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Plant Viruses

**Characterisation of resistance
in African cassava genotypes
against *Indian* Cassava mosaic begomoviruses**

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Outline

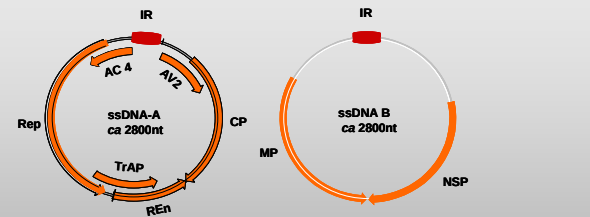
- Current virus situation of cassava
- Terms & definitions of virus resistance
- Techniques used in resistance screening
 - Correlating virus with host response
 - Quantifying resistance
- Cassava responses to begomovirus infections



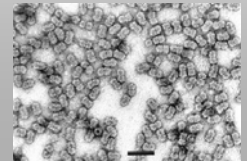
Cassava mosaic disease can lead to failure of root formation and total loss of harvest



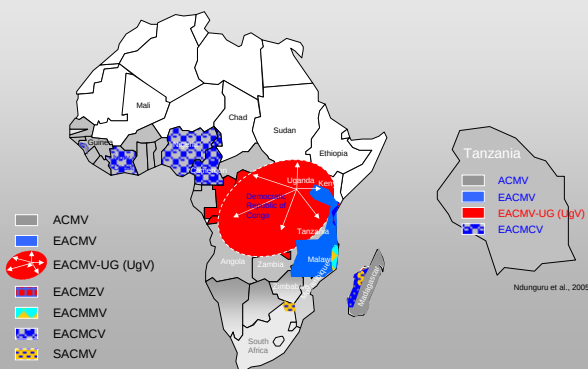
Cassava mosaic disease is caused by whitefly transmitted Geminiviruses



- ssDNA viruses with bipartite genomes
- replicate through a dsDNA intermediates in nuclei of infected cells
- unique cassava viruses



Virus situation in Africa – to date

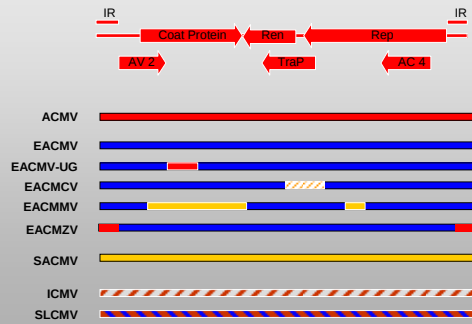


Cassava mosaic disease in India



Indian cassava mosaic virus
Sri Lankan cassava mosaic virus

Genome variation in Cassava mosaic begomoviruses (DNA A)



Consideration for deployment of begomovirus resistant cassava

- There are currently 6 distinct cassava virus species causing CMD in Africa & 2 distinct begomovirus species cause CMD in India
- There is a strong evolutionary force towards the development of new virus strains/variants with a focal point and centre of diversity in East Africa (Tanzania)
- The distribution of the viruses is at local focal points –EACMZV/EACMMV
- The virus EACMCV from Cameroon is present throughout West Africa and now also found in East Africa. The epidemiological significance is unclear.
- The epidemiological significance of the recombinant virus EACMV-UG, Uganda variant, is evident!
 - *Is this the most severe and dangerous virus problem?*
- *In India, the Sri Lankan cassava mosaic virus is the dominant virus type*
- *There is only little genome variation*
- *Few ICMV incidences in mixed SLCMV infections highlight SLCMV as the key target to be considered in resistance development!*

Definition of virus resistance

a host plant is resistant if it can suppress multiplication of a virus and consequently suppresses the development of disease symptoms

Resistance ranges from very high – immune to moderate or low but is always associated with lower levels of virus replication

Tolerance is a unique feature with negligible or mild disease symptoms but with normal levels of virus replication

Deployment of „natural“ virus resistance in Cassava at this stage is the only promising approach to counteract the Cassava Mosaic Disease

Screening for resistance against CMD

- is very difficult under field conditions
 - ? Virus types present in a given geography
 - ? Whitefly vector populations in time at location
- Resistance evaluation by scoring for incidence & severity of symptoms and disease progress is ambiguous and can be misleading

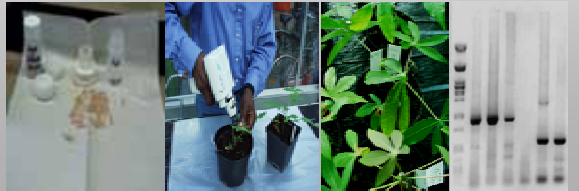
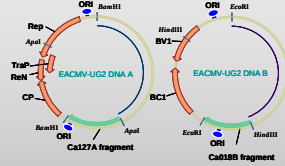


Approaches to generate defined infections in cassava with begomoviruses

Microprojectile bombardment

- genomic DNA from virus infected plants
- cloned infectious virus genomic DNA

Grafting



Inoculation of cassava genotypes with cloned Cassava mosaic viruses



Establishing mixed defined Cassava mosaic virus infections



Introducing pseudo-recombinant viruses

through inoculation of virus genomic component DNA A and DNA B mixes



Evaluation of virus resistance in cassava

- I Transplant virus infected scion
- II Inoculate scion with defined virus by approach grafting
- III Monitor disease development



CMD resistant cassava varieties recover from infection after an initial phase of symptom development and virus replication

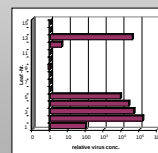


Response of TME3, TME 4 to single & mixed infections with ACMV / EACMV ICMV / SLCMV

A virus resistance status in cassava is expressed as recovery from symptoms

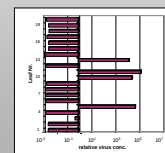


TMS 96/0304



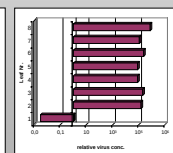
EACMV only in symptomatic leaves

TME 4

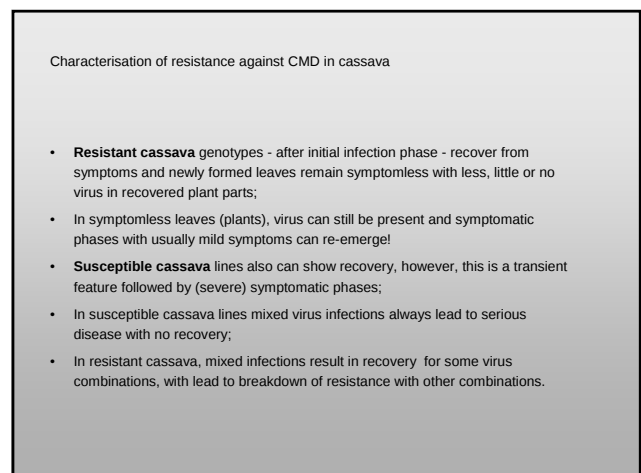
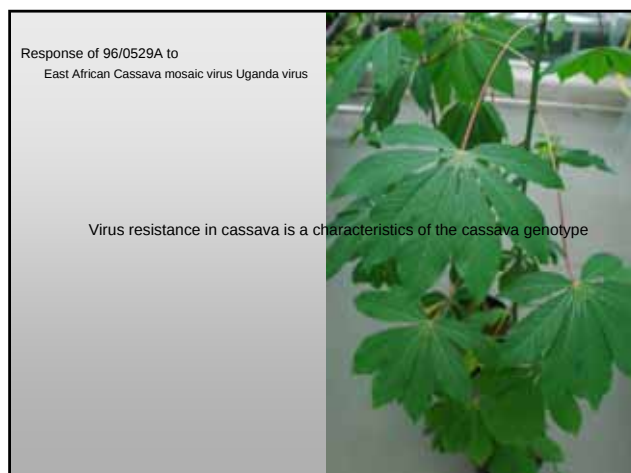
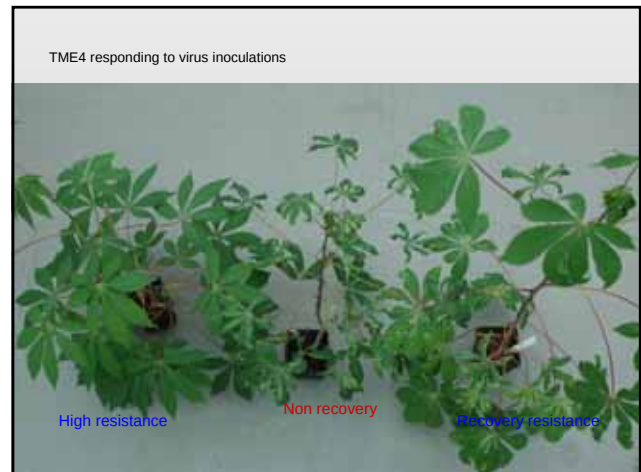
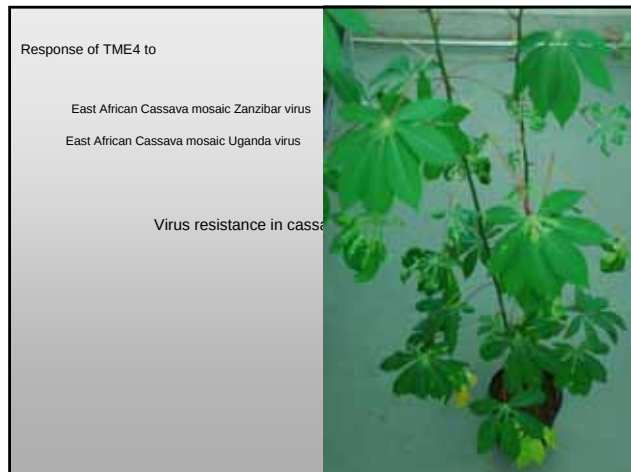


EACMV negative in non symptomatic plant parts

TME 117



EACMV distribution / symptoms homogenous



Sources of resistance against CMD begomoviruses from Africa and India

Accession	Resistance single	Resistance multiple	Type	Susceptibility
TME 117 TME 177 I30572 TME 1 TMS/0304	No	No	S	HS
TME 3 96/0160	ACMV/EACMV/ EACMCV/ICMV/ SLCMV	No	Rec.R	virus +
TME 4	ALL	ACMV/EACMV/ SLCMV	HR	Rec.HR EACMZV
96/1089A	ALL	ACMV/EACMV/ ICMV/SLCMV	HR	Rec.HR EACMCV/SLCMV
96/0529A	ACMV/EACMV/ EACMCV/ ICMV/SLCMV	ACMV/EACMV/ SLCMV	HR	R

Resistance in cassava against cassava mosaic viruses

- A good number of improved IITA varieties respond with recovery from infections with ACMV or ICMV as a non symptomatic phase of infection
- Most of the varieties were susceptible to EACMV species
- TME 4, 96/1089A, 96/0529A are excellent sources of resistance with differential resistance characters
 - Resistance is directed against all cassava viruses and their strain(s) incl. ICMV &/or SLCMV infections in India

Response of TME4 to mixed virus infections with CBSV / EACMV



Thank you very much for your attention