Climate Smart Coconut Genetic Resources

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Cocos nucifera L. belongs to the monocotyledon family Arecaceae (Palmae) in the subfamily Cocoideae and is the only species of the genus Cocos. The coconut palms are diploid with 32 chromosomes (2n = 2x = 32). The single stem of the coconut tree, lacks bark, cambium, and secondary growth features characteristic of gymnosperms and dicotyledons and hence the stem once formed never alters in thickness, except for a slight shrinkage when the stem gets old. The coconut palm is unbranched with only one growing vegetative bud at the terminal end of the stem, and if this gets damaged the palm dies. The coconut palm is considered as the most important of all tropical palms and the most extensively cultivated palm over several countries mostly spreading between 22° N and S latitudes. Although coconut palm plantations occur in most tropical and subtropical countries within 25 degrees of equator, the yield performance has known to be better within 20 degrees and in some extended areas having warm sea currents. Though originally a seaside palm, it is also being extensively cultivated by growers in interior areas in the tropical region contributing to the livelihood of millions of people. It is grown commercially as plantations upto about 800m from mean sea level in tropical regions. Coconut palm, once considered as mostly an oil seed crop, is now ranked as an important food crop as the palm supplies food, drink, and shelter, and provides variety of raw materials for several industrial products. Hence, the palm is often referred to as "The Tree of Wealth" and "The Tree of Life" as it provides all the necessities of life.

Genetic resources

In the absence of any wild relatives, the present-day population of the coconut palm presents a wide range of variability broadly grouped into two groups and categorized as Talls and Dwarfs, based on a few important characters like stature, growth characteristics of the palm, precocity in flowering and fruit characters. This is the widely accepted

classification used for distinguishing coconut cultivars among the growers too. The tall cultivars are the most cultivated ones for commercial production of copra and other kernel based products in all coconut growing regions, whereas the dwarfs are grown for their aesthetic value as well as for consumption as tender nuts.

In India, germplasm collection began in 1924 with the introduction of cultivars from Fiji, Indonesia, Malaysia, Philippines, Sri Lanka and Vietnam. The germplasm collection was intensified in 1952 and in 1958 the first indigenous germplasm survey and collection was started. In 1983 to 1986, 24 accessions were collected from Pacific Ocean countries such as Fiji, French Polynesia, Samoa, Tonga, Papua New Guinea and Solomon Islands and conserved at World Coconut Germplasm Centre at Port Blair, South Andaman. The Central Plantation Crops Research Institute Kasaragod is actively involved in the collection and conservation of coconut biodiversity in the field gene bank for utilization in the coconut improvement programme. The institute has undertaken exotic collections of coconut

Distinguishing traitsand status of Tall and Dwarf coconut genetic resources

Trait	Tall	Dwarf
Stem circumference	Sturdy with prominent bole at base	Thin, cylindrical stem without bole at base
Initiation of flowering	Late (5-7 years)	Early (3-4 years)
Mode of pollination	Predominantly cross pollinated	Predominantly self-pollinated
Intra-spadix overlapping of male and female phases of flowers	Absent	Present
Inter-spadix overlapping of male and female phases of flowers	Rare	Frequent
Colour of fruits and petioles	Generally, mixtures of greens and browns among different palms	Either pure green, yellow, red yellow (orange) or brown
Arrangement of leaf scars on the trunk	Widely spaced from 5cm to 15 cm	Closely spaced less than 5 cm
Annual height increment	More than 50 cm	Less than 50 cm
Leaf and bunch attach-ment with stem	Very strong	Fragile
Leaf length and leaflet breadth	Longer leaves with broader leaflets	Shorter leaves with narrower leaflets
Fruit size	Very small to very big	Small to medium
Phenotypic variation Within cultivar Between cultivars	High High	Low High
Root distribution	Generally, more dense and plentiful	Less dense and few
Productive life span	About 60 years	About 40 years
Distribution	Widely cultivated types for copra and oil purpose	Less widely cultivated, preferred for tender co-conuts and use of parents in hybrid production

germplasmfrom several countries and conserved at field gene banks. Further, extensive prospection and collection of indigenous coconut germplasm from different coconut growing regions of the country has been undertaken over the years and distinct accessions have been conserved in the National Active Germplasm Site at the Institute.

Presently, ICAR-CPCRI has the world's largest collection of coconut germplasm with about 460 accessions from 28 countries, representing coconut germplasm of South and Southeast Asia, Caribbean Islands, Indian Ocean Islands, Pacific Ocean Islands and African countries and India. The indigenous coconut germplasm comprises collections from Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Goa, Gujarat, Orissa, West Bengal, Assam, Meghalaya, Bihar, Andaman and Nicobar Islands and Lakshadweep Islands.

Tall and Dwarf genetic resources

The predominant varieties that are grown in coconut growing regions of the country are either selections from the respective local tall or dwarf populations of that region or hybrid progenies evolved using those selected tall and dwarf cultivars. Both tall and dwarf selections have been used for the development of hybrids with an aim to combine the earliness of dwarfs with the hardiness and high fruit yielding character of tall parents, and to exploit the potential hybrid vigour for other desirable traits. Some of the important distinct coconut cultivars of different coconut growing regions of the world are listed here.

Identification of trait specific accessions in India

The assembly of these collections in ex situ conservation plots of ICAR-CPCRI, Centres of AICRP on Palms, ICAR-CIARI, Port Blair has helped in identification of some accessions for specific traits over the years which are used in the ongoing improvement programmes or could be used in future breeding programmes. The perennial nature of the collections in gene bank provide opportunity to use them for evaluation against emerging issues like new pest or disease outbreak, moisture stress tolerance,desirable morphological traits, fruit component traits, product diversification, insect/ disease resistance/tolerance and exhibition of novel traits. The observed response of the germplasm provides information on the presence / expression of adaptive traits in the accessions and helps in identification of trait specific accessions. The identified trait specific accessions in India which have potential for use in breeding programmes are given here. Some of these are actively being used in crop improvement programmes for the targeted traits.

Climate change effects and the resources:

The effects of climate change such as moisture stress, elevated CO2, flooding, cold injury, outbreak of diseases and pests, heavy winds cause immense damage to the coconut palms. There are genetic resources to address these effects which have showed some adaptive traits under such conditions.

Drought tolerance

Coconut palm requires an average monthly rainfall of 150 mm for ideal palm growth and good nut yield and unlike annuals, the adverse effect of drought

Important tall and dwarf coconut cultivars

Region	Tall cultivars	Dwarf cultivars
Southeast Asia	Malayan, Klapa Wangi, Philippines, San Ramon, Laguna, Lono, Dalig, Makapuno, Bali, Tenga, Thai Tall, Java, Cochin China	Malayan Dwarfs (red, yellow, green), Thailand Green, Aromatic Green, Nias Yellow, Nias Green, Bali Yellow, Coco Nino, Catigan, Tacunan Green, Pilipog Green, Catigan Green,
Central and South America Atlantic	Surinam, Jamaica, Sanblas, Panama Tall	Surinam Brown, Brazilian Green Malayan Dwarfs
Africa	East African, West African Tall	Cameroon Red, Pemba Dwarfs
Pacific Ocean Islands	Markham, New Guinea, Karkar, Rotuma, Fiji, Samoan, Rangiroa, Lifou, Solomon, Rennell, Vanuatu, Gazelle Peninsula Tall	Niu Leka, Hari Papua, Madang Brown, Vanuatu Red, Malayan Dwarfs
Indian Ocean Islands	Seychelles, Comoros, Coco Raisin, Coco Bleu, Sambava Tall	Pemba Dwarfs (red, yellow, green)
South Asia	Indian West Coast, Indian East Coast, Tiptur, Andaman Giant, Andaman Ordinary, Lakshadweep Ordinary, Lakshadweep Micro, Kaithathali, Kappadam, Benaulim, Sri Lankan, Gonthembili	Chowghat (orange, yellow, green), Gangabondam Green Dwarf, Lakshadweep (orange, yellow, green), Andaman Dwarf (yellow, green, orange), King Coconut, Sri Lankan (red, yellow, green)

Trait-specific accessions of coconut identified in India.

Important tall and dwarf coconut cultivars

Trait	Accessions
High female flower production	Spicata Tall, Laccadive Micro Tall, Ayiramkachi Tall, Champin Micro Tall, Katchal Micro Tall
Large inflorescence	Borneo Tall
Higher copra content (>300 g)	San Ramon Tall, Malayan Tall, Markham Tall, Laccadive Giant Tall
Lower copra content (<125 g)	Surinam Brown Dwarf, Chowghat Green Dwarf (CGD), Malayan Yellow Dwarf (MYD), Laccadive Micro Tall, Ayiramkachi Tall
Dwarfness with high copra	Niu Leka Dwarf, Cameroon Red Dwarf, GBGD selection
Higher proportion of kernel to the fruit weight	Katchal Micro, Nicobar Micro
High Oil content (>72 %)	Laccadive Micro Tall
Dwarf with high copra content (>200 g)	Camaroon Red Dwarf, Niu Leka Green Dwarf
High copra/oil output (>4 mt copra/ha and >2.5 mt oil/ha)	Fiji Longtongwan Tall, Adirampatnam Tall, Cochin China Tall, Java Tall, Philippines Ordinary
Ball-shaped copra production	Laccadive Micro Tall, Tiptur Tall, West Coast Tall (WCT), Ayiramkachi Tall, Java Tall
Good quality tender nut water	Chowghat Orange Dwarf (COD), Malayan Orange Dwarf (MOD), Philippines Ordinary Tall, Malayan Green Dwarf (MGD), Gangabondam Green Dwarf (GBGD), Cochin China Tall, MYD, Kulasekharam Green Tall (KGT)
Drought tolerance	Andaman Giant Tall, WCT, Java Tall, Federated Malay States, Laccadive Ordinary Tall, Cochin China Tall, Tiptur Tall

Important tall and dwarf coconut cultivars

Trait	Accessions
Root (wilt) disease resistance	Chowghat Green Dwarf (CGD), MGD
Eriophyid mite resistance	COD, KGT, WCT-spicata
Stem bleeding – less infection	Cochin China Tall, GBGD, Laccadive Ordinary Tall (LCT)
Aroma in coconut water and meat	Klapawangi Tall, Andhra Aromatic Dwarf
Sweet endosperm	Mohacho Narel
Sweet tender husk and mature soft husk	Kaitathali Tall
Soft endosperm	Andaman Thairu Thengai or Nei Thengai or Ghee Thengai
Pink husk (tender fruits)	Guelle Rose Tall, West Coast Pink Tall, San Ramon Pink, Andaman Pink, San Blass Pink, Philippines Lono Pink
Horned coconut	Andaman Horned Coconut
Compact crown	Niu Leka Green Dwarf
Early flowering	Chowghat Green Dwarf, Hari Papua Orange Dwarf, Nikkore Orange Dwarf
Vigorous seedling parameters	FMS, Philippines Ordinary, Borneo, Kurmadera Tall
Smallest fruits	Laccadive Mini Micro

persists for the subsequent two to three years. In India, coconut is cultivated predominantly under rainfed conditions in coastal and southern parts of the country, whereover 90% of the coconut area occurs in the country. The major coconut growing areas in this region is exposed to the vagaries of monsoon, resulting in poor yields or wilting of palms under extreme conditions. Therefore, there is a need to evolve drought/moisture stress tolerant coconut varieties.

Although coconut is known to grow on its own in several tropical islands and coastal areas, adequate irrigation, or well-distributed rainfall to ensure soil moisture is essential to realise the potential higher productivity or sustenance of palms in many plantations. The palms that are periodically exposed to inadequate rainfall or prolonged dry periods resulting in poor yield and continuous dry periods may lead to complete drying of palms. The adverse effects of drought on coconut can persist even for the subsequent 2-3 years drastically affecting the health of the palms. It is increasingly reported that many coconut growing areas experience erratic rainfall pattern, prolonged drought, extreme weather conditions and higher temperature because of climate change affecting the coconut yields. In severe cases, most of the palms die and the surviving palms take a long time to recover from the shock provided not exposed by stress again. Under these circumstances, developing drought tolerant varieties/ hybrids is of great importance to increase coconut production in affected areas. Drought tolerance in coconut has been attributed to many phenotypic traits such as high root mass and fine root density, physiological traits such as leaf stomatal frequency, stomatal index, chlorophyll fluorescence, epicuticular wax content, activities of lipases and proteases.

Possibility of identifying drought tolerant cultivars has been revealed based on different anatomical, physiological and biochemical parameters, viz., accumulation of epicuticular wax on the leaf surface, low stomatal frequency and leaf water potential, the activity of enzymes like glutamate oxaloacetate transaminase (GOT) and acid phosphatase. After screening of different coconut genotypes for drought tolerance, West Coast Tall (WCT), Federated Malay States (FMST), Java (JVT), Fiji (FJT), Andaman Giant Tall (AGT), LCT x GBGD (Laksha Ganga) and LCT x COD (Chandra Laksha) were found to be drought tolerant in a study. Genetic analysis of drought responsive physiological characters in coconut was taken up using line x tester analysis, involving two dwarf lines (CGD, MYD) and four tall testers (ECT, PHOT, LCT, FMST). The studies indicated differential response in the seedlings for drought sensitive traits viz., transpiration rates, lipid peroxidation, photosynthetic rates (Pn) and water potential. Both additive and non-additive gene actions in the expression of above traits and higher SCA for transpiration rate was reported, indicating heterosis for this character. Photosynthetic rates were observed to be governed by non-additive gene action and can be exploited for yield improvement through heterosis breeding. The nature of gene action governing some of these drought sensitive traits can be exploited in selective breeding for drought tolerance. The identified drought tolerant genotypes are currently being used in the breeding programs at ICAR-CPCRI, Kasaragod, to evolve high yielding, drought tolerant hybrids. A technology evaluation trial of the identified lines and hybrids has been established in drought prone Sivaganga district of Tamil Nadu during 2009 and evaluation is in progress.

Based on screening for selected morphological and physiological traits, drought-tolerant cultivars have been identified at CPCRI, namely, WCT x WCT, LO x COD, Federated Malay States, Java Giant, Fiji, Laccadive Ordinary and Andaman Giant. These cultivars are currently utilized in the breeding programs along with other selected tall types. The high yielding hybrid combinations, Laccadive Ordinary Tall x Chowghat Orange Dwarf, Malayan Yellow Dwarf x West Coast Tall, MYD x TPT have been found to be drought tolerant and later released as improved varieties such as Chandralaksha, Kalpa Samrudhi, Kalpa Sreshta. Selections from LCT, TPT, FMST, WCT were also recommended and released having better drought tolerance such as Chandrakalpa, Kalpatharu, Kalpa Ratna and Kera Keralam. Screening conserved coconut germplasm and its evaluation in drought-prone areas for their performance and adaptability may take a very long time. Hence, the possibility of utilizing the available plantations in drought prone areas for identification of putative drought tolerant palms based on the phenotype and the physiological parameters has been attempted. Utilization of such in situ drought tolerant palms from drought affected areas in the breeding programs would be expected to reduce the time duration required for breeding varieties. Preliminary observations revealed that the seedlings of the putative drought tolerant palms identified in situ from East Coast Tall population of Tamil Nadu are more vigourous under uniform for seedling

traits highlighting the potential of natural selection. The identified in situ palms were used to develop hybrids with selected dwarf and being evaluated. Since, the tall cultivars are known to be resilient than the dwarf cultivars, the selected individual talls are crossed to produce tall x tall and dwarf x tall hybrids combinations for further evaluation. Preliminary results indicated significant differences among tall x tall hybrids for the fruit yield under moisture stress conditions and the hybrid WCT x FJT appears to be better over other hybrids. As it is expected that the requirement for moisture stress tolerant coconut materials would increase in the years to come, there is urgent need for identification and purification of more coconut cultivars or genotypes for use in evaluation for drought tolerance combining other desirable traits such as dwarfness and precocity in bearing.

Cold Tolerance

Primarily, coconut, being a crop of tropical regions requiring good rainfall and warm weather for better yield performance with fruit set, the palms are known to be highly susceptible to low temperatures. The low temperature affects the leaf production and thereby inflorescence production. The fruit set is also affected, and the unopened male and female flowers appear dried and shed prematurely. The flowering and fruit set is affected below 13°C. From a study in China, it was observed that the spear leaf damage, drying of leaves and uneven or wrinkled kernel inside the nuts are symptoms due to cold injury. Although no breeding efforts have been extensively carried out, few accessions of Hainan Tall of China and Kamrup Tall of India are reported to possess cold tolerance. Besides, the coconut populations established in elevated places such as Nilgris and parts of Coorg hilly areas of India offer scope for identifying cold tolerant genotypes. CPCRI has collected such putative cold tolerant coconut accessions from Karnataka and Sub-Himalayan terai region of West Bengal. The coconut area expansion in colder plains of northern part of India necessitates identification and development of cold tolerant lines soon.

Wind tolerance

Extremes of weather due to severe cyclones and storms in the recent years caused extensive damage to coconut palms in the east coast states Tamil Nadu, Andhra Pradesh, and Orissa. This necessitated the need to search for coconut cultivars tolerant to wind damage. Traditionally palms of certain tall coconut populations such as Andaman Ordinary, Andaman Giant, Lakshadweep Ordinary and Fiji Tall are known to possess better wind tolerance. The dwarf cultivars are considered fragile with weak leaf attachment. However, it was observed that Malayan Orange and Yellow dwarf palms in Tauveni Island are seen little affected than the Rotuma and Fiji tall planted at the same location. The height of palm and weight of crown could be a factor in winder tolerance in addition to strong stem and extensive root system. The palms of Niu Leka Dwarf and Compact Dwarf types (reported as fourth generation progenies of MOD x NLAD crosses) with Orange and Green coloured fruits is a preferred cultivar among the home gardeners in Fiji and other Pacific Islands as they exhibited higher level of wind tolerance as they withstood several cyclones. The dense crown with closely arranged thick leaves in Niu Leka and its hybrids could be the reason for the heavy wind tolerance.Recently, a coconut selection from ECT population named VPM-6 which was found to recover comparatively earlier from the cyclonic damages was identified and recommended for the cyclone prone areas from Coconut Research Station, Veppankulam through ICAR-All India Coordinated Research Project on Palms.

Flood tolerance

Although coconut palms do not grow well under waterlogged conditions, some coconut types in natural coconut groves of Nicobar district and little

Andaman are found to grow well and yield well under waterlogged conditions. The fruits of these palms also show characteristic sharp beaks facilitating the fallen nuts to anchor well in waterlogged conditions and germinate. However, systematic evaluation for flood tolerance or water logging has not been reported.

Disease Resistance

Coconuts are infected by several diseases in different growing regions including fungal and phytoplasmal diseases. Each coconut region has different priorities with regards to tackling diseases considering the potential damages. Globally, the lethal yellowing disease caused by phytoplasma is considered as the devastating one in many countries. Besides, the root (wilt) of India, Weligama leaf wilt of Sri Lanka, Foliar Decay Disease of Pacific region, Cadang cadang disease Philippines, bud rot, stem bleeding, basal stem rot of many regions are the major diseases assumed significance. In India, the important diseases of coconut are bud rot caused by *Phytophthora palmivora*; Leaf rot caused by *Colletotrichum gloeosporoides, Exserohilum rostratum* and *Fusarium solani*; Stem bleeding caused by *Thielaviopsis paradox*a; Basal Stem Rot or Thanjavur wilt caused by *Ganoderma lucidum* and *G. applanatum*. Coconut palms are also affected by root (wilt) disease caused by phytoplasma.

Root (wilt) disease

The coconut root (wilt) disease, the major disease-causing huge production loss in major coconut areas in Kerala state of India, is a non-lethal, debilitating malady, caused by Phytoplasma that reduces the production potential of the palm. The symptoms of the disease are characteristic bending of the leaflets termed "flaccidity", along with foliar yellowing and marginal necrosis of leaflets followed by a progressive decline in yield. Investigations carried out at CPCRI, Regional Station, Kayamkulam on the etiology of the disease, suggested the association of phytoplasma (Solomon et al. 1983). Considering the phytoplasmal etiology of the disease, development of resistant varieties is the practical solution for the management of the disease. Screening of available coconut germplasm by planting seedlings in a disease affected farm at CPCRI Regional Station, Kayamkulam was initiated in 1961. Radha (1961) reported a higher degree of resistance to both leaf rot and root (wilt) in Andaman Ordinary Tall and New Guinea Tall based on disease incidence in the field. Large-scale screening trials undertaken during 1972 at CPCRI, Kayamkulam and in farmers' gardens revealed that all the evaluated cultivars and hybrids have contracted the disease.

A comprehensive breeding program for evolving resistant/tolerant coconut varieties was implemented at CPCRI in 1988. The high-yielding, disease-free palms existing amidst heavily diseased palms in disease hotspots were used as the base material. Systematic evaluation trials have led to the release of three coconut varieties with resistance/tolerance to root (wilt) disease. Observations in farmers gardens and in a screening, trial involving ten varieties revealed that Chowghat Green Dwarf had the highest level of resistance. Considering the high yield and low incidence of root (wilt) disease, the selection made from CGD was released under the name Kalpasree for cultivation in homesteads of the root (wilt) prevalent areas. Subsequently, studies carried out from a seed production plot at the Coconut Development Board Farm at Neriamangalam, planted with five dwarf varieties of coconut, namely, Malayan Green Dwarf (MGD), Malayan Yellow Dwarf (MYD), Malayan Orange Dwarf (MOD), Chowghat Green Dwarf (CGD) and Chowghat Orange Dwarf (COD) in 2004 resulted in identification of another promising variety, Malayan Green Dwarf as resistant to root (wilt) disease. The popular cultivated variety West Coast Tall (WCT) which was used as control showed 84% disease incidence whereas, CGD showed maximum resistance with disease incidence of 19.9% followed by MGD with 22.4%. Observations on CGD x WCT progenies, planted during 1991 indicated that 70% of the hybrids became infected with the disease within 18 years of planting. Even though a majority of CGD x WCT hybrids were diseased, they gave a 10-year cumulative average yield of eighty-four nuts/palm/year indicating that this hybrid is tolerant to root (wilt) disease. Considering the performance of CGD x WCT in the root (wilt) disease prevalent area it was released under the name Kalpa Sankara. The resistant WCT palms in the hotspot areas are also identified and released as a Tall selection for root (wilt) disease prevalent areas with a name Kalpa Vajra.

Anatomical studies in dwarf varieties revealed that lower cuticle thickness was more in MGD (10.27 µm) compared to other varieties. Younger leaves of CGD had higher values for leaf thickness (1077.65µm), parenchyma width (47.29 µm) (between the vascular bundle and epidermis), and larger distance between the stomata to phloem tissues (88.25 µm). These morphological/ structural features may be some of the factors contributing for higher level of resistance reported in CGD and MGD.

Bud rot disease

The susceptibility to bud rot and nut fall caused by Phytophthora palmivora was a major factor limiting coconut production in Indonesia. He also reported the hybrid MYD x PYT as most resistant, cultivars PYT, RLT, DJP and DBI as more resistant and the Hybrid PB 121 and WAT as more susceptible to bud rot of coconut. The dwarf palms with erect leaves such as Chowghat Orange Dwarf palms are susceptible to bud rot disease as the rupturing or bending or breakage of the spindle during moderate to heavy winds cause the entry of pathogen. Besides, the spindles damaged by rhinoceros beetles are also prone to bud rot infection.

Insect resistance

Several insect pests attack coconut palms, of which, rhinoceros beetle and red palm weevil are the two major ones. These respond to conventional plant protection measures and therefore no specific breeding programmes for developing resistant genotypes have been initiated. Preliminary screening of cultivars/ hybrids against leaf eating caterpillar, Nephantis serinopa Meyr. and rhinoceros beetle, Oryctes rhinoceros Linn. By early workers indicated variations in susceptibility among cultivars, though no resistant variety was observed.

Eriophyid mite (*Aceria guerreronis Keifer*) has become a major problem in the major coconut growing regions of the country since 1990s and has drastically reduced the nut yield as well as quality of nuts. As it is very difficult to completely eradicate the pest through conventional plant protection measures, the necessity of identifying eriophyid tolerant varieties assumes greater significance. Different workers have reported association of fruit characters with mite resistance: shape, colour of the fruit, tightness of tepals, gap between the rim of the fruit and aestivation of tepals. Digital phenotyping of tender coconut fruits and morphological traits associated with eriophyid mite infestation was undertaken and reported colour of inner tepal and firmness of the three-month-old tepals as major traits associated with infestation by eriophyid mite. High degree of mite tolerance was reported in a Cambodian variety with tight tepals. At CPCRI, very less mite infestation was reported in fruits of COD and Kulasekharam Green Dwarf (KGD), while LCT and SSAT showed severe mite infestation. Kalpa Haritha, a high yielding tall selection of KGD, released for commercial cultivation in the states of Kerala and Karnataka, recorded lesser incidence of eriophyid mite infestation (11.55 infested nuts) amidst heavy infestation (53.9% infested nuts in WCT) on other palms in the vicinity. A coconut tall type has been reported from Assam with three whirls of sepals and recorded very less incidence of mite due to complete tightness of sepals over the button preventing the entry of mites.

Conclusion

Several coconut varieties have been developed for drought tolerance, tender coconut purpose, mite tolerance, root (wilt) disease resistance and several genetic resources have been identified for specific conditions. As the climate change effects are dynamic in plantation crops such as coconut, the conserved coconut genetic resources should be carefully observed for identifying the potential ones for tackling each effect. Conservation of these diverse genetic resources under varied environments will help in generating information on their response to adverse or favourable conditions over the years. Such information,if recorded meticulously over the years will be very useful in addressing the issues of climate change effects by using the identified coconut genetic resources in the ongoing research and development programmes. Farmer participatory evaluation of those identified types along with the local coconut genetic resources under varied climatic conditions will aid in recommending the identified lines for specific environments and climate change effects with sustained productivity.