The Evaluation of Morphological Differences between Green Dwarf × Sri Lankan Tall and Yellow Dwarf × Sri Lankan Tall Hybrids

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ABSTRACT

The recommended coconut cultivar CRIC65 was developed by crossing Sri Lankan Dwarf forms, Green and Yellow, with Sri Lankan Tall. Although recommended under the same cultivar name certain morphological differences have been observed between these two hybrids. The current study was conducted to evaluate and compare stem, leaf, crown and fruit morphology and the yielding ability of the two hybrids. A total number of 80 palms representing 40 palms each from two hybrids were selected to collect the morphological data. Primary data for stem and leaf morphology, nut setting percentage and fruit morphology were scored while secondary data for nut yield and fruit components were obtained to evaluate the differences between the two hybrids. Statistically significant differences were observed for stem morphology, number of leaflets and certain fruit component parameters in the detailed analysis with primary data. Furthermore, the analysis of secondary data revealed annual nut yield differences and also differences in fruit components between the two hybrids. In conclusion the study revealed that the hybrid Green Dwarf x Sri Lankan Tall to be the better nut producer and the hybrid Yellow Dwarf x Sri Lankan Tall to produce larger nuts in general.

KEYWORDS: Fruit component, Morphology, Nut setting, Nut yield

INTRODUCTION

Coconut (*Cocos nucifera* L.) belongs to the family Arecaceae and is one of the major plantation crops in the tropics. Different communities in this region have used coconut for food, health and general well being. They referred to coconut as the "tree of life" and every part of coconut palm is used for different purposes. Sri Lanka is the 4th largest coconut producing country in the world having approximately 440,000ha of land (Liyanage, 1999) under coconut cultivation. Coconut industry has a great impact in the economy of Sri Lanka accounting for about 1.7 percent of Gross Domestic Product (GDP) and 2.5 percent of foreign exchange earnings (Anon, 2006). It is a main source of food in addition to bringing foreign exchange earnings for national economy. It also provides a large number of employment opportunities both in the plantation sector and the coconut industry. The national coconut production in Sri Lanka in 2006 is 2866 million nuts, while the current productivity is 6486 nuts/ha/yr (Anon, 2006) which can be increased up to 10,000 nuts/ha/yr by adapting proper agronomic practices with the use of improved planting material.

Although, there is a considerable productivity, coconut industry in Sri Lanka is faced with many challenges today due to shortage of land, high cost of inputs, low productivity due to nutrition depletion, recurrent droughts, newly emerging pest and diseases, shortage of skilled labourers etc. Strengthening of breeding programme is one of the priority areas of increasing productivity by developing varieties to give high yields with more tolerance to biotic and abiotic stresses.

Coconut Research Institute of Sri Lanka (CRISL) has been involved in the development of improved coconut hybrids mainly for higher yield and precocity. Accordingly, CRISL has recommended the cultivars CRIC60 (Sri Lankan Tall [SLT] × SLT), CRIC65 (Sri Lankan Dwarf [Green and Yellow] × SLT), CRISL98 (SLT × San Ramon), and one estate selection Moorock (Everard, 2004) for planting in order to increase the productivity of coconut in Sri Lanka.

Among the above cultivars CRIC65 is produced by crossing Sri Lankan dwarf forms, green dwarf (GD) and yellow dwarf (YD) with SLT palms. The hybrid CRIC65 is early flowering (3-4 years) with average production potential of 110 nuts/palm/year under rain-fed conditions with good management. Average production of copra is about 210g/nut. It also has a proven ability to produce higher toddy yields (1250ml/palm/day) (Liyanage *et al.*, 1990) with 15%-18% sugar due to the higher number of inflorescences available for tapping in the hybrid. This is recommended for planting in better environments preferably with irrigation during drought and in home gardens. In general improved cultivars are capable of producing 30-40% higher yields than indigenous populations of the ordinary tall cultivars.

However, some differences have been observed between GD×SLT hybrid and YD×SLT hybrid such as yielding patterns of two hybrids, tolerance to *Aceria* mite. Although, there are some

differences between two hybrids both these are commonly referred to and recommended as CRIC65.

The current study was conducted with the objective of determining morphological traits with respect to stem, leaf and fruit characters which differ between the two hybrids (GD × SLT and YD × SLT) within the cultivar CRIC65.

METERIALS AND METHODS

The study was conducted at the Genetics and Plant Breeding Division of the Coconut Research Institute, Lunuwila, Sri Lanka during the period of March to September in the year 2007. Morphological data given below were collected following the descriptors for coconut outlined by International Plant Genetic Resource Institute (IPGRI).

Leaf, stem and crown morphology

A total of 70 palm representing 35 palms each from the two hybrids (GD × SLT), (YD × SLT) was selected from the cultivar evaluation experimental site at Bandirippuwa estate, Lunuwila for obtaining leaf, stem and crown morphology. All the selected palms were of the same age and were under similar management practices.

The stem morphology traits girth at 20cm above soil level, girth at 1.5m height and stem height; leaf morphology traits petiole length (from base of petiole to the most proximal leaflet), petiole width, rachis length (from the base of petiole to the tip), number of leaflets, average width of 4 leaflets, and average length of 4 leaflets (at insertion of first leaflets) were scored.

A total of 80 palms including the above 70 palms were selected for counting the setting percentage of female flowers into fruits (*i.e.* From female flower to fruit).

Study of fruit components

The same 70 palms used for recording stem and leaf morphology were used for obtaining detailed fruit component data. The fruit and nut traits, weight of fresh nut, weight of split nut, weight of nut, weight of kernel, dry weight, fruit polar circumference, fruit equatorial circumference, fruit polar length, fruit equatorial length, nut polar length, nut equatorial length, endosperm thickness and shell thickness were scored in one nut representing each palm following the IPGRI coconut descriptors.

Study of secondary yield and fruit component data

Annual nut yield of 80 palms each form the two hybrids GD x SLT and YD x SLT grown in the same field during 1996 to 2004 was obtained for the period 1996-2004 from the records maintained at the Genetics and Plant Breeding Division of CRISL. Furthermore, fruit components fresh nut weight, husked nut weight, split nut weight and kernel weight of 120 nuts from each hybrid in each year covering the period from 1997 to 2000 were also obtained for analysis.

Data analysis

The data were analyzed by performing analysis of variance among variables using statistical software package MINITAB.

RESULTS AND DISCUSSION

The means and the standard deviations of selected important traits are given in Table 01.

Stem and leaf measurement

The girth of stem at 20cm and 1.5m from the ground level and stem height were significantly different between GD × SLT and YD × SLT. Furthermore, a significant difference between two hybrids was also observed for number of leaflets. The GD × SLT is smaller than YD × SLT with respect to stem girth. Moreover, YD×SLT palms are taller than GD × SLT palms as indicated by the means.

The analysis of nut setting percentage did not reveal any statistically significant difference between the two hybrids.

Table 1. Means and the standard deviations (in parenthesis) of morphological traits measured

Trait	GD×SLT	YD×SLT
Primary data		
*Girth at 20cm	113.6 (9.3)	126.5 (21.3)
*Girth at 1.5m	77.1 (6.5)	85.3 (10.2)
*Stem height	640.1 (115..5)	831.3 (207.3)
*Number of leaflets	206.8 (10.4)	216.3 (10.7)
Fresh weight	1114.5 (468.4)	1335.8(386.8)
*Split nut weight	754.8 (301.8)	884.5 (171.4)
*Nut weight	372.5 (113.3)	453.8 (96.0)
*Kernel weight	245.1 (75.4)	292.6 (73.4)
Secondary data		
Fresh fruit weight (1997)	1224.9 (310.4)	1294.2 (350.4)
*Fresh fruit weight (1998)	1300.1 (306.0)	1403.8 (371.5)
*Fresh fruit weight (1999)	1303.6 (370.8)	1339.5 (355.0)
*Husked nut weight (1997)	657.7 (161.2)	707.9 (186.9)
Husked nut weight (1999)	719.8 (183.1)	744.5 (162.9)
Husked nut weight (2000)	750.6 (183.1)	781.6 (218.2
*Split nut weight (1997)	469.8 (124.0)	508.7 (112.0)
*Split nut weight (2000)	552.5 (121.5)	597.6 (1713)
Kernel weight (1997)	321.6 (68.7)	336.8 (93.9)
Annual nut yield (1998)	53.65(31.61)	60.73 (34.01)
Annual nut yield (1999)	102.5 (55.8)	88.8 (46.0)
*Annual nut yield (2001)	89.9 (30.5)	76.2 (36.4)
*Annual nut yield (2002)	43.5 (20.9)	35.6 (14.7)

*Traits which showed statistically significant difference at $p>0.05$

Detailed fruit component analysis

Kernel weight is the most important component in relation to copra production. The analysis of kernel weight of the two hybrids revealed statistically significant differences between the two hybrids. In addition, there was a significant difference in nut weight and split nut weight between the two hybrids. Furthermore, fresh nut weight also was revealed to be different at the probability level of P = 0.051. These results indicate that nuts of the two hybrids are different in their capacity for copra production. GD x SLT hybrid produce nuts with less fresh weight, split nut weight and less kernel content compared to YD x SLT (Table 1).

Analysis of secondary fruit component data

The analysis of annual fruit component study from 1997 to 2000 revealed statistically significant differences between the two hybrids. Fruit components, fresh fruit weight in 1998 and 1999, husked nut weight in 1997 and split nut weight in 1997 and 2000 were significantly different between the two hybrids. Accordingly, YD×SLT shows higher values than GD×SLT for fresh nut weight (Figure 1), husked weight and split weight during all years (apart from one year for husked nut weight) considered for the analysis. These parameters are the most important fruit components in relation to copra production. Consequently, the results indicated the overall superiority of YD×SLT over GD x SLT in per nut copra production.

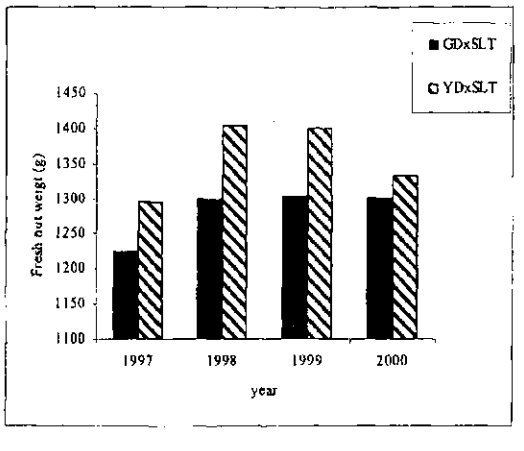

Figure 1. Fresh fruit weight difference between GD×SLT and YD×SLT

Secondary nut yield data

The analysis of variance for annual nut yield per palm in the years 2001 and 2002 revealed statistically significant differences between the two hybrids. Accordingly, GD×SLT hybrid produced the highest nut yield in most years considered for the analysis (Figure 2).

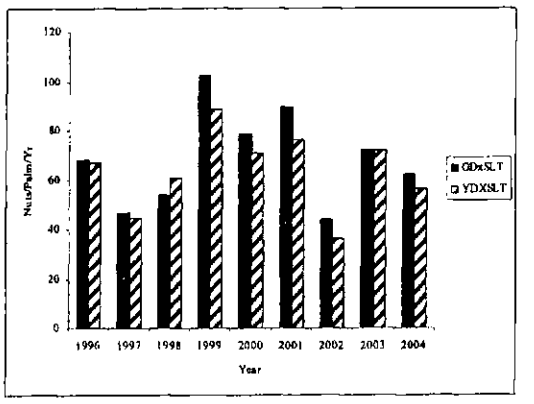

Figure 2. Nut yield difference between GD×SLT and YD×SLT

CONCLUSIONS

The two hybrids show clear morphological differences with respect to stem girth, stem height and number of leaflets. In addition these two hybrids differ in their capacity for nuts and copra production during certain years. The hybrid GD x SLT produces more nuts in certain years while the hybrid YD x SLT produces nuts with higher weights. The two hybrids seem to differ in their response to varying environmental conditions with respect to nut and copra production. The study revealed the hybrid GDxSLT to be the better nut producer and the hybrid YDxSLT to produce larger nuts in general.

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