

Variation and cultivar nomenclature in *Musa*, AAA group, Cavendish subgroup.

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VARIATION AND CULTIVAR NEMENCLATURE IN *MUSA*, AAA GROUP, CAVENDISH SUBGROUP.

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ABSTRACT - As a result of somaclonal variation, all of the height classes of the Cavendish Subgroup have been produced from one clone of Grand Nain multiplied *in vitro*. Six height classes have been identified among the somaclonal variants: Extra Dwarf Cavendish, Dwarf Cavendish, Dwarf Grand Nain, Grand Nain, Giant Cavendish-Robusta and Lacatan (Pisang Masak Hijau). A review of variation among clones in the Cavendish Subgroup is made as a basis for recommendation to avoid confusion in cultivar nomenclature. Many cultivars closely related but distinct with respect to height and foliage and fruit characteristics can only be distinguished when compared side-by-side or under the same ecological conditions. Plant height, ratooning time, bunch and finger size, foliage characteristics (area, leaf index, radius covered) and bunch weight-height ratio are the most important criteria for characterizing a cultivar and should be included in all cultivar descriptions. The widely grown Grand Nain, Poyo, Giant Cavendish, Williams and Dwarf Cavendish can be used as reference cultivars when classifying new or unknown clones.

INTRODUCTION

Simmonds (1954 a, b) has reviewed the origins and characteristics of the Cavendish Subgroup of cultivars of *Musa* AAA. Five of these cultivars are the basis of the international trades. All the cultivars have arisen by mutation in the field (Simmonds, 1954 a, b; Gross and Simmonds, 1954; Stover and Simmonds, 1987).

In vitro multiplication of banana plants is a rapid and efficient method of obtaining disease-free plants. Unfortunately, somaclonal variation can be a problem when Cavendish Subgroup plants are mass-produced in large numbers *in vitro* (Stover and Buddenhagen, 1986; Stover, 1987). A study of «off-type» plants of the Grand Nain variety produced *in vitro* has shown that all height classes of the Cavendish Subgroup have been produced as a result of

VARIATION ET NOMENCLATURE DES CULTIVARS DU GENRE *MUSA*, GROUPE AAA ET SOUS-GROUPE CAVENDISH.

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RESUME - Du fait de variation somaclonale, on a obtenu des classes de toutes hauteurs de bananiers du sous-groupe Cavendish à partir d'un clone de Grande Naine multiplié *in vitro*. Six classes ont été définies parmi les variants: «Cavendish Extra Nain», «Petite Naine», «Dwarf Grand Nain», «Giant Cavendish», Robusta et Lacatan (Pisang Masak Hijau). Un passage en revue de la variation, au sein du sous-groupe Cavendish est présenté pour servir comme base de recommandation afin d'éviter des confusions dans la nomenclature. Beaucoup de cultivars très voisins mais distincts par la hauteur, le feuillage et le fruit peuvent être différenciés seulement s'ils sont comparés côte à côte ou dans les mêmes conditions écologiques. Hauteur du plant, rejettage (surface, rapport foliaire, rayon couvert), taille du régime et du doigt, caractéristiques du feuillage ainsi que rapport hauteur/poids du régime sont les critères les plus importants et devraient trouver leur place dans toutes descriptions. Grande Naine, Poyo, Giant Cavendish, Williams et Petite Naine, largement répandues peuvent servir de référence pour classer des cultivars nouveaux ou inconnus.

somaclonal variation. This variation and variation in general among Cavendish Subgroup cultivars and their nomenclature are discussed in this paper.

METHODS

Off-type banana plants scattered throughout an area of 600 ha planted with Grand Nain produced *in vitro* were measured (height and foliage characteristics). The origin of these plants and propagation methods were previously described (Stover, 1987). Full height differential between cultivars is not expressed until the second or third ratoon crop. Second or third ratoon plants with fruit were classified with respect to height and foliage characteristics following the guidelines established by Simmonds (1954 a, b). Data from the literature were examined to determine the most important variation among cultivars in the Cavendish Subgroup. The use of this variation in identifying specific clones and the nomenclature of the most important commercial cultivars in international trade is outlined.

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OBSERVATIONS

Somaclonal variation in height classes among Grand Nain plants produced *in vitro*.

The relative percentage of various height classes from plants produced *in vitro* was previously described (Stover, 1987). In addition to these, two new height classes have been found : Dwarf Grand Nain and Lacatan. All classes are outlined in Table 1. The Dwarf Grand Nain height class was previously lumped with the Dwarf Cavendish class but is distinct in that it clearly falls between Dwarf Cavendish and Grand Nain in height (Table 1). The Dwarf Cavendish and Dwarf Grand Nain height classes comprised more than 70 percent of all the mutants. In contrast, the Lacatan height class was rare and surveyors reported no more than 10 plants observed in 600 ha of Grand Nain multiplied *in vitro*.

Variation among Cavendish Subgroup cultivars in Honduras.

The United Fruit Company carried out studies with six cultivars in the 1960s. Data from some experiments are

shown in Table 2. Four height classes are represented : Lacatan (486 cm), Robusta-Valery-Congo (371-384 cm), Giant Cavendish (347 cm), Grand Nain (287 cm). There were significant differences in ratooning speed at low populations of around 900 plants per ha. There were no significant differences in bunch weight (not shown) except that Lacatan bunches were about 15 percent smaller. Stover (1982) studied Valery and Grand Nain in Honduras and proposed Grand Nain as a banana ideotype because of height, foliage architecture and superior yield.

Variation among Cavendish Subgroup cultivars in Australia and Elsewhere.

The largest comparative study of Cavendish cultivars was carried out by Turner and Hunt (1984) in Australia (Table 3). Fourteen cultivars were compared representing the following height classes : Extra Dwarf Cavendish, Dwarf Cavendish, Giant Cavendish, Robusta and Lacatan. The largest differences among cultivars were in plant height, bunch weight and bunch weight-height ratio (about 44%). Bunch weight-height ratio is an indication of the amount of plant dry matter in the fruit and in the pseudostem - the higher the ratio the more in fruit. Williams has almost

TABLE 1 - Plant characteristics of six height classes derived from Grand Nain as a result of somaclonal variation *in vitro*.

	«Extra Dwarf Cavendish»	«Dwarf Cavendish»	«Dwarf Grand Nain»	«Grand Nain»	«Giant Cavendish-Robusta»	«Lacatan»
Height cm	152	208.0 ± 4.76	253.7 ± 4.54	295.7 ± 3.27	373.1 ± 2.92	477
Range cm	132-168	184 - 229	236 - 274	279 - 315	359 - 384	-
Leaf length cm	-	182.0	206.4	241.3	272.6	335
Leaf width cm	-	87.1	88.4	98.6	98.6	77
Leaf area m ²	-	1.27	1.46	1.90	2.15	2.06
Leaf index	-	2.09 ± 0.02	2.34 ± 0.03	2.44 ± 0.03	2.76 ± 0.03	4.35
Range	-	2.02 - 2.26	2.15 - 2.46	2.30 - 2.55	2.65 - 2.86	-

Notes :

- Plant characteristics have been observed on 10 plants per class except for Lacatan
- Height was measured on plants with second or third ratoon fruit from ground to top of peduncle emerging from pseudostem.
- Only one Lacatan plant was observed and no leaf measurements were taken on the «Extra Dwarf Cavendish» plants.

TABLE 2 - Some plant characteristics of Cavendish cultivars in Honduras.

Cultivar and origin	Ratoon crops harvested per year	Height area 1 (cm) (2nd ratoon)	Height area 2 (cm) (5th ratoon)	Plant radius area 2 (cm) (946 plants/ha)
Lacatan (Jamaica)	1.29	486	-	-
Robusta (Jamaica)	1.34	384	-	-
Valery (Indo China)	1.54	382	393	328
Congo (Surinam)	1.36	371	-	-
Giant Cavendish (Aguan Valley, Honduras)	1.37	347	376	320
Grand Nain (Caribbean ?)	1.69	287	312	277

Notes : Plant radius is distance along ground from base of pseudostem to tip of longest leaf. Height is taken after shooting.

TABLE 3 - Plant and fruit characteristics of Cavendish subgroup cultivars in Australia (after Turner and Hunt, 1984).

	Characteristics second ratoon				
	Bunch weight height ratio (kg/m)	Plant height (cm)	Plant to harvest (months)	Bunch weight (kg)	Finger weight (g)
Pisang Masak Hijau	6.1	371	45.7	22.6	118.0
Robusta	6.8	333	39.7	22.6	130.2
Veimama	10.0	295	40.3	29.6	147.4
Mons Mari	9.2	289	45.1	26.7	122.2
Hochuchu	9.7	282	37.4	27.4	132.1
Williams	12.1	276	42.5	33.5	142.8
Williams (pubescent)	11.0	267	40.9	29.5	135.4
Cavendish C	11.8	267	38.8	31.7	147.1
New Guinea Cavendish	11.5	263	36.1	30.3	134.4
Cavendish N	9.7	255	44.0	24.8	130.5
Chinese Cavendish	10.9	245	37.9	27.3	129.9
Cavendish S	9.6	202	39.3	19.5	113.3
Dwarf Cavendish	10.5	190	37.3	24.5	118.5
Dwarf Parfitt	7.2	98	42.2	7.1	41.9

double the amount in fruit compared with Robusta. Time to the second ratoon from planting varied from 36 months with New Guinea Cavendish to 45 months with Mons Mari and Pisang Masak Hijau (Lacatan).

Rodriguez *et al* (1984) studied twelve Cavendish cultivars in Cuba. Height varied from 121 cm for Enano de Puerto Rico to 236 cm for Robusta 1697. Among the twelve cultivars there were five selections of Robusta. Within the Robusta selections height varied from 155 to 236 cm, bunch weight from 10.3 to 20.9 kg (3 harvests) and time from planting to the first harvest 339 to 557 days.

Holder and Gumbs (1983) and Holder and Taylor (1986) studied Robusta and Giant Cavendish in St Lucia. These varieties differed in height, leaf index, leaf area and yield. Giant Cavendish outyielded Robusta because of fewer losses from toppling, as a result of its lower stature.

However, Giant Cavendish was more sensitive to drought stress. Experiments in Jamaica (Walker, 1970) showed significant differences in ratooning speed and yield among Valery, Robusta and Lacatan with Valery being superior.

DISCUSSION

A study of somaclonal variation in Grand Nain produced *in vitro* has detected all height classes described by Simmonds (1954 a, b) as derived from natural mutation in the field. Because of the increasing importance in international trade of Grand Nain and varieties lower in stature than the Giant Cavendish-Robusta group, the Grand Nain and Dwarf Grand Nain height classes have been separated from the Dwarf Cavendish and Giant Cavendish-Robusta height classes (Table 4). Undoubtedly a detailed study of somaclonal variation would show a continuum in height gradations between the shortest and tallest classes in Table

TABLE 4 - Comparison of different height classes in the Cavendish Subgroup.

Source	Class					
	1	2	3	4	5	6
This paper	Extra Dwarf Cavendish	Dwarf Cavendish	Dwarf Grand Nain	Grand Nain	Giant Cavendish Robusta	Lacatan
Stover and Simmonds 1987	Extra Dwarf Cavendish	Dwarf Cavendish	-	Grand Nain	Giant Cavendish	Pisang Masak Hijau
Simmonds, 1954 a	Extra Dwarf Cavendish	Dwarf Cavendish	-	Giant	Robusta	Lacatan
Simmonds, 1954 b	Extra Dwarf Cavendish	Dwarf Cavendish	-	Giant Cavendish	Robusta	Lacatan
Approximate height, second ratoon (cm)	132-168	184-229	236-274	287-320	359-384	400 up
Major commercial varieties	None	Dwarf Cavendish	None	Grand Nain Umalog	Giant Cavendish Robusta, Valery, Poyo, Williams, Mons Mari	Lacatan Bout Round

Notes : Heights are comparable only when cultivars are grown in adjacent areas in the same soil. All six height classes were derived from Grand Nain multiplied *in vitro*.

1 and 4. However, for purposes of nomenclature of the important commercial varieties it is useful to have height classes.

It is unlikely that any new commercial variety will be planted on a large scale in the tropics that is taller than Williams which in Honduras is about 40 cm taller than Grand Nain. Grand Nain has replaced Valery in most of Central America plantations because of low losses from wind, compact foliage permitting higher populations and fast ratooning.

Within the Grand Nain and Giant Cavendish-Robusta classes it appears that there is a wide variation in ratooning speed and that selection for faster ratooning clones will result in higher yields. A Grand Nain-like selection in Tabasco, Mexico is reported to be 30 percent faster ratooning than Grand Nain (personal observation).

As height declines in cultivars more dwarf than Grand Nain finger length tends to become shorter. Little is known about fruit quality in the new Dwarf Grand Nain height class but field observations indicate most selections will have a smaller bunch and shorter fingers than Grand Nain.

In the international trades fingers shorter than 15 cm are usually not accepted and first class packs have a minimum finger length of 17-20 cm (measured along the curve from the pedicel to the flower scar).

In the nomenclature of the Cavendish cultivars there has been some confusion caused by lumping certain cultivars together as synonyme (e.g. Grand Nain, Williams, Giant Cavendish). When these varieties are grown side-by-side they have distinct differences in height and other characteristics. Many of the Cavendish cultivars in the different height categories can only be distinguished when grown side-by-side. Height and fruit and leaf size varies with location and growing conditions, especially soil texture and fertility. Leaf index varies less but by itself is not sufficient to identify a variety. Therefore, side-by-side comparisons are needed of plant height, ratooning time, bunch and finger size, foliage characteristics (area, leaf index, radius covered) and bunch-height ratio before combining or separating cultivars. For comparative purposes one or more of the widely grown and studied cultivars should be included. These reference cultivars are : Grand Nain, Robusta (Poyo), Giant Cavendish, Williams and Dwarf Cavendish.

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VARIATION UND NOMENKLATUR DER ZUCHTSORTEN DER SPEZIES MUSA GRUPPE AAA UND UNTERGRUPPE CAVENDISH.

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KURZFASSUNG - Aufgrund somaklonaler Variationen ist es gelungen, anhand eines *in vitro* vermehrten 'Grande Naine' - Klons Cavendish - Bananenpflanzen jeder Höhe zu züchten. Unter den Varianten wurden sechs Höhenklassen definiert: 'Cavendish Extra Nain', 'Petite Naine', 'Dwarf Grand Nain', 'Giant Cavendish', 'Robusta' und 'Lacatan' (Pisang Masak Hijau). Innerhalb der Cavendish-Untergruppe wird eine Variationsübersicht gebracht als Empfehlungsgrundlage, damit es in der Nomenklatur nicht zu Verwechslungen kommt. Zahlreiche Zuchtsorten, die eng beieinander liegen, sich jedoch nach Höhe, Blattwerk und Frucht unterscheiden, lassen sich nur in körperlichen Nebeneinander oder unter denselben Umweltbedingungen differenzieren. Höhe der Jungpflanze, Triebe (Oberfläche, Blattverhältnis, abgedeckter Radius), Größe des Bananenbüschels und Bananenfingers, Kenndaten des Blattwerks, sowie das Verhältnis zwischen Höhe und Gewicht des Büschels, sind die wichtigsten Kriterien und sollten in alle Beschreibungen Eingang finden. Die weit verbreiteten Varianten Grande Naine, Poyo, Giant Cavendish, Williams und Petite Naine können als Bezugspunkt für neue bzw. unbekannte Zuchtsorten und deren Klassifikation dienen.

VARIACION Y NOMENCLATURA DE LOS CULTIVARES DEL GENERO MUSA, GRUPO AAA y SUBGRUPO CAVENDISH.

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RESUMEN - Debido a la variación somaclonal se han obtenido clases de bananos de todas las alturas del subgrupo Cavendish a partir de un clono de Grande Naine multiplicado *in vitro*. Se han definido seis clases entre los variantes: «Cavendish Extra Nain», «Petite Naine», «Dwarf Grand Nain», «Giant Cavendish», Robusta y Lacatan (Pisang Masak Hijau). Un paso en revista de la variación en el seno del subgrupo Cavendish se presenta para servir como base de recomendación con el fin de evitar confusiones en la nomenclatura. Muchos cultivares muy próximos pero distintos por la altura, el follaje y el fruto pueden diferenciarse sólo si se comparan el uno junto al otro o en las mismas condiciones ecológicas. Altura de la planta vástago (superficie, relación foliar radio cubierto), tamaño del racimo y del dedo, características del follaje así como relación altura/peso del racimo son los criterios más importantes y deberían encontrar su sitio en todas las descripciones. Grande Naine, Poyo, Giant Cavendish, Williams y Petite Naine, ampliamente extendidos, pueden servir de referencia para clasificar cultivares nuevos o desconocidos.

