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The History and Current Status of Banana Fusarium Wilt :

From bananarama to bananageddon?

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Bananarama

According to one legend the fruit that Eve found irresistible in the Garden of Eden was not the apple, but the banana. Whether true or not, for thousands of years since the banana has been the source of pleasure, and occasionally trouble

Fusarium Wilt (Panama disease) in Central America

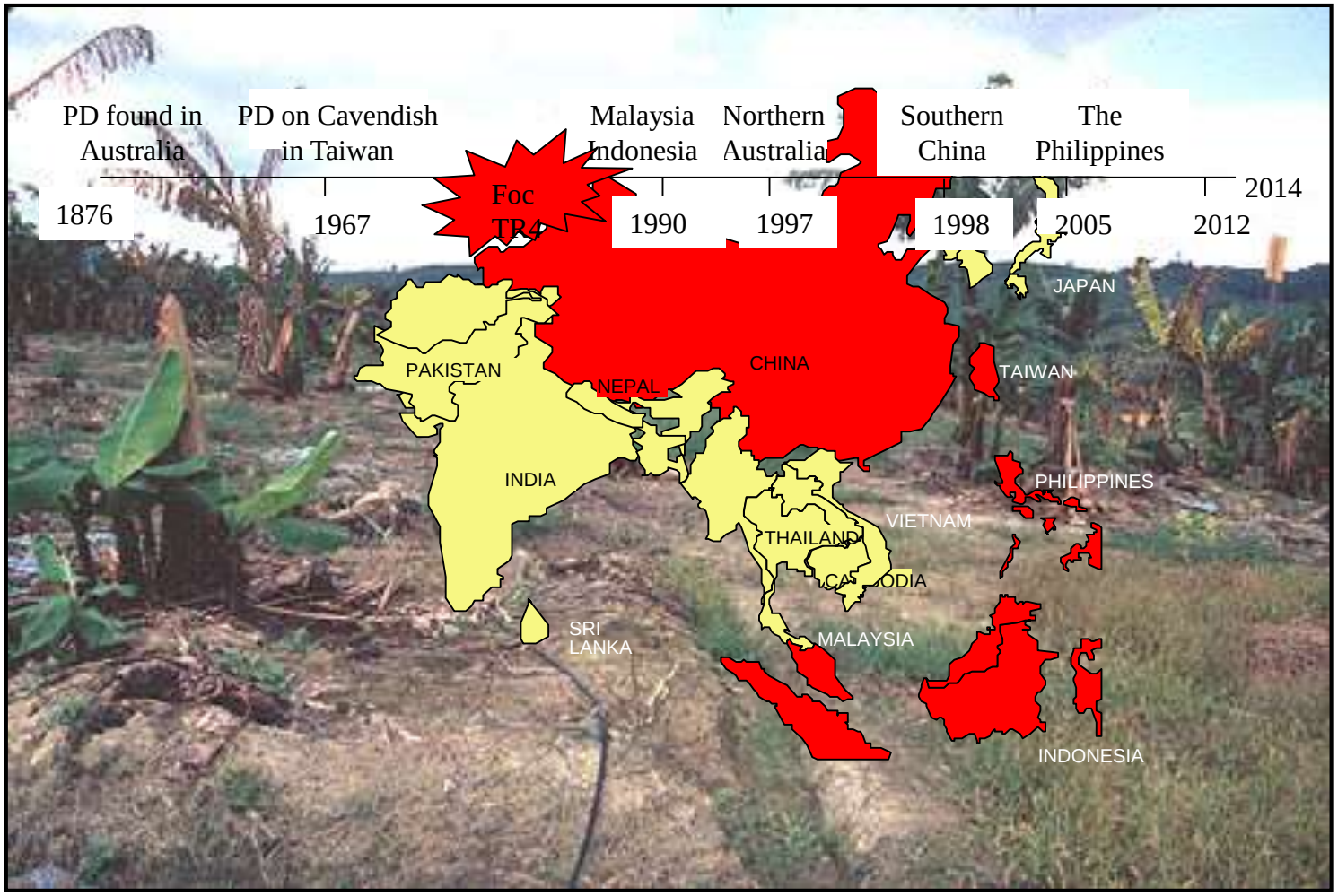
Spread of Fusarium wilt

Gros Michel converts to Cavendish

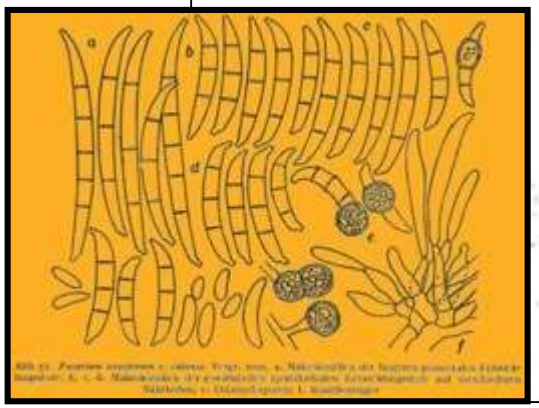
Gros Michel - 1919

Cavendish - 2014

Fusarium wilt on Cavendish bananas



Infection biology and symptomology



Fusarium wilt: Races in Foc

Race 1 ⇒ **‘Gros Michel’ (AAA), ‘Silk’ (AAB), ‘Pome’ (AAB), ‘Pisang Awak’ (ABB)**

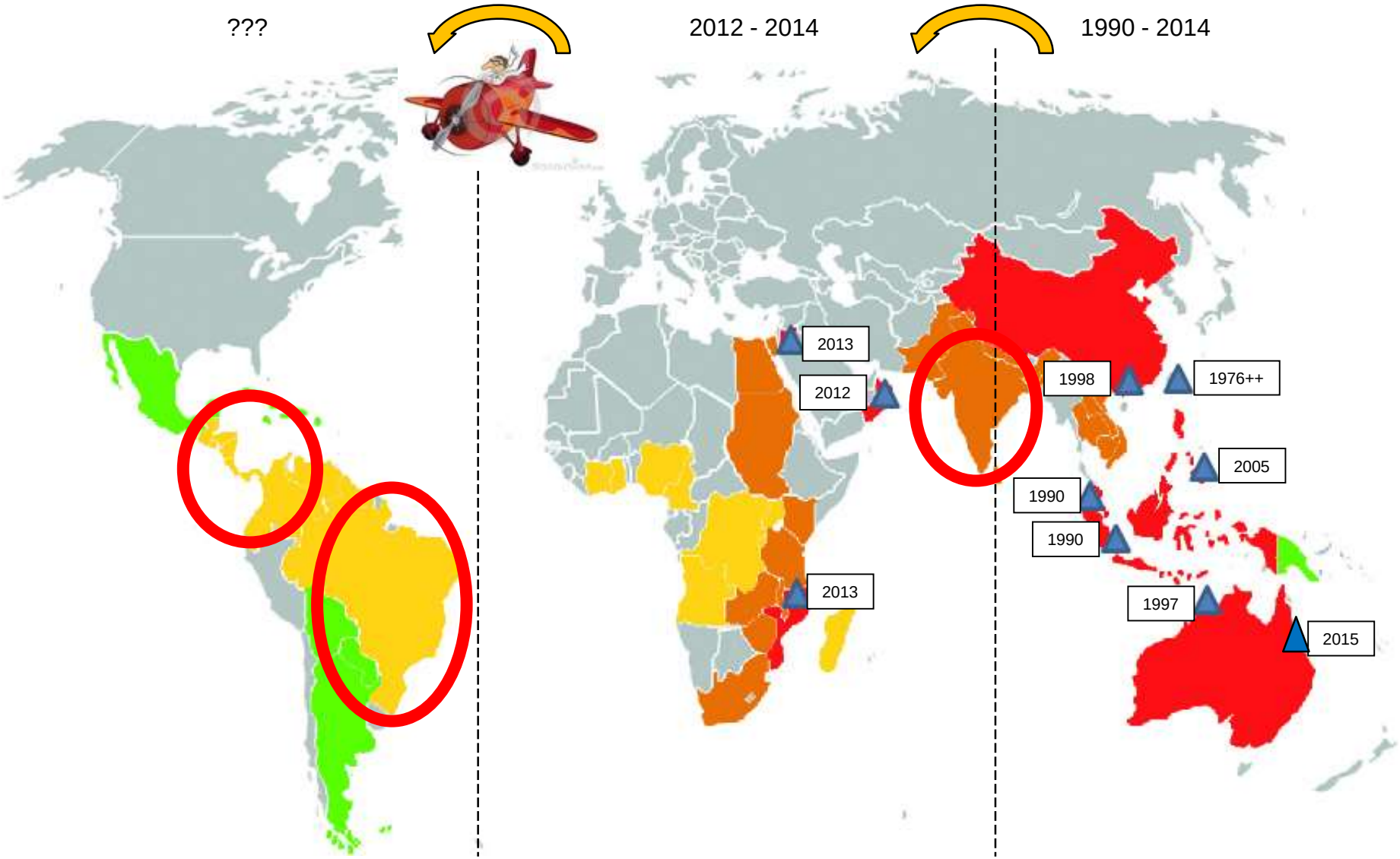
Race 2 ⇒ **‘Bluggoe’ (ABB)**

Race 3 ⇒ ***Heliconia* species**

Race 4 ⇒ **Cavendish (AAA), ‘Pisang Mas’ (AA), cvs susceptible to Foc races 1 and 2**

- **“tropical”**
- **“sub-tropical”**

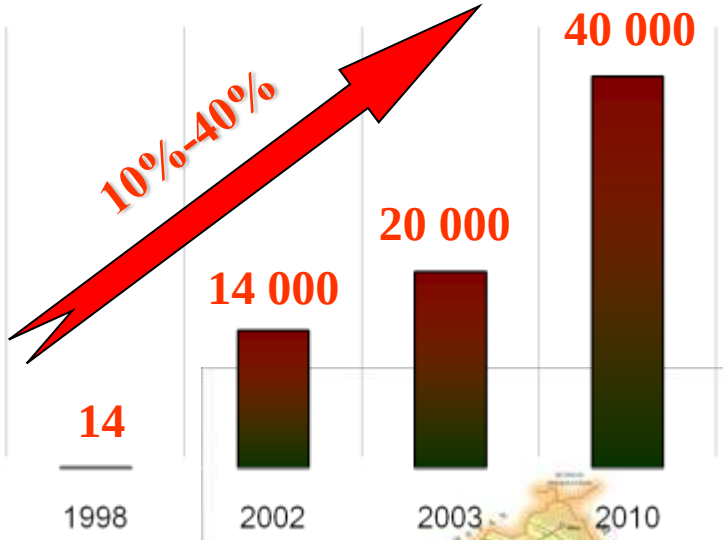
Global distribution of Foc TR4



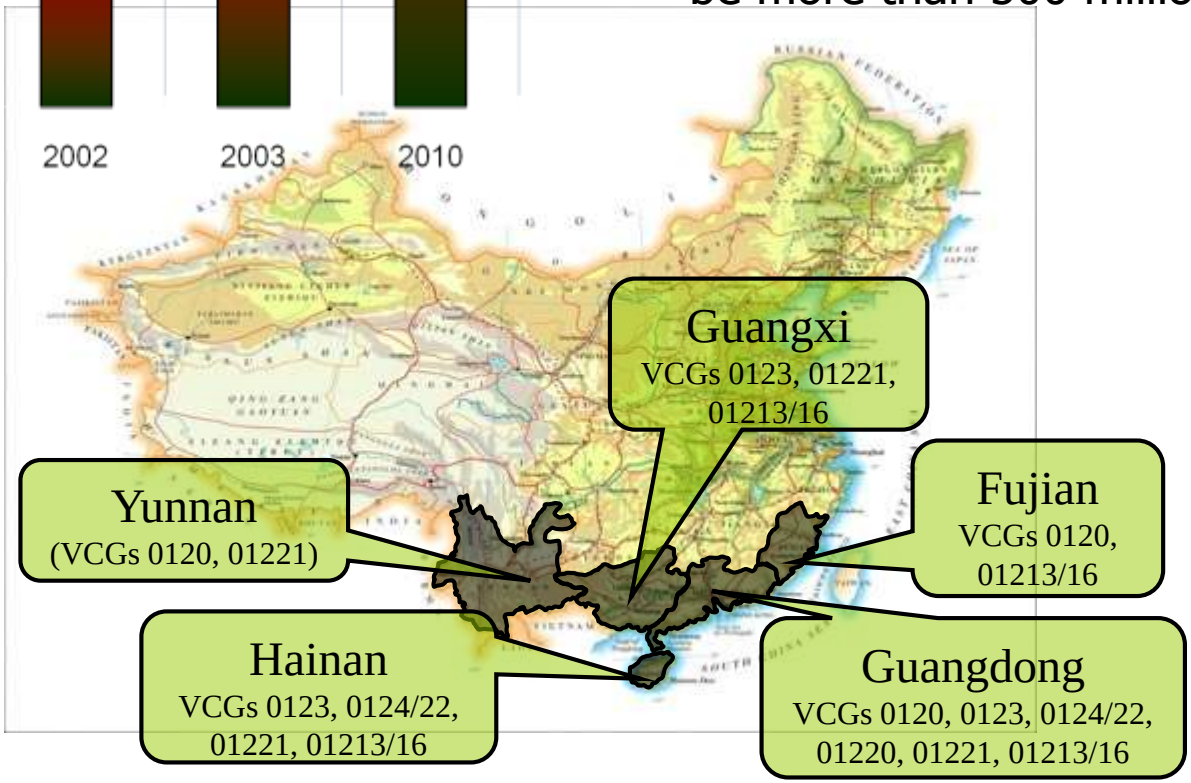
Banana Fusarium wilt in The Philippines

- The Philippines is the second largest exporter of bananas
- Cavendish cultivars accounting for about 51% of national banana production, Saba 29%, Lakatan 10% and Latundan about 11%.
- More than 80% of the bananas (and 99% of the Cavendish cultivars) are produced in Mindanao.
- 2001: Cavendish bananas in the highlands severely affected by Fusarium wilt
- 2003: Sporadic cases observed in lowlands
- 2005: Significant increase in lowlands
- 2013: Small-scale growers severely affected

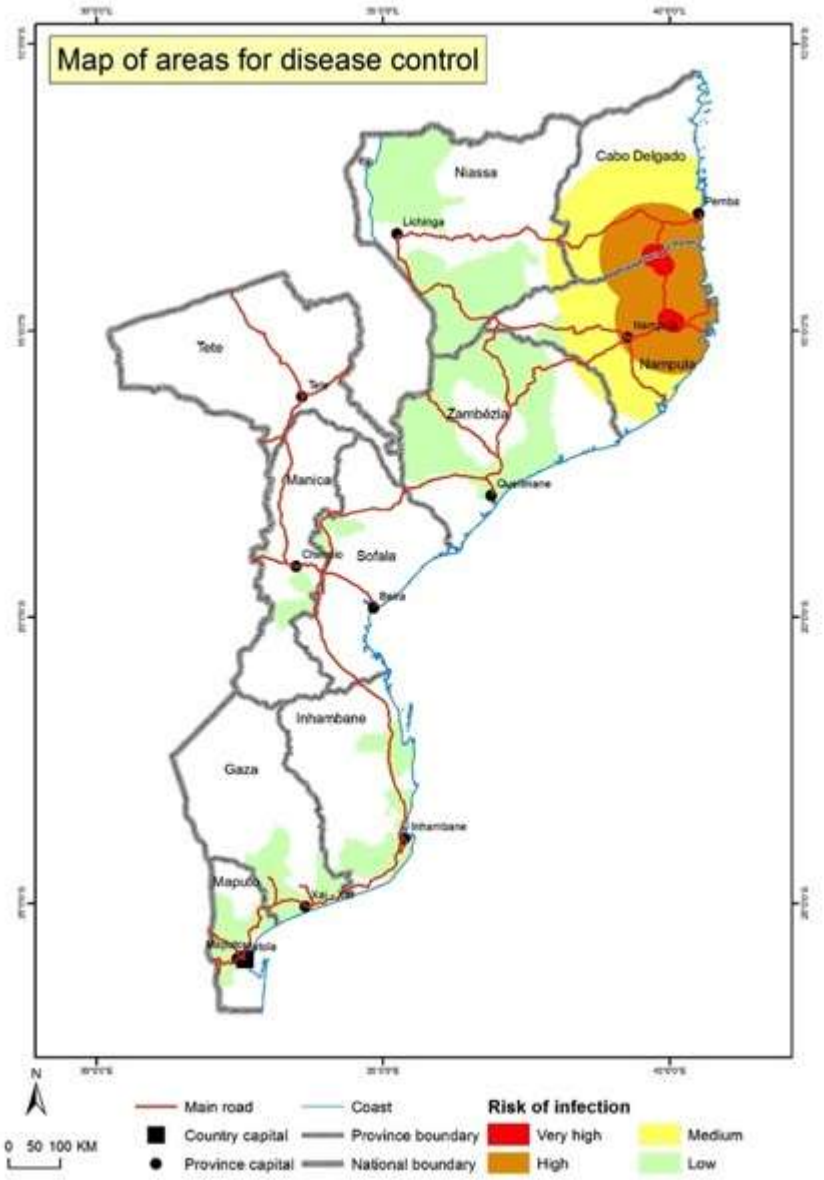
Occurrence of Fusarium wilt in China



- Fusarium wilt was first discovered in Fanyu of Guangzhou city in 2001
- The disease now occurs in all of the main production areas
- Cost of Fusarium wilt estimated to be more than 500 million Yuan/year



Foc TR4 in Mozambique



Efforts to contain Foc TR4 on-farm

Flooding and poor drainage

- Run-off water is a major source of Foc TR4 spread on and off farm
- Flooding and poor drainage all contribute to waterlogging
- No means to treat run-off water before flowing into Monapo river

Foc TR4 epidemic in Mozambique

Dealing with Foc TR4

Three common ways to deal with Foc TR4:

a. Exclusion (preventing it from entering countries/regions/farms): Latin America, India
b. Early detection and containment: Jacaranda in Mozambique; north Queensland
c. Management: Philippines, Taiwan, Indonesia

When disease cannot be prevented/controlled (stopped), and has to be managed:

a. Basis would be resistant plants
b. In the case of Cavendish bananas, only somaclones are available
c. Supported by an integrated disease management strategy
d. Replacement of bananas with other crops

Improved Foc TR4 management strategy

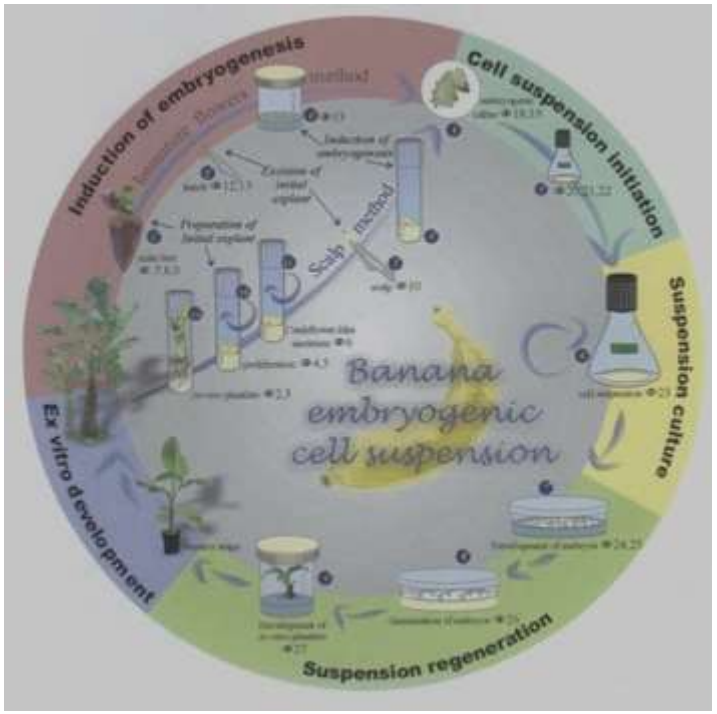
The new, improved strategy for Foc TR4 consists of two main components:

1. The management of Fusarium wilt on the farm where containment was no further possible
   - Proper destruction of infected plants
   - Water management
   - Soil management
   - Planting of resistant plants

2. The prevention of Foc TR4 to spread beyond farm borders
   - Movement of planting materials
   - Movement of soil (shoes, vehicles)
   - Movement of water

Resistance in banana to Foc

- Conventional improvement
  - Classical breeding
- Unconventional improvement
  - Somaclonal variation
  - Mutation breeding
  - Genetic engineering



Bananas resistant to Foc TR4

Cavendish somaclones

Somaclones in Philippines

Farm name	Planting date	Variety	# seedlings	FW incidence (%)	
				Aug 2013	Feb 2014
Phil Fresh Fruits	Oct 2012	GCTCV 219	3800	0.1	1.39
		G Naine	200	79.5	100
Bancud Farm	Oct 2012	GCTCV 219	500	0	2
		G Naine	100	46	97
Lapiz Farm	Oct 2012	GCTCV 219	1800	0	0
		G Naine	200	2.5	76

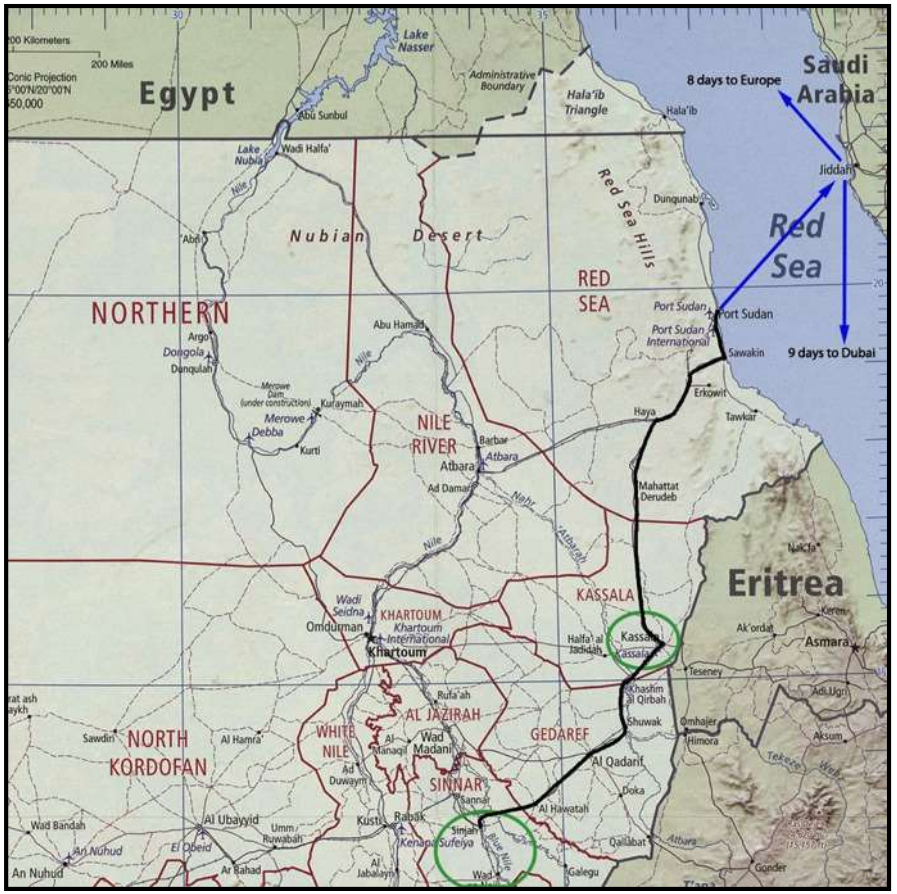
Somaclones in Mozambique

Banana production in Africa

- Approximately 30% of global bananas are produced in Africa
- Africans consume more bananas than any other continent
  (up to 250 kg/person/yr in Uganda)
- Most bananas are grown for local consumption, with limited exports
- Production systems include small and large commercial growers, subsistence farming and backyard plantings
- Production is affected by biotic and abiotic stresses, such as soil fertility decline and diseases
- Large monoculture Cavendish plantations are expanding in eastern Africa

Mixed cropping systems - Nampula

Cavendish production in east Africa



Source of map: [*Perry-Castañeda Library Map Collection*]

Photo by Gerardo Gutiérrez

Evaluation of African bananas in Asia

- Natural infection by *Fusarium oxysporum* f. sp. *cubense* TR4

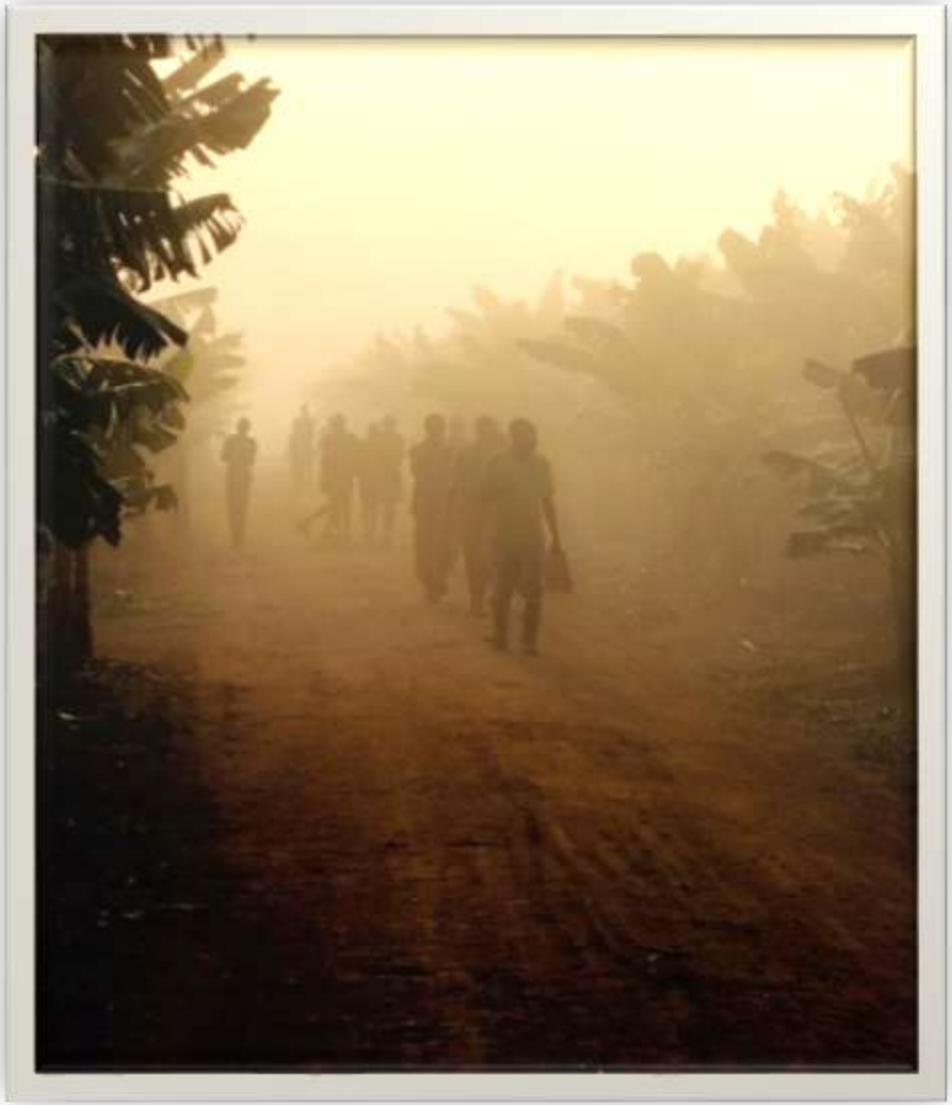
Results: Mindanao, Philippines

BANANA CULTIVARS	ITC CODE		NAME	VARIETY	# PLANTS	As of week 2, 2013			Mortality
						% PD	% Moko	% BBT	
African Varieties	1	ITC0081	Igitsiri (Intuntu)	EAHB - AAA	100	3			12
	2	ITC0084	Mbwazirumi	EAHB- AAA	100	3	2	7	18
	4	ITC0166	Ingagara	EAHB- AAA	100	5		2	11
	5	ITC0179	Inkira	EAHB- AAA	100	4			18
	8	ITC0217	Akpakpak	Plantain – AAB	100	1			4
	9	ITC0519	Obubit Ntanga	Plantain – AAB	100	0	2		13
	13	ITC1354	Enzirabahima	EAHB- AAA	100	3	1	1	12
	14	ITC1355	Kazirakwe	EAHB- AAA	100	1		6	7
	15	ITC1465	Ibwi	EAHB- AAA	100	32		11	3
	10	ITC0570	Williams	EAHB- AAA	100	46		3	1

Prospects and challenges

- Is Foc TR4 more damaging than Foc race 1
- How did Foc TR4 spread to the Middle East and Mozambique?
- Can banana production continue in the presence of Foc TR4?
- What are the differences in managing Foc TR4 by small subsistence growers and large commercial growers?
- Will Foc TR4 wipe out the world's bananas?

Acknowledgements



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