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**RESEARCH ARTICLE**

# Varietal Classification of New Coconut (*Cocos nucifera L.*) Forms Identified from Southern Sri Lanka

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## ABSTRACT

Coconut in Sri Lanka is currently classified into 15 different coconut forms grouped under three varieties, namely Typica, Nana and Aurantiaca. Several new coconut morphotypes that were not represented in the previous classifications were identified during a recent coconut germplasm exploration mission in the Southern Province of Sri Lanka. The visual morphological features of several new coconut morphotypes (Ran pol, Bothal thembili, Juwan, Murusi, Dothalu and Thatin) were characterized with the objective of including them in the taxonomic classification of coconut in Sri Lanka. Stature and breeding behaviour were the main features observed while stem morphology, root bole formation, crown size, nut morphology and bearing patterns, and other specific morphological features were recorded. The data provided morphological evidence to classify Ran pol, Juwan and Rath gon thembili as new forms of variety Typica; Green dwarf 'Murusi', Yellow dwarf 'Murusi' and Brown dwarf 'Murusi' as forms of variety Nana; and Bothal thembili as a new form of variety Aurantiaca. The morphotypes, Thatin and Dothalu were identified as forms of variety Typica but the sample size was too small for confirmation.

**Key words:** coconut, varietal classification, Sri Lanka.

## INTRODUCTION

The classification of coconut has not been adequately standardized, and different authors in different countries use different terminology. Generally, coconut is classified, based on its stature and breeding behaviour, into two broad groups or types: tall (also termed typica) and dwarf (also termed nana). In addition, a few intermediate groups, sometimes referred to as semi-talls or semi-dwarfs have also been recognized. King coconut in Sri Lanka (Liyanage, 1958), Gangabondom in India (Menon and Pandalai, 1958) and Niu Leka Dwarf in Fiji (Powell, 1868; Bourdeix et al. 2005) are examples of such intermediate groups.

The first systematic classification of coconut germplasm in Sri Lanka was reported in 1958

(Liyanage, 1958). This classification, based largely on stature and reproductive behaviour of the palm, recognizes three varieties, namely Typica (tall), Nana (dwarf) and Aurantiaca (intermediate). There are several morphotypes in each variety and these were termed as 'forms within varieties'. Liyanage's classification recognizes 13 forms within the three varieties. With the subsequent additions made by Wickremaratne (1984) and Perera et al. (1997) 15 coconut forms have been recognized within the three varieties in Sri Lanka (Table 1).

Variety Typica Nar. (tall) is the most abundant coconut variety in Sri Lanka and most coconut growing countries. It is tall in stature and naturally outbreeding. Typica forms usually take 5-6 years to flower and they produce flowers continuously. They are hardy palms that tolerate a wide range of environmental conditions. Typica, Navasi, Gon-thembili, Ran-thembili, Pora-pol, Bodiri, Kamandala and Dikiri are the different forms of the variety Typica (Table 1). The form Typica (Sri Lanka Tall), is grown on a commercial scale for production of endosperm, shell and fibre products. The other forms are found scattered in small numbers, mainly in home gardens. They are of little economic significance other than as candidates for breeding improved varieties.

Variety Nana (Griff) Nar. (dwarf) is short in stature and naturally inbreeding. It flowers early in about 3-4 years from planting and is a seasonal bearer. Nana forms suffer adversely from drought, pests and diseases. Dwarf coconuts are not grown on a plantation scale but are extensively used in the production of coconut hybrids because of their short stature, precocity and profuse bearing ability. Green dwarf (pumila), yellow dwarf (eburnea,), red dwarf (regia) and brown dwarf braune (Perera et al. 1997) are the forms of the variety Nana (Table 1).

Variety Aurantiaca Liy., which includes king coconut and similar forms, is intermediate in stature, predominantly inbreeding and late flowering. Flower production, which commences about 5 to 6 years after planting, is seasonal. The low tolerance to drought, pests and diseases restricts the areas in which king coconuts thrive. Tender king coconut, with its bright orange epicarp, and high sucrose, sweet nut water, is a very popular beverage coconut. Variety Aurantiaca has three forms, namely king coconut (thembili), rathran thembili and navasi-thembili (Table 1).

Genetic variation in the germplasm pool provides material for crop improvement. Much of the diversity of coconut forms hitherto identified in Sri Lanka has already been extensively tested in breeding programmes. However, there is a need for more germplasm with diverse characteristics to meet the requirements of the coconut breeding programme. A survey, in the Southern Province of Sri Lanka, to explore new germplasm to enrich the Coconut Research Institute germplasm collection (Everard et al. 2004), identified several new coconut phenotypes that merit detailed morphological assessment (Ekanayake et al. 2007). The aim of the current study was to morphologically differentiate the new forms identified in the Southern Province, and accordingly classify them under varieties.

**Table 1:** Varieties and forms of coconut found in Sri Lanka

| Common name (Variety/form) | Specific morphological and reproductive features |
|---|---|
| *Sri Lanka Tall* (Typica/*Typica)* | Tall stature, allogamous, heterogeneous, flowers in 6 –7 years, medium sized nuts, 20-25 nuts per bunch, 60-80 nuts per palm per year |
| *Gon Thembili* (Typica/*Gon thembili*) | Similar to *Sri Lanka Tall*. Ivory coloured nuts, petioles and inflorescences |
| *Nawasi* (Typica/*Nawasi*) | Similar to *Sri Lanka Tall*. Soft mesocarp - edible in the immature nut, yields soft fibre when mature. |
| *Pora Pol* (Typica/*Pora pol*) | Similar to *Sri Lanka Tall*. Remarkably thick shelled nuts |
| *Ran Thembili* (Typica/*Ran thembili*) | Similar to *Sri Lanka Tall*. Pink coloured mesocarp in immature fruit and a pink whorl under the perianth. Large nuts. |
| *Kamandala* (Typica/*Kamandala*) | Similar to *Sri Lanka Tall*. Large sized nuts (largest among local forms), and few nuts per bunch (2-5 nuts per bunch). |
| *Bodiri* (Typica/*Bodiri*) | Similar to *Sri Lanka Tall*. Small sized nuts and large number per bunch (30-100 nuts per bunch). Seasonal nut production. |
| *Dikiri* (Typica/*Dikiri*) | Similar to *Sri Lanka Tall*. Some nuts contain a jelly-like albumen/endosperm. |
| *King Coconut* (Aurantiaca/*King coconut*) | Intermediate stature, autogamous, homogeneous, fruits in 6-7 years, seasonal flower production, medium sized nuts with orange epicarp and sweet nut water, 25–50 nuts per bunch. |
| *Nawasi Thembili* (Aurantiaca/*Nawasi thembili*) | Similar to *King Coconut*. Soft and edible mesocarp like *Nawasi* |
| *Rathran thembili* (Aurantiaca/*Rathran thembili*) | Similar to *King Coconut*. Pink coloured mesocarp and a pink whorl under the perianth. |
| *Green dwarf* (Nana/*Green dwarf* or *pumila*) | Dwarf stature, autogamous, homogeneous, fruits in 3–4 years, small sized nuts with green epicarp, low copra content, 80-150 nuts per palm per year |
| *Yellow dwarf* (Nana/*Yellow dwarf* or *eburnea*) | Similar to *Green dwarf*. Nuts with yellow epicarp. |
| *Red dwarf* (Nana/*Red dwarf* or *regia)* | Similar to *Green dwarf*. Nuts with red epicarp. |
| *Brown dwarf* (Nana/*Brown dwarf* or *braune*) | Similar to *Green dwarf*. Nuts with a brown epicarp. |

## MATERIALS AND METHODS

A survey was conducted in Galle area (Coordinates 603'0"N 80013'0"E) (Figure 01) in the Southern Province of Sri Lanka. The surveyed lands were home gardens and small holdings where the traditional coconut varieties are planted, rather than the plantations where the commercial cultivars are grown. Much of the information regarding the different phenotypes and their locations were received from the coconut pickers in the area.

Six new morphotypes of coconut, identified in the survey, by their vernacular names, Ran pol, Bothal thembili, Juwan, Murusi, Dothalu

**Table 2:** Morphological characters and the traits scored for characterizing coconut morphotypes

| Character | Traits scored |
|---|---|
| Stem morphology | stature (tall/dwarf) |
| | presence/absence of bole |
| Crown morphology | crown size (well spread/small) |
| Fruit morphology | fruit colour |
| | fruit shape |
| | fruit size |
| Breeding behaviour | self/cross pollinating nature |
| | seasonality |
| Yield | prolificacy |

and Thatin were assessed by studying the morphological parameters of the stem, crown and fruit, their reproductive and bearing behaviour as well as other specific morphological features. All these morphotypes were found in a few villages clustered around Unawatuna in Galle District of the Southern Province of Sri Lanka. Samples of 7-10 palms each of Ran pol, Bothal thembili, Juwan and Murusi were assessed but only two palms of Thatin and one palm of Dothalu were available for this study. The morphological traits were scored over a period of 3 years to observe the temporal variation of the traits in each phenotype. Apart from the morphological traits specified in Table 2, other visually observable specific features of the new morphotypes were also recorded.

## RESULTS AND DISCUSSION

### Grouping the new phenotypes under coconut varieties

The main morphological features used to group coconuts are the stature and breeding behaviour. In addition, the presence or absence of a bole, shape of the crown and regularity of bearing were taken into consideration. These features of the varieties Typica, Nana and Aurantiaca, and of the newly identified coconut morphotypes are presented in Table 3. Some features of the new morphotypes are illustrated in Figures 1-9.

*Figure 1:* Ran pol crowns and nuts

*Figure 2:* Bothal thembili

*Figure 3:* Juwan coconuts

*Figure 4:* Murusi (Green)

*Figure 5:* Thatin coconut

*Figure 6:* Dothalu coconut

*Figure 7:* Rath gon thembili

*Figure 8:* Yellow Murusi

*Figure 9:* Brown murusi

**Table 3:** Basic morphological descriptors utilized in coconut varietal classification in Sri Lanka and the corresponding features of the seven newly identified coconut morphotypes

| Variety/ Morphotype | Stature | Breeding behaviour | Root bole | Crown | Bearing habit |
|---|---|---|---|---|---|
| Typica | tall | cross pollinating | present | well spread | year-round |
| Nana | dwarf | self pollinating | absent | small | intermittent |
| Aurantiaca | intermediate | self pollinating | present | medium | intermittent |
| Ran pol | tall | cross pollinating | present | well spread | year-round |
| Bothal thembili | intermediate | self pollinating | present | medium | intermittent |
| Juwan | tall | cross pollinating | present | well spread | year-round |
| Murusi (green, yellow and brown) | dwarf | self pollinating | absent | small | intermittent |
| Rath Gon thembili | tall | cross pollinating | present | well spread | year-round |
| Thatin | tall | cross pollinating | present | well spread | year-round |
| Dothalu | tall | cross pollinating | present | well spread | intermittent |

The variety Typica essentially comprises tall and predominantly cross pollinating coconut palms. The data presented in Table 3 suggest that Ran pol, Juwan, Thatin, Dothalu and Rath Gon thembili can be grouped under variety Typica. Presence of a root bole is yet another prominent morphological feature defining tall coconuts and all the above mentioned phenotypes display prominent root boles. Furthermore, these phenotypes exhibit well spread crowns and a year-round bearing pattern, which are also features characteristic of Typica. In regard to Thatin and Dothalu, as the sample size in the current study was inadequate, their grouping needs to be confirmed by studying more palms or by studying the selfed progeny of the 2 morphotypes.

Bothal thembili, with its intermediate stature, self pollinating breeding behaviour and the orange coloured fruit epicarp can be included in the variety Aurantiaca, which includes all king coconut types in Sri Lanka. The medium sized crown and intermittent nut production provide further evidence for this classification.

The dwarf stature, predominantly self breeding nature, absence of a root bole, relatively small crown and the seasonal nut production provide evidence for considering Murusi as a Nana (dwarf) variety.

**Classification of the new coconut phenotypes as forms within varieties**

Distinct morphological features are used to classify different forms within a variety. The different forms within a variety possess the basic requirements to be included under that particular variety. In addition, each form has unique morphological features to distinguish it from all the other forms. Fruit colour, fruit size, fruit shape, petiole colour, mesocarp or endocarp softness and thickness, and the prolificacy of nut production are examples of traits used to distinguish forms within varieties. Table 4 presents the specific morphological features of the new coconut phenotypes, identified from Southern Sri Lanka, which enable them to be regarded as forms within the three main varieties of coconut in Sri Lanka. Consequently, the new forms listed in Table 4 are not only different from each other, but also different from the forms identified by Liyanage (1958), Wickremaratne (1984) and Perera et al. (1997).

**Table 4:** Specific morphological features of the new coconut types identified in Southern Sri Lanka and their classification as forms within varieties

| Vernacular name (Variety/form) | Specific morphological features |
|---|---|
| *Ran pol* (Typica/*Ran pol*) | Tall palms with stout fast growing stems. Very large round coconuts of mostly brown or less commonly green fruits. Plicata leaves (attached leaflets, especially in young fronds) |
| *Bothal thembili* (Aurantiaca/*Bothal thembili*) | Intermediate palms producing orange, elongated coconuts of unique shape. |
| *Juwan pol* (Typica/*Juwan*) | Tall palms producing round small nuts. A high number (10-20) nuts per bunch. |
| *Murusi* (*Green*) (Nana/*Green 'Murusi'*) | Dwarf palms producing green small coconuts which are rounder in shape than green dwarf nuts. Seasonal nut production. |
| *Murusi (Yellow)* (Nana/*Yellow Murusi'*) | Dwarf palms producing yellow small coconuts which are rounder in shape than yellow dwarf nuts. Intermittent nut production. |
| *Murusi (Brown)* (Nana/*Brown 'Murusi'*) | Dwarf palms producing brown coloured small coconuts which are rounder than brown dwarf nuts. Seasonal nut production. |
| *Rath Gon Thembili* (Typica/*Rath Gon thembili*) | Tall palms bearing orange coconuts. The petiole fronds and the inflorescences also are of the same colour. |
| *Thatin* (Typica/*Thatin)** | Tall palms producing elongated small coconuts with thick kernels and thin husks. |
| *Dothalu* (Typica/*Dothalu*)* | Tall palms producing green small elongated coconuts. A large number of nuts per bunch (20-40) Very sweet nut water. Seasonal nut production. |

* Sample size was inadequate to classify precisely

**Table 5:** Comparison of the nut size and kernel weight of the dwarf and Murusi forms

| Phenotype | Nut size (polar circumference cm) | Kernel (g/nut) |
|---|---|---|
| *Green Murusi* | (54.1) | 239.3 |
| *Green dwarf* | (49.8) | 135.8 |
| *Brown Murusi* | (56.0) | 210.6 |
| *Brown dwarf* | (47.2) | 185.7 |
| *Yellow Murusi* | (53.9) | 221.0 |
| *Yellow dwarf* | (64.0) | 272.3 |

The green, yellow and brown phenotypes of 'Murusi' are classified within the relevant colour form of variety Nana (Table 4). This differentiation between Murusi and the relevant colour form of dwarf is mainly based on the differences in nut size and kernel weights of the dwarf and Murusi forms (Table 5). As shown in Table 5, Green and Brown Murusi produces larger and heavier nuts than the relevant dwarf forms while Yellow Murusi produces smaller and lighter nuts than Yellow dwarf.

Many of the forms of coconut identified earlier (Kamandala, Bodiri, Pora pol, Dikiri etc.) were also naturally distributed in the Southern Province of Sri Lanka and testifies to the rich morphological diversity of coconuts in the area. The local community identifies the new coconut phenotypes by their vernacular names indicating that they have been grown or found naturally in the area over a long period of time and are not freaks or recent mutants. However, these traditional coconuts are endangered due to ongoing urbanization and coconut replanting programmes. Recognizing these coconut phenotypes as forms and their inclusion in the classification will draw attention to the possible existence of more traditional coconut phenotypes in Sri Lanka and the need for their conservation as germplasm accessions. These diverse materials are likely to carry valuable genes for exploitation in future coconut hybridization programmes for diverse uses in addition to being used directly for commercial purposes such as beverage coconuts and daily culinary requirements.

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## REFERENCES

Bourdeix, R. Santos, G. Labouisse, J. P. and Baudouin, L. (2005). Useful definition of terms and nomenclature, In: Coconut Genetic Resources, P. Batugal, V. Ramanatha Rao and Jeffrey Oliver, ed., IPGRI, Rome, pp 9-10

Ekanayake, G. K., Perera, S. A. C. N., Dassanayake, P. N. and Everard, J. M. D. T. (2007). Identification, characterization and conservation of new coconut phenotypes from Southern Sri Lanka. Proc. 12th Forestry and Environment Symp 2007. pp 76-77

Everard, J. M. D. T. (2004). Report of the Genetics and Plant Breeding Division, Coconut Research Institute, Sri Lanka. 73-77.

Harries, H.C. (1978). The evolution, dissemination and classification of Cocos nucifera L. Bot. Rev., 44: 205-317

Liyanage D. V. (1958). Varieties and forms of the coconut palm grown in Ceylon. Ceylon Coconut Quart., 9:1-10

Manthriratna M. A. P. (1972). The performance of dwarfs (Cocos nucifera L. variety nana) as a plantation crop in Ceylon. Ceylon Coconut Quart., 23:92-99

Menon, K P V. and Pandalai, K M. (1958). The coconut, A Monograph, Indian Central Coconut Committee, pp 86-102

Perera, L. Peries, R R A. (1997). Brown dwarf: a recent addition to the varieties and forms of coconut palm grown in Sri Lanka. Cocos 12: 82-84.

Powell, T. (1868) On various Samoan plants and their vernacular names. Journal of Botany (London) 6: 278-285, 242-347, 255-370, Cited in Harries, H C. (1978). The evolution dissemination and classification of Cocos nucifera L., Bot. Rev., 44: 205-317

Wickremaratne, M. R. T. (1984). Report of the Genetics and Plant Breeding Division, Coconut Research Institute, Sri Lanka. 45.