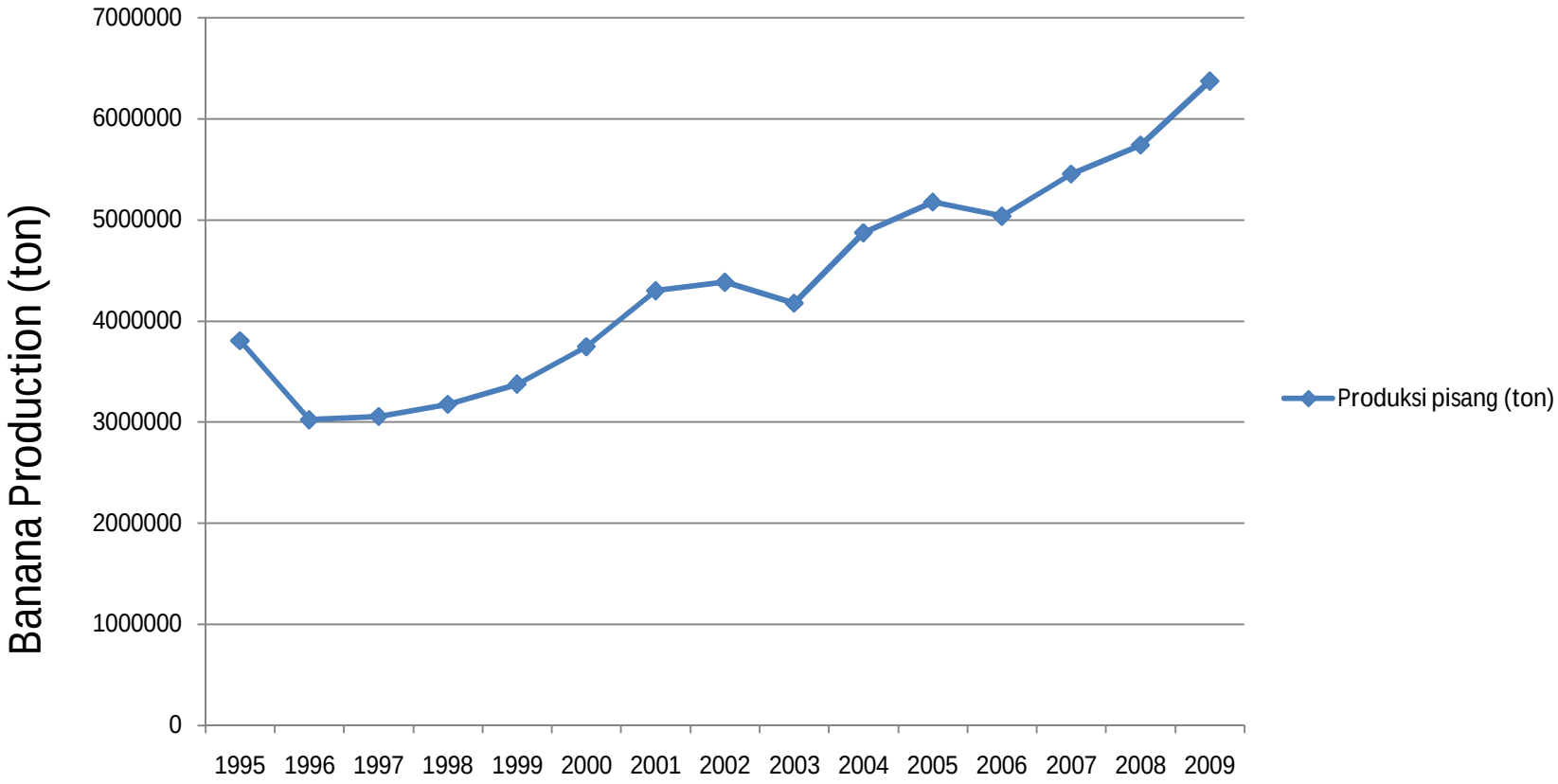
MANAGING BANANA DISEASES - THE INDONESIAN EXPERIENCES

Siti Subandiyah
Dept. of Entomology and Plant Pathology
Faculty of Agriculture, Universitas Gadjah Mada
Bulaksumur, Yogyakarta, 55281 Indonesia
ssubandiyah@yahoo.com

ECONOMIC IMPORTANCE OF BANANA IN INDONESIA

- Banana contribute 35% in production of tropical fruits in Indonesia
- Grow every where, mostly small holders, few banana industries
- Desert and cooking bananas with many varieties

BANANA PRODUCTION IN INDONESIA 1995-2009



Source: Indonesian Statistic Center Agency

Banana Germ Plasma in Yogyakarta

More than 300 accessions of banana collection

Nursery of Banana Industry

In vitro propagation

Backyard Banana Production

Field Production of Banana Industry

Banana Production

Banana Market

Production Constrains

- Scatter small holders and not intensive cultivation make it difficult for wide area production management

- Low quality of fruits

- **Diseases spread**

Major Diseases

- Banana Blood Disease (Blood Disease Bacterium / BDB)
- Fusarium Wilt (*Fusarium oxysporum* fsp *cubens* / Foc
- Bunchy Top Virus (Banana Bunchy Top Virus / BBTV)
- Leaf spots (Sigatoka etc)

Banana Export Volume

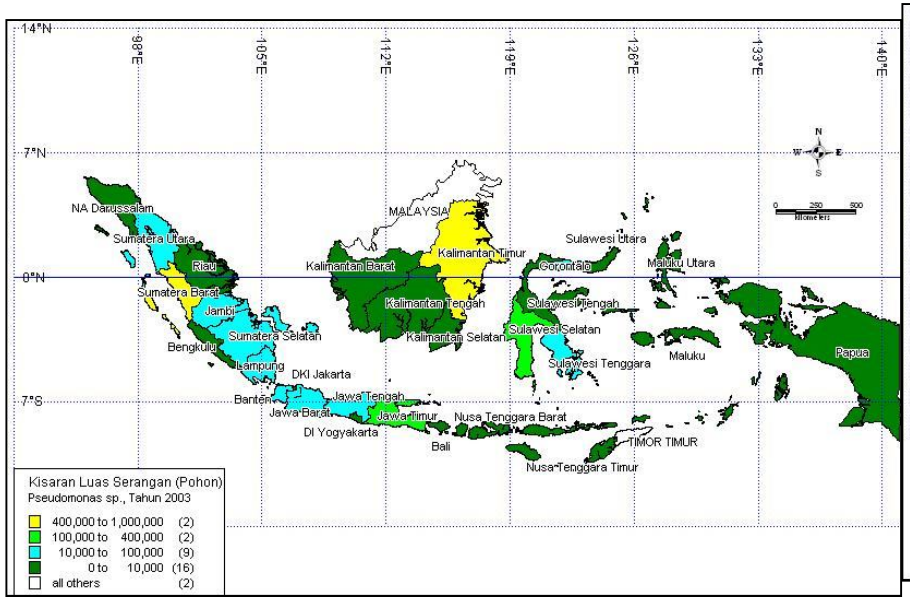
Source : United Nations Commodity Trade Statistic Database

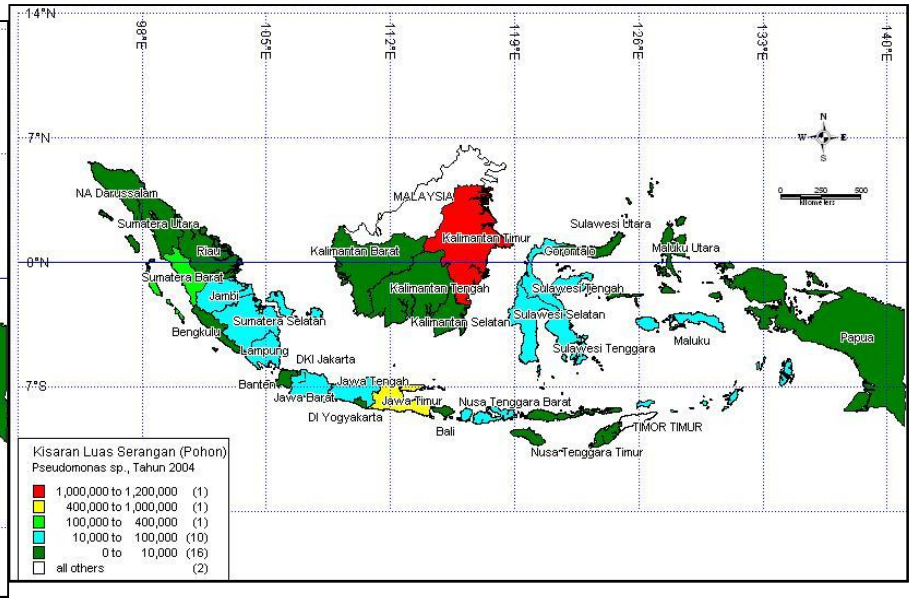
Disease Intensity of Banana Wilts in South Bengkulu District

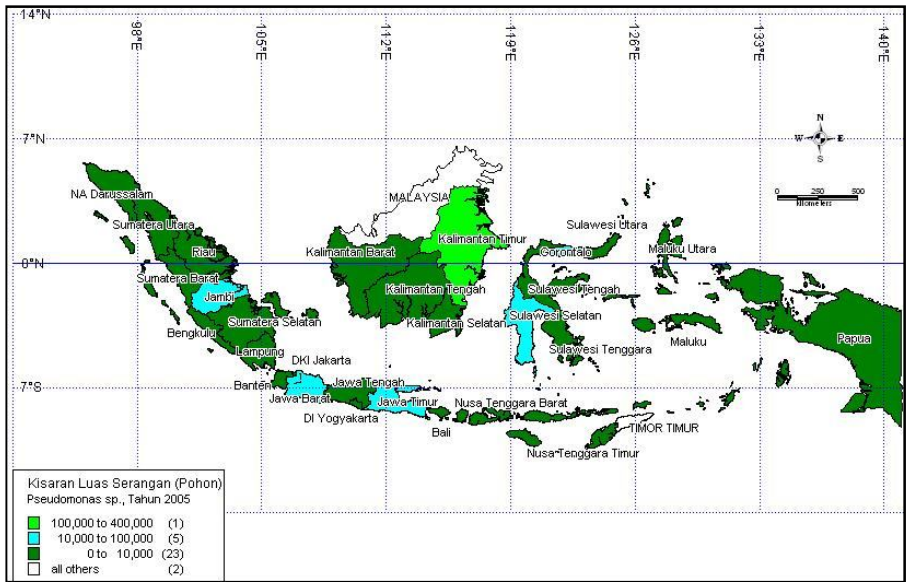
No	Banana Cultivar	Disease Intensity (%)
1	Kepok /Saba	46.86
2	Ambon / Gros Mitchel	71.67
3	**Jantan**	1.49
4	Tanduk / Plantain	5.56
5	Rawas	0
6	**Muli**	0
7	Kapar	0

Source : BPTP West Sumatera

Map of BDB Distribution in Indonesia 2003 - 2005







Banana Wilts – Blood Disease

Cavendish at NTF banana industry in Lampung

Banana Blood Disease in East Kalimantan

Observation of banana wilts in the field

Blood Disease

Blood Disease











Blood Disease Bacterium

- **Firstly described in 1920s found in Celebes (Sulawesi island) as *Pseudomonas celebensis***

- **As the member of *Ralstonia solanacearum* species complex in Phylotype IV (Moko pathogen in Phylotype II)**

- **Slow growing on agar medium with the ∅ 2-3 mm in 5 days on CPG medium**

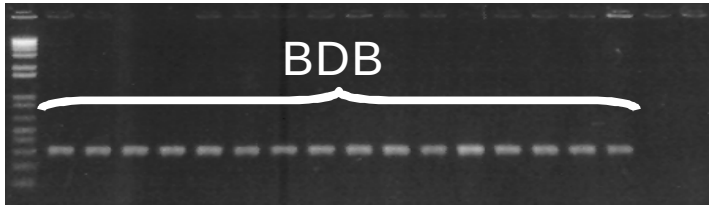
- **Not infectious on Solanaceaous plants**

- **Survive with mild symptom on *Heliconia spp. and Canna spp.***

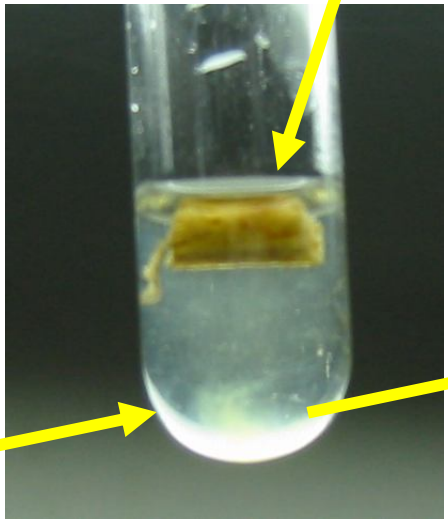
Blood Disease Bacterium continue

- Soil borne but the population declines sharply in few months
- Insect transmitted (by pollinators, decay visiting insects, banana pests)
- In the field cooking banana (kepok, saba, pisang awak etc) were found with highly incidence of BDB infection compared to dessert banana

BDB Diagnostic PCR



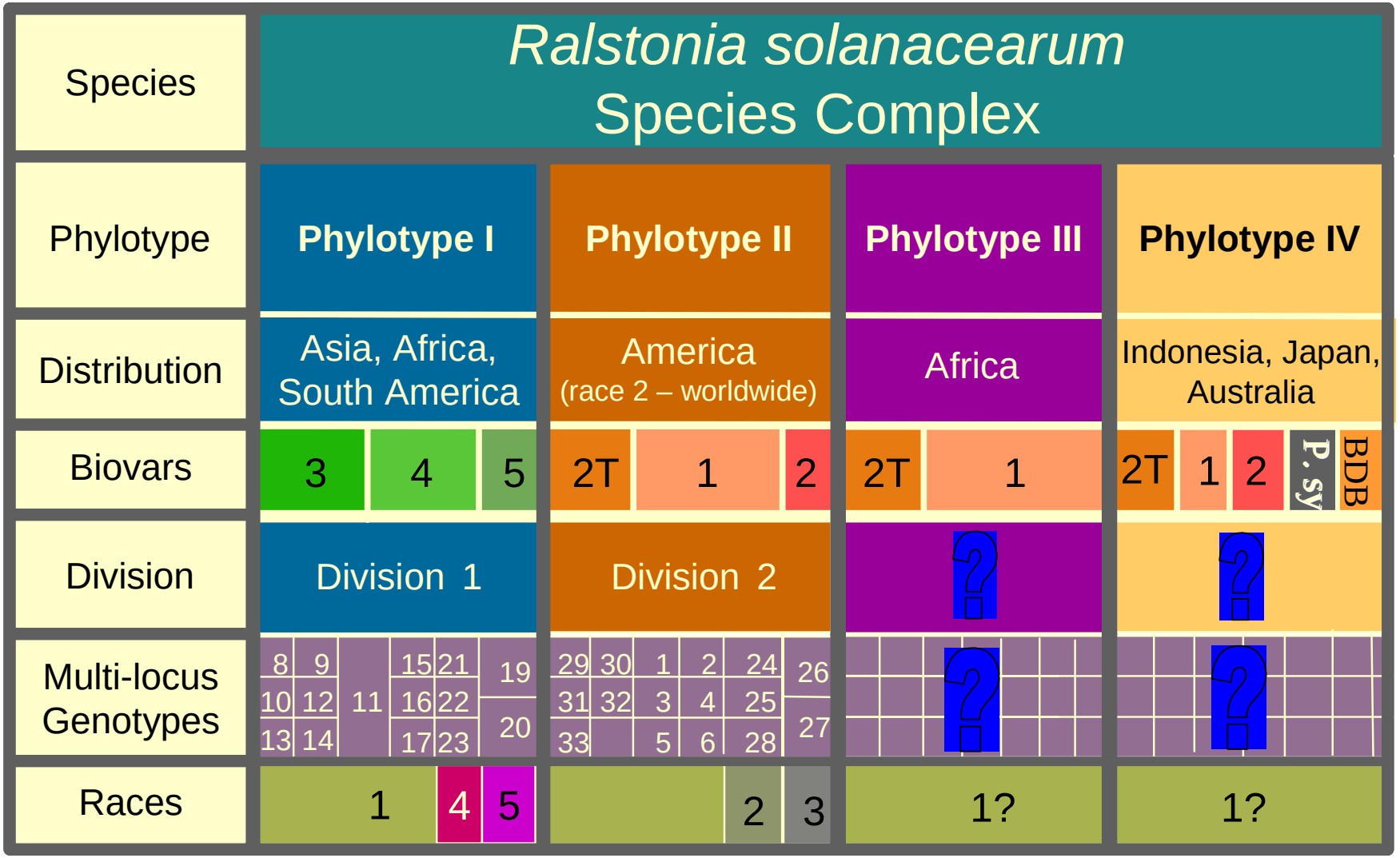
The primer sequences are in press



Ooze

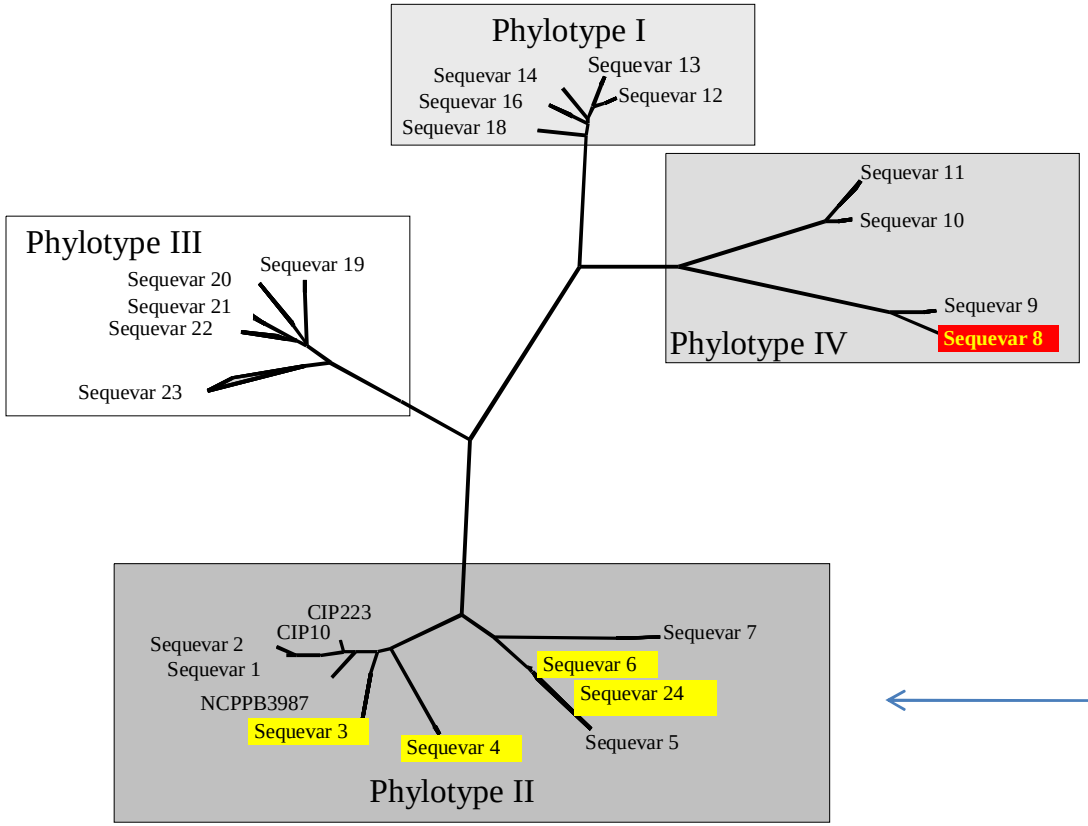
PCR

BDB (Phylotype IV) vs Moko pathogen (Phylotype II)



The phenotypic based schemes (biovars and races) and genotypic based schemes (RFLP analysis and phylotyping). (After Gillings and Fahy (1994)

BDB vs Moko Pathogen continue

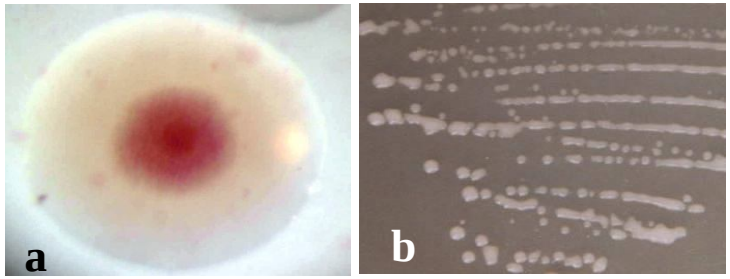


BDB

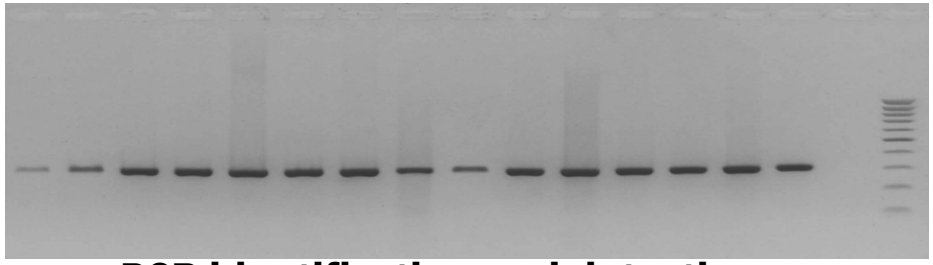
Moko pathogen

Phylogenetic tree generated from partial endoglucanase gene sequence data s howing the phylogenetic relationships of sequevars and phylotypes (Fegan et al in press)

Blood Disease Bacterium

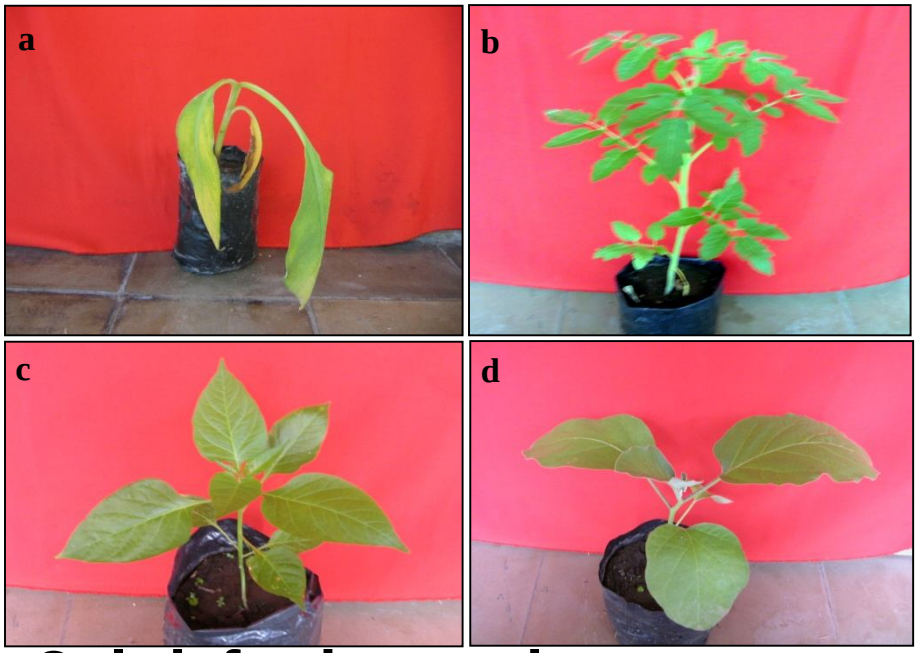


Slow growing on CPG/TZC,
∅ 2-3 mm in days



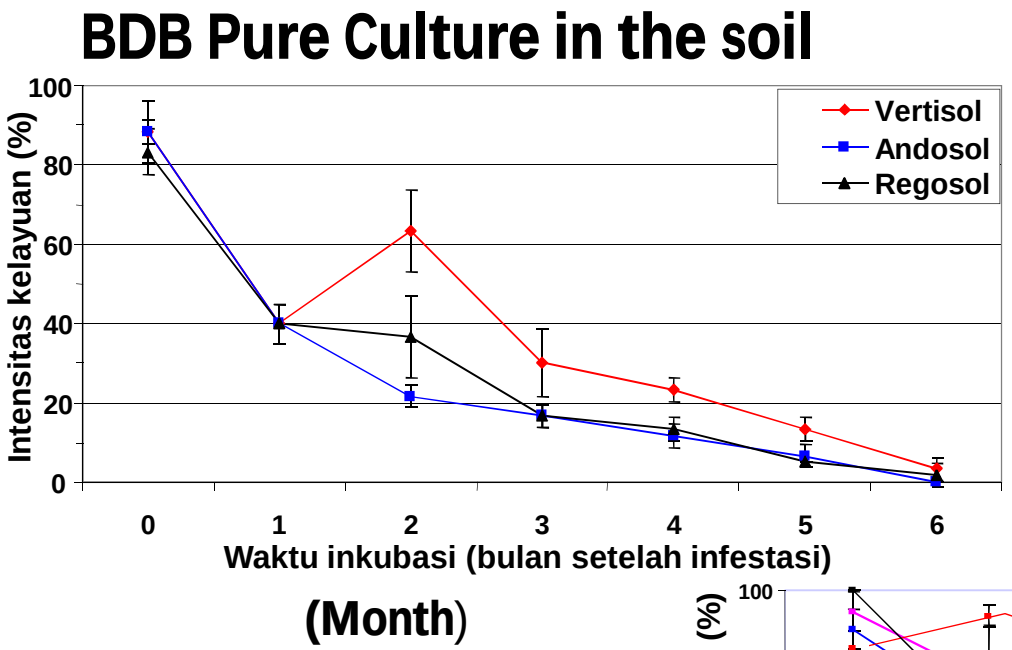
PCR identification and detection

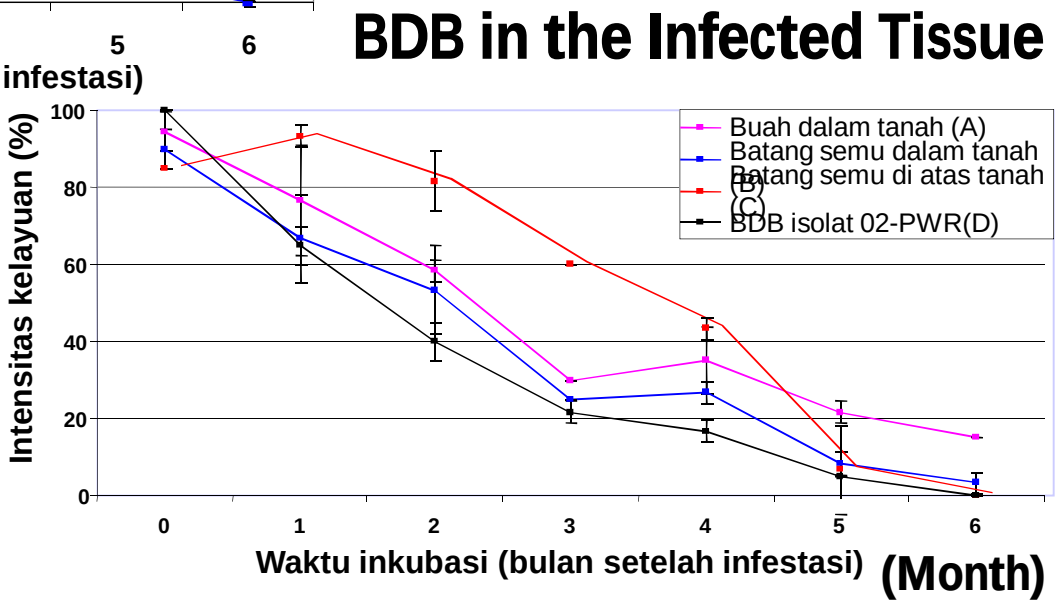
Survive with mild symptom on
Heliconia spp and *Canna* spp



Only infectious on banana,
not infectious on *Solanaceaous* plants

Survival of BDB in the Soil





Fusarium Wilt,
Fusarium oxysporum fsp. *cubense* (Foc)

Comparison of BDB vs Foc diseases

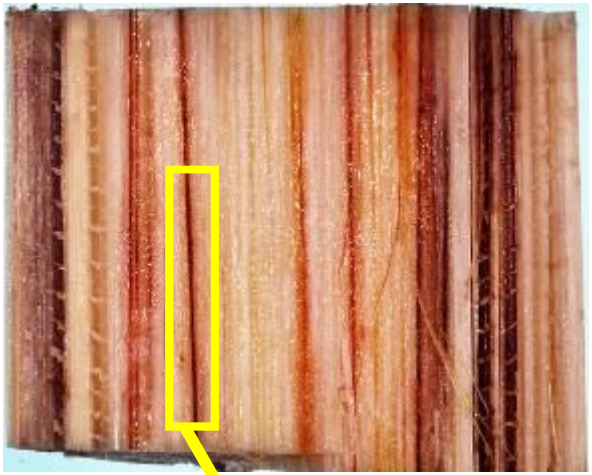
	Fusarium Wilt	Blood Disease
Organism	FOC (Fungus)	BDB (Bacterium)
Ooze from infected tissue	NO	YES
Found in Fruit	NO	YES
Point of Entry into Plant	From soil	Male flower (bracts, via insects), injury, and soil
Spread in Plant	Root→inner cortex of butt→Pseudostem	Bract→True stem→Fruit pulp→→Butt→Stem of Sukcer
Resides in Soil	Yes	Yes, shorterterm
Resides in Plant Material	Yes	Yes, short term

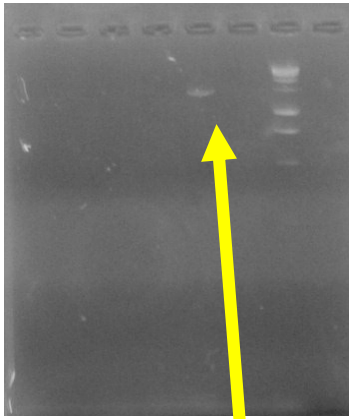
	Fusarium Wilt	Blood Disease
Resistance to	**Exists (No externally visible indicator)**	**NON , only escape**
Leaf Symptoms (Unbunched)	**Yellow leaves, start at the bottom and work up leaving dead leaves at bottom, affected leaves retain normal shape**	Top Leaves Green, mid leaves yellow, Bottom leaves green, affected leaves bow downwards
Leaf Symptoms (Bunched)	**"unbunched"Same as**	**Last leaf emerged is yellow**
Matt Survival	**Mother plant dies, suckers survive (Sucker dies in very susceptible varieties)**	**Mother plant dies and suckers may survive**
Internal symptoms - Fruit	**NO**	**YES**
Internal symptoms - True Stem	**NO (only occur under extreme conditions)**	**YES (?mother to daughter spread, ?soil spread)**
Internal symptoms - Pseudostem	**Leaf sheathes, long unbroken red-brown streaks**	**NIL or YES accationally**
Speed of Symptom development	**Slower**	**Faster**
Odour from sever symptoms	**"Fusarium" smell (TR4)**	**NIL (not to be confused with "Erwinia" smell of soft rot)**
Most common infection site	**Root**	**Male Flower Bract**

Host origin, cultivars, host genotype from race 4 isolates of Foc and isolate grouping based on VCGs

Isolates	Host origin	Cultivars	Host genotype	VCGs
Bnt2	**Yogyakarta**	**Pisang Awak**	**ABB**	**01213/16**
Mln1	**Yogyakarta**	**Pisang Kepok Kerau**	**ABB**	**01213/16**
Srg1	**Central Java**	**Pisang Raja**	**AAB**	**01213/16**
Bgl6	**Central Java**	**Pisang Raja**	**AAB**	**01213/16**
Bgl3	**Central Java**	**Pisang Kepok**	**ABB**	**01213/16**
A13	**Yogyakarta**	**Pisang Ambon**	**AAA**	**01213/16[c]**
Gnk3	**Yogyakarta**	**Pisang Ambon**	**AAA**	**0120**
Wsb5	**Central Java**	**Pisang Ambon**	**AAA**	**0120**
Lmp1	**Lampung (Sumatera)**	**Pisang Raja Nangka**	**AAB**	**01213/16**
Kjg1	**East Kalimantan**	**Pisang Ambon**	**AAA**	**01213/16**

Tropical race 4 - FOC PCR

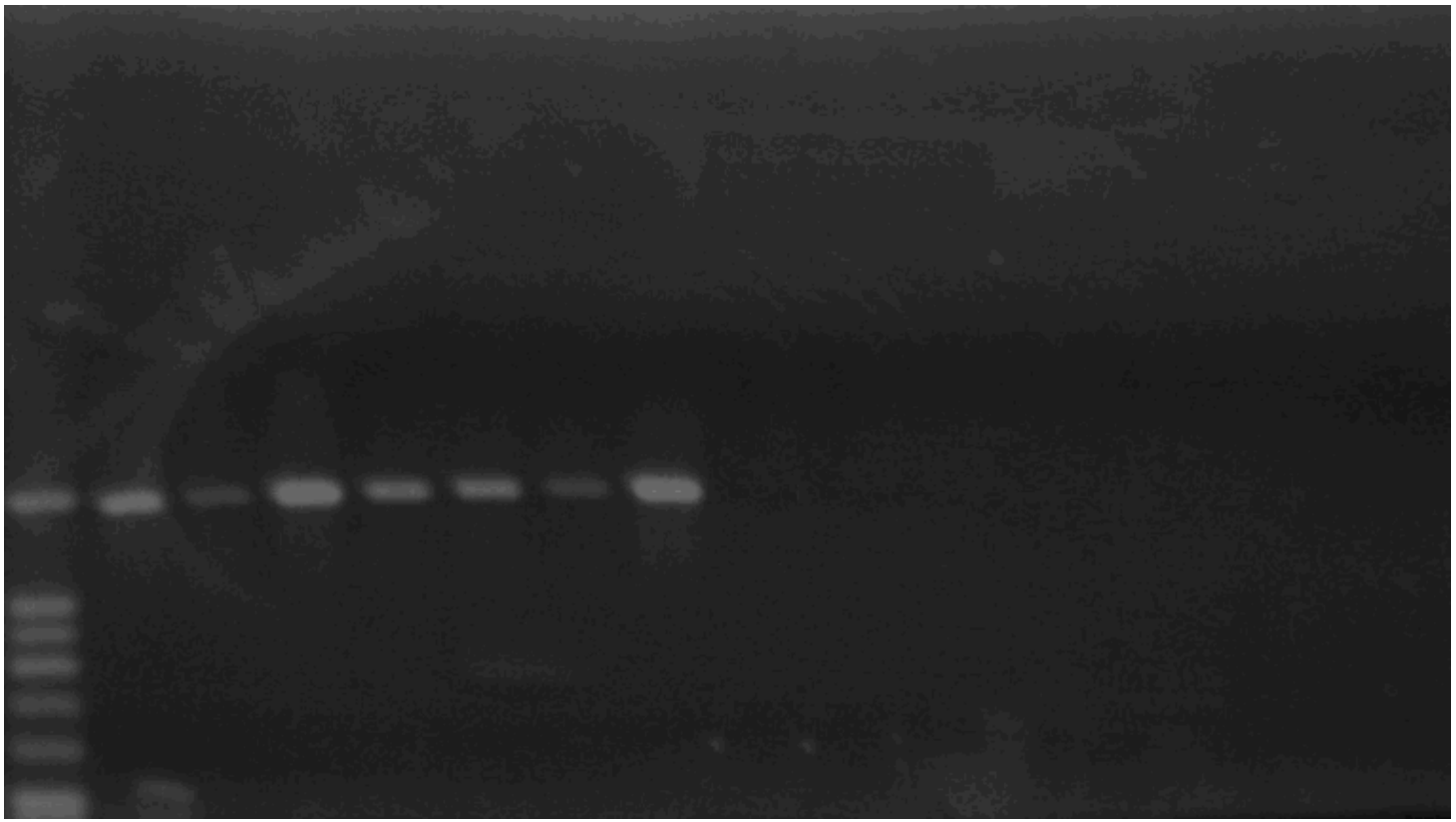




PCR

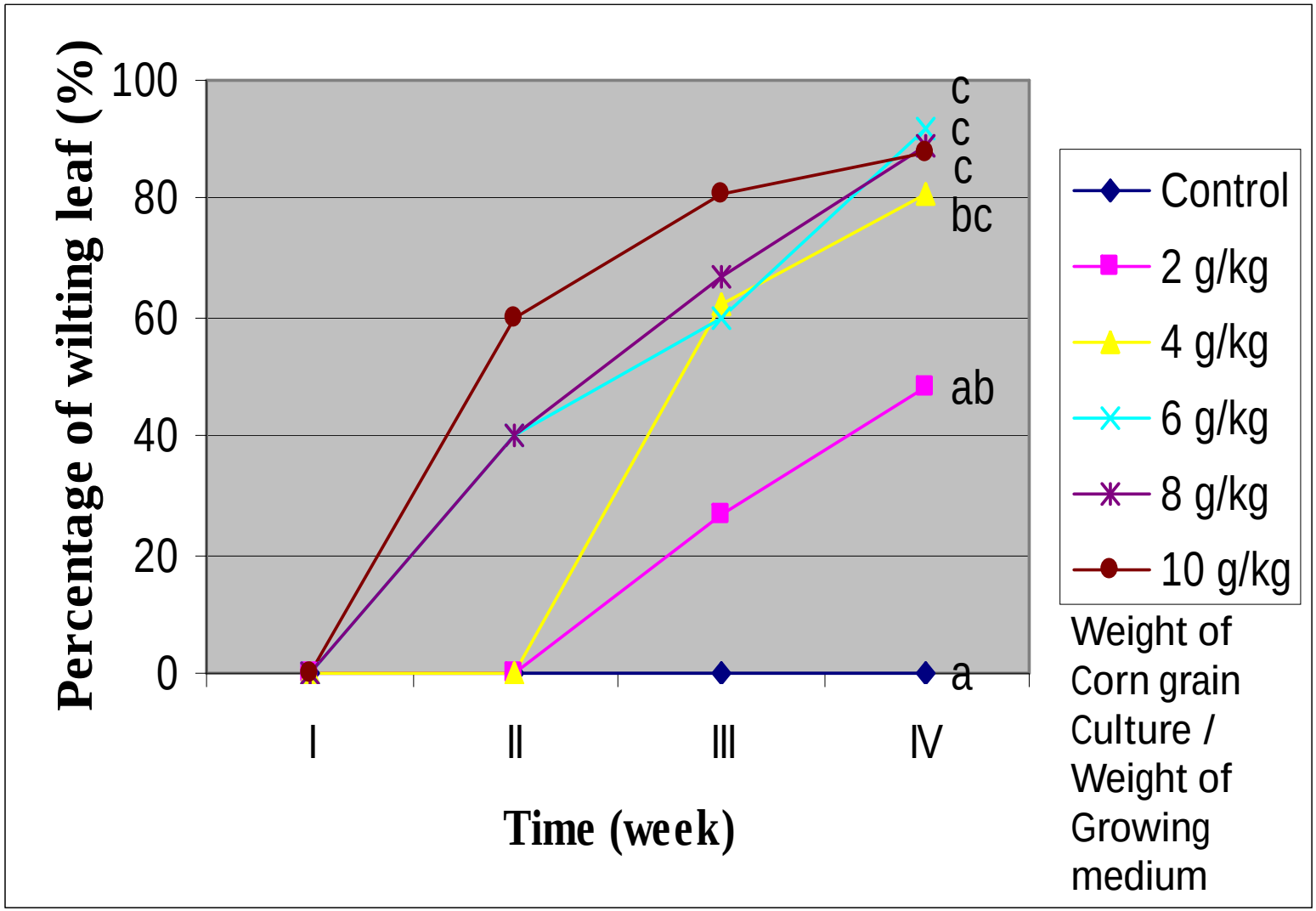
Extract DNA

Foc TR4 PCR identification



The primer sequences are in press

Inoculation of Foc at different population density, the higher the concentration the higher the disease severity and the shorter the incubation period



Incidence of Foc samples found in Sumatera, Bangka, Java, and Kalimantan

No	Type of Banana	%
1	Pisang Ambon (Gros Mitchel)	44
2	Pisang raja	15
3	Pisang Kepok	15
4	Pisang Awak	20
5	Cavendish	5

- **Field trial showed that Barangan was highly susceptible towards TR4 of Foc infection dying in the first year after field planting , whereas cultivar Kepok Kuning, Puju and Panjang were more resistant and survive until the fifth year but declining**
- **Resistance mechanism of banana cultivar was correlated with peroxidase activity in the plant roots. The higher peroxidase activity, the more resistance the banana cultivar towards TR4 of Foc infection**

Source : Arif Wibowo 2011

MANAGEMENT OF BANANA WILT DISEASES

- Integrated control with wide area management is needed
- National Banana Wilt Task Force was established in Indonesia early 2000
- Eradication by herbicide or kerosene mat injection, burning or digging the infected mats/tissues
- Isolating the infected mats/lands

MANAGEMENT OF BANANA WILT DISEASES continue

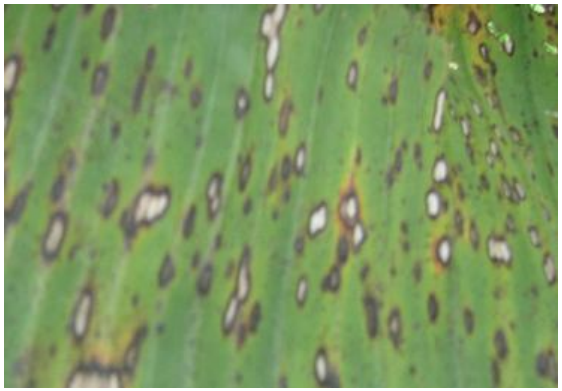
- Disease Free seedlings (from tissue culture) for replanting and never use suckers obtained from infected mats or endemic area
- Optional planting dessert banana in BDB endemic areas with flower/fruit bagging and male flower de-budding
- Avoid planting dessert banana in Foc endemic areas
- Planting cooking bananas in Foc endemic areas and plant rotation.

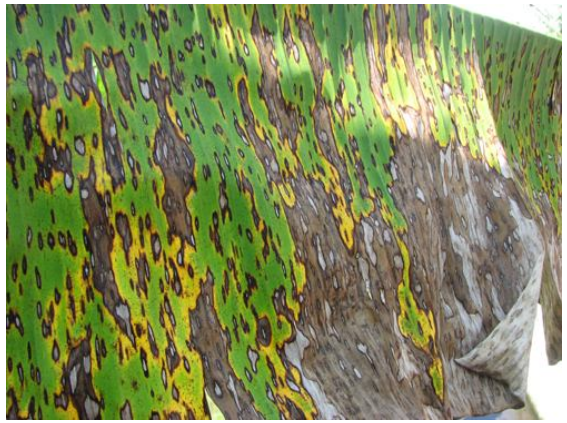
MANAGEMENT OF BANANA WILT DISEASES continue

- De-budding male flowers after fruiting
- Bagging the fruits using insecticide plastic/paper bags
- Biological control using fluorescent pseudomonads, *Trcichoderma*, *Giocladium* etc with compost application, however the results may be not consistent
- Intensive cultivation with organic fertilizers (composts, humus etc)
- Disinfection of agricultural tools used in the field

Flower de budding and fruit bagging to protect from visiting insects

Banana Leaf spots





Virus Diseases

Bunchy Top

Mosaic

Aknowledgement

Appreciation and gratefully thank you to ITFnet for inviting and providing travel grant to joint this workshop

TERIMA KASIH