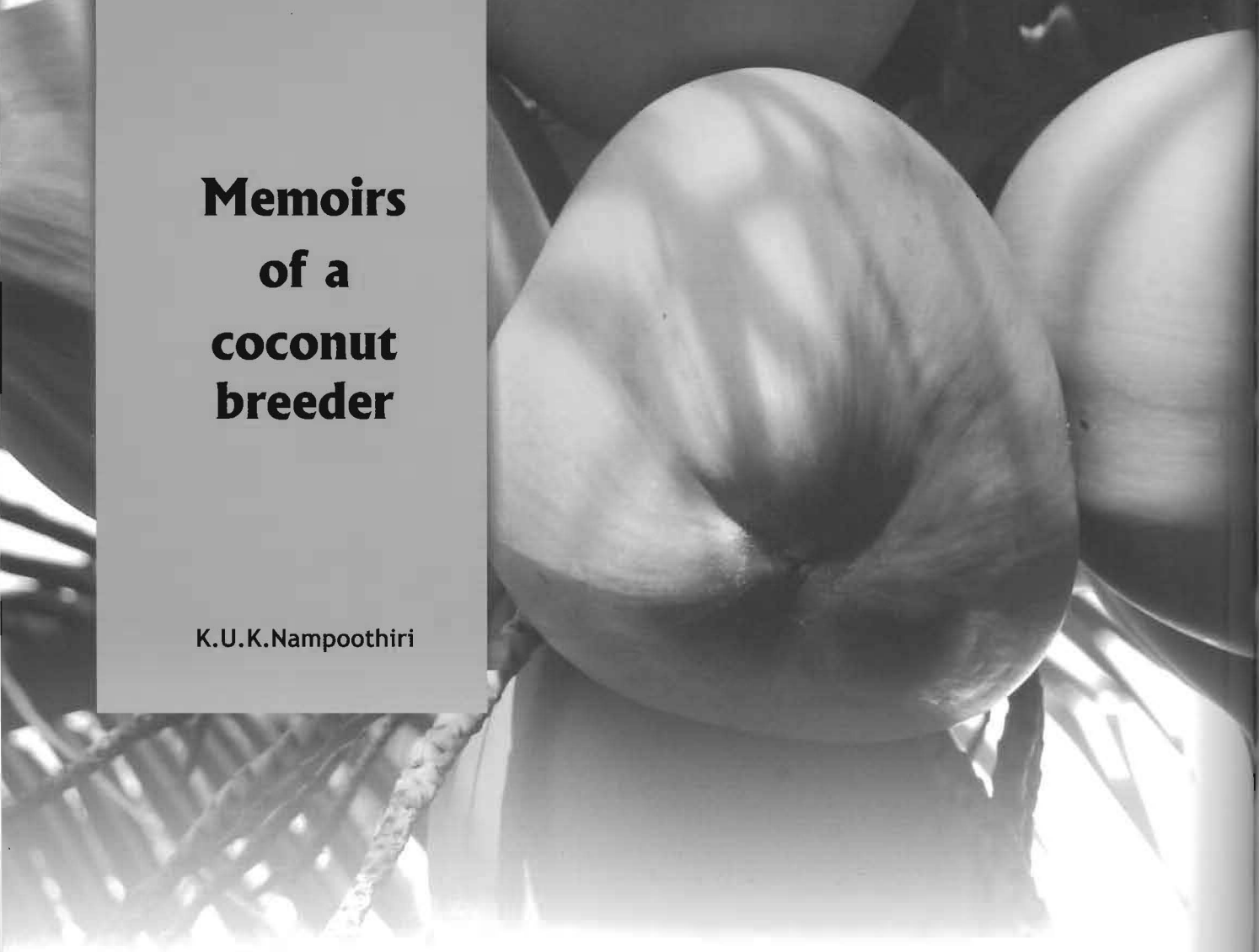
Memoirs of a coconut breeder



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Coconut has a special place in the heart of every Keralite and mine is no different. My professional association with coconut dates back to 1964 when I joined as a senior scientist in the Central Coconut Research Station under the erstwhile Indian Central Coconut Committee which later bifurcated as Coconut Development Board to take care of the development aspects and Indian Council of Agricultural Research taking care of the research aspects (Anexure I). I was guided by late Mr. Satyabalan who was a prolific writer and Dr. M.C.Nambiar, a noble person, ably helped by experienced botanists like Mr.R.V.Pillai and Ms.Rathinam. I learned that coconut research has a long history in India, dating back to 1916 undertaken at Pilicode, Nileswar and Kasaragod research stations under the erstwhile Madras Presidency. However there was no organized research and everyone was free to carry out their own work; for example, I started with pollen studies and even cytological studies on weeds in coconut which would not have been the priorities for sure. Right from the beginning efforts were made to collect germ plasm and the earliest record of exotic germplasm collecton is that of 1924. There was a comprehensive collection of 24 cultivars from six countries in the pacific Ocean regions in 1982 under FAO/IBPGR funding. The major concern was the inadvertent introduction of diseases, to circumvent which a World Coconut Germ plasm centre was established in the Andaman islands, which was later handed over to another ICAR Institute- Central Agricultural Research Institute. In 1952 itself comprehensive collections of indigenous materials were made. Today CPCRI has the largest collection of genetic material with 268 indigenous and 132 exotic accessions from 28 countries Some of the collections are also maintained at All India

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coordinating centres and Universities depending on the local relevance.

Although there was no information on gene action involved in the inheritance of yield and yield attributes, selection of mother palms based on yield was an age old practice in all the traditional coconut growing countries. Then I came across the papers on concept of pre potent palms by the great Dr. Harland who had visited the CCRS in 1957. According to him, pre potent palms are those which in spite of having been indiscriminately pollinated are sufficiently possessed with dominant yield factors to ensure that their offsprings are also high yielding. In a plantation of 1400 palms at Kasaragod high yielders were only 8.6 %. Evidently, the number of pre potents will still be lower. Our group in the botany division realized the opportunity to use the prepotency hypothesis for refining the mass selection procedure which was the most popular method in vogue that time. Since study of adult palm progenies is time consuming, laborious and resource demanding, attention was given to identify pre potents through seedling selection. Simultaneously, a few high yielding palms in the campus were selected and seedlings from open pollinated seeds of these palms were raised, selections were made based on seedling measurements and field planted, with the idea of identifying pre potent palms through progeny testing. We could later identify 8 such palms out of which in fact three were so apparently outstanding that they were already being continuously used for seed production for years.

I was then lucky to undertake my Ph.D. work on coconut under the guidance of none other than Professor M.S.Swaminathan at the Indian Agricultural Research Institute. In view of the difficulties in growing coconut under Delhi climate, I was permitted to do the research work at Kasaragod, an opportunity not given by the Institute to any other student. This also gave me the opportunity to join as Assistant Botanist to which post I was selected while I was doing my Ph.D. work. I understand that my thesis " Biosystematic studies in *Cocos nucifera*" is the first one on coconut in the world. I remember with gratitude the help given by all my friends in the genetics division and

Annexure I. Important milestones in coconut research and development

Year	Event
1916	Initiation of coconut research in the country
1924	Introduction of exotic germ plasm from Asian and Pacific countries
1937	Report of hybrid vigour in T x D coconut hybrids by Dr. J.S.Patel
1945	Establishment of Indian Central Coconut Committee (ICCC)
1947	Taking over of coconut research station, Kasaragod by ICCC
1959	First Conference of Coconut research workers at Trivandrum
1966	Establishment of Directorate of Coconut Development
1970	Establishment of Central Plantation Crops Research Institute
1972	Establishment of All India Coordinated Project
1972	Laying out of world's first coconut hybrid evaluation trial in diallel mating design
1978	Multi-storeyed coconut cropping system model
1981	Establishment of Coconut Development Board
1982	Introduction of exotic germplasm from Pacific Ocean islands
1983	Phytoplasmal etiology of root (wilt) disease
1983	Establishment of high density multi-species cropping system with 17 crop species
1984	Release of Kera Sankara, Chandra Sankara and Chandra Kalpa coconut varieties
1991	Platinum Jubilee of coconut research and International Conference on coconut
1993	Release of Chowghat Orange Dwarf, Chandra Laksha & Kera Chandra varieties
1998	Establishment of International Coconut Gene Bank for South Asia in Kidu
2008	Phytoplasma association with root (wilt) disease - through PCR technique
2008	Kalpa Dhenu, Kalpa Mitra, Kalpa Pratibha and Kalparaksha released
2009	Establishment of Agri-Bioinformatics Promotion Centre
2009	Release of Kalpa Samrudhi, Kalpa Sankara, Kalpasree & Kalpatharu varieties
2010	International Conference on Coconut Biodiversity for Prosperity
2012	Kalpa Samrudhi, Kalpa Sankara, Kalpasree notified by CVC

friends like Late Mrs. Kamaladevi in supervising the pollination work, extractions for electrophoresis and so on when I was in Delhi.

By 1970 the Institute was reconstituted and named as the Central Plantation Crops Research Institute (CPCRI) under Indian Council of Agricultural Research. The research work was being reorganized and made more systematic by the then dynamic Director, Dr.K.V.Ahammed Bavappa. It was in 1972 that we had a very serious discussion on coconut breeding under the guidance of Dr. B.R.Murthy. The first statistically laid out trial with 12 popular varieties of coconut was conducted in the hill block. The main constraint in laying out such breeding and agronomy trials was and remains to be the non availability of sufficient land. It was the pioneering work of Dr.J.S.Patel that led to exploitation of heterosis which opened new vistas in coconut breeding. The main planting material T xD and D x T hybrids were in great demand. Dr. C.A. Ninan had then published evidence to show that the recombinants of Chowghat Orange Dwarf was similar to D x T hybrids in performance.

The argument was that these could be the segregants among the progenies of the dwarfs which are not 100% homozygous. But the occurrence of such palms were only in the range of 10-15%. It is a proof of farmers' ingenuity that the recombinants of selected Chowghat Orange Dwarf palms, identified in the nursery was already being sold for many years as Komadan by a family by the same name in Chengannur (a town in central Kerala) and was very popular among the farmers. By this time enormous data had been accrued on performance of varieties. Since the All India Coordinated project on palms was initiated by 1972, it was found convenient to test them under varied climatic conditions as these centres were located in different states.

As on today there are 18 varieties and 15 hybrids released by various agencies for cultivation in different states. In this context, I very vividly remember the discussions in 1984 at Kanakakkunnu palace, Thiruvananthapuram, during the proposal for release of coconut hybrids for the first time during the All India Coordinated project workshop. It is mandatory to get the proposal for variety release approved in the workshop for all India release. There were heated arguments for and against the release and it was only by midnight consensus was arrived to release the T x D and D x T hybrids by the names Kera Sankara and Chandra Sankara. The farmers had complaints against the hybrids that they show alternate bearing, buckling of bunches and have poor quality nuts as well as less longevity and that they are prone to theft due to dwarf stature and so on; some of which are genuine whereas others are not. A detailed study on the performance of high yielding coconut varieties/hybrids was undertaken in 1998 by Sri. P.K.Thampan under a project financed by the APCC (Asian Pacific Coconut Community). It was a fact that there was no uniformity in the hybrid population because of the very heterozygous nature of the parents and the seedling selection, in which 35 % of the non vigorous ones are culled out being not efficient enough to ensure any noticeable uniformity. The breeders however could claim the precocity and heterosis exhibited by the hybrid progenies and there was unprecedented demand for hybrid planting material with research organizations, universities and development agencies expressing their inability to cope with the situation. This situation was made full use of by certain unscrupulous private nurseries in selling spurious materials as hybrids for huge profits and no one could do anything. The poor farmers could realize the folly only after a lapse of 6 or 7 years. It should however be mentioned that certain private entrepreneurs like DJ farms, Madurai had maintained their credibility and their hybrids- Malayan Dwarf Yellow x East Coast Tall (DJ hybrids) are in very high demand. Here the main redeeming feature is the stringent selection of parental palms and seedlings (25-30%). There was a serious attempt made to establish seed gardens in Karnataka, Tamil Nadu and Odisha in late 70s with an estimated production of 1.0 million quality seedlings per year. It is unfortunate that none of them could achieve the targets due to sheer mismanagement. The seed gardens under CPCRI and Coconut Development Board could meet the demand only partially with an annual production of 7-8 lakh seedlings. Unfortunately the situation remains the same with a current demand of 14 million seedlings as against a production of 8 million per year. It can be found that the coconut farmers possess very good palms which are used as mother palms and they are popular in the locality. Now that the Protection of Plant Varieties and Farmers' Rights Authority proposes to register farmers' varieties, the enlightened coconut farmers can register their varieties and claim ownership for the same.

In 1974, I co-authored an article on coconut breeding with Dr. K.V.A. Bavappa in which we suggested a Reciprocal Recurrent Selection model and indicated the whole breeding cycles diagrammatically. Here West Coast Tall and Chowghat Orange Dwarf were taken as the two base populations, each of them being continuously improved not only for yield but also for uniformity through selection at mother palm and seedling stages followed by *inter se* mating between selected palms within the varieties. Evidently crosses should be effected only between parents showing high combining ability. With every stage of the breeding cycle, taking 15 - 20 years, the performance could be expected to better by 15 %. It was also shown by the agronomists that the hybrids perform to their potential only when grown under recommended agricultural practices. The world's first coconut evaluation trial in diallel mating design was planted in 1972. Attempts were made to raise selfed progenies with a view to crossing them to exploit hybrid vigour to the maximum extent. This however did not meet with success since the palms became extremely weak by S_3 generation. It is felt that inbreeding followed by hybridization between pure lines have not received adequate attention. Where inbreeding depression is apparent, introgression with other palms could be attempted followed by another cycle of inbreeding.

Yield *per se* is not of great concern since the released varieties/hybrids have the potential to give 25 kg of copra per palm/year. The concern has been about the diseases prevalent in most of the coconut growing states. Whether it is root (wilt) disease in Kerala or Thatipakka disease in Andhra Pradesh or Tanjavur wilt in Tamil Nadu or crown rot disease in Assam, the diseases have been the most important single constraint in realizing the potential yields. Attempts were made to screen all the available varieties and hybrids for field tolerance against (root wilt) disease a debilitating disease reported since 1908, for which no control measure was in sight. Since open pollinated progenies did not give any encouraging result, selfed and *inter se* pollinated progenies of selected varieties were also field tested in the disease affected areas. The confusion on etiology which varied from fungus, bacteria, virus and finally to MLOs (Mycoplasma Like Organisms), was a major impediment in resistance breeding. In 1987, a comprehensive breeding strategy for the purpose was drawn up. It basically envisaged identification of high yielding disease free palms of WCT and CGD in disease endemic areas, screening them serologically and histochemically to establish freedom from MLOs, and using these palms as parents in deriving progenies for further field testing. Following this, very elaborate surveys were made in the hot spots and 293 West Coast Tall palms and 59 CGDs were selected based on a set of defined criteria. A large number of open pollinated, selfed and *inter se* crossed progenies were tested. Since CGD x WCT hybrids were found promising a seed garden was established for large scale production at Neriamangalam (Kerala state) under the coconut Development Board. However these hybrids also succumbed to the disease later. Planting of nuts from the selected WCTs continued, but here again the supply of such seedlings remained dismally low compared to the requirement, particularly due to the high demand for new plantings in border areas from where disease affected palms were removed to keep the inoculum low under a massive project supported by the Coconut Development Board. The only tolerant varieties have been the Malayan Green Dwarf and Chowghat Green Dwarf from which Kalpa Raksha and kalapasree have been released and notified in 2008 and 2012 respectively for cultivation in the root (wilt) disease affected areas of Kerala state because of its higher level of resistance to the disease. Similar attempts are necessary to breed tolerant varieties against Tanjavur wilt and Thatipaka disease.

In view of the competition from other oil yielding crops especially oil palm, it will be wise to seek other avenues of using this crop such as for tender nut water. CDB has been aiming to increase the consumption to 20-25 % from 8% at present. There are many varieties suitable for tender nut and among them Chowghat Orange Dwarf has been identified as the most suitable variety for the purpose and released for cultivation in 1991. Although intercropping was in vogue in many coconut growing states, it was put on a scientific footing, through a series of trials laid out with a large number of crop combinations in what was called multistoried cropping. Attempts to define a proper ideotype and breeding for the same especially to suite high density cropping systems have so far evaded the breeders.

Biotechnology tools complementing with conventional breeding techniques can be a very powerful tool in producing desirable and novel coconut varieties. We look forward to

this technique for micro propagation of specially unique genotypes such as super palms, Makapuno, disease tolerant palms etc. Though the tissue culture work started in India in 1980, micro propagation using adult coconut palm tissues still remains a dream of the biotechnologists. While reports from Wye college, United Kingdom and IRHO,Montpellier, France are silver linings in this field, its commercialisation has not been possible mainly because of problems of repeatability. Raju, Anitha Karun and associates of CPCRI have standardized technique for field collection and inoculation of embryos using a portable hood. This will help to circumvent the problems of large size of coconuts and phytosanitary rules restricting exotic introductions. Coconut accessions collected from eight countries could be field planted using this technique. It will be economically advantageous if the embryo culture technique can be used to multiply Makapuno type of coconut which are not amenable for seed multiplication. Molecular marker technology comes handy for germ plasm identification and genetic mapping. Similarly molecular techniques can be very effectively used for detection of pathogens as is being attempted in the case of lethal yellowing, Cadang Cadang etc

In 1975, I was deputed by Government of India to Nigeria to initiate coconut research in that country and to train personnel on coconut. The first task was to convince the public about the beneficial effects of coconut products and their varied uses because the people were under the impression that even the tender nut water causes diarrhoea and infertility or any other disease as per their whims and fancies. The Nigerian Institute of Oil Palm Research where research on coconut, oil palm, raphia and other palms were being undertaken, had few exotic and indigenous collections facilitated by Late Mr. Obasola. An extensive collection was made by me from 7 states where the crop could be found though sporadically. A piece of 500 hectare land in Badagry, Lagos State was obtained with great difficulty from the chieftains, which has not been possible even after five years of relentless effort by the institute in the past. A substation was established here with minimum infrastructural facilities. A germ plasm block, varietal trial, a 20 ha seed garden and a fertilizer trial were laid out. The early performance was very good especially because there were no serious diseases or pests afflicting coconut. Now lethal yellowing disease has become a major problem in Nigeria also. They could allot me a post graduate hand only at the very last leg of my five years of deputation whom I trained adequately and handed over charge before returning to India in 19 81. During this period I could visit, on my own, CRI, Sri Lanka and the IRHO, Abidjan, Cote'd'Ivoi're (the then Ivory Coast) where extensive advanced coconut field research was being undertaken. They had their laboratories in Montpellier, France where all the laboratory work was done. Unfortunately the country doesn't use much of coconut products and large number of nuts could be seen strewn around the gardens, beaches and so on. It was a proud moment in my life when I received the Platinum Jubilee Award by the Indian Society for Plantation cops " for outstanding contributions in coconut breeding" during the International symposium held in 1991.

The establishment of International Coconut Genetic Resources Net work (COGENT) in 1992 gave a boost to various activities related to coconut breeding. It is a global research net work organized by the International Plant Genetic Resources Institute (Now Bioverstiy International) with support from member countries. Starting with 15 countries it has grown rapidly to cover 39 countries now, including India. Dr. M.K.Nair was the first member to represent India followed by me and then the succeeding directors of CPCRI. Two major international supports we received were for the establishment of an International coconut gene bank for south Asia in Kidu (on a severe competitive basis from other countries), and to undertake the embryo culture work at CPCRI. An International Coconut Genetic Resources Database (CGRD) was developed for which a major contribution was from the descriptors facilitated by Dr. Ratnambal from India The molecular work was spearheaded by the Montpellier laboratory (France) led by Dr. Bordeaux. Technical and financial help was also received in training and exchange of information on coconut germ plasm. Although member countries agreed for reciprocal access to germ plasm, very little could be achieved on this front because of lack of political will. There were some impediments for us since coconut is not in the priority list in India. There has been a lull in its activities recently and the ensuing meeting proposed at Cochin, India in July,2012 is hoped to revive its activities so that the expectations of the member countries to improve coconut profitability in a sustainable manner are fulfilled.