



Evaluation of dwarf varieties of coconut for wilt resistance, nut yield and quality of tender coconut water

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ABSTRACT

The present study was undertaken to evaluate the suitability of dwarf varieties of coconut for tender nut purposes in the root (wilt) prevalent disease tracts. Studies revealed that the quantity and quality of tender coconut water differed significantly depending on the variety. Among the varieties, the volume of tender nut water was highest for King Coconut, but the quality was rated only as average. The quality of tender nut water regarding total soluble solids (TSS) and organoleptic evaluation score was highest for Gangabondam Green Dwarf. There was no significant difference in the pH of the tender nut water of different varieties, and the values ranged from 5.06 to 5.34. The mineral composition of tender nut water was also estimated, and the highest potassium content was recorded in Niu Leka Dwarf (2285 ppm), followed by Andaman Green Dwarf (2182.5 ppm). However, the highest sodium content was recorded in Andaman Green Dwarf (34.6 ppm), followed by King Coconut (19.63 ppm). Characters like the volume of tender nut water, TSS, organoleptic score, potassium content, nut yield and reaction to root (wilt) disease were considered for selecting the most suitable tender nut varieties. Gudanjali Green Dwarf, Andaman Green Dwarf and Kalpasree were found to be promising for the root (wilt) disease prevalent tract owing to their tender nut qualities, nut yield and resistance to root wilt disease.

Keywords: *Cocos nucifera* L., Tender nut water, Root (wilt) disease, Green dwarf varieties.

INTRODUCTION

Coconut is an important crop along the coastal tract of India and is inter-connected with the subsistence of millions of farm families. In India, majority (50%) of the coconuts produced is consumed raw, around 11% is used for tender nut purpose and 2% alone is utilized for value addition (Muralidharan and Jayashree, 6). Tall varieties occupy more than 95% of the area under coconut. Of late, dwarf varieties are gaining popularity due to its short stature, resistance to biotic stresses and easiness for harvesting. Tender coconut is valued both for its sweet water and the delicious meat. It is very popular as a refreshing natural, nutritious, medicinal drink with well acceptable flavor and taste (Rethinam and Nandakumar, 11). It contains sugars, proteins, growth promoting factors and various nutrients need for the human body (Shaw and Srivastava, 12). Quality and acceptability of nut water mainly depends on the variety, nut maturity and environmental factors. The rising popularity of tender coconut as a health drink, has resulted in increased demand for seedlings of dwarf varieties of coconut. Screening of coconut varieties for traits such as volume of tender nut water, sweetness of

water and mineral content especially potassium can help to find suitable varieties for the purpose of tender nut. Dwarf and semi-tall types such as Chowghat Orange Dwarf, Malayan Orange Dwarf, Malayan Green Dwarf, Malayan Yellow Dwarf, Gangabondam, King Coconut etc. are excellent source of quality tender nut (Rethinam and Nandakumar, 11). The semi-tall variety King Coconut has long been known in Sri Lanka as the ideal variety for tender coconut (Bandaranayake and Fernando, 3).

Root (wilt) is a debilitating disease of coconut and development of resistant varieties is one of the ideal strategies for management of the disease. Systematic evaluation trials involving coconut germplasm at ICAR-CPCRI Regional Station, Kayamkulam resulted in the identification of two dwarf varieties resistant to root (wilt) disease viz., Kalparaksha and Kalpasree. In order to screen the reaction of other dwarf varieties of coconut to root (wilt) disease, a trial involving seven dwarf varieties was laid out at ICAR-Central Plantation Crops Research Institute. Although dwarf varieties are gaining popularity, their nut characters and oil yield are not favourable for large-scale commercial cultivation. Hence, the investigation was undertaken to evaluate dwarf varieties of coconut for tender nut purpose, especially for the root wilt disease affected area.

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MATERIALS AND METHODS

The experimental materials were planted during May 2013 at ICAR-CPCRI, Regional Station, Kayamkulam (Kerala) with seven dwarf varieties of coconut at a spacing of 7.5 × 7.5 m. The design was Randomized Block Design with three replications and nine palms per replication. Management of the experimental palms was done as per the recommended package of practices.

For studying the suitability of dwarf varieties for tender nut purpose, in addition to the seven varieties, Chowghat Orange Dwarf (COD, a variety released exclusively for tender nut purpose) was used as control. The list of varieties used in the study is given in Table 1. The experiment for studying tender nut character and quality was carried out in a Completely Randomized Design (CRD) during 2018-2020. The data was pooled and statistical analysis was carried out.

For tender nut studies, seven month old tender nuts were harvested during summer months and five nuts were taken at random from the replicated palms. The total soluble solids (TSS) were recorded with hand refractometer and pH of the coconut water was determined with digital pH meter. The mineral composition of tender nut water was estimated using Atomic Absorption Spectrophotometer. Sweetness of tender nut water was evaluated based on standard organoleptic test on a 1-5 hedonic scale (Choi, 4). Scoring for incidence of root (wilt) disease was done based on appearance of foliar symptoms like flaccidity, marginal necrosis and yellowing (Radha and Lal, 9). The average nut yield during the period 2016-2020 was recorded.

Table 1. Details of dwarf varieties of coconut used in the study

Sl. No.	Variety	Shape of fruit	Nut colour
1	Kalpasree	Oblong	Green
2	Kalparaksha	Round	Green
3	Niu Leka Dwarf	Oblong	Green/Brown/ Bronze
4	Andaman Green Dwarf	Oval	Green
5	Gudanjali Dwarf	Oblong	Green
6	Gangabondam Green Dwarf	Pear or Papaya shaped	Green
7	King Coconut	Oval	Orange
8	Chowghat Orange Dwarf	Round	Orange

The suitability of different dwarf varieties for tender nut purpose was worked out based on six selected parameters using weighted average method. Among the tender nut quality parameters, four selected traits viz., volume and sweetness of tender nut water, potassium content and TSS were taken into account. Reaction to root (wilt) disease and annual nut production were also considered. The values obtained for each selected trait were converted to corresponding score of 10, 8, 6, 4, 2, 1 and 0 (10 for the highest value and 0 for the lowest value). However, for root (wilt) disease incidence, score of 10 was marked for the variety with lowest disease incidence and 0 was marked for the variety with highest disease incidence. Weightage for each trait was assigned based on the average of expert opinion. More weightage was given to yield and root (wilt) disease resistance (20% each) and a weightage of 15% each was given for the four tender nut characters. The seven coconut varieties were finally ranked based on the total score obtained.

RESULTS AND DISCUSSION

The quality and quantity of nut water of tender coconut showed wide inter-varietal variation. Significant differences were also observed for characters such as weight of tender nut, volume of tender nut water and TSS. The results are presented in Table 2.

The fruit weight varied significantly from 1296 to 2180 g at tender nut stage. Fruit weight at tender nut stage was highest in Niu Leka Dwarf (2180 g) followed by Kalparaksha (1864 g) and the lowest was for King Coconut (1296 g). The nut size and shape are found to vary with varieties. Attri *et al.* (2) evaluated different cultivars of coconut at tender nut stage and found that at 7-8 months maturity, the weight of nut varied from 1.315 kg in Malayan Orange Dwarf to 2.815 kg in Andaman Tall. Similar variation for fruit weight in coconut was observed by Tripura and Paramaguru (14) and many other workers.

Although the fruit weight was lowest for King Coconut, volume of water was highest for King Coconut (563 ml) followed by Gangabondam Green Dwarf (476 ml). Gudanjali Green Dwarf recorded the lowest tender nut water content (257 ml). Similar results for variation in tender nut water have already been reported by Vijay *et al.* (15).

Tripura and Paramaguru (14) studied the nut water quality of various exotic and indigenous coconut accessions and reported that maximum quantity of tender nut water was for Andaman Giant (724 ml) and the lowest for Arasampatti Tall (106.30 ml). In tender coconut, volume of water is an important economic character and it should not be less than

Table 2. Tender nut characters of dwarf varieties of coconut

Variety	Weight of fruit (g)	Volume of tender nut water (ml)	TSS (°Brix)	pH	Organoleptic score
Kalpasree	1482 ^b	294 ^f	5.8 ^{cd}	5.22 ^a	3
Kalparaksha	1864 ^a	435 ^c	6.1 ^{bc}	5.32 ^a	3
Niu Leka Dwarf	2180 ^a	400 ^d	6.5 ^{ab}	5.33 ^a	3
Andaman Green Dwarf	1476 ^b	440 ^c	5.36 ^d	5.06 ^a	3
Gudanjali Green Dwarf	1479 ^b	257 ^g	5.62 ^{cd}	5.12 ^a	3
Gangabondam Green Dwarf	1470 ^b	476 ^b	7.12 ^a	5.34 ^a	4
King Coconut	1296 ^b	563 ^a	5.64 ^{cd}	5.07 ^a	2
Chowghat Orange Dwarf	1407 ^b	352 ^e	6.8 ^a	5.26 ^a	3
CV (%)	16.37	6.49	8.035	4.048 ^a	
CD _(0.05)	0.336	33.9	0.636	NS	

250 ml per nut (Apshara *et al.*, 1). In the present study, volume of tender nut water ranged from 257-563 ml indicating that all varieties used in the present study were suitable for tender nut purposes with respect to volume of water.

Total Soluble Solids is a measure of sugars present in tender nut water and it varied significantly among varieties. Among the different varieties, Gangabondam Green Dwarf recorded the highest TSS value (7.12°Brix) and that of COD (control) was 6.8°Brix. Andaman Green Dwarf recorded the minimum TSS value of 5.36°Brix. Poduval *et al.* (8) reported that maximum TSS (7.4) was recorded at seven months in Straight Settlement Green and Laccadive Micro and the minimum TSS was recorded in T × D (2.0). Nadasabapathy and Kumar (7) reported that TSS was found to be higher for Chowghat Green Dwarf (5.17) followed by COD (4.90) and the minimum was recorded in Tiptur Tall

(4.56) at tender nut stage. Apshara *et al.* (1) reported higher TSS in T × D and D × T hybrids involving COD.

There was no significant difference in the pH of the tender nut water of different varieties and the values ranged from 5.06 to 5.34. Tripura and Paramaguru (14) reported highest pH of tender nut water in Guam (6.86) followed by MGD (6.66) and the lowest pH values in St. Vincent (5.10).

The level of the minerals present in the tender nut water depends on the amount of these minerals present in the soil, irrigation water and coconut cultivars. Tender coconut water is a drink rich in all essential minerals and is a source of electrolytes like potassium and sodium, which are needed for normal body function. Among the various minerals present in tender nut water, potassium is a major constituent. Highest potassium content was recorded in Niu Leka Dwarf (2285 ppm) followed by Andaman Green Dwarf (2182.5 ppm) (Table 3). Potassium content was

Table 3. Mineral composition of tender nut water

Variety	Potassium (ppm)	Sodium (ppm)	Manganese (ppm)	Zinc (ppm)	Copper (ppm)	Iron (ppm)	Boron (ppm)
Kalpasree	1940.6 ^c	12.5 ^c	4.0187 ^a	0.5897 ^b	0.0018	0.0825	0.7428 ^b
Kalparaksha	1780 ^e	14 ^c	3.254 ^b	0.7246 ^a	trace	0.0918	0.8147 ^{ab}
Niu Leka Dwarf	2285 ^a	17.8 ^{bc}	2.5931 ^d	0.8095 ^a	0.0118	0.246	0.7899 ^{ab}
Andaman Green Dwarf	2182.5 ^a	34.6 ^a	3.9613 ^a	0.8065 ^a	trace	0.1766	0.8643 ^a
Gudanjali Green Dwarf	1997.5 ^c	9.8 ^c	2.1187 ^e	0.2765 ^e	0.0015	trace	0.4672 ^d
Gangabondam Green Dwarf	1940 ^c	12.8 ^c	2.824 ^c	0.4768 ^c	0.0051	0.2653	0.7475 ^b
King Coconut	1900 ^d	19.63 ^b	3.5735 ^{ab}	0.3889 ^d	0.0037	0.138	0.657 ^{bc}
Chowghat Orange Dwarf	2004 ^{bc}	20.3 ^b	2.147 ^{de}	0.756 ^a	trace	0.057	0.3888 ^d
CV (%)	3.903	15.447	12.12	11.16			11.89
CD _(0.05)	98.89	4.639	0.474	0.092			0.107

lowest in Kalparaksha (1780 ppm). Damodaran *et al.* (5) observed significant differences between the coconut cultivars in respect of sodium and potassium levels. The potassium level ranged from 2797 ppm in WCT to lower potassium levels in MYD (1998 ppm) and COD (2003 ppm). Ratnambal (10) evaluated Malayan Dwarf cultivars at tender nut stage (seven months) and found maximum potassium (2142 ppm) in MOD and the lowest in MYD (1988 ppm).

The sodium content of tender nut water varied significantly among the different varieties. Highest sodium content was recorded in Andaman Green Dwarf (34.6 ppm) followed by King Coconut (19.63 ppm). The lowest sodium content was recorded in Gudanjali Green Dwarf (9.8 ppm). The observation is in conformity with the findings of Damodaran *et al.* (5) and Ratnambal (10). In the present study, the range recorded for sodium content was between 34.6 ppm in Andaman Green Dwarf to 9.8 ppm in Gudanjali Green Dwarf.

Manganese, Boron, Zinc and Iron are required by the body only in minute quantities. Manganese content was highest in Kalpasree (4.019 ppm) and was lowest in Gudanjali Green Dwarf (2.119 ppm). Boron is also a micronutrient with diverse and vitally important role in human health. Boron content was highest in Andaman Green Dwarf (0.8643 ppm) and lowest was in Chowghat Orange Dwarf (0.3888 ppm). Zinc content was highest in Niu Leka Dwarf (0.8095 ppm) and lowest was for Gudanjali Green Dwarf (0.2765 ppm). Iron content was highest in Gangabondam Green Dwarf (0.2653 ppm) followed by Niu Leka Dwarf (0.246 ppm).

Gangabondam Green Dwarf was ranked as 'very good' based on organoleptic evaluation with the highest score of four. Tender nut water of other varieties viz., Niu Leka Dwarf, Kalpasree, Kalparaksha, Andaman Green Dwarf and COD was rated as 'good' and that of King Coconut was rated only as 'average'.

Ratnambal (10) evaluated Tall and Dwarf varieties suitable for tender coconut and compared it with the released cultivar COD and reported that all ten tall cultivars and six dwarf cultivars were found to be 'good' based on organoleptic test.

Incidence of root (wilt) disease was recorded and the results are presented in Table 4. After seven years of planting, maximum root (wilt) disease was observed in Gangabondam Green Dwarf (14.8%), followed by King Coconut (11.1%) and Andaman Green Dwarf (7.4%). Kalpasree and Gudanjali Green Dwarf were free from root (wilt) disease. The nut yield based on four years (2016-2020) average is also furnished in Table 4. The highest nut yield was recorded in Gudanjali Green Dwarf (78.1 nuts/palm/year) followed by Andaman Green Dwarf (71.9 nuts/palm/year) and Kalpasree (70.5 nuts/palm/year).

For identifying suitable varieties for the tender nut purpose in the root (wilt) diseased tract, characters like volume and sweetness of tender nut water, TSS, potassium content, resistance to root (wilt) disease and nut yield were considered. The weighted average of these characters is presented in Table 4. The highest average score with regard to suitability for tender nut was recorded for Gudanjali Green Dwarf (6.25) followed by Andaman Green Dwarf (6.10) and was ranked first and second respectively. Kalpasree was ranked third with an average score of 5.75. Kalpasree was released during 2012 as resistant to root (wilt) disease and its tender nut water has superior quality (Thomas *et al.* 13). The suitability of dwarf cultivars of coconut like COD, Chowghat Green Dwarf (CGD), Gangabondam, MOD, Cameroon Dwarf and King Coconut for tender nut purpose has already been reported by Ratnambal (10). Although Gangabondam Green Dwarf and King Coconut are reported to be suitable for tender nut by several workers from other countries, our study reveals that these varieties are not suitable in the root

Table 4. Incidence of root (wilt) disease, nut yield and ranking of dwarf varieties of coconut

Sl. No.	Variety	Root (wilt) disease incidence (%)	Four years average nut yield (per palm/year)	Weighted average score for ranking
1	Kalpasree	0	70.5	5.75 ³
2	Kalparaksha	3.7	68.0	5.10 ⁵
3	Niu Leka Dwarf	7.4	54.0	5.60 ⁴
4	Andaman Green Dwarf	7.4	71.9	6.10 ²
5	Gudanjali Green Dwarf	0	78.1	6.25 ¹
6	Gangabondam Green Dwarf	14.8	54.4	4.90 ⁶
7	King Coconut	11.1	59.4	4.05 ⁷

*Nut yield not statistically significant

+Weighted average score followed by superscript denotes the ranking

(wilt) disease affected areas because of its higher susceptibility to root (wilt) disease.

Taking into account different parameters related to tender nut quality, nut production and reaction to root (wilt) disease, three coconut varieties namely Gudanjali Green Dwarf, Andaman Green Dwarf and Kalpasree were found to be promising specifically for tender nut purpose in the root (wilt) disease hotspots.

AUTHORS' CONTRIBUTION

Conceptualization of research, Designing of experiments & Contribution of experimental materials (RJT, MS), Execution of field/lab experiments and data collection (MS, JM), Analysis of data and interpretation (CKN, RJT, MS), Preparation of the manuscript (MS,RJT)

DECLARATION

The authors declare that there is no conflict of interest

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