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HETEROSIS BREEDING IN COCONUT — PAST, PRESENT AND FUTURE*

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ABSTRACT

The coconut improvement programme through breeding was initiated in the early part of the current century. The discovery of hybrid vigour in coconut in India by Patel (1937) was a significant landmark in the history of coconut improvement. Subsequently, systematic efforts were made in Sri Lanka, Ivory Coast and Jamaica which led to the successful exploitation of hybrid vigour in coconut. Selection of elite parental palms, testing their combining ability and establishing seed gardens with promising parental lines for hybrid seed production, are the important steps in heterosis breeding. The desired traits both from Dwarf and Tall parents are brought together in hybrids. Due to the concerted efforts of coconut breeders many hybrids have been released for cultivation in different coconut growing countries. Notable among them is the Ivory Coast hybrid MAWA of I.R.H.O., which has been widely distributed in different S. E. Asian countries like Indonesia, Thailand, Malaysia, Philippines etc. The historical background of heterosis breeding, present status and future programmes envisaged in various coconut growing countries have been reviewed in this paper.

INTRODUCTION

The coconut palm (*Cocos nucifera* L.) is one of the most versatile species providing food, a refreshing drink, shelter and several products for industrial use. It ranks first among the oil yielding crops of the world in terms of geographical distribution as it is grown in more than 90 countries of the tropics. Being a small holder's crop, it is a source of income to millions of small and marginal farmers. Das (1985) reported that the average productivity of coconut in the world has shown a declining trend during 1966–80. This, coupled with an increasing demand for coconut products underscores the need to enhance the productivity of coconut. Varietal improvement is one of the basic steps towards achieving higher productivity. Organised research efforts for improvement of coconut were initiated in the early part of 19th century but the progress was very slow till 1960.

Coconut has not received the attention that it deserved mainly due to some unique problems encountered with the crop. The perennial habit, long juvenile period, highly outcrossing and heterozygous nature, difficulties in clonal propagation and large area required for systematic experimentation are some of the barriers to achieve rapid progress in coconut breeding. Among the several breeding methods, exploitation of heterosis had the maximum impact in coconut improvement. Since the desired characters such as high yield, precocity in bearing, better quality, high copra and oil content, drought tolerance and disease resistance are distributed among different varieties or different individuals of the same variety, hybridization is by far the most useful method to bring together the desirable traits. Harland (1957) advocated the exploitation of hybrid vigour to increase the productivity of coconut. He

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emphasized the need to involve diverse parents to realize higher genetic gain which was further supported by Bourdeix (1988). The higher yield potential of coconut hybrids and their better field performance under ideal conditions clearly indicated the scope of heterosis breeding in coconut.

Eversince heterosis or hybrid vigour was discovered in maize by Shull (1910) and East (1908) there have been successful attempts to exploit this phenomenon in various other crops including coconut. The first coconut hybrid was produced in Fiji in 1928 between Malayan Dwarf and the local Niu Leka Green Dwarf. However, the manifestation of hybrid vigour was reported for the first time in India by Patel (1937) in a cross between West Coast Tall as a female parent and Chowghat Green Dwarf as male parent. The hybrid seedlings were characterized by early germination, higher vigour in terms of height, girth at collar and number of leaves as compared to the progeny of the female parent. The heterotic effect in the intra- and intervarietal crosses was subsequently confirmed by John and Narayana (1949), Rao and Koyamu (1952), Satyabalan (1956), Liyanage (1956) and Bhaskaran and Leela (1964). Better performance of Tall x Dwarf hybrids was also reported from Indonesia by Tammes (1955). No serious efforts were made in earlier years to produce Dwarf x Tall hybrids due to limited number of dwarf palms available for crossing. However, the superior performance of some natural hybrids of Orange Dwarf prompted the breeders to attempt controlled crossing between dwarf x tall types (Satyabalan, 1976). Ninan and Satyabalan (1964) showed that Chowghat Orange Dwarf x West Coast Tall hybrid was superior to both the tall parent and its reciprocal combination in spathe production, nut and copra yield. These findings coming primarily from India and Sri Lanka, and subsequent developments in Jamaica and Ivory Coast, led to the successful exploitation of heterosis through a systematic hybridization programme. Encouraged by the positive results of heterosis breeding, many coconut growing countries have planned systematic crossing programmes to exploit heterosis. The research efforts of Sri Lankan Coconut Research Institute (CRI), Coconut Industry Board (CIB) of Jamaica, Joint Coconut Research Scheme (JCRS) of Solomon Islands and IRHO in Ivory Coast have been instrumental in making the hybrid coconut technology a practical proposition. Detailed information on heterosis breeding of coconut has been provided by Harland (1957), Satyabalan (1982), Bavappa and Nampoothiri (1973), Iyer et al, (1978), Bavappa and Rao (1985), Santos (1988) and De Silva (1989). An attempt is made in this paper to review the progress of heterosis breeding in major coconut growing countries of the world to highlight the problems being faced in India.

India

Systematic work on hybridization in India was started in 1930's between West Coast Tall (WCT) as a female parent and Chowghat Green Dwarf (CGD) as the male parent. This is considered to be one of the notable achievements in coconut breeding as Patel (1937) who studied the performance of these Tall x Dwarf (T x D) hybrids reported for the first time the manifestation of hybrid vigour in coconut. This important finding paved the way for the subsequent successful exploitation of this phenomenon in many coconut growing countries of the world. The hybrids germinated early and were very vigorous characterized by increased height, collar girth and more number of leaves compared to the progeny of female parent. The superiority of T x D hybrids has subsequently been confirmed by many workers (Satyabalan, Ratnam and Kunjan, 1970). Till the middle of 1950's, the emphasis was on the

production of T x D hybrids as the number of dwarf palms then available was very few. Among the different dwarfs tested as male parents, Chowghat Orange Dwarf (COD) and Gangabondam (GB) were found to be superior to Chowghat Green Dwarf (CGD). The superiority of Gangabondam, a dwarf variety from Andhra Pradesh as a male parent with good combining ability has also been reported from Nileshwar by Krishnan and Nambiar (1972). On the other hand, Ramachandran et al. (1974) established the superiority of local Green Dwarf and Malayan Yellow Dwarf (MYD) as the best combiners with tall cultivars. This clearly suggests that both Dwarfs and Talls differ in their combining ability and there is a need to select the parental combinations based on their combining ability. The fact that the geographically different dwarfs result in superior hybrids was confirmed by Bavappa, Sukumaran and Mathew (1973) based on their studies with different T x D hybrids. Kannan and Nambiar (1974) indicated that the hybrid Lakshaganga (LO x GB) was the best among six combinations in which GB was the common male parent.

The interest in D x T hybrids started with the observation by Rao and Koyamu (1955) that off-type plants in the progeny of dwarf palms were superior in growth characters, which were later proved to be Natural Cross Dwarfs (NCD's). Satyabalan (1956) and Ninan and Satyabalan (1964) reported the superiority of Natural Cross Dwarfs (NCD's) in terms of nut and copra yield. The excellent performance of Natural Cross Dwarfs (NCD's) of Chowghat Dwarf Orange prompted the breeders to produce more and more D x T hybrids. The D x T hybrids produced by controlled pollination using COD as female parent and selected WCT as pollen parent were markedly superior both in nut production and copra out-turn (Satyabalan and Vijayakumar, 1982). The detailed survey conducted on the performance of various cultivars, D x T and T x D hybrids under identical conditions, indicated the overall superiority of D x T hybrids (Anonymous, 1979). It was also observed that tree to tree variation was minimum in this hybrid.

Encouraged by the superior performance of D x T hybrids and their reciprocal combinations, different inter-varietal crosses involving promising exotic and indigenous varieties were made. In India, production and evaluation of different hybrid combinations is being carried out at the Central Plantation Crops Research Institute (CPCRI), Kasaragod, Kerala Agricultural University (KAU), and four other research centres. At CPCRI 95 cross combinations involving different Tall and Dwarf cultivars (22 T x D's, 18 D x T's, 51 T x T's and 4 D x D's) are currently under evaluation. Based on the evaluation of some of these hybrids which have attained bearing, three hybrids have been released for commercial cultivation. These hybrids are COD x WCT (Chandra Sankara), LO x COD (Chandra Laksha) and WCT x COD (Kera Sankara). The hybrids LO x GB (Laksha ganga), AO x GB (Ananda Ganga) and WCT x GB (Kera Ganga) have been released by the Pilicode centre of the Kerala Agricultural University. Two other hybrids, East Coast Tall (ECT) x Dwarf Green (VHC–1) and ECT x MYD (VHC–2), developed at the Veppankulam centre of Tamil Nadu G.D. Naidu Agricultural University have been released for cultivation all over the state. The details of these hybrids are furnished in Table I.

Rajagopal, Kasturi Bai and Voleti (1990) have screened some of the hybrids and parents for drought tolerance and found that LO x COD (Chandra Laksha) was the most drought tolerant hybrid. This hybrid had a more efficient soil water extraction and stomatal regulation mechanisms as compared to

Table I. *Performance of released coconut hybrids in India*

Hybrid	Parentage	Nut yield/ Palm/Yr. No.	Copra yield		Copra/ha (t)	Oil content (%)	Released by
			Mean/Nut (g)	Mean/Palm (Kg)			
Chandra Sankara	COD x WCT	116	215	24.94	4.36	68	CPCRI
Kera Sankara	WCT x COD	108	187	20.20	3.54	68	CPCRI
Chandra Laksha	LO x COD	109	195	21.26	3.72	69	CPCRI
Laksha Ganga (PHC-1)	LO x GB	108	195	21.06	3.69	70	KAU
VHC-1	ECT x DG	98	135	13.23	2.32	70	TNAU
VHC-2	ECT x MYD	107	152	16.26	2.85	69	TNAU
Ananda Ganga (PHC-2)	AO x GB	95	216	20.52	3.59	68	KAU
Kera Ganga (PHC-3)	WCT x GB	100	201	20.10	3.52	69	KAU
WCT		80	176	14.08	2.46	68	—

the susceptible hybrid COD x WCT (Chandra Sankara). The higher nutrient utilization ability of the hybrid COD x WCT has also been demonstrated by Hameed Khan et al., (1986). They found that the hybrids responded well to lower levels of applied fertilizers and gave more yield than the West-Coast Tall which received double the normal dose of fertilizers.

Though it has been reported by IRHO that the cross combination of Malayan Yellow Dwarf x West African Tall gives over 95% MAWA hybrids, the hybrid recovery as scored in the nursery of COD x WCT combination varies from 30 to 40% at present. Studies at CPCRI (Sukumaran and Iyer, unpublished) have shown that the different sources of COD palms when pollinated with a common source of WCT pollen gave hybrid recovery ranging from 10 to 100% based on seedling score. This clearly indicated that the different dwarf palms are of variable genetic make up in terms of their homozygosity (homogeneity), and hence points to the vital importance of selecting high combiners among the Dwarf palms and maximise their population by systematic selfing. Satyabalan and Rajagopal (1987) have shown that by proper selection of parents based on nut characters (Dwarf palms having shell content less than 20% of husked nut weight as female parents and pollinated with tall palms having more than 150g copra/nut and husk content of less than 50%) the hybrid recovery in terms of nuts sown could be improved to an extent of 28.6 to 79.1%.

The selection criteria employed at present for selection of true D x T hybrids is based on colour and vigour of the one year old seedlings. Only vigorous ones showing brownish petiole colour and early splitting are selected as genuine D x T, and even those vigorous, early splitting ones with yellow/orange types (Intermediates) are rejected as non-hybrids. These vigorous yellow/orange types have been reported to be good yielders but critical

data on copra and oil quality are lacking. If these yellow/orange vigorous seedlings are also classified as hybrids then the recovery percentage could certainly be improved. This segregation pattern with regard to colour and vigour needs to be better understood and more field data on their performance is called for. Biochemical data have revealed higher chlorophyll content and higher NR activity in the greenish brown vigorous D x T seedlings as compared to the other segregants (Shivashankar, Rajagopal and Ramadasan, 1985).

In view of the vast potential of coconut hybrids in achieving higher levels of production, emphasis should be laid in future to select promising talls and dwarfs from different geographical regions based on their combining ability so as to realize enhanced hybrid vigour. Developing uniform populations of talls and dwarfs by successive cycles of inbreeding will receive greater attention as it is a pre-requisite for the successful exploitation and fixation of heterosis and higher hybrid recovery. The high out-turn of copra realized in T x T crosses in Indonesia indicated the possibility of upgrading Talls. Greater emphasis should be laid in the production of Tall x Tall crosses utilizing some of the promising talls like Laccadive Ordinary, Andaman Ordinary, Philippines Ordinary, West African Tall and Renell Tall. Concerted efforts are under way to supply the nucleus parental materials for the production of required hybrid seedlings for the chain of seed gardens that have already been established in different coconut growing states.

Philippines

In Philippines, the leading producer and exporter of coconut and coconut products, systematic efforts for coconut improvement were initiated in late 1960's. A detailed account on evaluation of coconut hybrids in the Philippines is outlined by Santos (1988). The first local hybrid was reported to have been made by the Bureau of Plant Industry (BPI) in 1950's, between Coconino Green Dwarf (CND) and Laguna Tall (LAG). Though the hybrid was better than the local tall, no further efforts were made to popularize its cultivation (Santos, 1988).

The Philippines Coconut Authority (PCA) started the production and systematic evaluation of coconut hybrids since early 1970's. With the idea of widening the genetic base and to meet the increased demand of quality planting material for a vast replanting programme, PCA introduced four hybrids from Ivory Coast to test their performance alongwith the local talls. The hybrids introduced were, Malayan Yellow Dwarf (MYD) x West African Tall (WAT) or MAWA, Malayan Red Dwarf (MRD) x WAT, Cameroon Red Dwarf (CRD) x WAT, and Equatorial Guinea Green Dwarf (EGD) x WAT. These hybrids were compared with local talls in three PCA research centres and 133 pilot farms spread over eight different agroclimatic regions. Initial evaluation indicated that the hybrids were vigorous and precocious, and produced more leaves (Santos, 1988). Magat et al ,(1980) compared the performance of these hybrids under highly suitable (1.5 months dry period), suitable (3–4.5 months dry period), and fairly suitable (6 months dry period) conditions. In general, the hybrids planted in highly suitable areas had better growth compared to those grown in fairly suitable areas. The MYD x WAT hybrid (MAWA) performed well initially even in fairly suitable areas indicating its tolerance to water stress. However, Santos (1988) indicated that MAWA hybrid showed sensitivity to specifically poor conditions. Santos (1988) studied the initial performance of the hybrids and observed that the hybrids proved to be more precocious and higher yielding than any of the local talls in all the test sites. The Ivory Coast hybrids *viz.*, MYD x WAT

and MRD x WAT are quite popular and they covered an area of about 56,000 ha by the end of 1985.

Prior to the large scale introduction of Ivory Coast hybrids for replanting programme, PCA initiated the crossing proggramme with the local varieties. From among the 42 hybrids, three were selected based on their performance over a period of 15 years. These local hybrids *viz.*, PCA 15–1 (Catigan Green Dwarf x Laguna Tall), PCA 15–2 (Malayan Red Dwarf x Tagnanan Tall) and PCA 15–3 (Malayan Red Dwarf x Bay Bay Tall) were recommended for general use during 1988. The salient features of these hybrids are furnished in Table II (Cano, Bahala and Santos, 1989). Though MAWA hybrid is early in bearing and has high yield potential, its large scale cultivation in the Philippines has not been recommended due to its requirement of favourable conditions, higher susceptibility to bud-rot and the smaller nut size (Cano et al., 1989). On the other hand, the local hybrids have not only wider adaptability but also possess good nut size, and are therefore being produced in large scale for distribution.

In the Philippines, the future thrust is towards the production and evaluation of more Tall x Tall hybrids in view of the increasing demand for coconut wood, and also the severe damage due to typhoons. Efforts are under way for the large scale production of hybrid seedlings required for a massive replanting programme.

Ivory Coast

Although organized research efforts for coconut improvement started a bit late (1960's) in the Ivory Coast, the I.R.H.O. (the French Organization doing pioneering Research on oil yielding crops including coconut and oil palm) has made impact on coconut production through the popular hybrids of PB (Port Bouet) series which are grown in many countries. Progress of coconut breeding in the Ivory Coast has been summarized by De Nuce de Lamothe, Wuidart and Rognon, (1980). Production and evaluation of a large number of cross combinations between origins, individuals and accessions was given priority in the coconut improvement programme. Emphasis laid on the individual

Table II. *Basic features of coconut hybrids recommended for release in the Philippines*

Features	PCA 15–1	PCA 15–2	PCA 15–3
Parentage	CAT x LAG	MRD x TAG	MRD x BAY
Age at first flowering (yrs.)	3–4	3–4	3–4
No. of bunches/year	14	15	14
No. of nuts/palm/year	81	75	63
Copra/nut (g)	266	296	277
Copra/palm/year (Kg)	22.0	19.0	15.0
Copra/ha/year (t) Mean	3.0	2.5	2.0
1989	4.0	5.2	4.9

Source: Cano et al., (1989).

combining ability tests and methods developed for large scale hybrid seed production through assisted pollination have paid rich dividends (Wuidart and Rognon, 1981). Initially, Dwarf x Tall crosses were produced with the purpose of bringing together the precocity, dwarfness and homogeneity of dwarf parents, and hardiness and high copra content of the tall cultivar. This resulted in some precocious hybrids which had almost twice the production potential of traditional tall cultivars. The Marc Delorme Coconut Research Station in the Ivory Coast and Saroutou Research Station in Vanuatu which form the basic network of IRHO's experimental work, have tested/are testing 110 cross combinations produced over the years in 30 comparative yield trials (De Nuce de Lamothe, 1990). Besides, 225 individual combining ability tests comprising 150 Tall x Tall and 75 Dwarf x Tall crosses have also been carried out.

The evaluation of a series of PB hybrids resulted in the identification of MAWA (PB–121) hybrid, a cross between MYD and WAT with an average yield potential of more than 5.7 t copra/ha/year. Another hybrid PB–111 (CRD x WAT) was also precocious and proved to be superior to the tall varieties in all locations. The other hybrids MRD x Rennel Tall (RT) and MRD x Tahiti Tall (TT) have a potential of producing 448 g and 303 g copra/nut respectively as against 266 g of MAWA hybrid (De Nuce de Lamothe et al., 1980). The precocity of D x T hybrids was shown by production beginning 12–24 months earlier than talls and shorter time taken to reach peak production. The fact that superiority of D x T hybrids is not restricted to precocity alone is evident as hybrids which are not equally precocious yield much more than the traditional varieties. De Nuce de Lamothe (1990) observed that hybrids gave 147 to 226% more yield over the local tall cultivars.

PB–213 is a Tall x Tall hybrid between WAT x RT. The cumulative yield of this hybrid by the 9th year was almost equivalent to that of PB 121 (14.3 t copra/ha) and it produced 2.7 times more yield than WAT (De Nuce de Lamothe et al., 1980). Other hybrids of interest are PB–122 (MYD x Polynesian Tall), PB–132 (MRD x Polynesian Tall) and Tall x Tall hybrid PB–214 (WAT x Vanuatu Tall). Salient features of some of these hybrids are furnished in Table III.

The work carried out till date suggests that only a part of the variability available has

Table III. *Performance of Ivory Coast hybrids (mean of 9-12 years data)*

Hybrid combination	Name	Bunches/ year	Nuts/ tree/ year	Copra/ nut (g)	Copra/ tree/ year	Copra/ha/year		Oil t/ha/ year
						+	%	
WAT		11.7	55	235	12.8	1.74	100	1.14
MYD x PYT	PB–122	13.8	104	253	26.3	3.57	205	2.30
MRD x PYT	PB–132	14.0	95	282	26.7	3.63	209	2.33
MYD x WAT	PB–121	14.5	104	247	25.8	3.50	201	2.28
*WAT x VTT	PB–214	13.6	114	209	24.0	3.26	225	2.10

*Mean of 10–13 years Source: Sangare et al., (1988).

been exploited. Efforts should be made for further exploitation of the variability for heterosis breeding. In view of the heterogeneity within the population of parents, it has become essential to take up a prebreeding programme in Dwarfs and Talls to achieve greater success through heterosis breeding in coconut. IRHO has initiated the programme of improving pollinator parents by repeated cycles of selfing and selection, the results of which would be very useful to the coconut breeders of the world.

Indonesia

In Indonesia, coconut improvement programmes were initiated around 1930's with the establishment of Coconut Research Station near Manado in North Sulawesi province and an experimental seed garden at Mapanget. Though the coconut improvement programmes were started in 1930's intensified coconut breeding in right direction commenced only after 1973 under a UNDP/FAO assisted project. Under this project, four cultivars *viz.*, Tenga Tall (TT), Bali Tall (BT), Palu Tall (PT) and Nias Yellow Dwarf (NYD) with a production potential of more than 3.5 tons of copra/ha/year were selected from North and Central Sulawesi, Central Java, Bali, Nias Island and North Sumatra for utilization in the breeding programme. Controlled pollinations were initiated in Nias island to produce Dwarf x Tall hybrids using Nias Yellow Dwarf as the female parent and the hybrids produced were planted in three varietal trials in 1978 mainly to study the general and specific combining abilities of the parents. The study resulted in the identification of three local Khina hybrids with a potential of 4.0 tons/copra/ha and were released by Coconut Research Station, Manado. They are Khina–I (NYD x TT) producing 25.3 Kg copra/palm and Khina–II (NYD x BT) with 31.0 kg copra/palm and Khina–III (NYD x PT) with 24.1 kg copra/palm. Their yield and yield attributes are given in Table IV.

Besides the use of local hybrids to increase the coconut production, Indonesian Govt. imported on a large scale, the exotic hybrids MYD x WAT (PB–121) and MRD x WAT from Ivory Coast and Malaysia in 1974 and these were planted along with NYD x WAT. Among these three hybrids, MYD x WAT produced 1198 kg copra/ha compared to 1047 kg of copra/ha in MRD x Rennel Tall and 1175 kg of copra/ha in NYD x WAT at

Table IV. *Yield and yield attributes of Indonesian hybrids*

Particulars	Khina–1 (NYD x TT)	Khina–2 (NYD x BT)	Khina–3 (NYD x TD)
1. First flowering	4th year	4th year	4th year
2. No. of Spadices/year	13	12	11
3. No. of nuts per palm/year	100	105	95
4. Weight of copra/nut (gms)	253	296	254
5. Yield of copra/palm/year (Kg)	25.3	31.0	24.1
6. Copra production (t/ha)	Over 4.0	Over 4.0	Over 4.0
7. Oil content (%)	61.78	60.61	62.48

Source : Davis et al., (1985)

the end of third year after coming into bearing (Tarigans and De Silva, 1988).

To compare the performance of local hybrids with imported hybrids, the Central Research Institute for Industrial Crops (CRIIC) laid out a trial, in 1975 involving four hybrids Khina–I, Khina–II, MYD x WAT (PB–121) and Beji Tall. The study revealed that under drought conditions, the imported hybrid (PB–121) behaved similar to Khina–I and Khina-II in withstanding prolonged droughts (Tarigans and De Silva, 1988).

The high copra out-turn (36 kg/palm) realized in Tall x Tall crosses within a single population of talls, (Davis, Sudasrip and Darwis, 1985) indicates the possibility of upgrading talls by selective crossing between superior palms for further utilization in the breeding programme to achieve higher yield levels. Emphasis should be laid on studying the combining ability of the individual palms within a cultivar.

Malaysia

Although coconut improvement programme commenced in the early part of the 19th century, when the Dwarf variety was recognized as precocious and high yielding, a review of the coconut research done in Malaysia has yielded only sparse information on breeding. Early attempts at crossing Talls with Malayan Dwarfs gave variable results and did not generate much excitement. The results of the breeding work done in Ivory Coast, Jamaica and Solomon Islands using the Malayan Dwarf as female parent renewed the interest in D x T hybrids in the early 1970's. In 1970, Malaysia had imported a lot of MAWA hybrids in order to compare their performance with the locally available hybrid combinations involving Malayan Red Dwarf (MRD) and Malayan Yellow Dwarf (MYD) as female parents, and Malayan Tall (MT), Rennel Tall (RT) and West African Tall (WAT) as male parents. The Malayan Dwarf combination with WAT was found to be superior to those of MT and RT as male parents for earliness in flowering, female flower production, leaf and spathe production. The copra yield per palm was also more in MYD x WAT (12.1 kg) compared to MRD x WAT (10.5 kg) at 49–54 months (Chan, 1978). The MAWA hybrid's performance was also reported to be good on coastal clays (Vanialingam, 1975) and on inland soils (Goh, Syed and Osman, 1982) in Malaysia.

Sri Lanka

In Sri Lanka, which established the first coconut seed garden in the world, the Coconut Improvement Programme through breeding was started in 1948 with the main objective of developing high yielding hybrids. A number of cross combinations involving Typica (Tall) and Nana (Dwarf) were evaluated in limited field trials and one hybrid CRIC–65 has been released for large scale cultivation. CRIC–65 is a Tall x Dwarf hybrid and showed precocity of flowering in 83.4% of the palms at 60 months (Manthriratne, 1978). It produces about 120 nuts/palm/year with 210–215 g copra/nut (Wickramaratne, 1988). This hybrid is produced on a commercial scale at the isolated seed garden in Ambakelle. The cultivar San Ramon introduced from Philippines is being utilized in the current breeding programme to develop drought tolerant hybrids (Wickramaratne, 1988).

Future thrust aims to develop drought tolerant cultivars/hybrids which would be specifically adapted to different agroclimatic regions of the country. Attempts are also being made to develop cultivars suitable for small holders and plantation holders with low/high input and optimum/maximum yields.

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