Varietal Resistance Evaluation of Cavendish Somaclones to Fusarium Wilt caused by *Fusarium oxysporum* f.sp. *cubense*, Tropical Race 4

AB Molina[1], EG Fabregar[2], EB Ramillete[2], VGO Sinohin[1]

[1]Bioversity International- Asia Pacific, Commodities for Livelihoods (CfL) – Musa Programme, Los Baños, Laguna, Philippines;
[2]Lapanday Foods Corporation, Davao City, Philippines

Introduction

Fusarium wilt disease, caused by *Fusarium oxysporum* f. sp. *cubense* (*Foc*), is a major concern of the global banana industry having wiped out the Gros michel plantations in Central America which consequently caused the costly shift to *Foc* resistant Cavendish varieties in the 1950s. A virulent strain that attacks Cavendish, the *Foc* Tropical race 4 (TR4), has been found causing epidemic on Cavendish in Asia. The recent epidemic of Fusarium wilt disease in Cavendish plantations in the Philippines (Figure 1) poses a serious threat to the sustainability of the multi-million dollar Cavendish-based export industry, to the country as top banana exporter in Asia (Figure 2), and to the local cultivars grown by small-scale farmers as well.

The use of resistant varieties for a long-term management strategy of *Foc* has long been sought for. But breeding programmes failed to produce varieties of equal or better productivity and quality and those which would satisfy the discriminating standards of the global market. The Taiwan Banana Research Institute (TBRI) has achieved some successes in the selection and use of disease resistant somaclonal variants of Cavendish as part of the integrated approach to sustain the banana export industry in that country. A number of these varieties were shared to Bioversity's International Transit Center (ITC) for inclusion in the International *Musa* Testing Program (IMTP). Subsequently, the ITC had distributed the varieties through Bioversity International's National Repository, Multiplication and Dissemination Center (NRMDC) programme in Asia for evaluation and adoption.

This paper reports the results of a field trial (under commercial plantation setting) of introduced somaclonal Cavendish selections from TBRI, comparing them with regular Cavendish varieties and some non-Cavendish local cultivars. Results of the study would of great value in the attempt to mitigate the threat of *Foc* epidemics in the country.

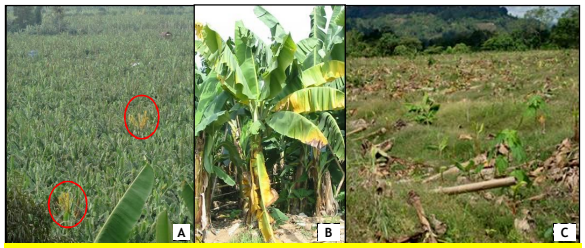

Figure 1. Farms affected by Fusarium wilt epidemic: (a) the sporadic appearances of Fusarium wilt disease during the early stage of the epidemic; (b) *Foc* TR4 infected Cavendish plant; and (c) abandoned area because of extensive disease incidence

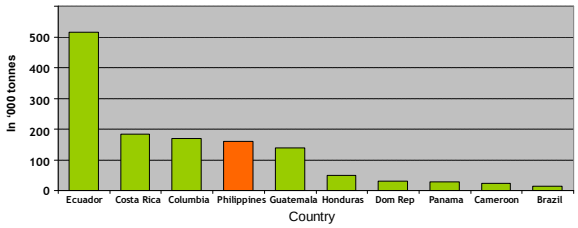

Figure 2. Top 10 banana exporting countries in 2010 (FAOSTAT, 2012)

Methodology

The trial was established in September 2009 with in the plantation of the Lapanday Foods Corporation, Lapuy and Callawa, Davao City, Philippines. The experimental field had previously a high level of incidence of Foc. Eight banana varieties (Table 1) were evaluated. Experimental units were planted with 10 tissue-culture derived plantlets, and were replicated 10 times, arranged in a completely randomized design. A total of 100 plants per cultivar were evaluated.

Disease incidence was assessed and recorded weekly by determining the number of infected plants, showing typical external symptoms of Fusarium wilt, like yellowing of older leaves and/or pseudostem splitting. To confirm infection, the pseudostem of suspected plants were cut cross sectionally to exame the confirmatory reddish to dark brown internal vascular tissue discoloration. To confirm the identity of the pathogen, stransa of infected pseudostem tissues were sent to Stellenbosh University for vegetative compatibility group analyses using the protocol described by Puhalla (1985)

Table 1. List of cultivars evaluated for resistance to *Foc* TR4

Cultivars	Genome	Sub-Group	Description
Grand Naine	AAA	Cavendish	Popular commercial export variety
GCTCV 105	AAA	Cavendish	Somaclonal selection from Taiwan
GCTCV 119	AAA	Cavendish	Somaclonal selection from Taiwan
GCTCV 218	AAA	Cavendish	Somaclonal selection from Taiwan
GCTCV 219	AAA	Cavendish	Somaclonal selection from Taiwan
Lakatan	AAA	Lakatan	Popular local dessert-type variety
Latundan	AAB	Silk	Popular local dessert-type variety
Cardava	ABB	Saba	Popular local cooking-type variety

Results & Discussions

Disease incidence: The reactions of the different cultivars to Fusarium wilt was assessed in terms of disease incidence as recorded at different weeks after planting. Results confirm the high susceptibility of commercial Cavendish varieties (Table 2 and Figures 3 and 4). Gran Naine succumbed to the disease with almost 100% incidence even before the flowering stage in the first crop which thwarted the development of a ratoon crop. On the other hand, the GCTCVs did not manifest disease symptoms in the first crops, although some infections were recorded in the ratoon crop (Table 2). Among the local cultivars, the popular cooking cultivar Cardava showed high resistance as it remained free from Fusarium wilt incidence even for the ratoon crop. Lakatan was most susceptible with 100% incidence in the primary crop. Latundan showed lower disease incidence compared with Lakatan and Gran Naine, but they eventually succumbed to the disease at a later stage of plant growth. Results from the VCG analyses of diseased samples down at Stellenbosch University confirmed that all infections were caused by the VCG 01213/16, the VCG for TR4.

Table 2. Fusarium incidence on selected banana cultivars in Lapuy and Callawa Davao City from 2009 to 2012

Cultivars	Fusarium wilt incidence (%) Lapuy	Fusarium wilt incidence (%) Callawa
Gran naine	97	17
GCTCV 105	-	0
GCTCV 119	1	0
GCTCV 218	-	6
GCTCV 219	1	1
Lakatan	100	42
Latundan	15	15
Cardava	0	0

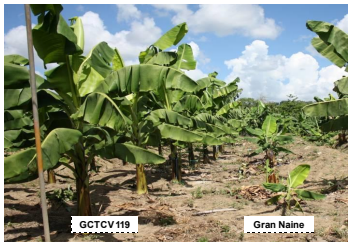

Figure 4. GCTCV 119 vs Grand Naine field trial in a heavily infested *Foc* TR4 farm, Philippines, March 2010

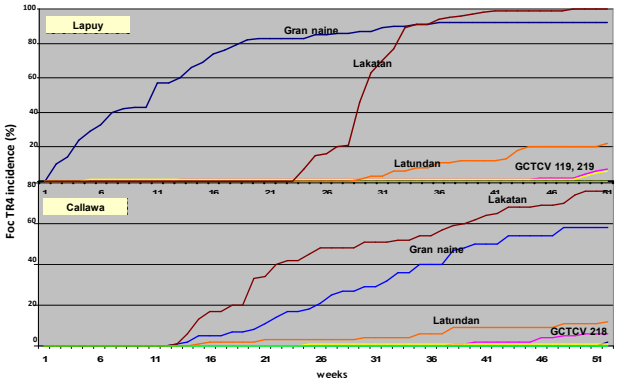

Figure 3. Fusarium incidence of different banana cultivars planted in Lapuy and Callawa, Davao City in 2009 - 2012)

All the GCTCVs were highly signififcant compared to Gran naine. Agronomic and yield data (Table 3) showed that GCTCV 119 and GCTCV 218 have comparable yield ang fruit quality as the existing commercial cultivar although their harvest maturity are a little bit longer. Chemical analyses showed that the GCTCVs were sweeter compared to Gran naine as shown by their higher total soluble solids (TSS) and lower titratable acidity (TA), indicating potential acceptance in the export market. These cultivars present great potential as components for an integrated management approach in managing TR4 for the export banana industry.

Table 3. Comparative agronomic and yield data (Primary Crop) and fruit characteristics of Gran Naine as against the *Foc* TR4 resistant GCTCV varieties

Cultivar	Agronomic and Yield Data				Fruit Characteristics					
					Hand Class		TSS		TTA	
	Plant height (inches)	Days to harvest	Days to Shooting	Bunch Weight (kg)	Primary Crop	Ratoon Crop	Unripe	Ripe	Unripe	Ripe
Grand Naine	223	337	262	16	9	9	3	17	0.16	0.26
GCTCV 119	261	355	274	17	7	9	4	21	0.14	0.24
GCTCV 218	270	357	274	15	7	10	4	21	0.14	0.24
GCTCV 219	287	367	289	23						

Poster paper presented during the International Banana Symposium, 19-22 November 2012, The Lees Hotel, Taiwan