Bioversity International

CGIAR
Science for a food secure future

Update of occurrence, impact, and mitigation measures of Foc TR4: the need for collaboration in Asia Pacific

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The Banana Fusarium Wilt

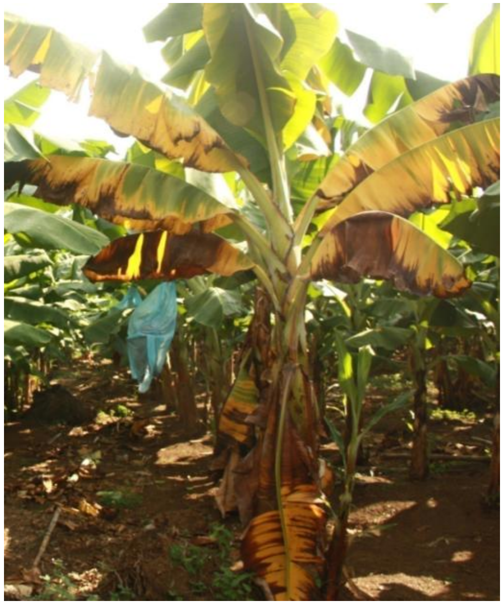
Fusarium wilt of banana caused by *Fusarium oxsyporum f. Sp. cubense* Tropical Race 4 (TR4) serious threat of the current and future of the Cavendish banana industry

Trade depends on one banana variety group, the Cavendish, grown in monoculture in a perennial cropping system, making it vulnerable to Foc TR4 epidemics

Remains in the soil and destructive for long time

Lack of economically effective chemical control

Resistant Cavendish extremely difficult to come by



Foc TR4 is primarily a Cavendish monoculture problem

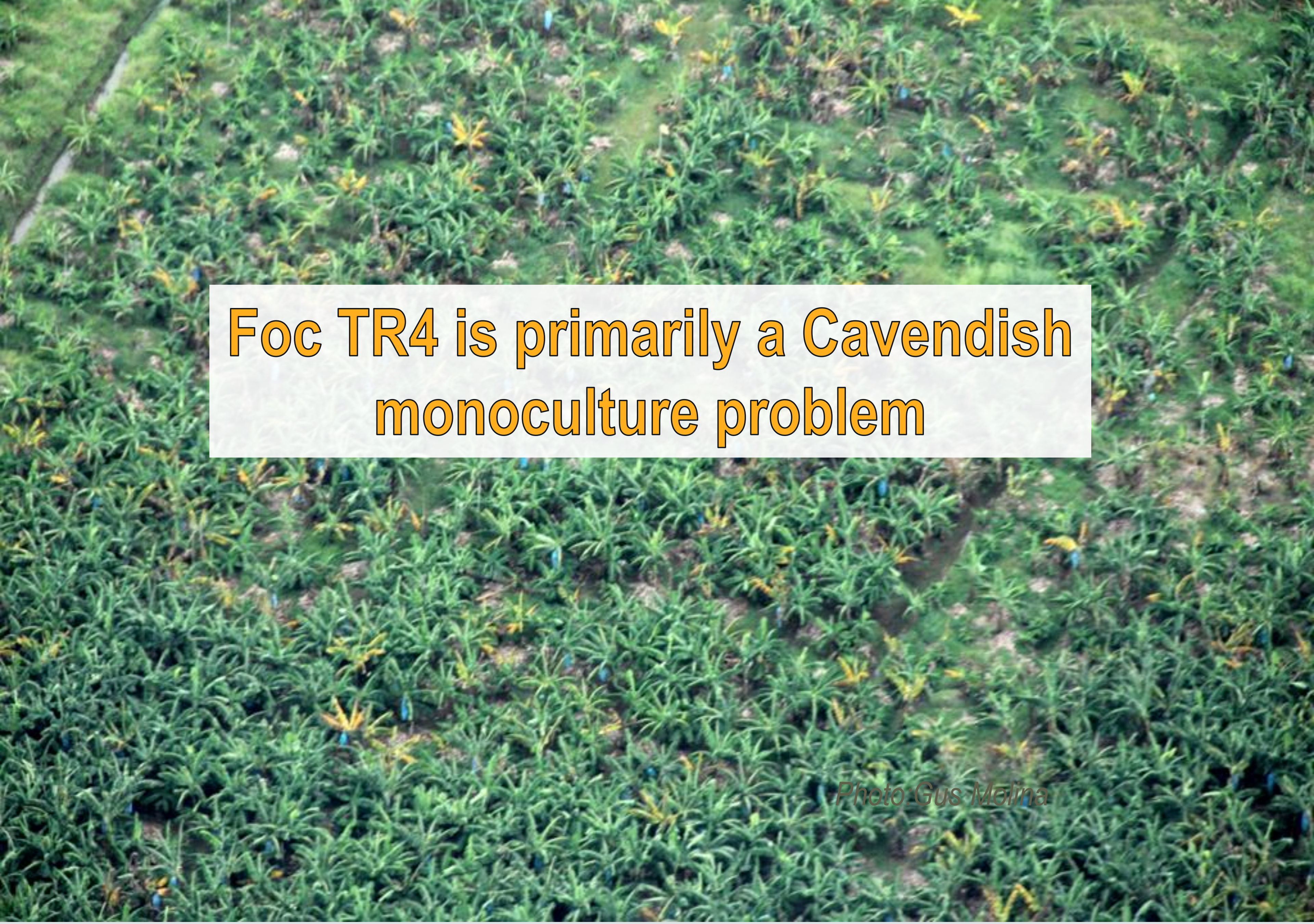
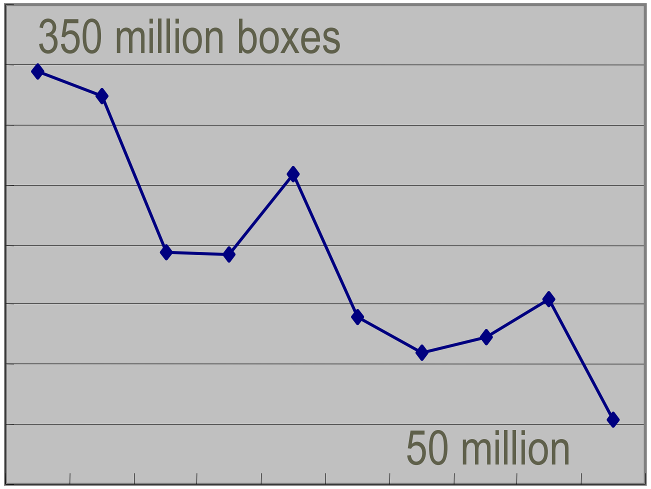


Photo Gus Molina

Panama Disease epidemics in Cavendish in Asia:

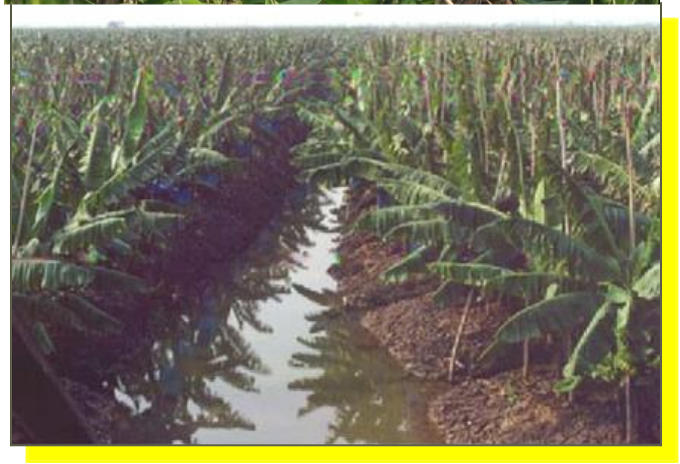
- Taiwan – 1967 (1990)*
- Indonesia/Malaysia – (1990)
- Australia - (1997)
- China 1996(2001)
- Philippines 2000 (2005)

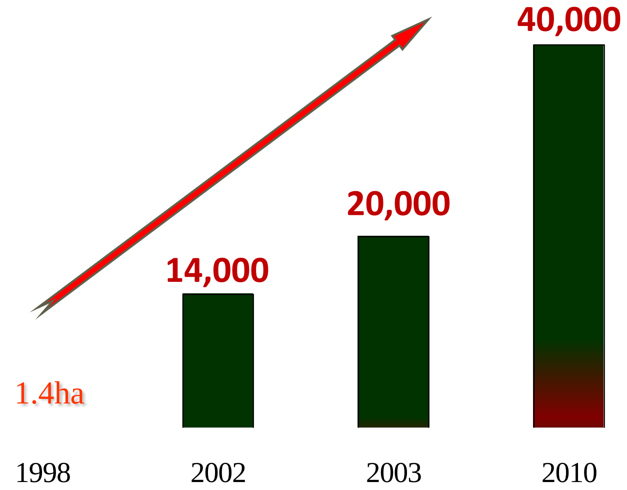


TR4 refers to the strain belonging to VCG 01213/16

TR4 in China

- 1996 – First incidence in Guandong, along the Pearl River. Spread through river-irrigation water
- 2001 – positive to VCG 01213-16 (TR4)
- 2010 – Spread to Hainan, Guangxi, Yunnan and Fujian provinces
- 2013 – 40,000 hectares affected in varying levels





Yi Ganjun, 2013

TR4 in Philippines

- 2000- first appeared in Cavendish plantation grown for “sweet bananas” in the highlands of Mindanao

- 2003 - sporadic cases traditional lowland plantations

- 2005–increased *Foc* infections in the lowland

- 2013 – Thousands of hectares affected Small-independent growers farms are most affected.



Confirmed Tropical Race 4 in 2005.

The Philippine Cavendish industry

- Total hectares: 82,000 has.
- $ >800 million export
- 320,000 direct employment
- 60% big plantations
- 40% small independent growers
- Small growers are most affected by severe epidemics.

- 3,000 has. abandoned
- 6,000 affected in varying levels

An industry at RISK!

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SOUTH-EAST ASIA
NEWS

Research urged to combat Philippine banana disease

Imelda Abano
7 October 2011 | EN

[MANILA] Scientists in the Philippines are urging their government to set up a national research centre to develop varieties of banana resistant to a disease now threatening plantations across South-East Asia.

Panama disease
become a major
bananas in the P
Flickr/Scot Nelso

The move follows appeals from growers who are facing the uncontrollable spread of Panama disease, caused by a destructive fungus that has wiped out banana varieties in the past.

The disease, also known as fusarium wilt, has been dormant for about 50 years, but a virulent strain has now reappeared in plantations in the Philippines, having spread from Australia to countries in Southeast Asia and Taiwan.

In the Philippines, the 'tropical race 4' strain has already wiped out 1,200 hectares of banana planta particularly the Cavendish variety, according to Stephen Antig, executive director of the Pilipino Banana Growers and Exporters Association (PBGEA).

SUN STAR
www.sunstar.com.ph

The dreaded Panama disease

By Henrylito D. Tacio
Sunday, October 23, 2011

ON NOVEMBER 28, 2008, Dr. Agustin Molina warned that "a more virulent type of Panama disease" that attacks banana "has already made its appearance in the country."

Dr. Molina, senior scientist and regional coordinator for Asia-Pacific of the Biodiversity International, sounded the alarm during a seminar convened at the Bureau of Agricultural Research (BAR).

Today, the warning has become a reality that now threatens the country's P35 billion banana industry. The disease has the potential of wiping out 1,200 hectares of banana plantations in Mindanao, particularly in Bukidnon.

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Research and Development in Asia (BAPNET)

- The *Foc* epidemics in China and the Philippines brought concerns in the region; new R&D initiatives to address the serious threat

- Bioversity International and its partners the Banana Asia Pacific Network put R&D to mitigate Foc TR4 a top priority agenda.

Banana Asia Pacific Network (BAPNET)Platform for Banana R&D collaboration in Asia-Pacific

Countries:

- Australia
- Bangladesh
- Cambodia
- China
- India
- Indonesia
- Myanmar
- Malaysia
- Papua New Guinea
- Philippines
- Sri Lanka
- Thailand
- Vietnam

Institutions:

- Taiwan Banana Research Institute
- South Pacific Community

Bioversity International
Asia Pacific Office: Secretariat

Bioversity/BAPNET: mitigating R&D initiatives

Goal: Manage where Foc TR4 occurs; Prevent spread to where it is not yet found

- Mapping the distribution of Foc TR4 and other races
- Prevent spread by raising awareness
- Readiness on the threat: training, workshops, symposia, public media.
- Develop disease management measures: varietal resistance; IPM approaches; biological control.
- Basic research: epidemiology, mechanism of soil suppression

Map of Distribution of *Foc* Strains in Asia

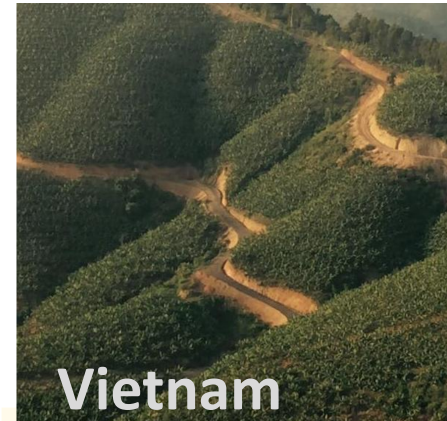
Country	Identified VCGs							
Indonesia	01213/16	0123	0124/5	01218	0120	0126	01219	0121
Malaysia	01213/16	0121	0124/5					
Taiwan	01213/16	0121						
Philippines	01213/16	0126	0122					
China	01213/16							
Bangladesh	0124/5	0128	01217	01220				
Cambodia	0124/5	0123	01221	01217				
India	0124/5	0128	01220					
Vietnam	0124/5	0123	0128	01221				
Sri lanka	0124/5	01217						
PNG	No Foc Isolated							

(Molina et al, 2010, APS, Hawaii)

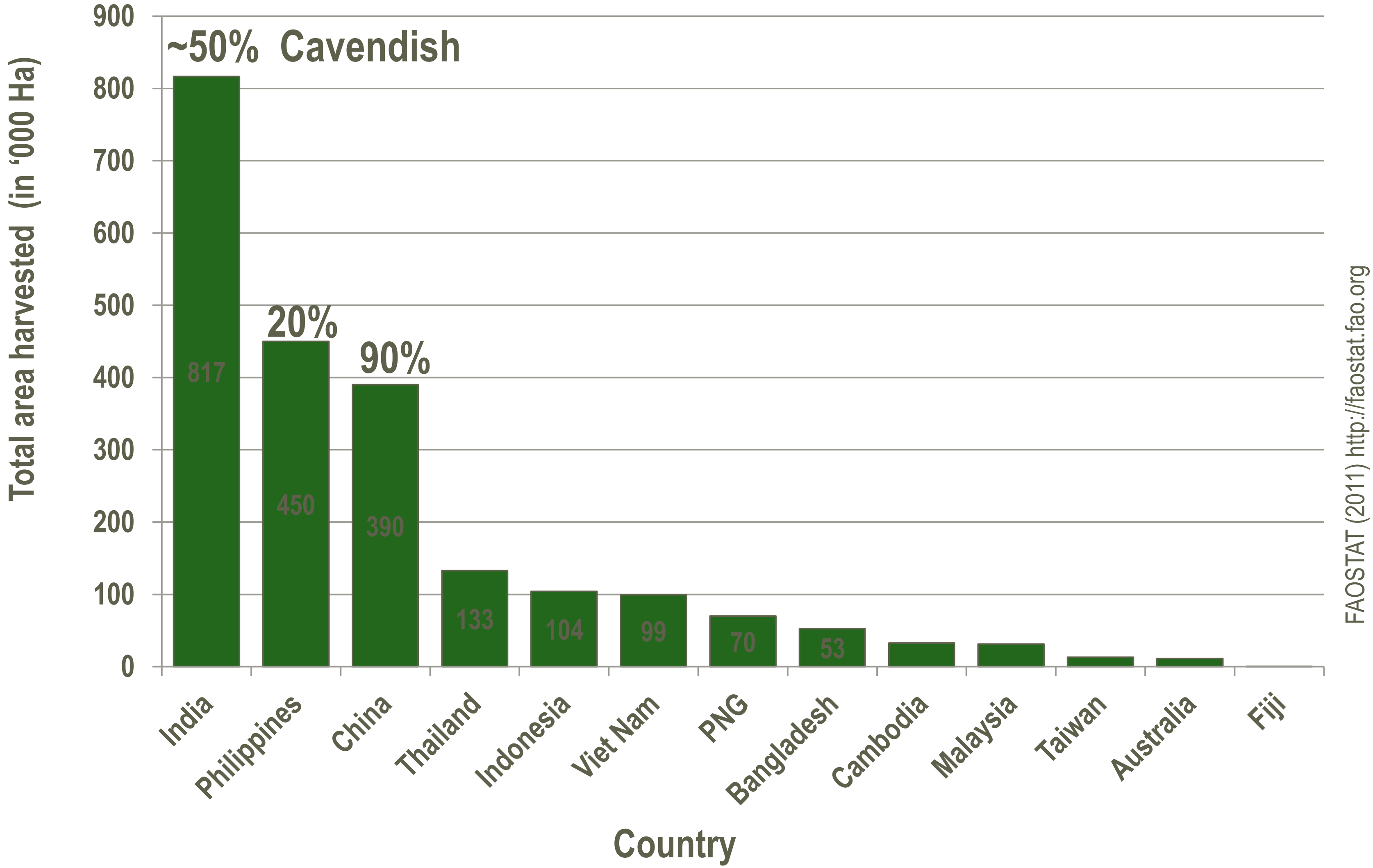
The distribution of TR4 in Asia

New Spreads of Foc TR4

- North Queensland, Australia(2015)
- Vietnam (2015)
- India (2015)
- Laos/Cambodia/Myanmar??



TR4-vulnerable banana production systems



Total Area Grown for Banana in different Asian countries

New spreads of Foc TR4 in Asia needs more than ever a stronger collaboration in addressing this serious threat. While TR4 may not cause total destruction of the banana industry, significant mitigation measures are needed to avoid losses of income and livelihoods!

10th BAPNET Steering Committee Members

Australia, Bangladesh, China, India, Indonesia, Malaysia, Papua New Guinea, Philippines, Secretariat Pacific Community, Thailand, TBRI, Vietnam

10th BAPNET Steering Committee Meeting Participants

Australia, Bangladesh, China, India, Indonesia, Malaysia, Papua New Guinea, Philippines, Secretariat Pacific Community, Thailand, Vietnam, South Africa, TBRI, Bioversity, CORBANA, UN-FAO, TFNet

BAPNET activities:

- Prevention of spread through raising awareness and capacity building on Surveilnce, diagnostics, and Disease management

Development of management strategies

Resistant Variety

- Conventional breeding produced disease resistant varieties but failed consumers acceptance

- The promise of molecular biology (transgenic/sysgenic) to produce a commercial variety is still wanting (since 1990, Pie in the Sky).

- Non-conventional method of crop improvement through somaclonal selections have produced Cavendish resistant to Foc TR4

FHIA 25, highly resistant to Black Sigatoka and Foc TR4

Somaclonal selection,TBRI, Taiwan

Low hanging fruits of science:
Somaclonal selection from TC variants
Taiwan Banana Research Institute

Highly resistant clones	Moderately resistant clones
GCTCV-40	GCTCV-46
GCTCV-44	GCTCV-53
GCTCV-104	GCTCV-62
GCTCV-105 (1995)	GCTCV-201
GCTCV-119 (1997)	GCTCV-215 (1991)
GCTCV-217 (1998)	GCTCV-216
GCTCV-218 (2002)	

Shared in Asia through BAPNET - IMTP/NRMDC

The Philippines initiative

Adapting GCTCVs to alleviate Foc TR4 in the Philippines – a public-private partnerships

Field valuations of GCTCVs against Foc TR4 started in 2006

Puyod's farm

Lapanday Fruits Corp

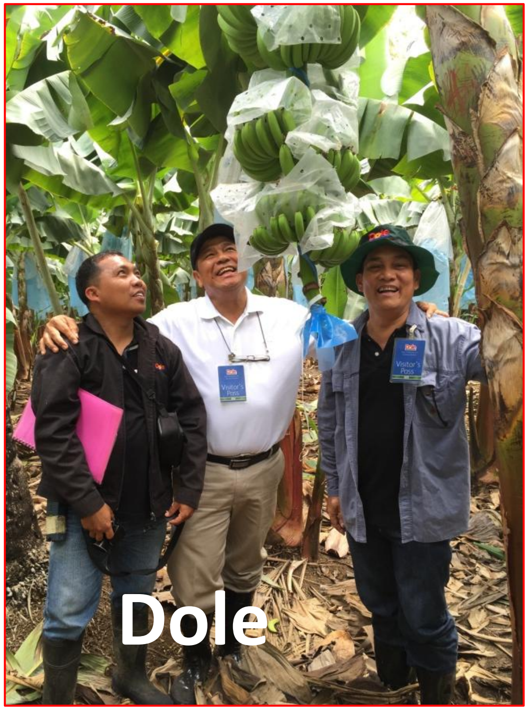
Fusarium wilt incidence (%) of introduced banana varieties evaluated in Davao, Philippines

Variety	Number of Experimental Plants	54 weeks	77* weeks	100 weeks*
GCTCV 105	**100**	**3**	**8**	**8**
GCTCV 218	**100**	**6**	**6**	**6**
GCTCV 219	**100**	**1**	**1**	**1**
GCTCV 119	**100**	**0**	**0**	**0**
Gran Naine	**100**	**64**	**78**	**80**

** Ratoon crop*

Managing TR4 in the Philippines

Commercial adoption of GCTCV 218
2015-date



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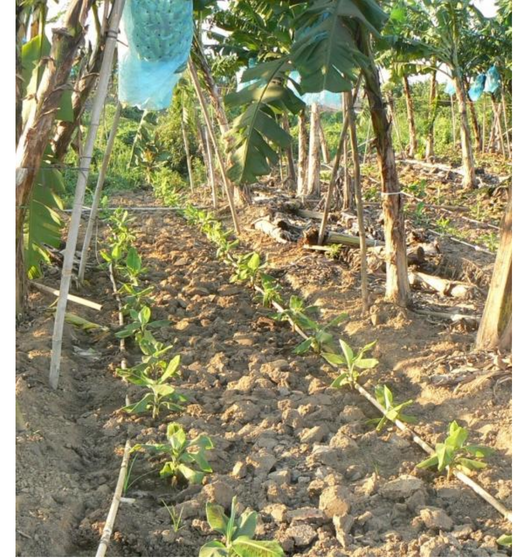
The Partnership

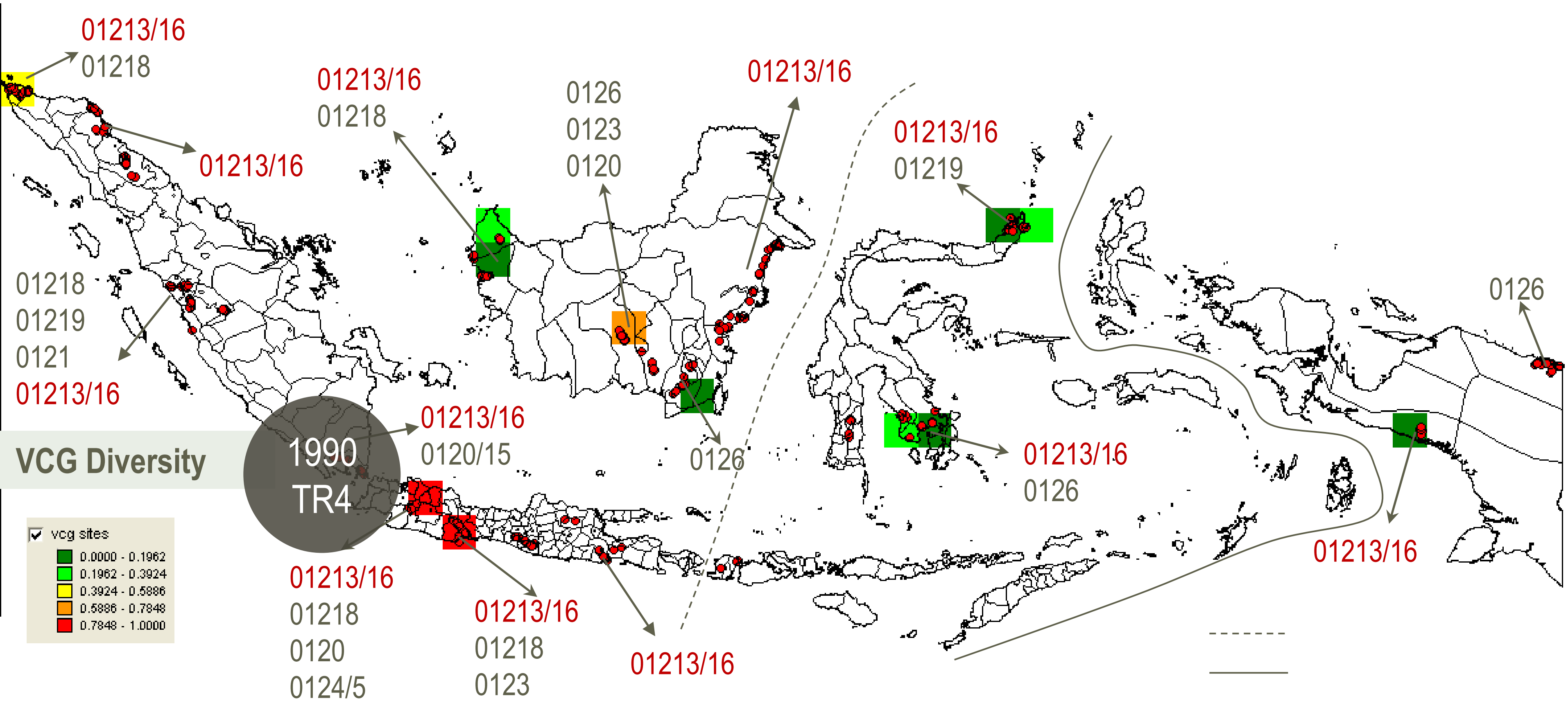
Managing Foc TR4 in Cavendish Indonesia

Nusantara Tropical Fruit Corp:

- 1990s – 4,500 hectares (with multinationals)
  Multinationals withdraw in 1992
- 2001 – 80% infection; area down to
  < 200 hectares for local markets
- Annual cropping with GCTCV 119/218 with
  recurrent selection (2004)
- Current area – >2,000 hectares; less than
  5% infection; perennial cropping



DISTRIBUTION OF STRAINS of FUSARIUM WILT IN INDONESIA



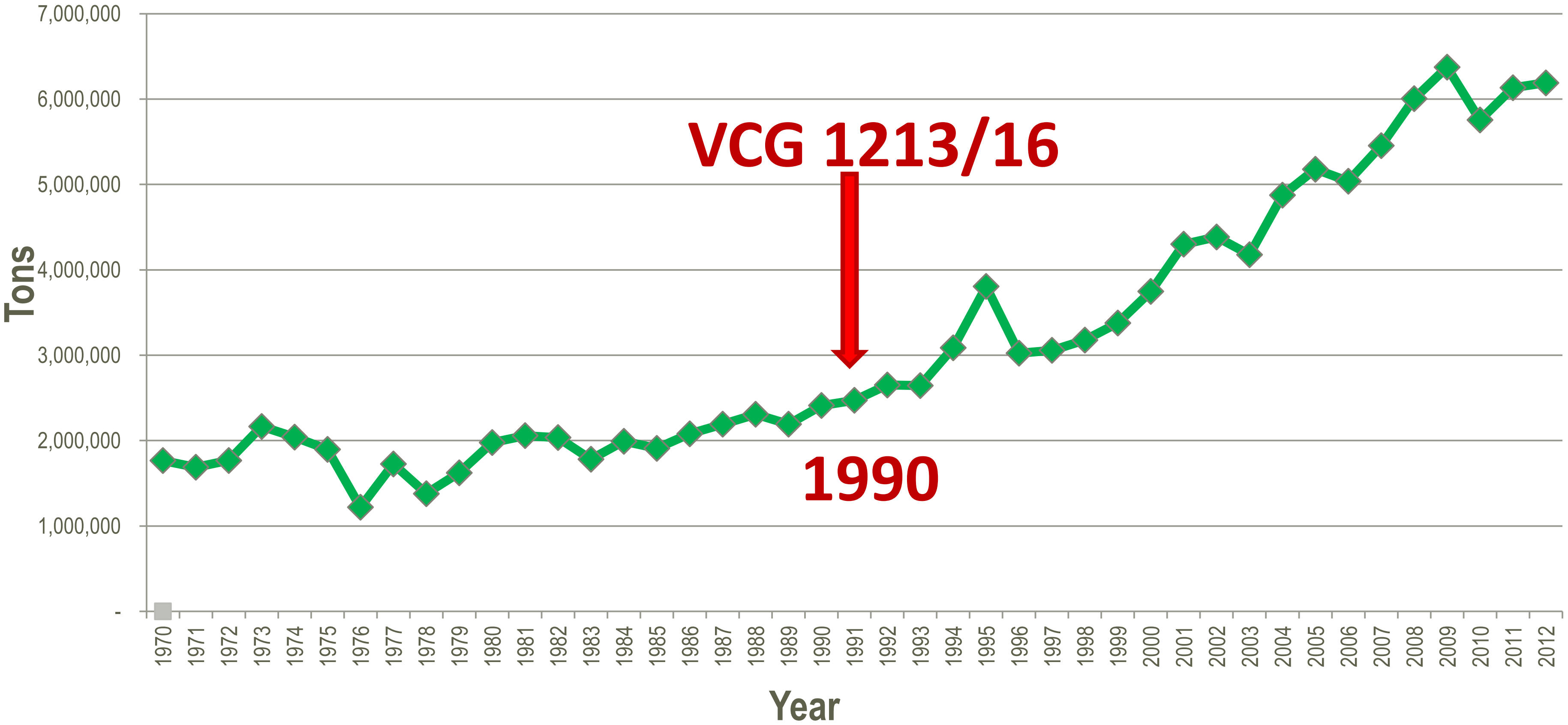
Study carried out by Bioversity, Indonesian and Australian partners funded by ACIAR-Australia

153 VCG analyses results (2008)

Note that VCG1213/16 was found in all islands. Most likely the strain has been widely distributed even before the epidemics on Cavendish in the 90s.

Catur Hermanto et al

Banana Production in Indonesia (1970-2012)



Since 1990 when TR4 was identified affecting Cavendish in Indonesia, banana production has continued to increase.

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Local cultivars grown by farmers in Indonesia

Resilience due to cultivar and cropping system diversity!

Kepok | Barangan | Tanduk | Ambon Kuning | Ketan | Ambon Hijau | Awak | Rajasere | Berlin | Tongkat langit

Source: Catur Hermanto,2012

Research Funding motivated

1990 PREDICTION OF MASSIVE DEVASTATION OF BANANAS:

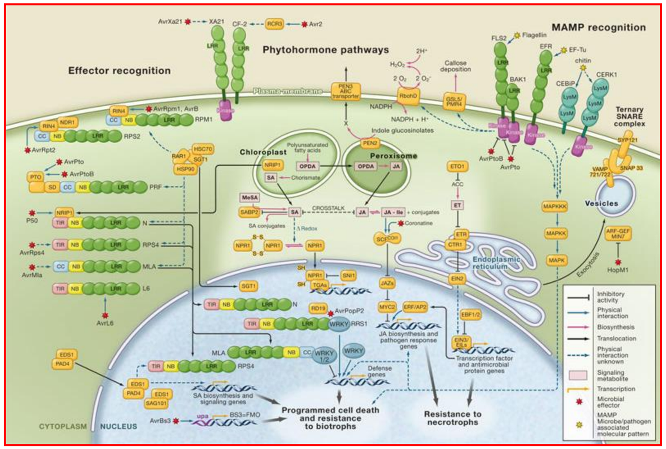
- Biotechnology- research

2003 PREDICTION :

Bananas disappear in 10 years - genomic research

2013 – Bananagedon- end of Bananas - GMO

"GMO research is promoted to be the ultimate approach in developing a TR4-resistant variety that will provide a long term solution of the problem "



"The GCTCVs are deliveratelу belittled by GMO GMO breeders"

"Where epidemics are threatening livelihoods of poor people, we can not wait for outputs of such long uncertain potentials".

"Pie in the Sky "

Low hanging fruits of science: GCTCVs

Thank you

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