Collecting banana germplasm from the AAA genomic group / Cavendish subgroup

Francisco Ricardo Ferreira*[1] and Sebastião de Oliveira e Silva[2]
[1]Embrapa Recursos Genéticos e Biotecnologia, Caixa Postal 02372, Brasilia, DF, Brazil; [2]Embrapa Mandioca e Fruticultura, Caixa Postal 007, Cruz das Almas, BA, Brazil. (* Corresponding Author. E-mail: fricardo@cenargen.embrapa.br)

ABSTRACT

Bananas for export are supported by only one clone of the Cavendish subgroup, the 'Grande Naine'. The vulnerability of a monoclonal crop is obvious. The objective of this paper was to report on collection of banana germplasm from the AAA genomic group/ subgroup Cavendish, in large and small plantations, for conservation, evaluation and selection studies. Two collection expeditions were carried out in the States of São Paulo and Minas Gerais. Fifty-six samples were collected that showed several variations among the clones, ranging from plant height to fruit size and shape. The material was registered in the Brazilian System of Genetic Resources Information (SIBRARGEN). The suckers were submitted to phytosanitary treatment, and then sent to Embrapa Cassava and Fruit Crops Center, in Cruz das Almas, Bahia State. The banana germplasm accessions were added to the banana active gene bank (BAG), where they will be evaluated for superior genotype selection.

KEY WORDS: *Musa acuminata*, genetic resources, varieties, clonal selection.

INTRODUCTION

The acquisition of promising germplasm introduced from other regions may accomplish the same purpose as a breeding program designed to obtain superior varieties. Thus introduction is considered a breeding method as it supplies the genetic variability necessary to obtain cultivars and/or clone selection (Elliot, 1958; Allard, 1971).

Low genetic variability in an agricultural crop is an imminent risk either because of lack of new cultivars or because of its vulnerability to biotic and abiotic factors. This is what happened in the past to the Latin American export banana cultivation based only on the Gros Michel cultivar, which was susceptible to the Panamá disease. Presently the same banana culture, used for export, runs a similar risk because it is based on practically one clone from the banana subgroup Cavendish, the 'Grande Naine' (Janick, 1998).

Somaclonal variation occurs in the banana at a much superior level to that observed in most other crops, probably due to mitotic instability which is not exclusive to tissue culture and has also been observed in the field, though less frequently (Shepherd, 1991; Withers, 1992). Thus the appearance of tens of cultivars of the (AAA) genomic group / Cavendish subgroup, and of AAB cultivars such as 'Pacovan', a mutant of 'Prata', can be explained. In addition, the practice of selecting superior clones may contribute to significant increases in the yield and quality of the fruits on the banana tree.

Natural mutants on banana trees have been selected in Israel, South Africa, Australia and Spain (Canary Islands). In South Africa, producers collaborate with this study by pre-selecting the clones in their plantations, which were then studied by public research institutions. In Israel, private companies have breeding programs and use clone selection as the most promising technique (Khayat et al., 1998).

The materials from Israel were assessed in the Philippines to verify the validity of the selection made in tropical regions. They presented greater yield (18%) and better quality than the local selections (Khayat et al., 1998). Today Israel exports these clones throughout the world, including Central and South America, and has more recently exported to the Brazilian Northeast. Clones selected in Israel, Taiwan, South Africa, Canary Islands and Australia are being assessed under the local conditions on the island of Madeira and in South Africa (Ribeiro and Silva, 1998; Eckstein et al., 1998).

Although more difficult than obtaining superior materials for quality, yield, architecture and plants, mutants more resistant to pests and diseases can be obtained using clone selection methods. In Taiwan, Hwang and Ko (1986) assessed the field behavior of several mutant clones from banana trees of the subgroup Cavendish derived from meristem culture,

and selected genotypes resistant to race 4 of *Fusarium oxysporum* f.sp. *cubense*, that causes Panamá disease.

The objective of this study was to collect banana germplasm, specifically from the AAA genomic group/ subgroup Cavendish, in producing areas, for later assessment and selection.

MATERIAL AND METHODS

The collection expedition routes were established based on the main cultivation areas of the banana tree AAA genomic group/subgroup Cavendish. The Vale do Ribeira and Planalto Paulista regions in São Paulo State were visited from 6 to 10 November 1999. The Northern and Northwestern regions of Minas Gerais were visited from 2 to 11 May 2000.

The following tools and materials, considered essential, were used in the banana germplasm collection expeditions: shovel, simple digger, knife, machete, bucket, leather and rubber gloves, fungicides/insecticides, pocket magnifying glass, measuring tape, color table, plastic bags, labels, permanent ink brush, pencil, pen, cardboard boxes (for packing), field book (collection records), altimeter and maps.

As banana trees multiply preferentially vegetatively, through suckers, about 10 to 15 shoots were collected per sample which became the accession representing that population. Shoots of the little horn, horn, big horn or rhizome type were collected from healthy vigorous plants with a good vegetative appearance. For prophylaxis purposes, the plants were cleaned by removing the leaves and roots from the rhizome base using a sharp knife or machete, to reduce the volume of the suckers and prevent the accumulation of adhered earth. The prepared suckers were placed in a fine mesh and previously identified plastic bags. Every two or three days, the expeditions stopped in a locality with the infrastructure of a shed, running water etc. The material was cleaned again , and the suckers were then submerged for 5 minutes in a Benomyl at 40g i.a./20L water and Carbofuran at 80ml i.a./20L water solution, removed from this solution , allowed to dry in the shade, and later re-packed in plastic bags. The bag was identified with a plastic or cardboard label, written in thick black lead pencil and a felt pen.

During the expeditions, the passport data, some of the characteristics of the plant, the flower and fruit, especially those belonging to the development and plant habitat assessment were noted for each assessment. The material was identified based on the information given by the producer. The photograph of the plant, some details of its organs, especially the reproductive ones, and the environment as a whole, may help sample identification and the description of its natural habitat. Therefore, whenever possible, several photographs were taken of each sample.

RESULTS AND DISCUSSION

Table 1 shows the banana material collected in the expedition to São Paulo and Minas Gerais States. Fifty-six clones were collected from cultivars of the AAA genomic group, subgroup Cavendish, 36 in São Paulo State and 20 in Minas Gerais State. Most of the clones were of the Nanicão cultivar (28), 16 of the 'Grande Naine', and 12 of other cultivars. Part of the samples collected were the best plants selected by the producer but, in some cases, the team selected at collection, always seeking for low stand plants with large bunches and well shaped fruit.

The Cavendish-type clones collected presented significant variations, ranging from plant height to fruit size and quality. In São Paulo State, where the suckers were collected, the banana plantations are formed from conventional shoots. In Minas Gerais, propagation is by *in vitro* materials in some banana plantations, where an appreciable somaclonal variation was detected, mainly for plant height.

Micropropagated suckers were used only on some farms, that would justify the appearance of somaclonal variation in greater quantity. However, a great variety was observed, mainly for the characteristics sought. It is believed that some of these variations are the result of the environmental effect (cultivation locality). However, somaclonal variation occurs in the banana at a much superior level to that observed in most other crops, probably due to mitotic instability, which is not exclusive to tissue culture, and is also observed in the field, though at lower frequencies (Shepherd 1991; Withers, 1992).

Considering that the tens of producers visited used suckers of different origins, and that the most vigorous, healthy and productive plants were collected, it is expected that some clones would be superior for fruit yield and quality as those obtained by Khayat et al. (1998) in Israel, and with greater tolerance to some pest or disease, as the Cavendish clones resistant to the race 4 *Fusarium oxysporum* f. sp. *cubense* that causes Panamá disease obtained by Hwang and Ko (1986) in Taiwan.

The information obtained from the producers was very important, as they live with the plant and

Table 1. Accessions of banana germplasm, collected in the São Paulo and Minas Gerais States, in the collecting expeditions, carried out in November 1999 and May 2000.

Accessions			Genomic/ Group	Local			
Collector Number	Name	BRA		City	Lat.	Long.	Alt.
FRF 1251	Naniquinha Batico	006556	AAA/Cavendish	Registro	24º34'S	47º52'W	20
FRF 1252	Nanicão Bático	006564	AAA/Cavendish	Registro	24º34'S	47º52'W	20
FRF 1254	Nanicão Franco	006581	AAA/Cavendish	Registro	24º38'S	47º54'W	20
FRF 1255	Grande Naine Franco	006599	AAA/Cavendish	Registro	24º38'S	47º54'W	20
FRF 1256	Nanicão/Grande Naine	006602	AAA/Cavendish	Registro	24º38'S	47º54'W	20
FRF 1257	Grande Naine Franco Israel	006611	AAA/Cavendish	Registro	24º38'S	47º54'W	20
FRF 1258	Grande Naine Franco Rio Claro	006629	AAA/Cavendish	Registro	24º38'S	47º54'W	20
FRF 1262	Grande Naine IAC	006653	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1263	Nanicão IAC	006661	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1264	Nanicão IAC Abóbora Verde	006670	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1265	Nanica IAC Salta do Cacho	006688	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1266	Imperial IAC	006696	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1267	Robusta IAC	006700	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1268	Burron IAC	006718	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1269	Canela IAC	006726	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1270	Poyô IAC	006734	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1271	Cavendish s/n IAC (111)	006742	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1272	Cuba IAC	006751	AAA/Cavendish	Pariquera-Açu	24º44'S	47º56'W	20
FRF 1280	Nanicão Rossete	006777	AAA/Cavendish	Jacupiranga	24º45'S	48º00'W	25
FRF 1281	Grande Naine Rossete	006785	AAA/Cavendish	Jacupiranga	24º45'S	48º00'W	25
FRF 1284	Nanicão Bentinho	006815	AAA/Cavendish	Cajati	24º47'S	48º08'W	30
FRF 1286	Kongo	006831	AAA/Cavendish	Sete Barras	24º21'S	47º56'W	25
FRF 1287	Grande Naine Magário	006840	AAA/Cavendish	Sete Barras	24º21'S	47º56'W	25
FRF 1288	Nanicão Magário	006858	AAA/Cavendish	Sete Barras	24º21'S	47º56'W	25
FRF 1289	Nanicão Jangada Leme	006866	AAA/Cavendish	Paranapanema	23º28'S	48º42'W	620
FRF 1290	Nanicão Jangada	006874	AAA/Cavendish	Paranapanema	23º28'S	48º41'W	635
FRF 1291	Nanicão Huber	006882	AAA/Cavendish	Paranapa-nema	23º23'S	48º49'W	650
FRF 1292	Nanicão Mario	006891	AAA/Cavendish	Avaré	23º06'S	48º54'W	750
FRF 1293	Nanicão Fernandes	006904	AAA/Cavendish	Avaré	23º06'S	48º57'W	670
FRF 1294	Grande Naine Fernandes	006912	AAA/Cavendish	Avaré	23º06'S	48º57'W	670
FRF 1297	Nanicão Olin	006921	AAA/Cavendish	Avandu	23º08'S	49º02'W	660
FRF 1300	Grande Naine Taperão	006947	AAA/Cavendish	Brotas	22º14'S	48º13'W	520
FRF 1301	Nanicão Taperão	006955	AAA/Cavendish	Brotas	22º14'S	48º13'W	520
FRF 1308	Grande Naine Ribeiro	007030	AAA/Cavendish	Nova Porteirinha	15º46'S	43° 18' W	505
FRF 1309	Nanicão Ribeiro	007048	AAA/Cavendish	Nova Porteirinha	15º46'S	43° 18' W	505
FRF 1310	Nanicão Damásio	007056	AAA/Cavendish	Janauba	15° 39'S	43° 33' W	520
FRF 1311	Nanicão Magário Verde	007064	AAA/Cavendish	Verdelândia	15° 35' S	43° 30' W	520
FRF 1312	Nanica Magário Verde	007072	AAA/Cavendish	Verdelândia	15° 35' S	43° 30' W	520
FRF 1313	Grande Naine Cobalchini	007081	AAA/Cavendish	Nova Porteirinha	15° 47' S	43° 20' W	516
FRF 1314	Grande Naine Cobalchini Baixa	007099	AAA/Cavendish	Nova Porteirinha	15° 47' S	43° 20' W	516
FRF 1315	Nanicão Oiola	007102	AAA/Cavendish	Nova Porteirinha	15° 48' S	43° 21' W	515
FRF 1316	Nanicão Souza	007111	AAA/Cavendish	Nova Porteirinha	15° 45' S	43° 19' W	505
FRF 1318	Nanicão Yamada	007137	AAA/Cavendish	Janauba	15° 47' S	43° 23' W	515
FRF 1319	Nanicão Yamada Baixa	007145	AAA/Cavendish	Janauba	15° 47' S	43° 23' W	515
FRF 1320	Nanica Magário Jana	007153	AAA/Cavendish	Janauba	15° 46' S	43° 24' W	510
FRF 1321	Grande Naine Magário Jana	007161	AAA/Cavendish	Janauba	15° 16' S	43° 24' W	510
FRF 1322	Nanicão Lima	007170	AAA/Cavendish	Capitão Enéas	16° 12' S	43° 51' W	530
FRF 1323	Grande Naine Colares	007188	AAA/Cavendish	Montes Claros	16° 13' S	43° 58' W	535
FRF 1324	Nanicão Colares	007196	AAA/Cavendish	Montes Claros	16° 13' S	43° 58' W	535
FRF 1334	Grande Naine Kinochita	007200	AAA/Cavendish	Pirapora	17° 22' S	44° 51' W	495
FRF 1335	Nanicão Iida	007218	AAA/Cavendish	Pirapora	17° 28' S	44° 50' W	490
FRF 1337	Grande Naine Graneira	007226	AAA/Cavendish	Pirapora	17° 26' S	44° 42' W	500
FRF 1338	Grande Naine Leão	007234	AAA/Cavendish	João Pinheiro	17° 25' S	46° 08' W	775
FRF 1341	Nanicão Veloso	007242	AAA/Cavendish	Paracatu	17° 12' S	46° 34' W	600
FRF 1344	Nanicão Cruvinel	007251	AAA/Cavendish	Paracatu	17° 15' S	46° 40' W	600
FRF 1345	Nanica Cruvinel	007269	AAA/Cavendish	Paracatu	17° 15' S	46° 40' W	600

certainly have relevant information on its correct identification and productive potential. Furthermore, they can collaborate decisively in the search for a superior mutant genotype.

During the collection expeditions, the collected samples were monitored and the suckers that were in an advanced state of putrefaction were eliminated and the others were cleaned regularly by washing in running water and phytosanitary treatment with recommended fungicide, insecticide/nematicide. At the end of the collection expeditions, the germplasm was processed by the phytosantitary inspection laboratory, and no disease or pest was detected.

Field books (collection registers) were completely filled out and entered in the computer. Data from each accession were registered in the data bank and the materials and the information sent to the banana Germplasm Active Bank, at Embrapa Mandioca and Fruticultura, where they were planted in the field for conservation, assessment and later selection.

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RESUMO

Coleta de germoplasma de banana do grupo genômico AAA subgrupo Cavendish

A bananicultura para exportação está baseada praticamente num único clone do subgrupo Cavendish, a `Grande Naine´. A vulnerabilidade do cultivo monoclonal é evidente. O objetivo deste trabalho foi coletar germoplasma de banana do Grupo AAA, subgrupo Cavendish, em bananais comerciais e/ou de pequenos agricultores, para posterior conservação, avaliação e seleção. Foram realizadas duas expedições de coleta, uma no Estado de São Paulo, abrangendo as regiões do Vale do Ribeirão e do Planalto Paulista; e outro em Minas Gerais nas regiões Norte e Noroeste do Estado. Foram coletadas 56 amostras de germoplasma de banana do grupo AAA, subgrupo Cavendish, apresentando variações significativas, desde porte de planta até tamanho e forma do fruto. Os clones coletados foram registrados no Sistema Brasileiro de Informações de Recursos Genéticos - SIBRARGEN e as mudas após passarem por processos de limpeza e tratamento fitossanitário, foram enviadas para a Embrapa Mandioca e Fruticultura, em Cruz das Almas-BA. Estes acessos foram incorporados ao Banco Ativo de Germoplasma (BAG) de Banana e serão avaliados, visando a seleção de genótipos superiores.

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