



Fusarium Wilt : Occurrence, impact, R&D and mitigation measures in Asia Pacific

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Panama Disease on Cavendish in Asia:

- Taiwan – 1967 (1990)
- Indonesia/Malaysia – 1990
- Australia - 1997
- China 1996(2000/2004)
- Philippines 1974(2005/2008)
- India (2009)*

Note: TR4 refers to the group belonging to VCG 01213/16

* VCG 0124/5

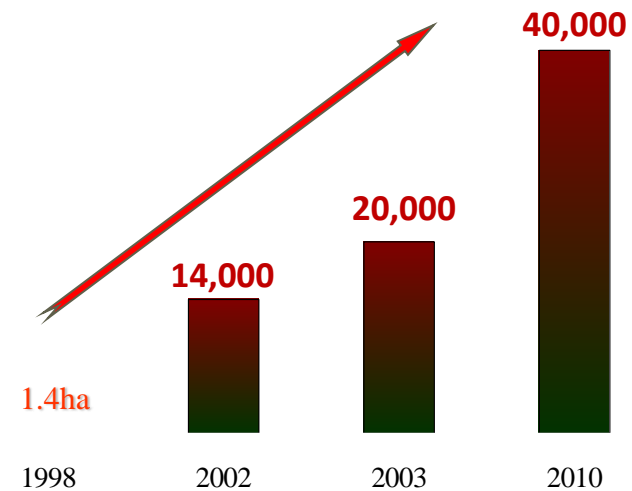
TR4 in Malaysia and Indonesia:

- Late 80s multinational companies established Cavendish plantations in Indonesia and Malaysia for the expanding markets of the middle east
- 1990-92 epidemics of Foc TR4 destroyed plantations
- Companies abandoned their plantations for export market



TR4 in China

- 1996 – First infection in Guandong,
- 2000 – positive for **VCG 01213-16 (TR4)**
- 2005 – more than 20,000 ha
- 2010 – Spread to Hainan, Guangxi, Yunnan and Fujian provinces
- 2013 – 40,000 hectares affected in varying levels



TR4 in Philippines

- 2001- first appeared in Cavendish plantation grown for “sweet bananas” in the highlands of Mindanao
- 2003 - sporadic cases observed in the traditional lowland plantations
- 2005–increased *Foc* infections in the lowland; further spread
- 2013 – Thousands of hectares affected
Small-independent growers farms are most affected.



The Philippine Cavendish industry

- Total hectares: 82,000 has.
- >\$ 750 million/yr export
- Employs 320,000 people
- 60% big plantation
- 40% small independent growers (1 to 200 hectares)
- Small growers are most affected by severe epidemics.
 - 3,000 has. abandoned
 - 6,000 affected in varying levels
- Big growers farms also affected but no accurate data



General epidemic in many small growers farms



Urgent need for a solution!

Research and Development in Asia (BAPNET)

The *Foc* epidemics in China and Philippines brought new concerns in the region; new R&D initiatives



Advancing banana and plantain R&D in Asia and the Pacific - Vol. 13

Proceedings of the 3rd BAPNET Steering Committee meeting held in Guangzhou, China
23-26 November 2004

A.B. Molina, L.B. Xu, V.N. Roa, I. Van den Bergh
and K.H. Borromeo, editors



Workshop recommendations

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Workshop recommendations

After the presentations, a workshop was held to review and discuss the status of the various projects in the region, the direction and the future plans of BAPNET. These were the recommendations formed by the committee members:

1. **R&D in the area of IPM with emphasis on banana fusarium wilt, banana viruses and bacterial wilt**

The observed infection of fusarium wilt on Cavendish in China, Taiwan, Indonesia, Malaysia, Philippines and Australia, and the absence or limited information about *Foc* from other countries such as Cambodia, Myanmar, Sri Lanka and other BAPNET member countries, necessitate a new survey-characterization of the *Foc* pathogen in the region. A map distribution of the various races and VCGs of *Foc* has to be developed. The Regional Coordinator (RC) together with Bob Williams of Australia will explore some possibilities of funding support for the activity from the Australian government.

2. **Review the status and need of a banana breeding programme in Asia**

Two ACIAR funded projects from 2006-2013

Risk Assessment - Mapping of *Foc* Strains in Asia

*Funded by ACIAR, BAPNET countries, with collaboration of DPI, Australia, FABI/Stellenbosch University

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, American Phytopathological Society)

Mitigation and prevention of spread



Management Strategy

- Managing Foc TR4 where it occurs
 - early detection and eradication
 - quarantine/disinfestation
 - varietal resistance
 - IPM tactics (biological, cultural etc)
- Prevention of spread in unaffected areas
 - raising awareness of threat
 - quarantine policies
 - capacity building



Foc TR4 Resistant Cavendish Variety

- The promise of breeding for disease resistant Cavendish still an elusive dream
- Conventional breeding produced disease resistance but failed consumers acceptance
- The promise of molecular biology (transgenic/sysgenic) to produce a commercial variety is still wanting.
- Non-conventional method of crop improvement through somaclonal selections have produced Cavendish resistant to Foc TR4 (since 1990s)



FHIA 25, highly resistant to Black Sigatoka and Foc TR4



Somaclonal selection, TBRI, Taiwan

Evaluation and adaption of resistant Cavendish Somaclones from Taiwan, and subsequent selection of improved types to rehabilitate severely affected farms:

- GCTCV 119 and improved selections
 - Philippines (GCTCV 219)
 - China
 - Indonesia
- GCTCV 218 and improved selections
 - Philippines
 - Taiwan
 - Indonesia



Reaction of Cavendish somaclones against TR4 (Davao, Philippines - 2011-2013)

Variety	Genome	Fusarium Wilt Incidence 52weeks (%)	Fusarium Wilt Incidence 77weeks (%)
Gran Naine	AAA	57	78
GCTCV 105	AAA	2	8
GCTCV 119	AAA	0	0
GCTCV 218	AAA	6	6
GCTCV 219	AAA	1	1

Foc TR4 incidence on pilot farms planted with GCTCV 219 and Gran Naine (November 2012- October 2014)

Farm name	Location	Number of Plants	Disease Incidence (%) GCTCV 219		Number of Plants	Disease Incidence (%) Grand naine	
			Plant Crop	1st Ratoon		Plant Crop	1st Ratoon
1. Phil. Fresh Fruits Corp.	Lasang, Davao City	3,800	1.4	0	200	100	
2. LMH Agri. Dev't. Corp.	San Isidro, Bunawan, Dvo. City	2,000	0.8	0	200	38	
3. Bancud Farm	Cuambogan, Tagum City, DN	500	2	0	200	97	
4. Lapid Farm	Talomo, Sto. Tomas, Dvo. Norte	1,800	0	0	200	100	
5. GEA Farm	San Roque, New Corella, DN	3,500	0.2	0	200	75	
6. Tindoc Farm	San Nicolas, Panabo, Dvo. Norte	1,500	1.8	0.13	200	100	
7. SFARBEMCO Farm	Camoning, Asuncion, Dvo. Norte	700	2.7	0	200	100	
8. GADI Farm	Tagnanan, Mabini, Comval Prov.	300	0.3	0	100	100	
9. TVPI Farm	Tagnanan, Mabini, Comval Prov.	1,100	0.1	0	200	100	
10. Lupiba Farm	Tugbok, Davao City	1,500	0.7	0	200	100	
11. Mauro Farm	Calinan, Davao City	2,000	0.6	0	200	100	



Grand naine

GCTCV 219

**Bancud farm, Tagum, Davao del Norte
(August 2013)**

GCTCV 219 at GEA Farm, Davao Del Norte)



Dec 2012



Oct 2013



Jan 2014



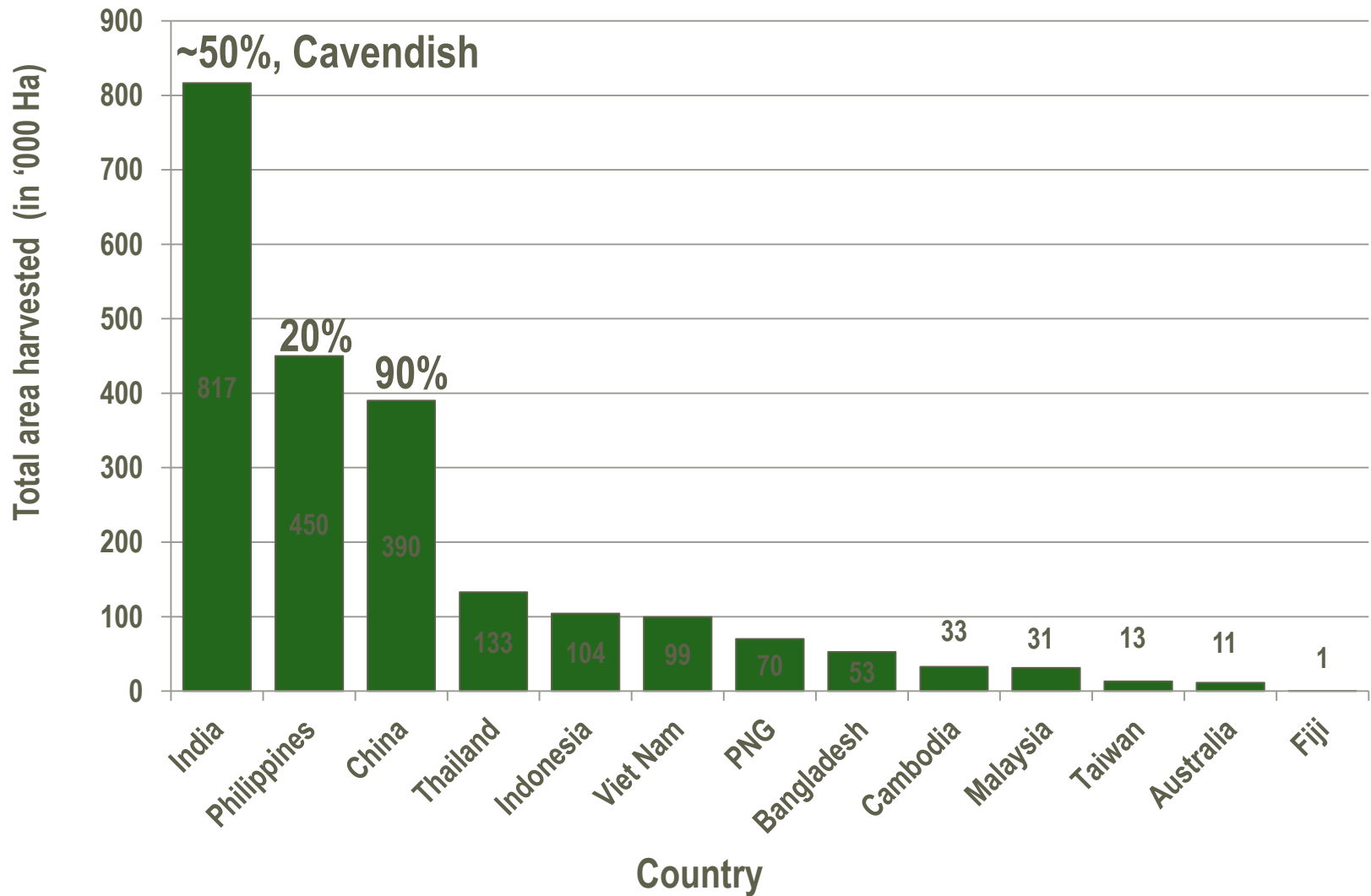
March 2014

An aerial photograph of a Cavendish banana plantation. The plants are arranged in neat rows, with many yellow flowers in bloom. Small blue markers are visible on the ground between the plants. The overall scene is a dense, green agricultural landscape.

**In Asia
Foc TR4 is primarily a Cavendish
monoculture problem**

Photo Gus Molina

Monoculture Cavendish – Foc TR4 vulnerable

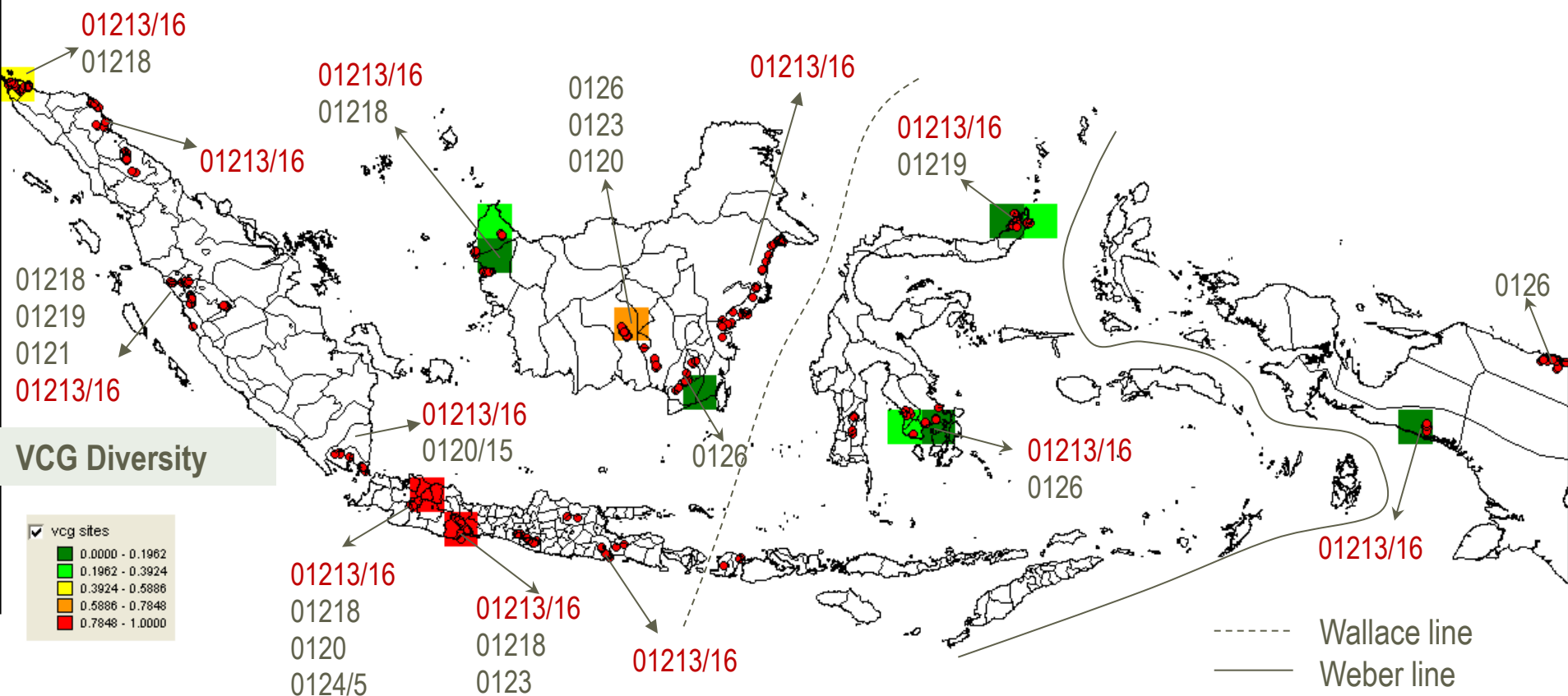


FAOSTAT (2011) <http://faostat.fao.org>

Total Area Grown for Banana in different BAPNET member countries

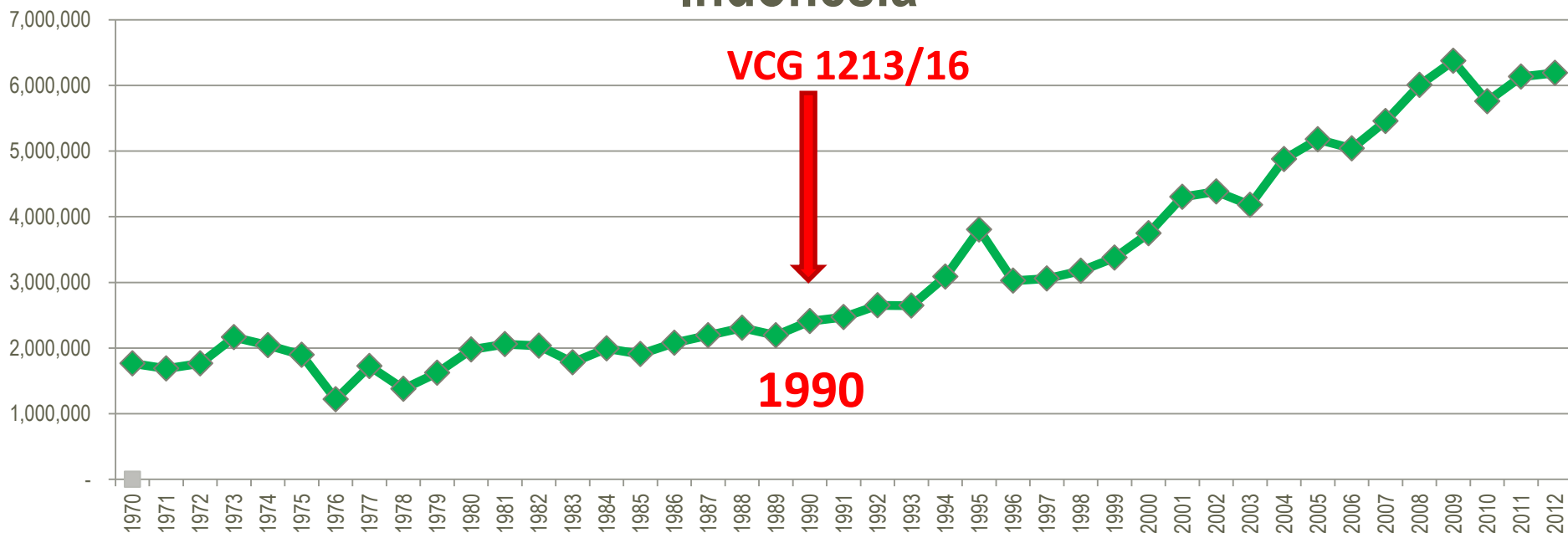
Distribution of *Foc* strains in Indonesia

- 8 VCGs, TR4 is everywhere



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

Resilience of banana production due to cultivar-copping diversity Indonesia



Survey carried out thru Bioversity/ACIAR project

Source: Catur Hermanto, 2012



Integrated Crop Production System in managing banana wilt diseases in small scale farms in Indonesia

- Project funded by ACIAR implemented by Bioversity and national partners

Resilience due to diversified cropping system

Managing soil for suppression of Race 1 on Lady Finger Australia

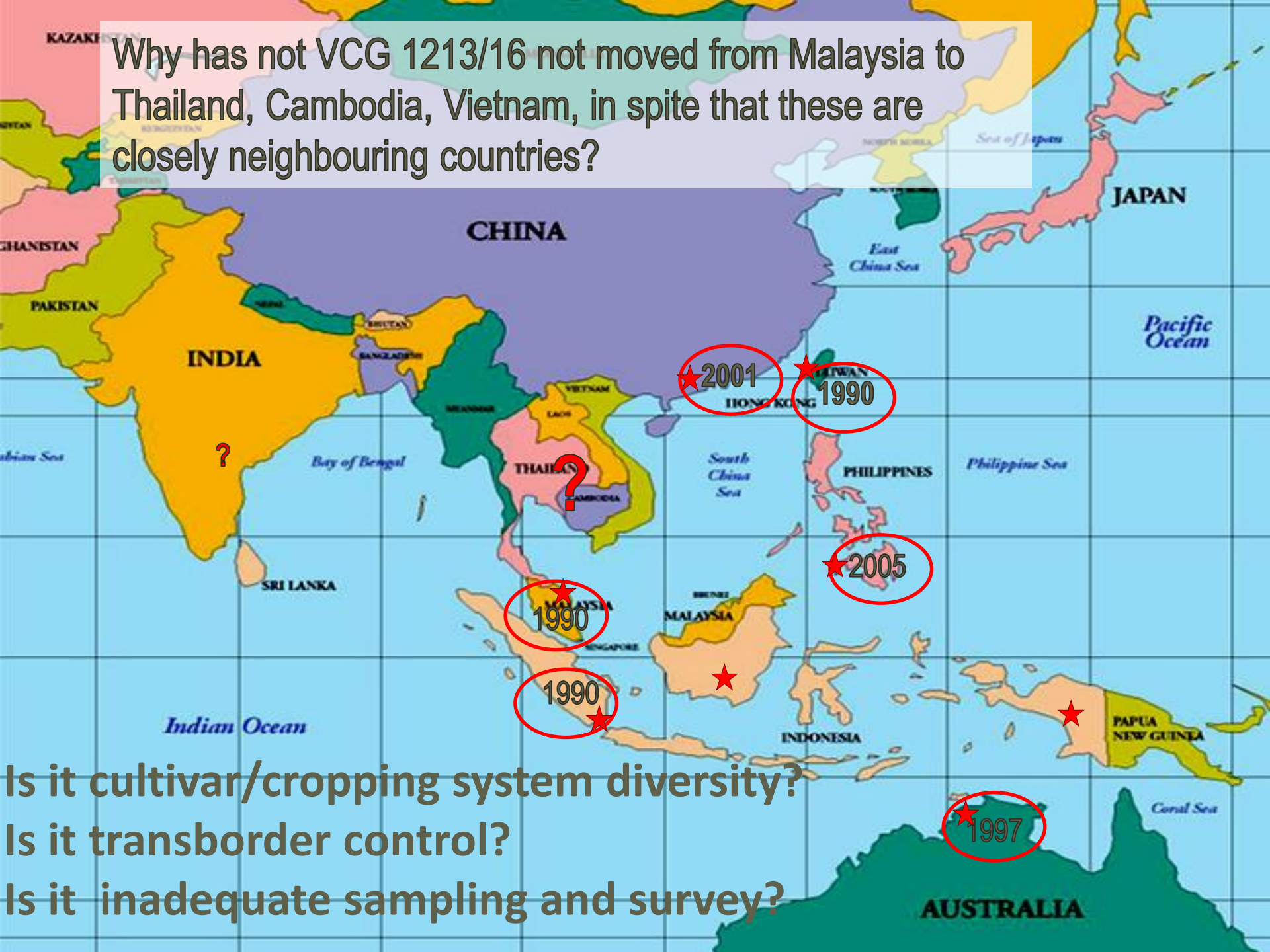


Ground Cover to promote soil suppression to Foc



Photo: Tony Pattison

Why has not VCG 1213/16 not moved from Malaysia to Thailand, Cambodia, Vietnam, in spite that these are closely neighbouring countries?



Is it cultivar/cropping system diversity?
Is it transborder control?
Is it inadequate sampling and survey?



Thank you

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