



# **Banana bunchy top disease**

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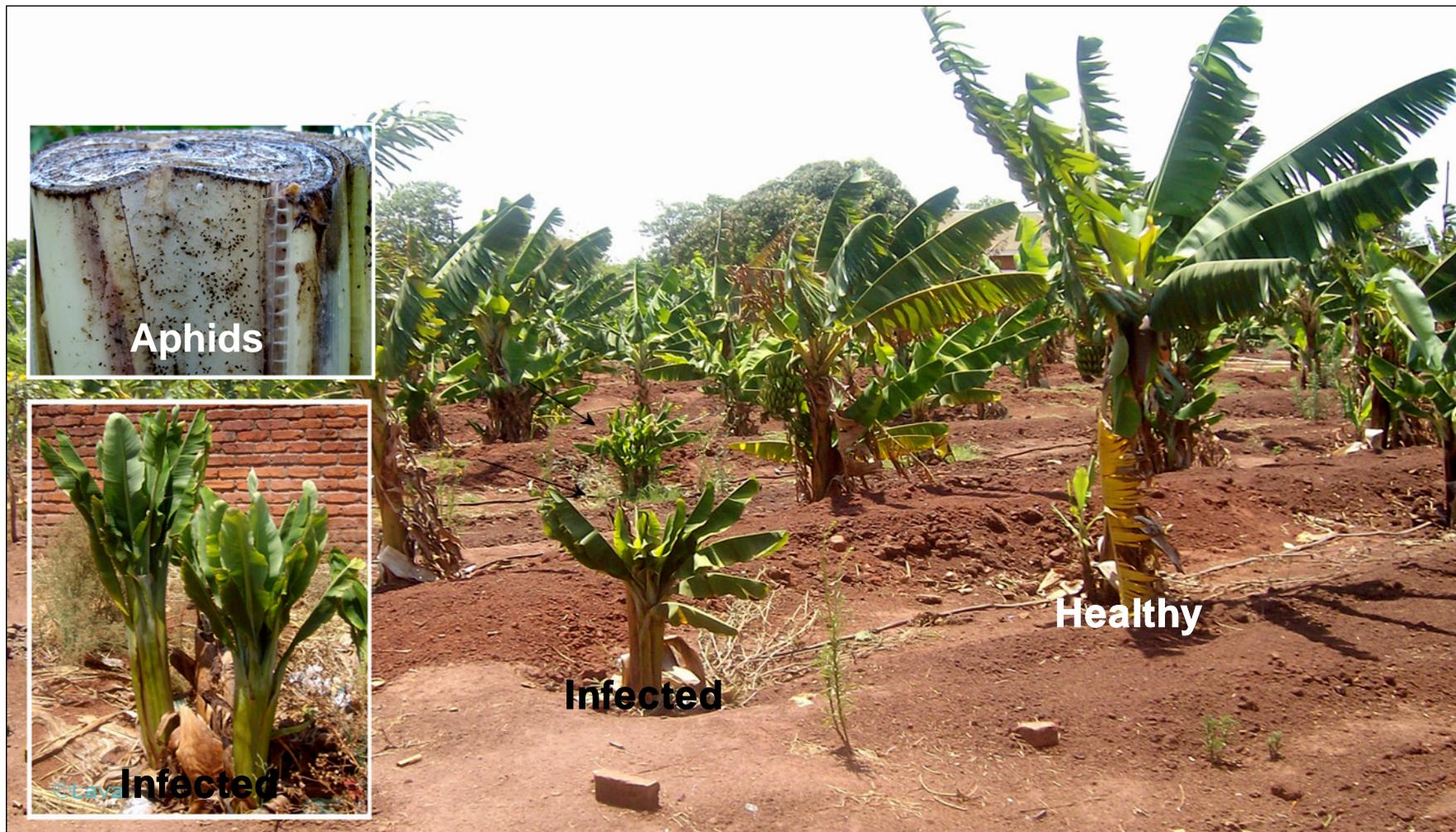
# **IITA** BBTD – the most destructive disease



**Banana aphid**

- Caused by *Banana bunchy top virus* (BBTV)
- Infects only *Musaceae* (banana, plantain and wild relatives) and Ensete
- BBTV is transmitted by the banana aphid, *Pentalonia nigronervosa*)

# **IITA** BBTD – the most destructive disease



- Causes extreme severe stunting and renders plants unproductive.



**A. Clumping (bunching)**



**B. Morse code chlorosis**



**C. Chlorotic streaks**

## Characteristic symptoms:

- Clumping at the top (A)
- Morse code (dash-dot) chlorosis on leaf lamina (B)
- Chlorotic streaks on petioles and pseudostem (C)

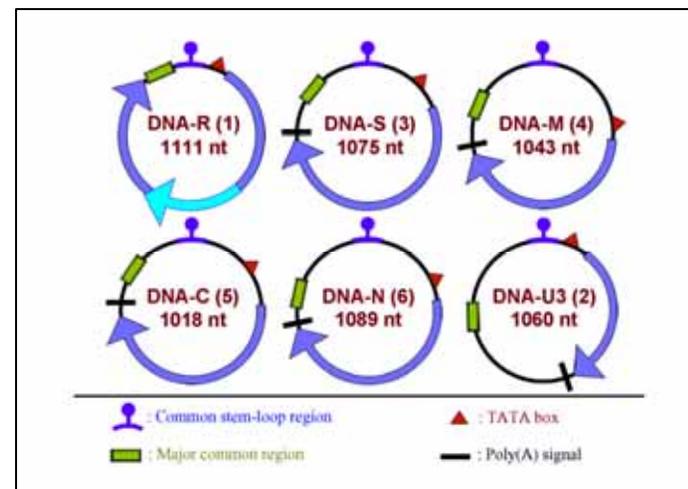
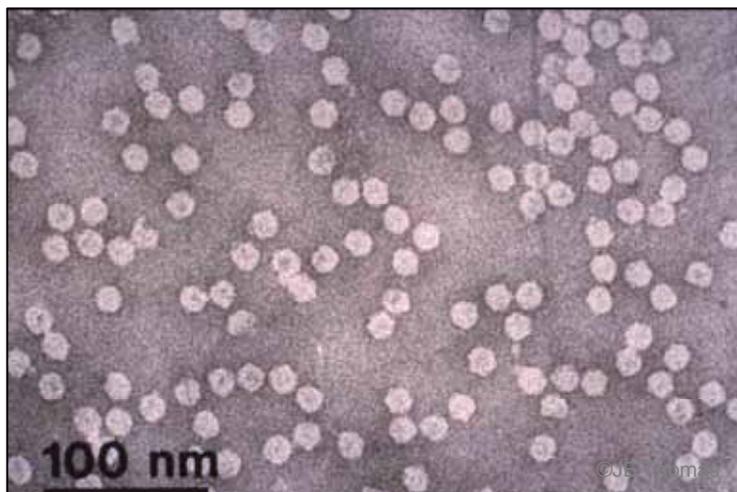


# **BBTD – symptoms**

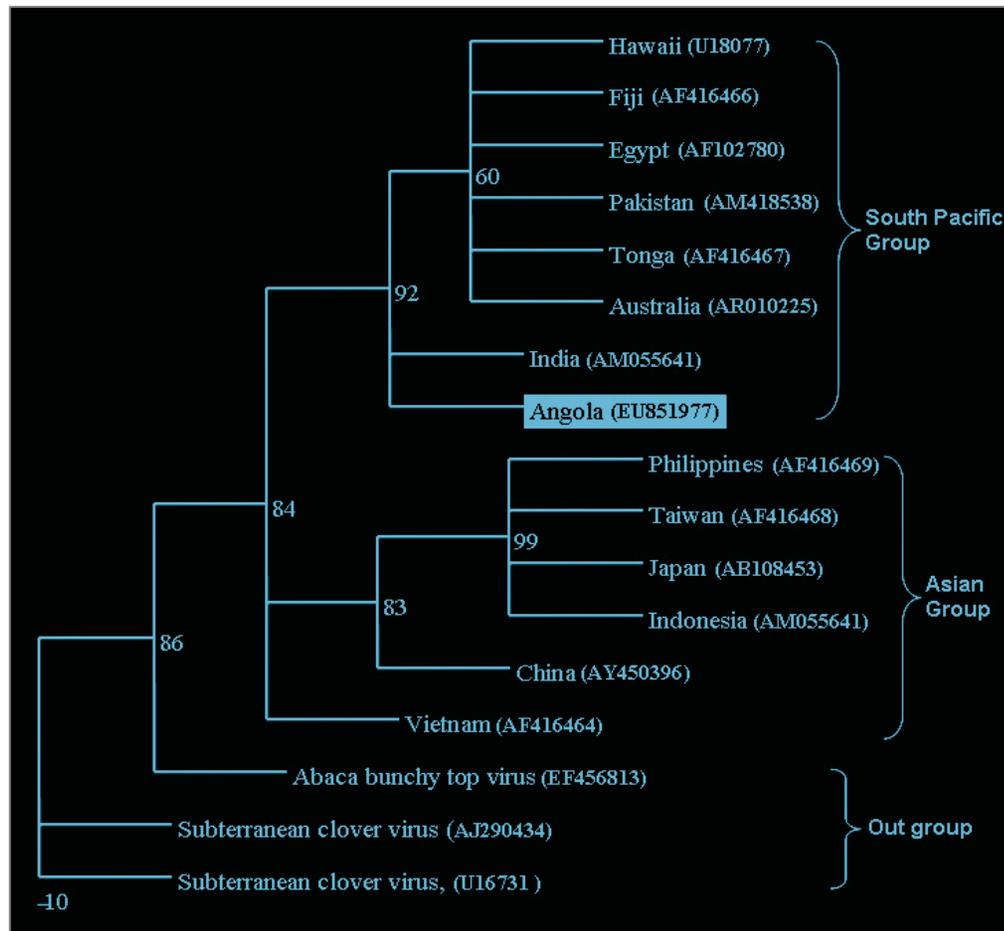
- **There are no immune genotypes**
- **Symptoms depends on cultivars**
- **Incubation period (time for first symptom appearance) is about 25 days in Cavendish (AAA) group**
- **Symptoms appear in leaves that are formed after infection**
- **Plants infected at late stage do not show symptoms, but suckers of such plants produce symptoms**
- **Symptom variation (severity) in plants within a mat is common**

# Genus *Babuvirus*; family *Nanoviridae*

- Multi-component, with ~20 nm isometric virions
- Genome is six segmented, single stranded circular DNA
- One structural protein of 20 kD (coat protein)
- Virus restricted to phloem tissue only

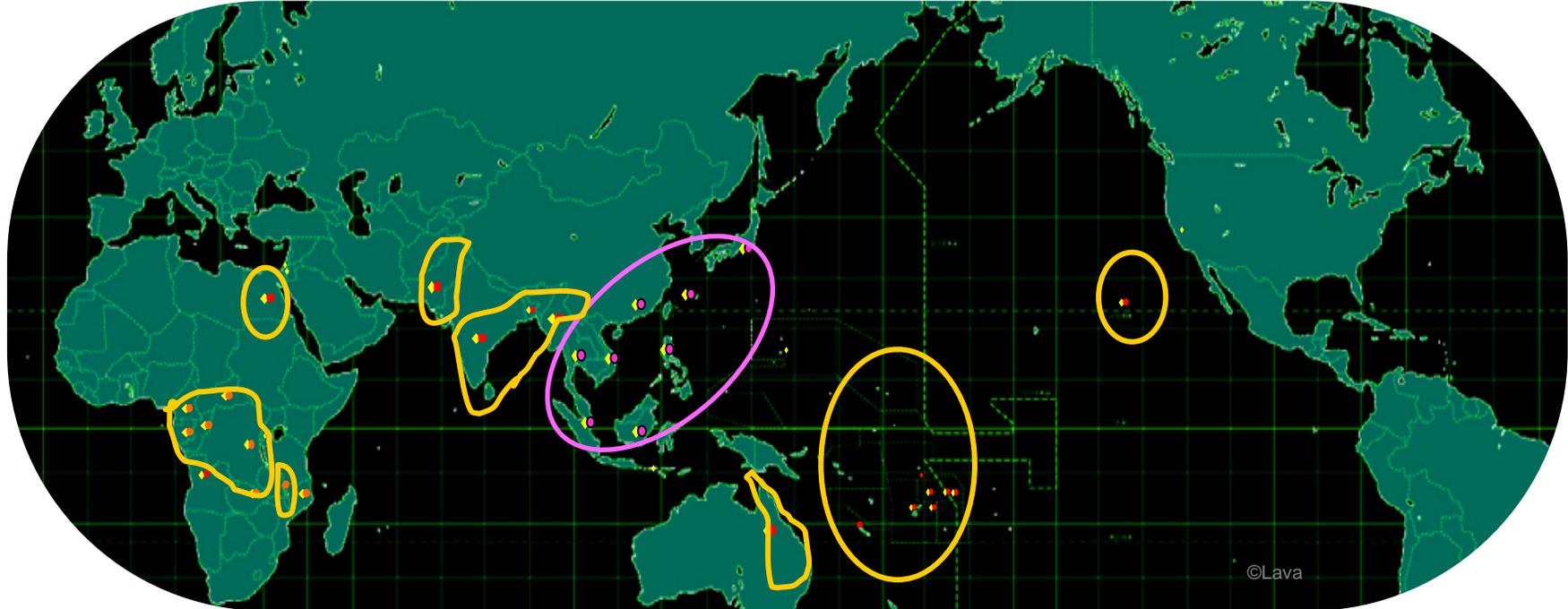


# BBTV: Diversity



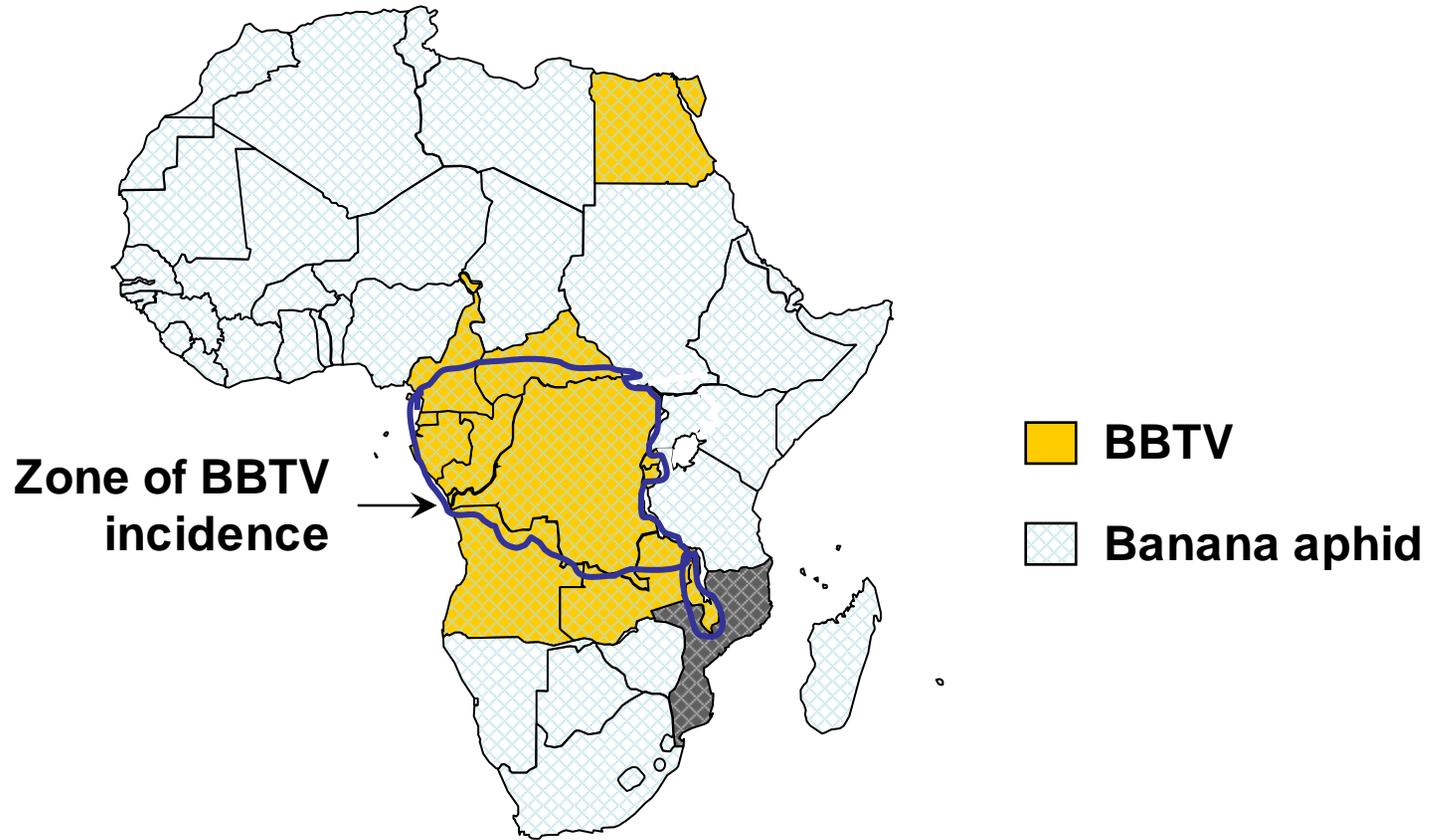
- Based on genomic diversity, BBTV isolates around the world forms two subgroups:

1. South Pacific
2. Asia



Continent	Virus	Countries
Australia	SP-group	Australia
Asia	SP-group	India, Pakistan, Sri Lanka, Myanmar, Bangladesh.
Asia	A-group	Taiwan, China, Japan, Philippines, Indonesia, Vietnam, Thailand
Africa	SP-group	Egypt, DRC, Congo, Cameroon, Angola, Malawi, Zambia, Rwanda, Burundi, Gabon, Editorial Guinea, CAR
South Pacific	SP-group	Hawaii and South Pacific islands (Fiji, Tonga, etc)

# BBTV: Distribution in Africa



# BBTV: transmission

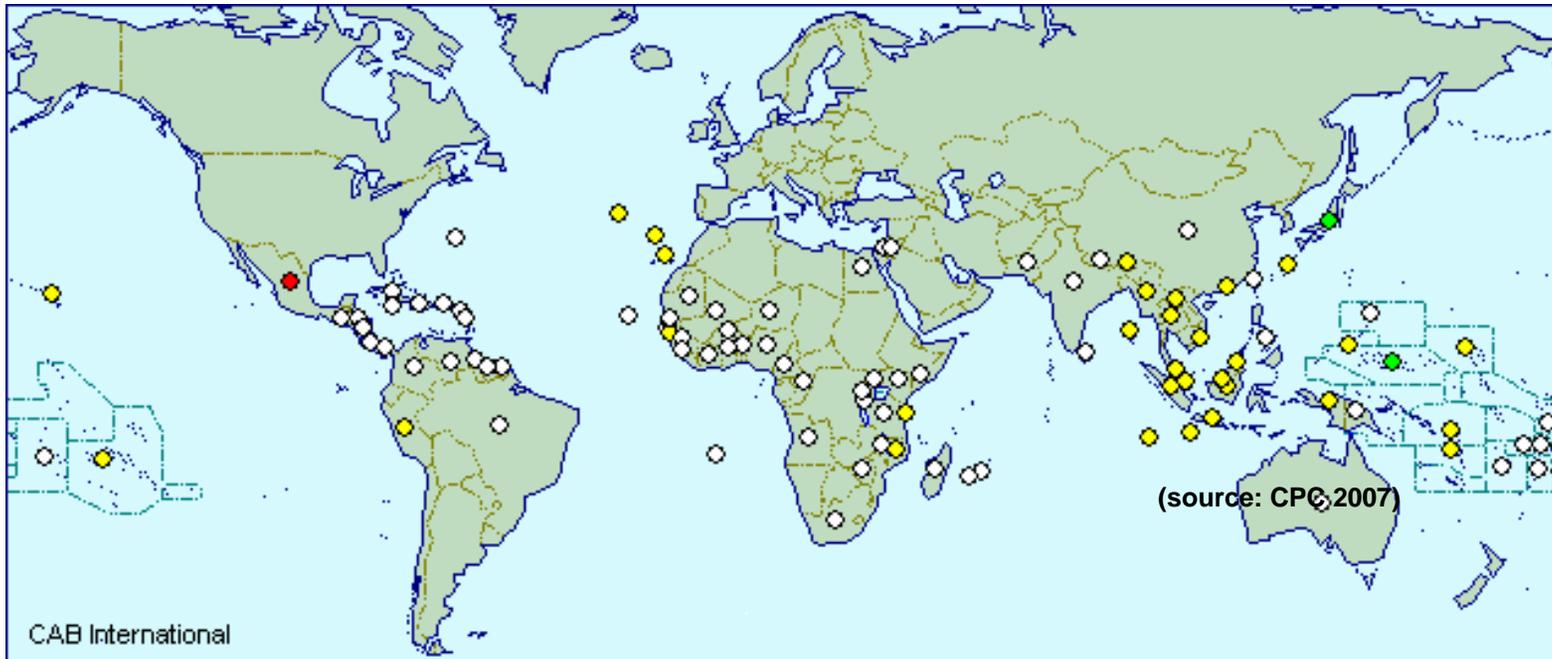
Natural transmission of BBTV is through:

- Banana aphid
- Suckers and corms
- Tissue culture plants



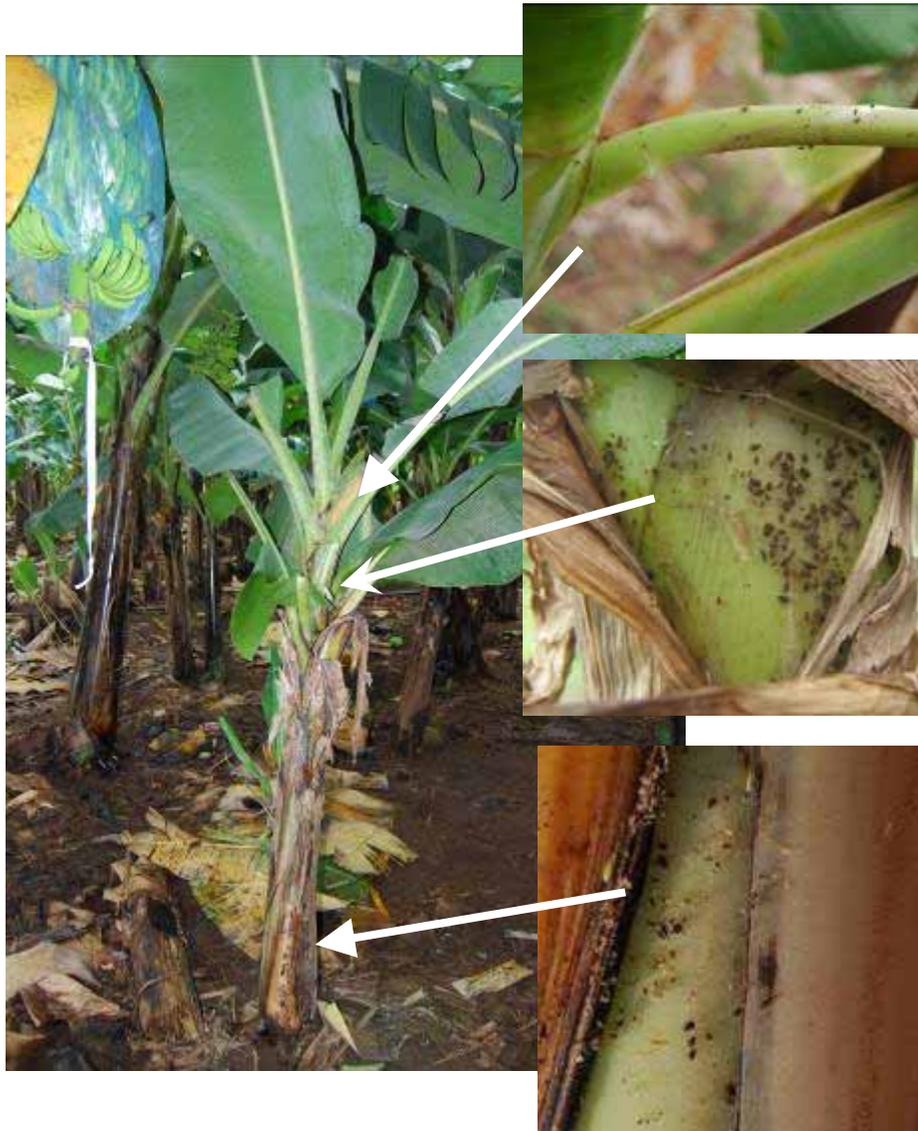
- But not by mechanical transmission, or through farming implements or any other means

# Banana aphid: distribution



**Putative area of origin: Papua New Guinea, Eastern Indonesia**  
**Little is known about timing invasion outside of its area of origin**

# Banana aphid: distribution



**Found on**

**Old leaf sheaths**

**Emerging leaves**

**Pseudostem**

**•Distribution depends on the cultivar and season**

# Banana aphid: Host plants

**Musaceae, Araceae, Commelinaceae, Zingiberaceae**

## Major hosts

*Musa* (banana and plantain), *Musa textilis* (manila hemp or abaca),  
*Colocasia esculenta* (taro)

## Minor hosts (at least 14)

*Xanthosoma mafaffa* (cocoyam), *Zingiber officinale* (ginger),  
*Aframomum daniellii*, *Costus afer*, *Alocasia* spp, *Alpinia* spp,  
*Elettaria cardamomum* (cardamom) , *Heliconia*, *Strelizia reginae*  
(Queens bird-of-paradise), *Hedychium coronarium*, *Canna* spp.



Cardamom

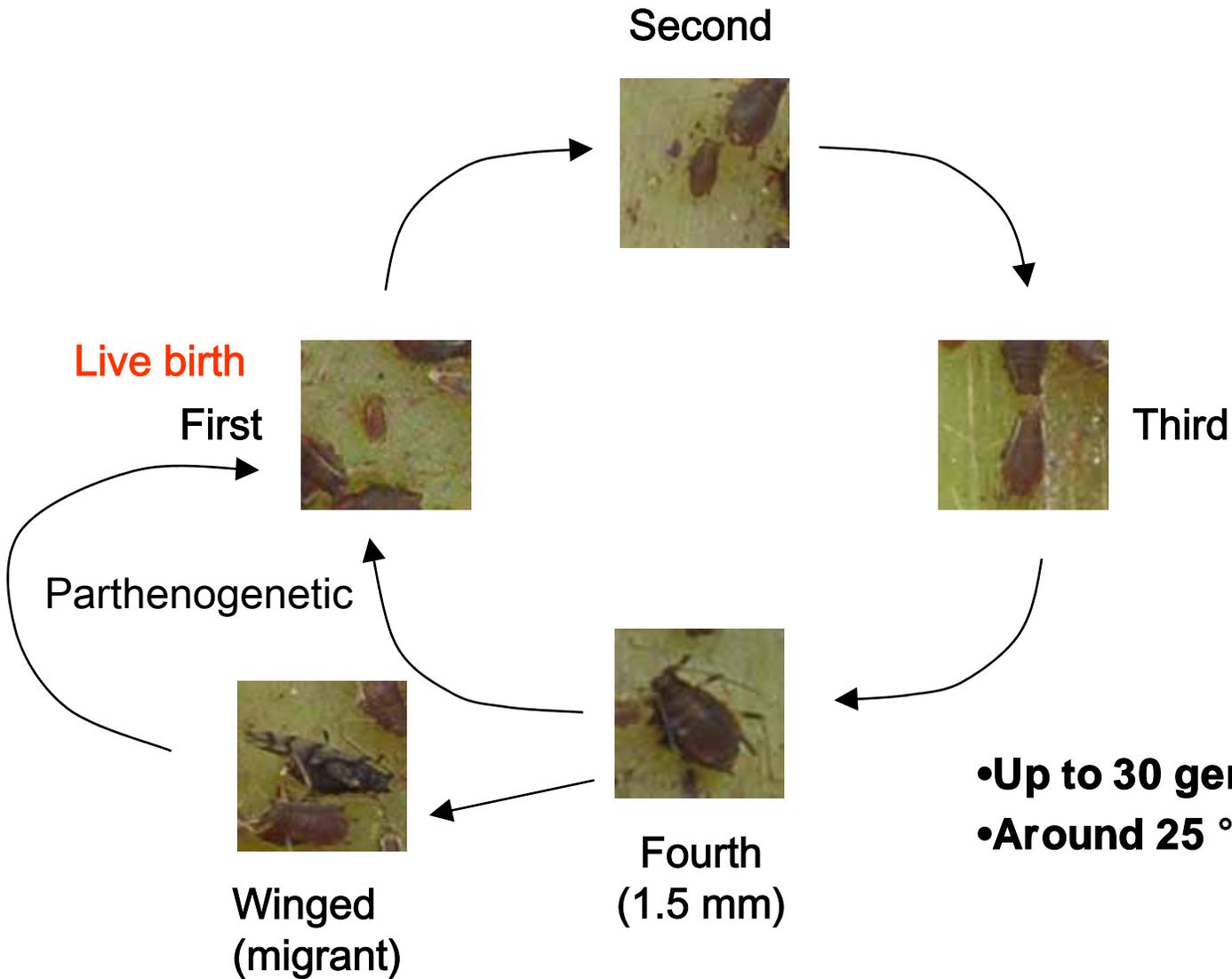


Cocoyam



Ginger

# Life cycle of the banana aphid



- Up to 30 generations per year;
- Around 25 °C is best for growth

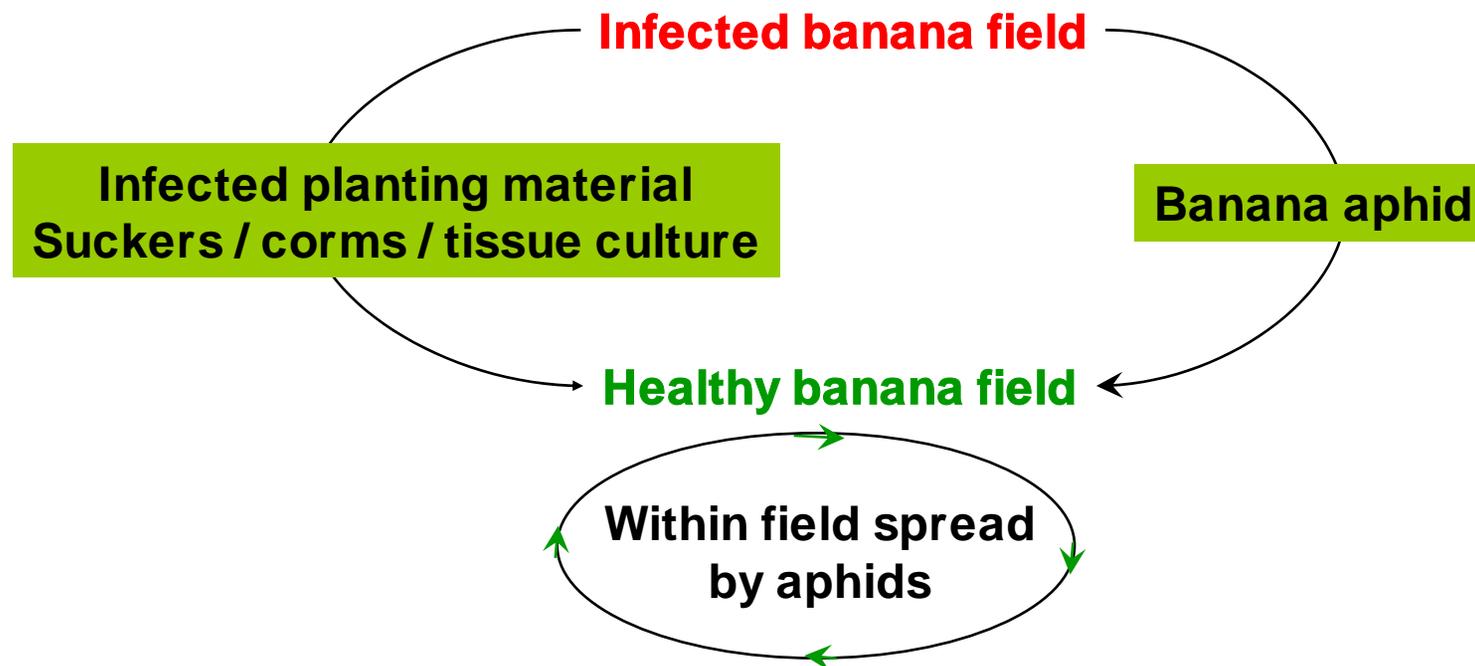


# Virus transmission by aphids

- **Banana aphid is the only vector**
- **Circulative, non-propagative mode of transmission**
- **Aphid retains infectivity for life**
- **All stages of aphids (nymphs and adults) can transmit the virus**
- **Single aphid can transmit the virus**
- **Virus is not transmitted through aphid eggs**
  
- **Minimum acquisition feeding period: 4 h**
- **Minimum inoculation feeding period: 15 min**
- **Latent period: 20 h**
- **Virus transmission depends on the temperature, stage of the aphid and plant access period.**

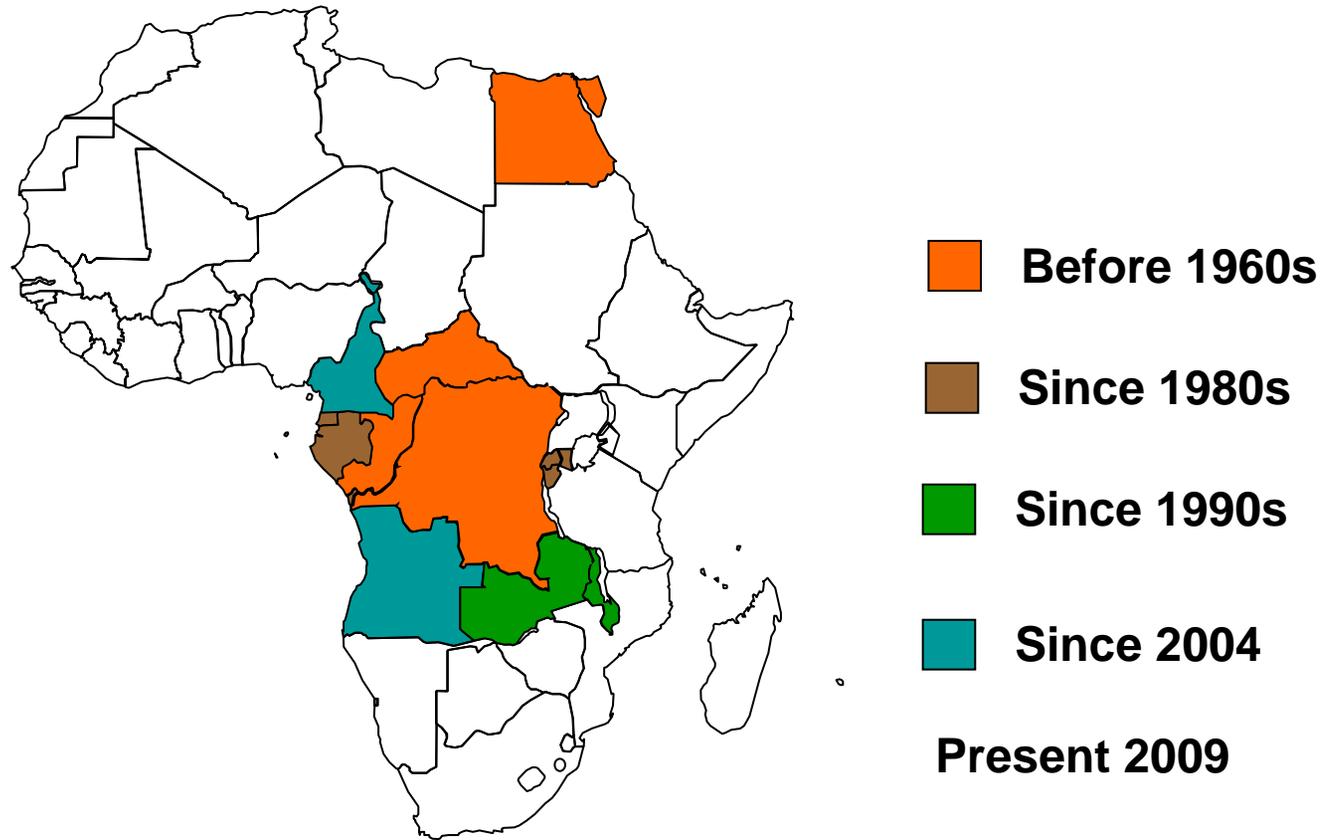
# BBTV epidemiology

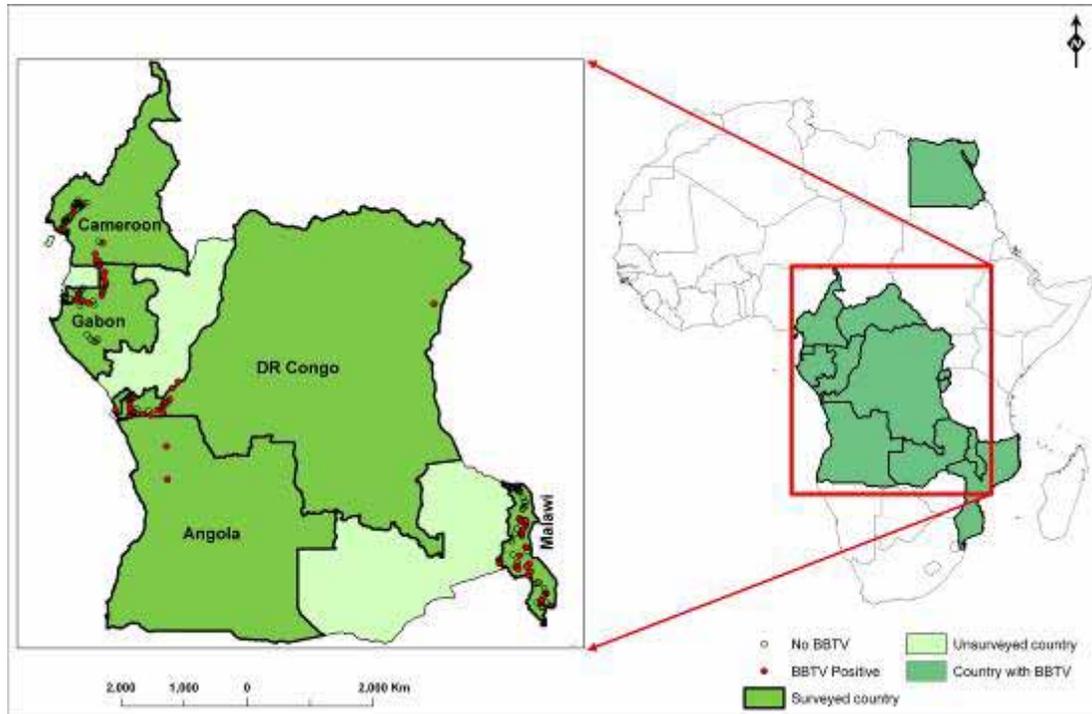
- Infection occurs through banana aphid transmission or movement of infected suckers / tissue culture plants



Type	Reliability	Remarks
Symptoms	++	Depends on the variety and time of infection
Transmission to indicator hosts	-	Virus is not mechanically transmissible; aphid vector transmission is impractical.
Electron microscopy	+	Not sensitive
ELISA / DIBA	+++	Most convenient assay; but less sensitive
NASH	++	Cumbersome, but effective
PCR	+++	Method of choice (Many procedures in use)

# BBTV: in Africa





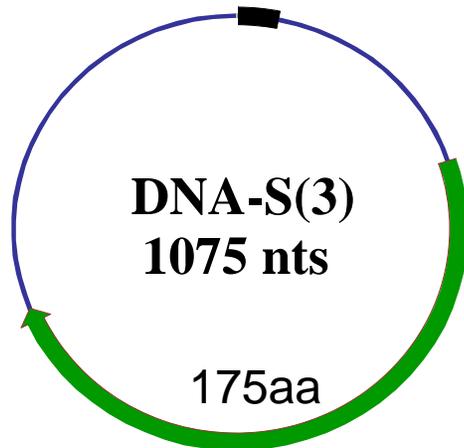
- Roving survey.
- Samples collected from symptomatic and asymptomatic plants for virus analysis.
- Interviews with farmers

•Surveys were also conducted in Nigeria, Benin and Ghana. There is no evidence of BBTV in these countries.

- **BBTV is widespread in Central and Southern Africa.**
  - **Disease affects are severe in Cavendish, but local varieties, despite infection can tolerate the disease.**
  - **Human movement of planting material seems to be the main reason for widespread distribution.**
  - **Role of aphid transmission is significant in most places.**
- **Infected plants are the potential sources for new spread.**
  - **Risk of spread is high in the routes of traditional exchange of planting material.**
  - **Important to protect the source sites.**

- Coat protein (DNA-S) gene sequences of 10 BBTV isolates from Cameroon, Gabon, DRC, Malawi and Angola determined.

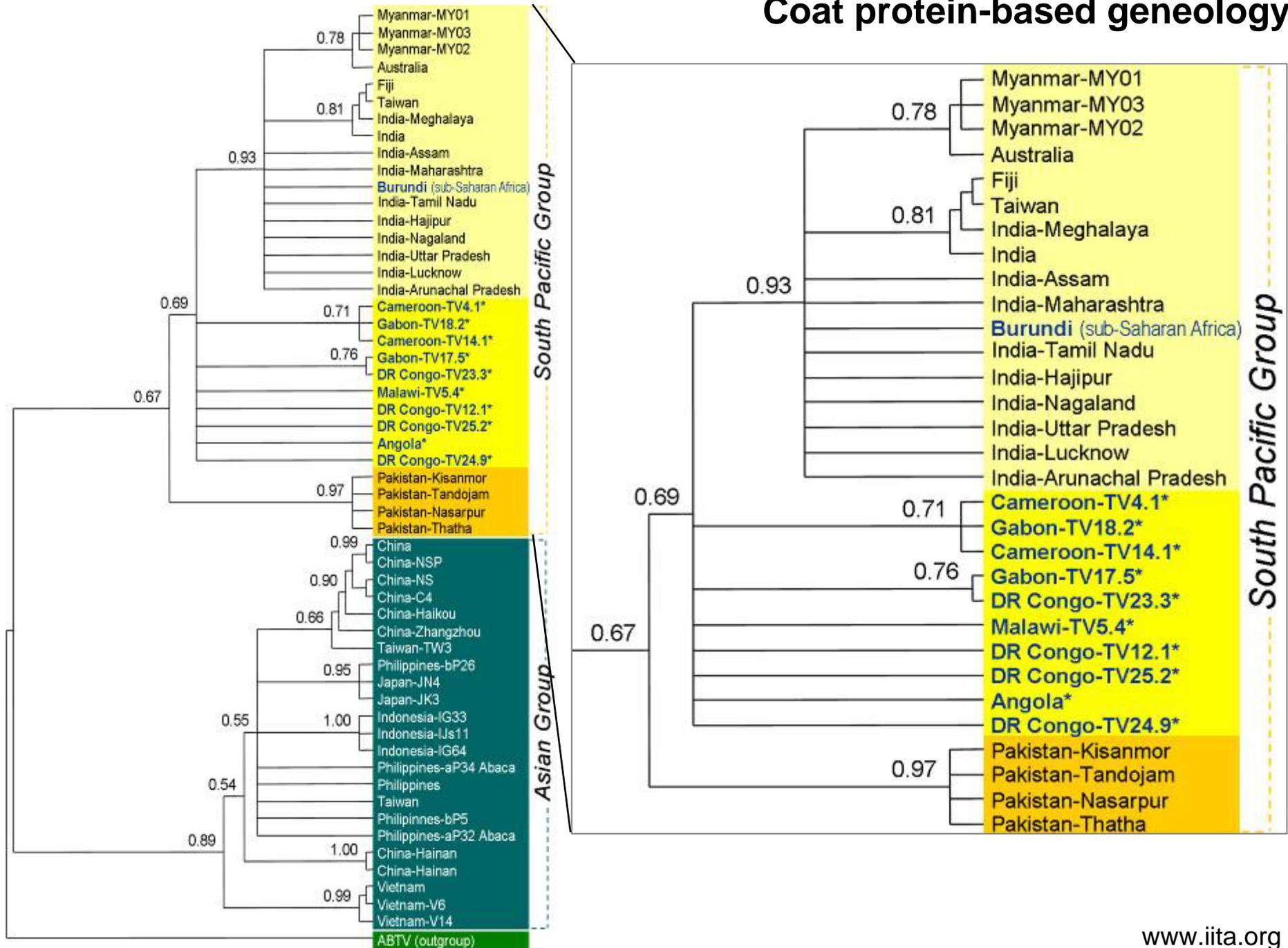
- Pair-wise comparisons of coat protein sequences (nucleotides / amino acids)



	Angola	TV12.1	TV14.1	TV17.5	TV18.2	TV23.3	TV24.9	TV25.2	TV4.1	TV5.4
Burundi	98/99	98/99	98/99	98/100	98/98	99/100	98/99	98/99	99/100	99/100
Angola		99/99	99/99	99/99	98/97	99/99	99/98	99/98	99/99	100/99
DRC-TV12.1			99/99	99/99	98/97	99/99	99/98	99/98	99/99	100/99
CM-TV14.1				99/99	98/97	99/99	99/98	99/98	100/99	100/99
GB-TV17.5					98/98	100/100	99/99	99/99	99/100	100/100
GB-TV18.2						99/98	98/96	98/96	99/98	99/98
DRC-TV23.3							99/99	99/99	100/100	100/100
DRC-TV24.9								98/98	99/99	99/99
DRC-TV25.2									99/99	99/99
CM-TV4.1										100/100
MW-TV5.4										

- Very high sequence similarities 98-100% sequence identity

# Coat protein-based geneology





- **BBTV in SSA aligns with BBTV isolates from South Pacific group.**
- **High sequence similarity between the BBTV isolates suggest a common origin.**

- **Severe incidence and spread seems to be due to**
  - **Increase in cultivation of most susceptible varieties, such as Cavendish**
  - **Planting of infected suckers**
  - **Aphids vector contributing to the secondary spread.**

- **Basic knowledge and technologies available to tackle the problem.**
- **Tolerant (or less susceptible) varieties available, which could avert economic losses .**
- **Awareness creation, training in virus monitoring and production of clean planting material is necessary.**



# BBTV control in SSA



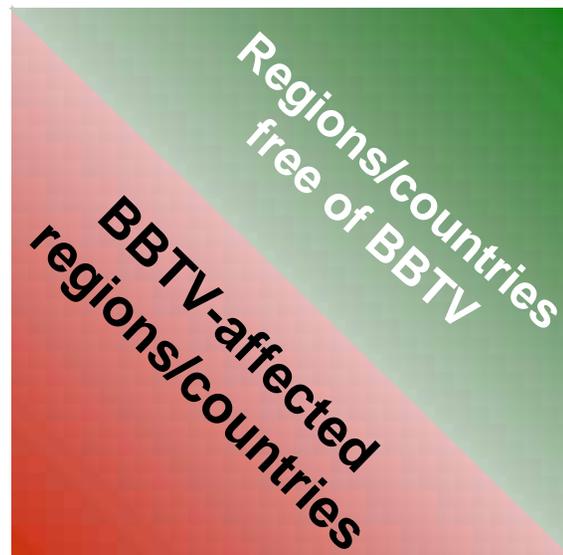
**1. Reduce sources of inoculum-  
Eliminate crop refuges**

**2. Reduce spread  
Vector control  
Physical barriers  
Seed testing**

**3. Reduce impact  
Replace infected mats  
Cultivate tolerant varieties**

**4. Avoidance by cultural methods  
Field isolation (buffer zone)  
Plant spacing**

**Exclusion & Prevention  
Control of material  
movement  
Awareness campaigns  
Increased vigilance  
Routine surveillance  
Field isolations**



# Eradication of BBTV-infected mats (virus & aphid sources)

## Herbicide treatment

- Insecticide spray
  - inject herbicide
  - Insecticide spray = **Plant & aphid death**

## Slash and burn or burry

- Uproot the infected mat and slash
  - burn / burry = **Plant & aphid death**

## Mechanized option



- Expensive
- Labour intensive
- Not ecofriendly
- Difficult to implement

- Sound implementation policy and government support
- Incentives to farmers
- Production and supply of clean planting material



# **BBTV Control in SSA**

- **Production and distribution of clean planting material is the key**
- **Protect new planting material from new infection**
- **Prevent further spread**

## **Immediate**

- **Awareness creation [Share information]**
- **Strengthen monitoring capacity [Diagnostics]**
- **Clearly delineate affected areas to contain the spread [intensive surveillance]**

## **Short to Medium-term**

- **Promote production and distribution of clean planting material**

## **Medium to long term**

- **Vector control and genetic enhancement**



**Thank you**

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