station de Recherches Cytopathologiques, St. Christol les-Ales) obtained evidence to suggest that the coconut yellow disease of West Africa was caused by microplasmalike organisms. Randles' (University of Adelaide, Glen Osmond) paper pointed out that in cadang-cadang disease, he discovered two low-molecular weight RNA species, which were structurally similar to two of the known viroids—potato spindle tuber and citrus exocortis viroids. Tsai and McCoy (both of the University of Florida, Fort Lauderdale) presented data on the attempts to transmit lethal yellowing of coconut palms by suspected vectors and the successful use of oxytetracycline for prophylactic and therapeutic treatment. Maramorosch (Rutgers, New Brunswick) gave an overview on the present status of rickettsialike and mycoplasmalike diseases of plants and their relevance to the coconut palm diseases. Regarding the etiology of Kerala wilt, he proposed that interactions between disease agents, plant hosts, and insect vectors could be manipulated to prevent the spread of the disease even if the etiology were uncertain. The need to determine the role of the burrowing nematode *Radopholus similis* in the root (wilt) disease was stressed by Ramakrishnan (University of Agricultural Sciences, Bangalore), especially since it has been found to cause extensive root damage in this palm.

In the session on Pests, seven papers were presented and they generally emphasized the need for adopting improved methods to control the various pests. The serious damages caused by rhinoceros beetle and the leaf-eating caterpillar in many coconut-growing countries were stressed in several papers.

In the session on Developmental Pro-

grams in India and other Countries, 16 papers were read. Six papers pointed out, more than anything else, the large gaps existing between the research findings obtained in the laboratories and the practices adopted by the farmers and the inadequacies of present extension methodology in transferring the knowledge to the farmer community. In this context, Venkataraman (Directorate of Agriculture, Madras) recommended for adoption by other coconut-growing countries the organizational structure for research and development of Sri Lanka and Jamaica.

In the Plenary Session, the delegates recognized the need for maintaining and strengthening the contacts made by the coconut research workers during the symposium. It was decided to form an international secretariat with its headquarters at Kasaragod (Kerala State, India) for the present for this purpose. All the delegates agreed that this symposium, the first of its kind on coconut, was successful in bringing together a large number of coconut research workers from several countries of the world. It also took note that others had been invited but that travel expenses for several other foreign delegates had not been forthcoming.

The proceedings of the symposium will be published in late 1978 by Wiley Eastern Limited, New Delhi.

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PALM BRIEFS

Mode of Germination in *Eugeissona tristis* Griff.

The lepidocaryoid genus *Eugeissona* with five species occurs only in the Malay Peninsula and Borneo. The species *E. minor* Becc., *E. insignis* Becc., and *E. utilis* Becc. are all Bornean. The two Malayan species are *E. brachystachys* Ridl., which is endemic to the National Park, Pahang, and *E. tristis* Griff., the common bertam (Fig. 1) occurring throughout dryland forests in the lowland and to about 2,500 ft in the mountains. There is little variation within the species *E. tristis* and only one variety (var. *gracilis* Dransfield) has been described from specimens collected in Johore.

The germination pattern of *E. tristis* does not conform to the variations described by Tomlinson (1960) for palm seedlings. Perhaps it is worthwhile here to present the sequence of events observed for discussion.

1. The clump-forming, "stemless" *Eugeissona tristis* at the fringe of the forest.