



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.



Characteristic symptoms:

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

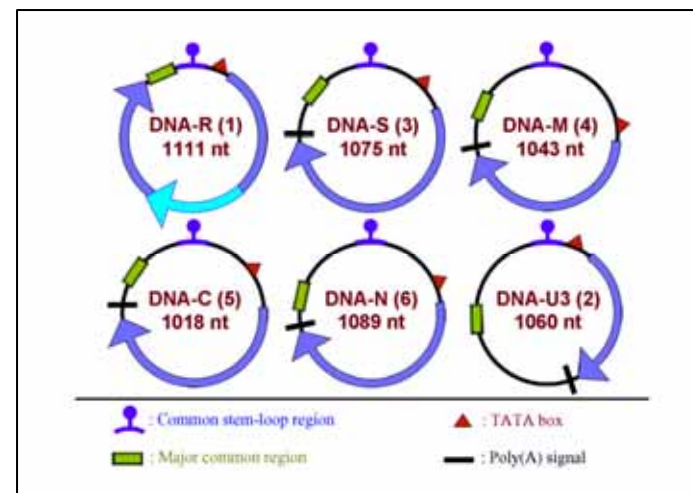
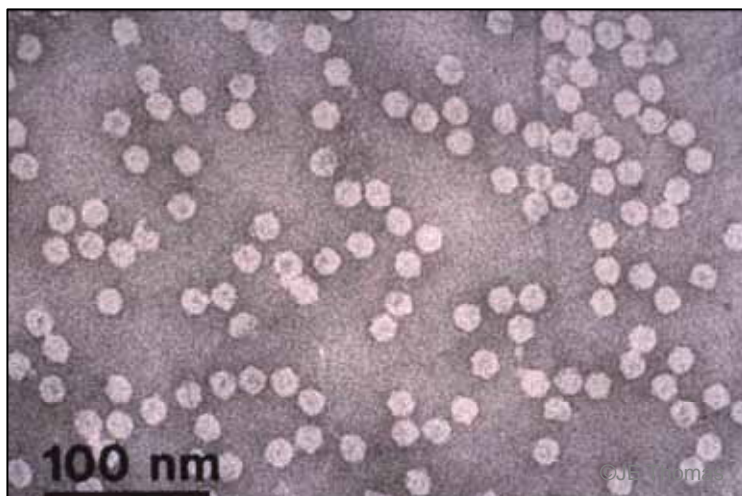


BBTD – symptoms

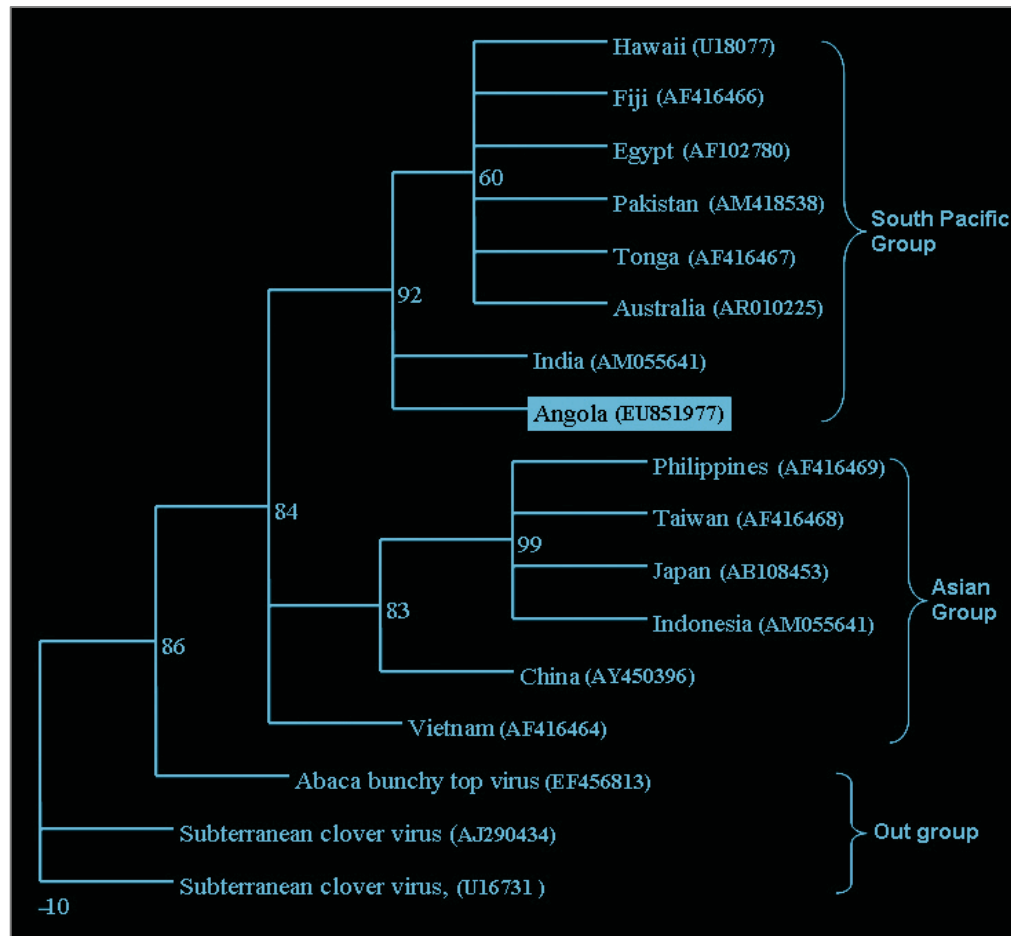
- **There are no immune genotypes**
- **Symptoms depends on cultivars**
- **Incubation period (time for first symptom appearance) is about 25 days in Cavendish (AAA) group**
- **Symptoms appear in leaves that are formed after infection**
- **Plants infected at late stage do not show symptoms, but suckers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

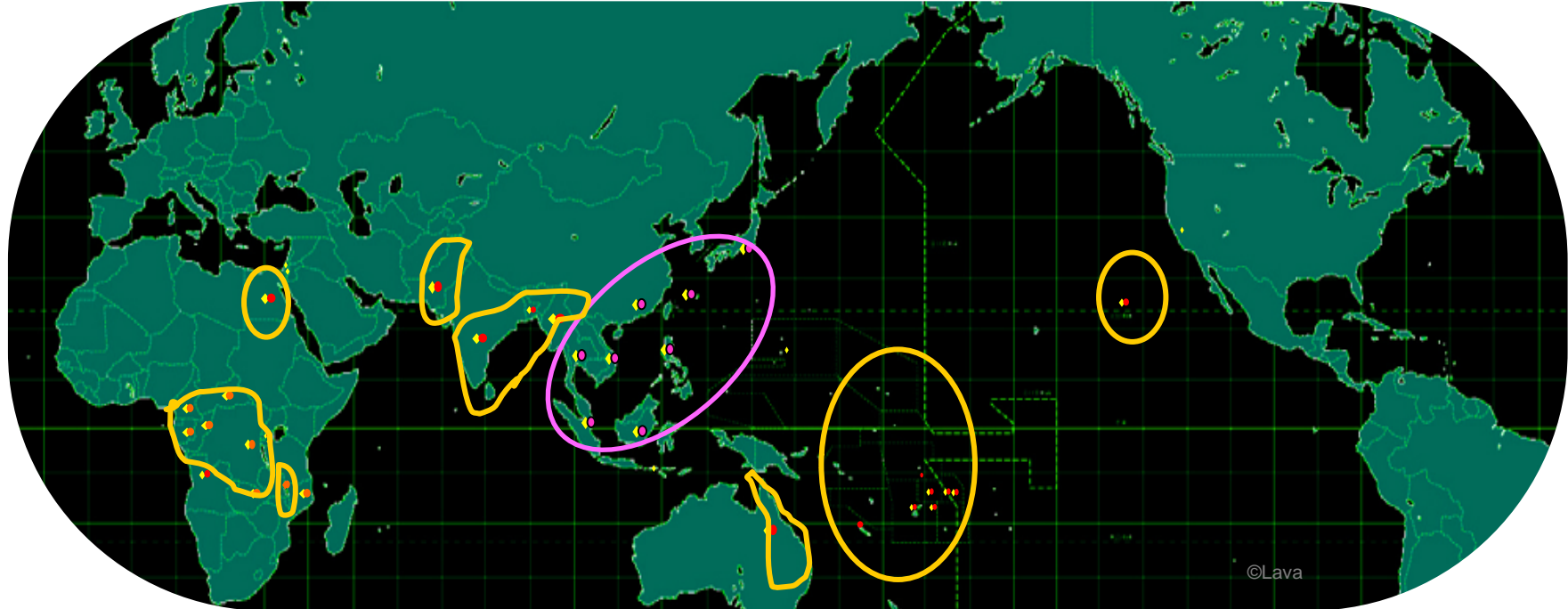


BBTV: Diversity



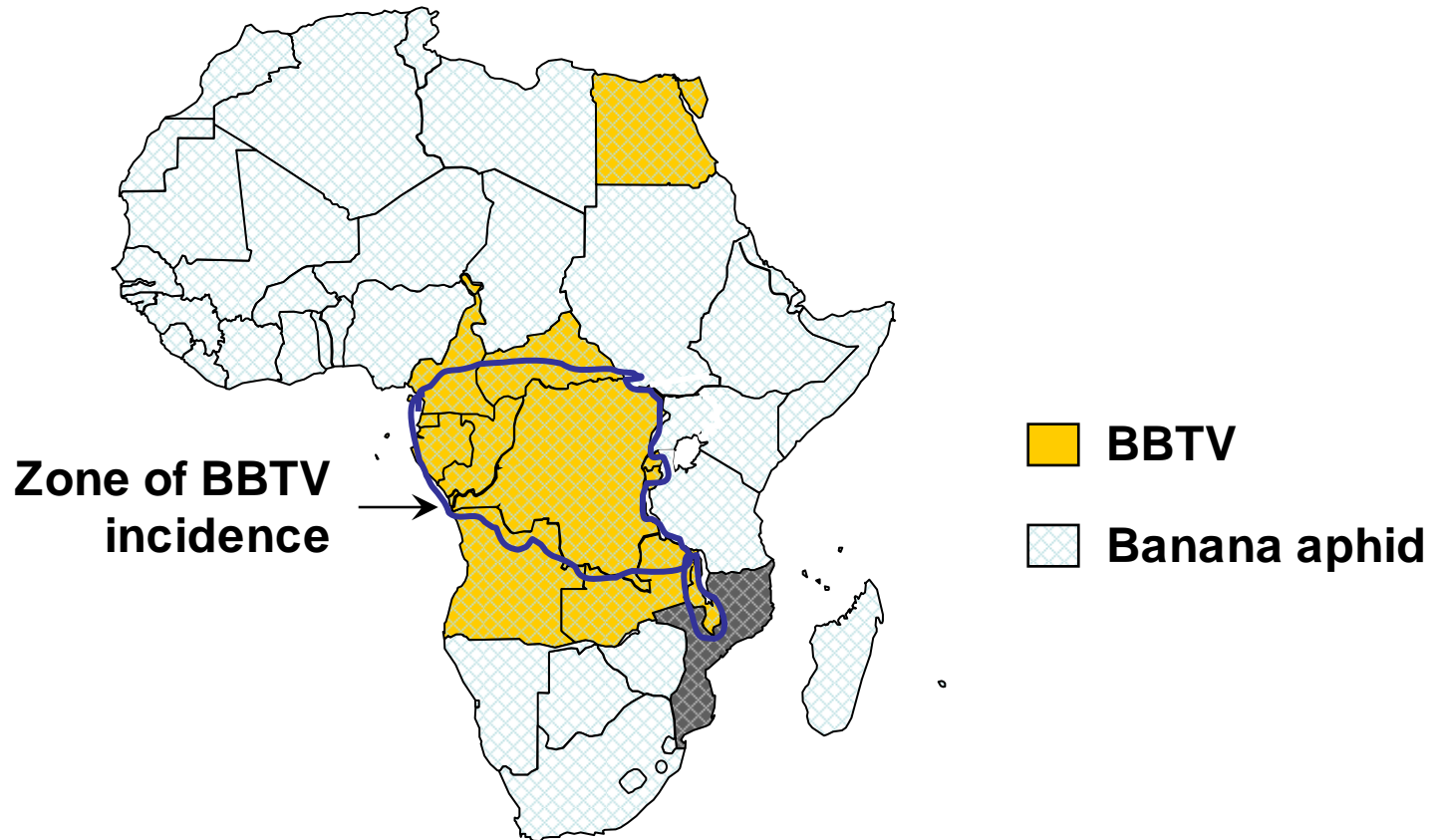
- Based on genomic diversity, BBTV isolates around the world forms two subgroups:

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

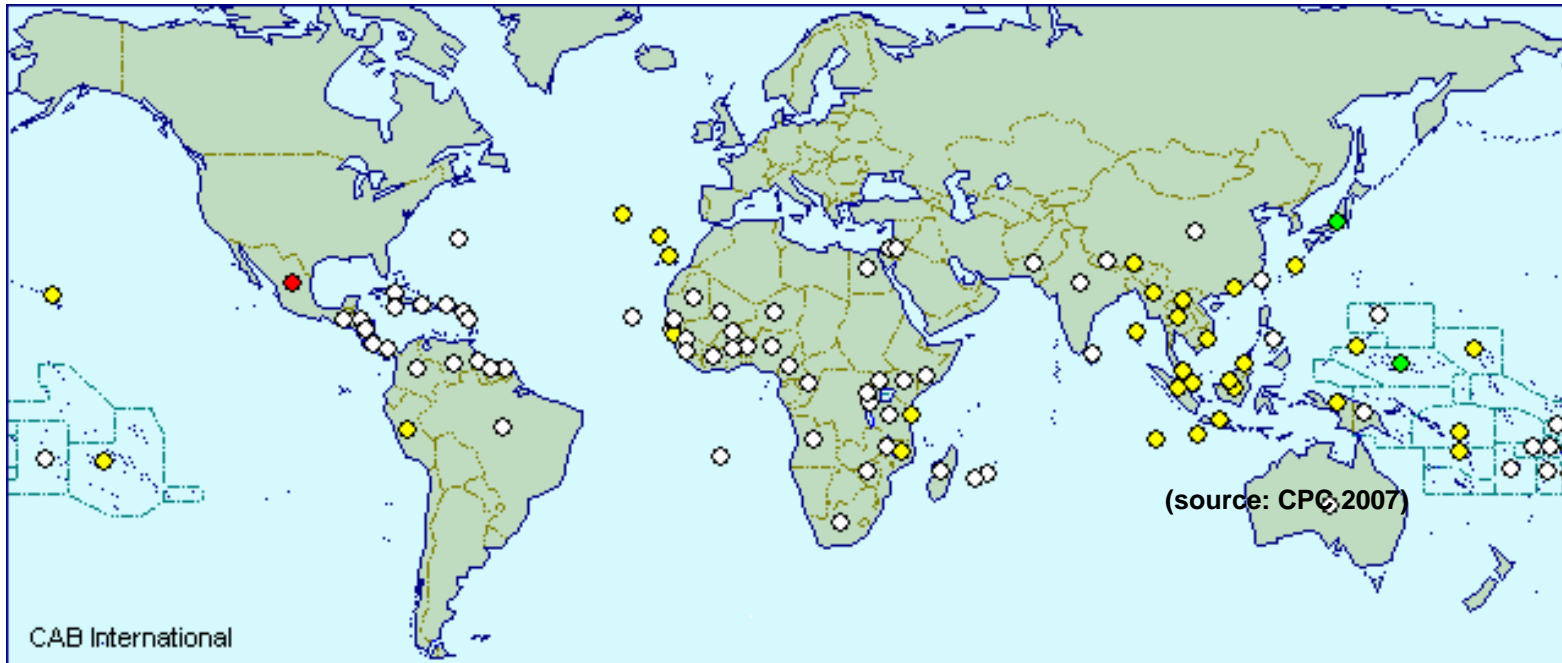
Natural transmission of BBTV is through:

- Banana aphid
- Suckers and corms
- Tissue culture plants



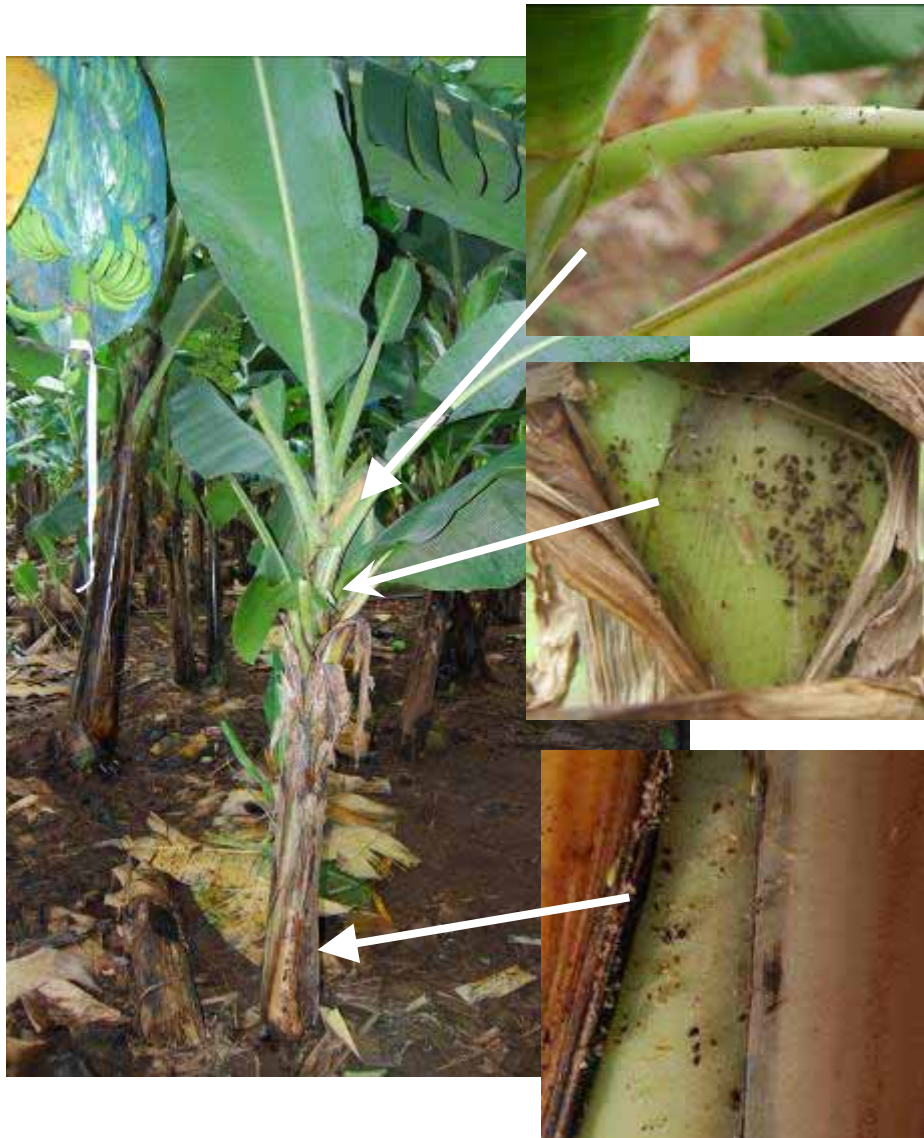
- **But not by mechanical transmission, or through farming implements or any other means**

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

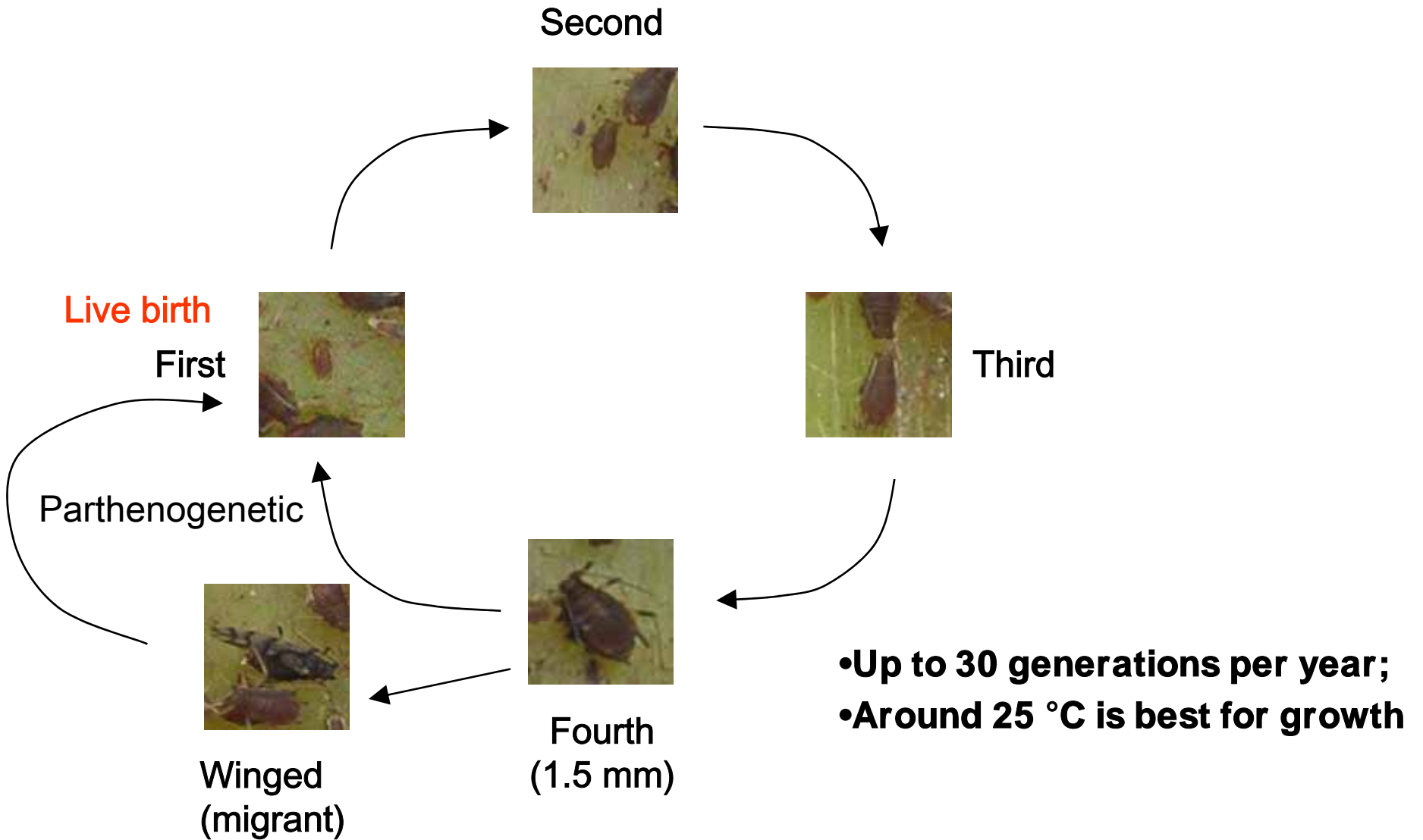


Cocoyam



Ginger

Life cycle of the banana aphid



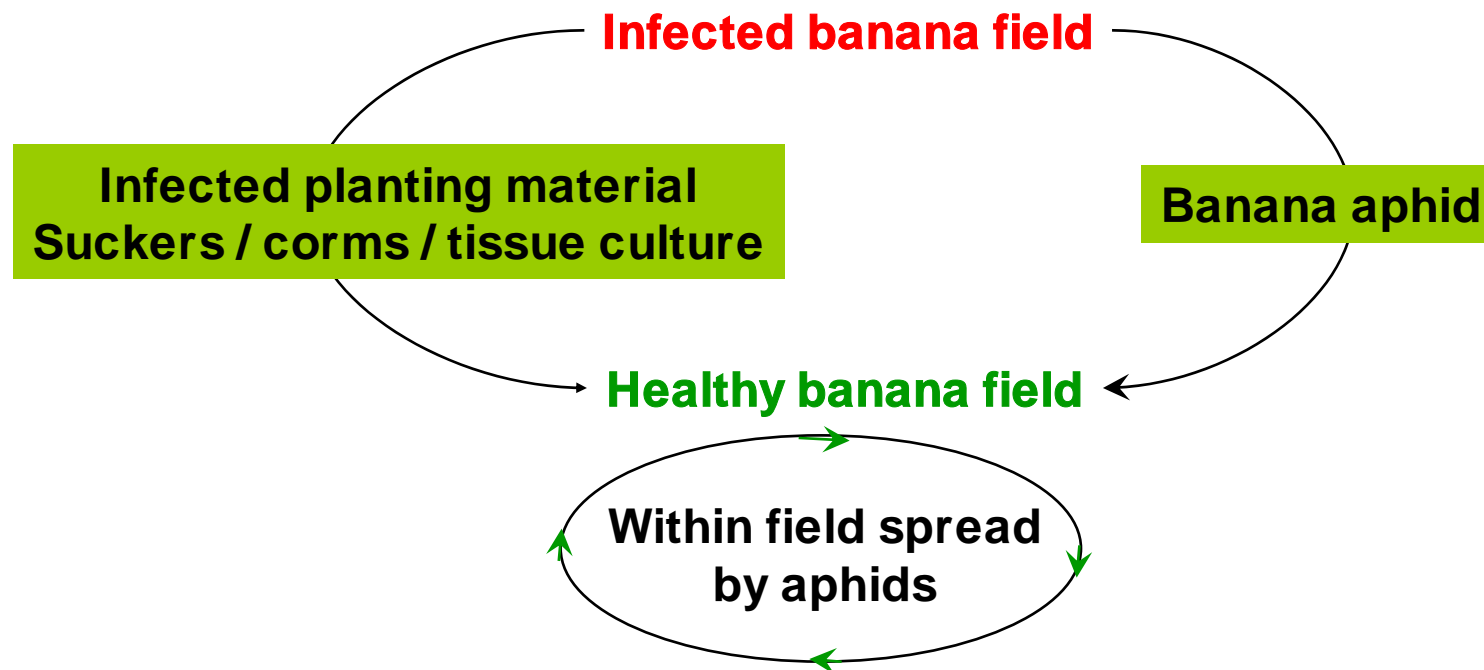
Virus transmission by aphids

- **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.**

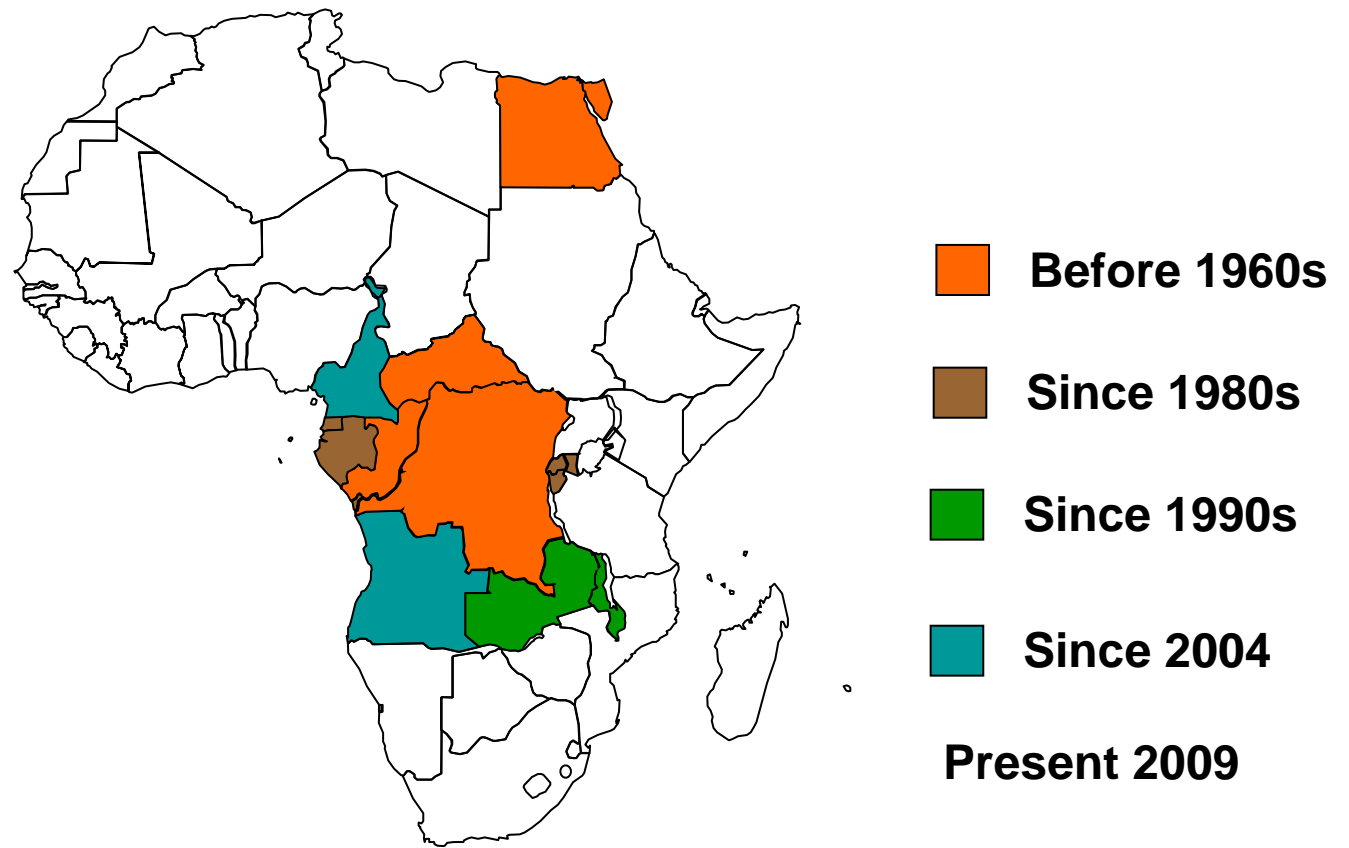
BBTV epidemiology

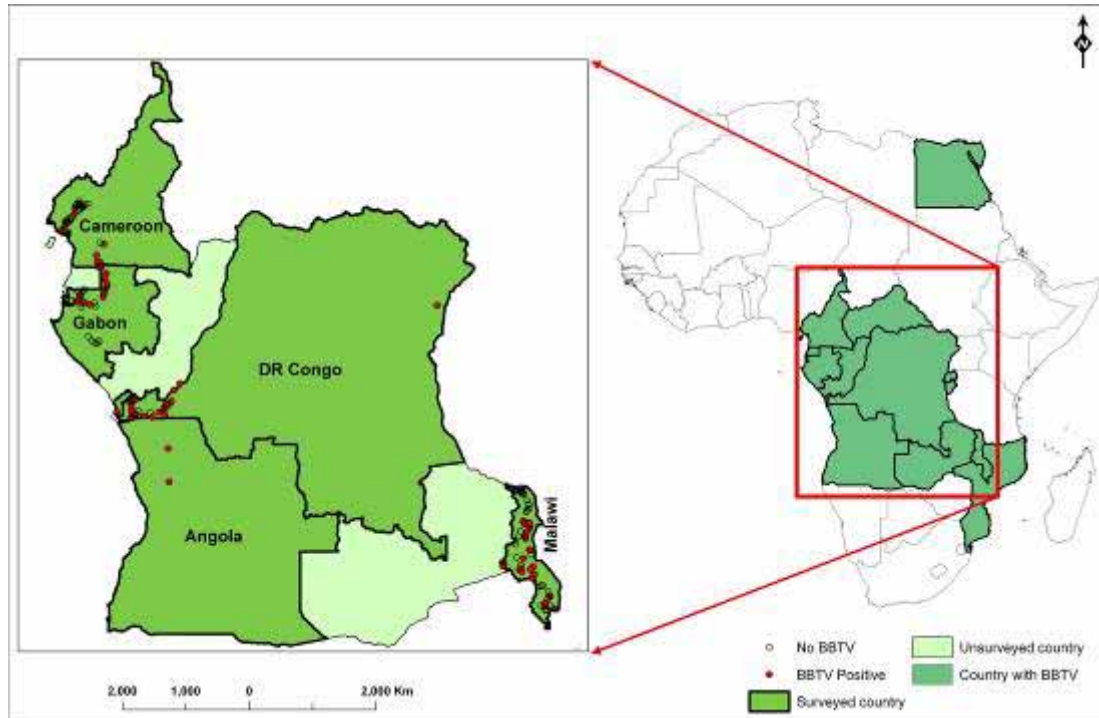
- Infection occurs through banana aphid transmission or movement of infected suckers / tissue culture plants



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





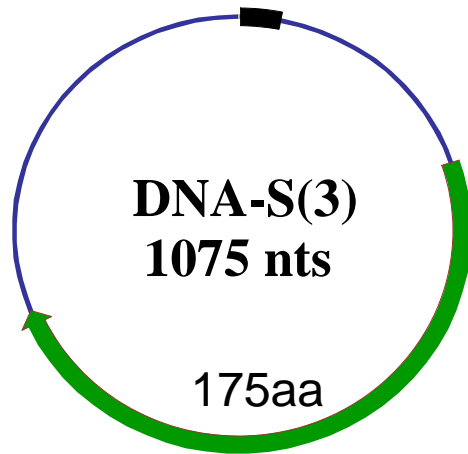
- Roving survey.
- Samples collected from symptomatic and asymptomatic plants for virus analysis.
- Interviews with farmers

•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.

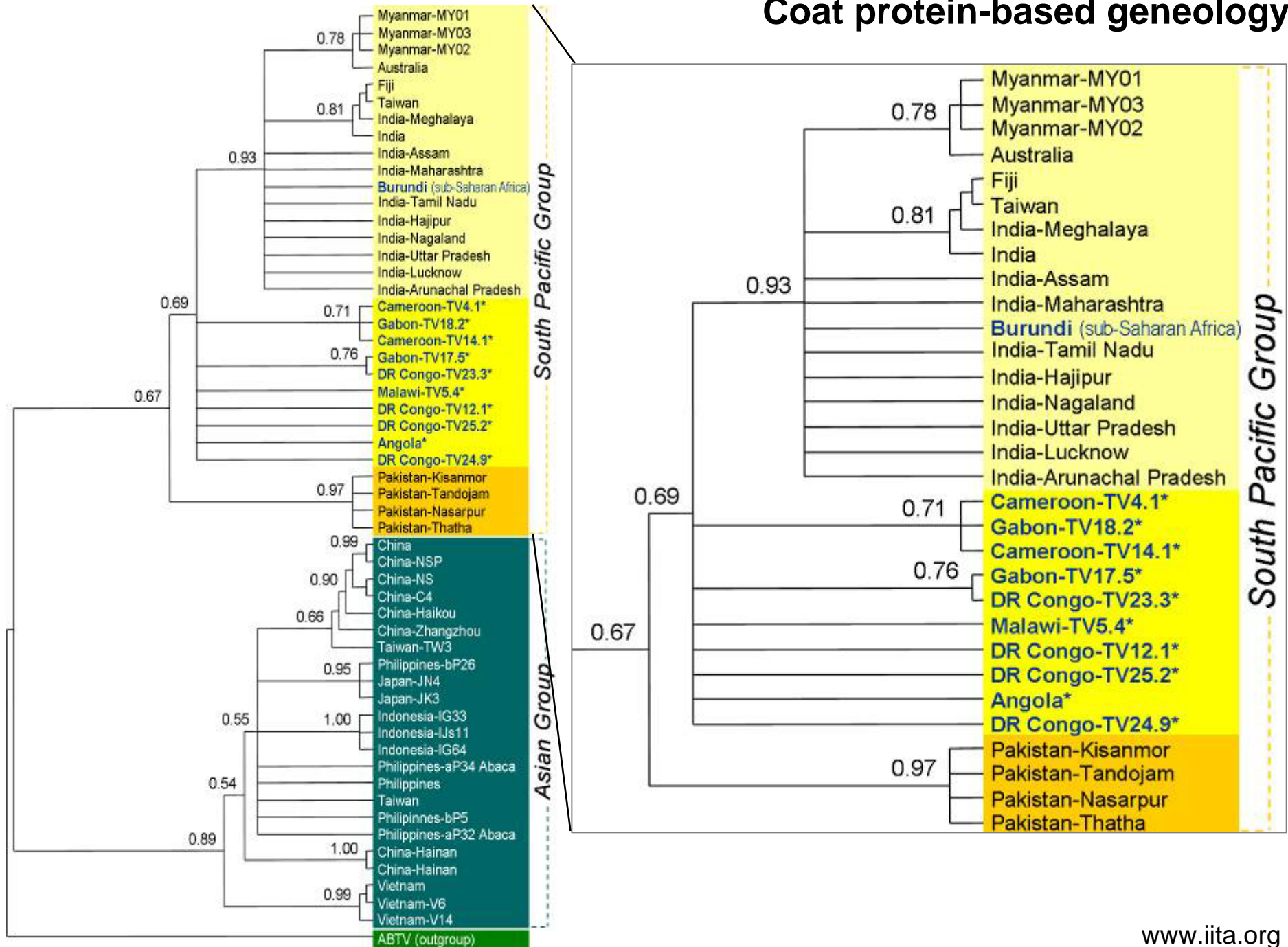
- Pair-wise comparisons of coat protein sequences (nucleotides / amino acids)



	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



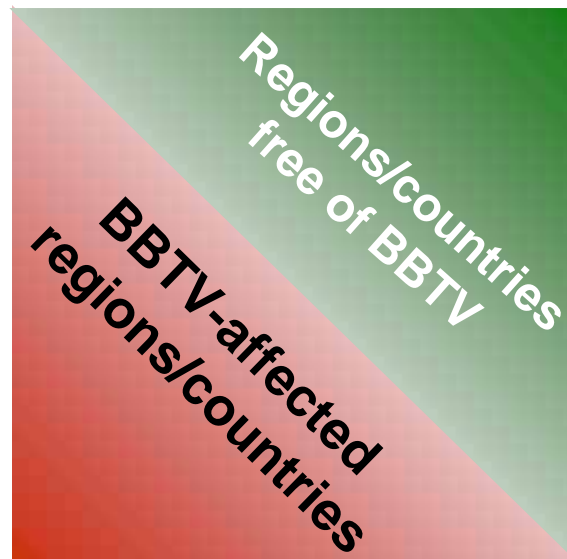
**1. Reduce sources of inoculum-
Eliminate crop refuges**

**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

IITA- FAO Regional Surveillance Workshop, January 25-29, 2010, Kigali

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