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Cassava mosaic virus in SE Asia: gaining momentum to address a potentially severe plant health threat

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Asia Cassava Entomologist

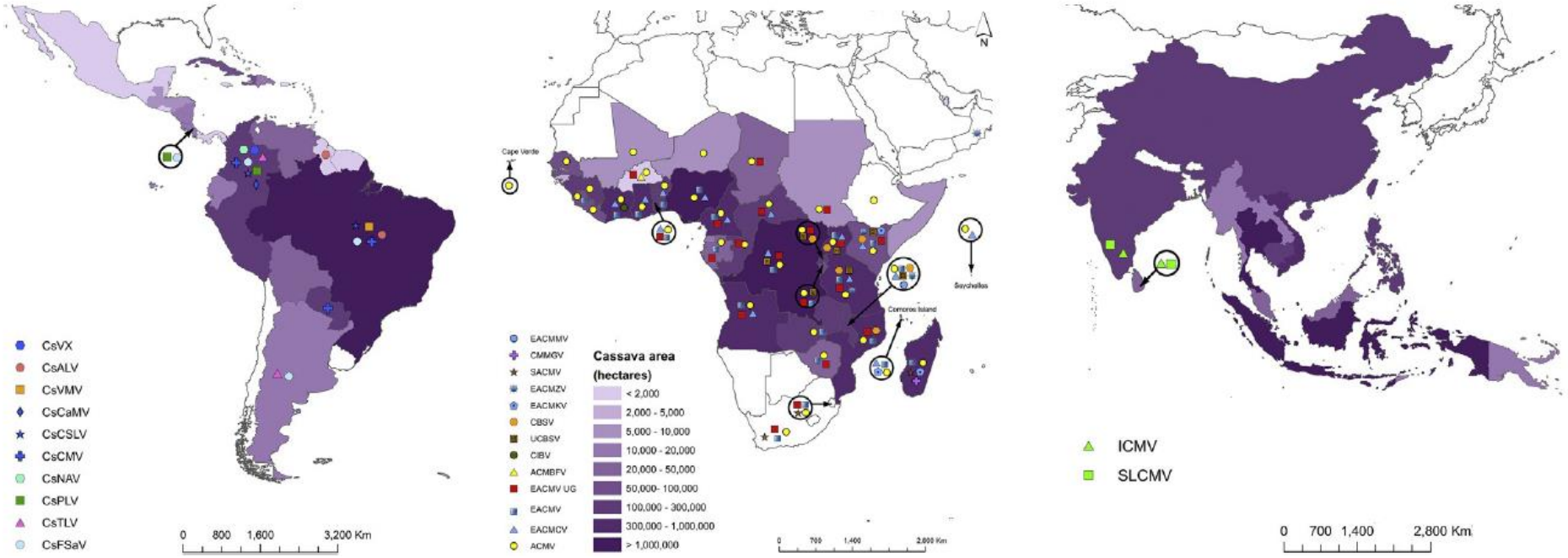
Cassava mosaic disease

Preferred Scientific Name:
Cassava mosaic disease

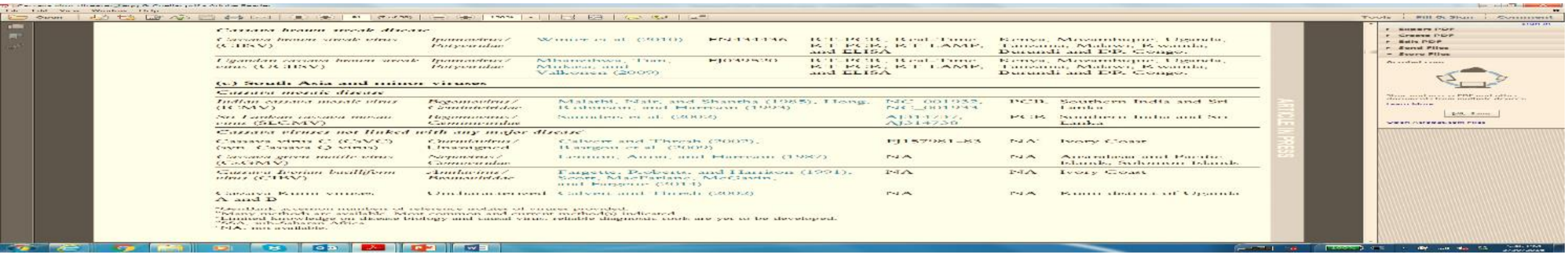
Cassava mosaic disease is caused by a combination of the three cassava mosaic geminiviruses. It primarily infects cassava plants and is transmitted by whitefly and the first reported infection was in 1984. Infections result in great economic loss and famine. The virus is the most detrimental disease affecting food supply in Africa.

Read more

Global cassava virus distribution - 2015



Asian cassava virus complex - 2015



Cassava brown streak disease					
Cassava brown streak virus (CBSV)	*Ipomovirus*/*Potyviridae*	Winter et al. (2010)	FN434436	RT-PCR, Real-Time RT-PCR, RT-LAMP, and ELISA	Kenya, Mozambique, Uganda, Tanzania, Malawi, Rwanda, Burundi and DR Congo.
Ugandan cassava brown streak virus (UCBSV)	*Ipomovirus*/*Potyviridae*	Mbanzibwa, Tian, Mukasa, and Valkonen (2009)	FJ039520	RT-PCR, Real-Time RT-PCR, RT-LAMP, and ELISA	Kenya, Mozambique, Uganda, Tanzania, Malawi, Rwanda, Burundi and DR Congo.
(c) South Asia and minor viruses					
Cassava mosaic disease					
Indian cassava mosaic virus (ICMV)	*Begomovirus*/*Geminiviridae*	Malathi, Nair, and Shantha (1985), Hong, Robinson, and Harrison (1993)	NC_001932, NC_001933	PCR	Southern India and Sri Lanka
Sri Lankan cassava mosaic virus (SLCMV)	*Begomovirus*/*Geminiviridae*	Saunders et al. (2002)	AJ314737, AJ314739	PCR	Southern India and Sri Lanka
Cassava viruses not linked with any major disease					
Cassava virus C (CsVC) (syn. Cassava Q virus)	*Ourmiavirus*/Unassigned	Calvert and Thresh (2002), Rastgou et al. (2009)	FJ157981–83	NA	Ivory Coast
Cassava green mottle virus (CsGMV)	*Nepovirus*/*Comoviridae*	Lennon, Aiton, and Harrison (1987)	NA	NA	Aneityum and Pacific Islands, Solomon Islands
Cassava Ivorian bacilliform virus (CIBV)	*Anulavirus*/*Bromoviridae*	Fargette, Roberts, and Harrison (1991), Scott, MacFarlane, McGavin, and Fargette (2014)	NA	NA	Ivory Coast
Cassava Kumi viruses A and B	Uncharacterized	Calvert and Thresh (2002)	NA	NA	Kumi district of Uganda

[a]GenBank accession numbers of reference isolates of viruses provided.
[b]Many methods are available. Most common and current method(s) indicated.
[c]Limited knowledge on disease biology and causal virus; reliable diagnostic tools are yet to be developed.
[d]SSA, sub-Saharan Africa.
[e]NA, not available.

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Wang et al., 2015. *Plant Disease*

Posted online on March 4, 2016.
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DISEASE NOTES

First Report of *Sri Lankan cassava mosaic virus* Infecting Cassava in Cambodia

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ABSTRACT

Cassava (*Manihot esculenta* Crantz) production can be severely affected by cassava mosaic disease (CMD) caused by viruses in the genus *Begomovirus* of the family *Geminiviridae*. Eight begomoviruses associated with CMD have been recorded on the African continent and two on the Indian subcontinent (Brown et al. 2015). Duraisamy et al. (2013) reported that two cassava geminiviruses on the Indian subcontinent—*Indian cassava mosaic virus* and Sri Lankan cassava mosaic virus (SLCMV)—were transmitted by the whitefly *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), but the genetic group(s) or cryptic species of the whitefly responsible for the transmission were not determined, as *B. tabaci* is now known as a complex consisting of >35 morphologically indistinguishable species (Liu et al. 2012). Cassava cultivation in Southeast Asia started in early 1900s, and today it has become one of the major crops in many countries in this region including Cambodia (FAOSTAT). However, cassava in Southeast Asia has not previously been identified to be infected by CMD. In May 2015, a virus disease outbreak of cassava with infected plants showing typical symptoms of CMD was observed in the field in Ratanakiri, KaunMoum,

Infection hotspot

Holley Eco-Industrial (Cambodia)Co.,Ltd fields

Photos taken in Dec 2015

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Sok Sophearith (CIAT)

Photos taken in Feb 2016 – Sok Sophearith, PDA Rattanakiri & CIAT virology team

Photos taken in Feb 2016 – Sok Sophearith, PDA Rattanakiri & CIAT virology team

Photos taken in Feb 2016 – Sok Sophearith, PDA Rattanakiri & CIAT virology team

Laboratory-based confirmation SLCMV presence

CIAT is a CGIAR Center

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CIAT Report, March 8th, 2016

Confirmation of the presence of Cassava Mosaic Disease (CMD) and *Sri Lankan Cassava mosaic virus* (SLCMV) in Cambodia: February, 2016.

Sophearith Sok, Monica Carvajal-Yepes, Wilmer J. Cuellar
International Center for Tropical Agriculture (CIAT).

After a Dec 2015 journal publication reported presence of Cassava mosaic disease (CMD) in the province of Ratanankiri (Cambodia), molecular assays were carried out to confirm pathogen identity and a larger field survey was initiated to determine the geographical distribution of CMD disease in Cambodia. More specifically, extensive sampling and PCR-based diagnostics was carried out in different Cambodian provinces, and on samples previously collected in a number of key Vietnamese cassava-growing regions.

The present document complements an earlier CIAT report – as presented to FAO Cambodia representatives and GDA officers on February 8th, 2016, in Phnom Penh (Cambodia). At the time, presence of the disease was suspected based upon visual confirmation of plants with CMD-like symptoms in cassava fields at the Holley Eco-Industrial Company in Ratanankiri (**Figure 1**).

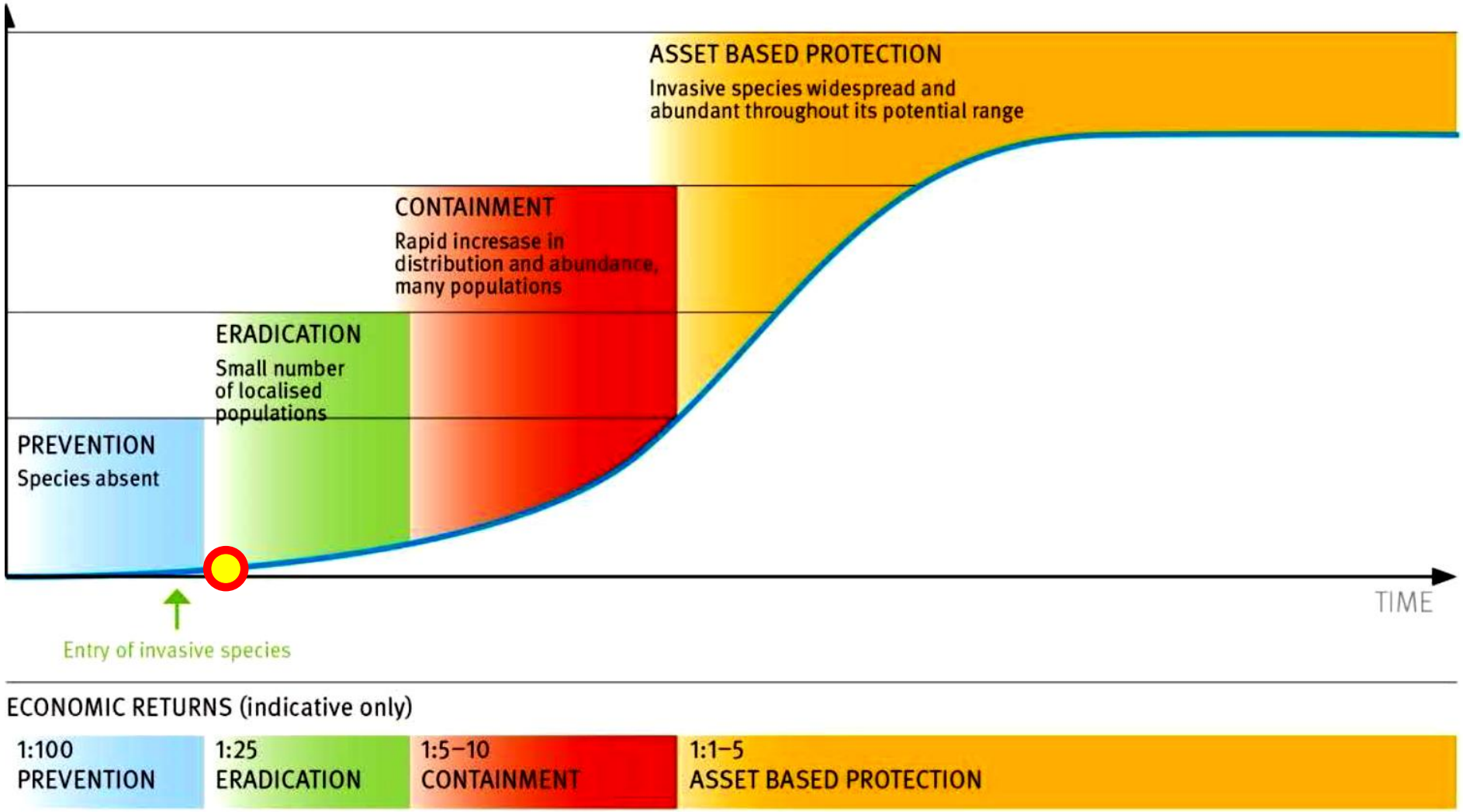
Administrators at Holley Eco-Industrial Company assured that affected fields were established with planting materials from the Vietnamese province of Tay Ninh. Nevertheless, after visual inspection of cassava plantlets collected in Tay Ninh in October-November 2015 (as part of another CIAT-led research program), no CMD symptoms were observed. Also, cassava plantlets that were collected in late 2015 in the Vietnamese provinces of Kon Tum, Gia Lai, Dak Lak and Dak Nong were inspected and equally did not exhibit symptoms of CMD.

Furthermore, the virus detected in Ratanankiri was identified as *Sri Lankan cassava mosaic virus* (SLCMV), indicating a likely origin of the planting material in Sri Lanka or South India - where SLCMV has been officially reported. Whitefly populations in Cambodia during the time of this inspection (4-11th of February) were low. Interestingly, no symptoms of CMD were observed in any other cassava plot inspected around the location of the Company or in other provinces of Cambodia. Therefore, CMD in Cambodia appeared to be limited to fields of the Holley Eco-Industrial company in Ratanankiri.

Next, laboratory tests at CIAT HQ were initiated on February 18th, using available ELISA and PCR detection tools. ELISA tests were carried out using a kit available from the "German Collection of microorganisms and Cell Cultures" (DSMZ) specific for SLCMV (Catalog#: AS-0424-0424/1). PCR primers were designed according to the specific sequence of the component-A of the SLCMV isolate reported in Cambodia (Genbank id. KT861468).

Report shared with Cambodian authorities & FAO – March 8, 2016

Early detection x rapid response



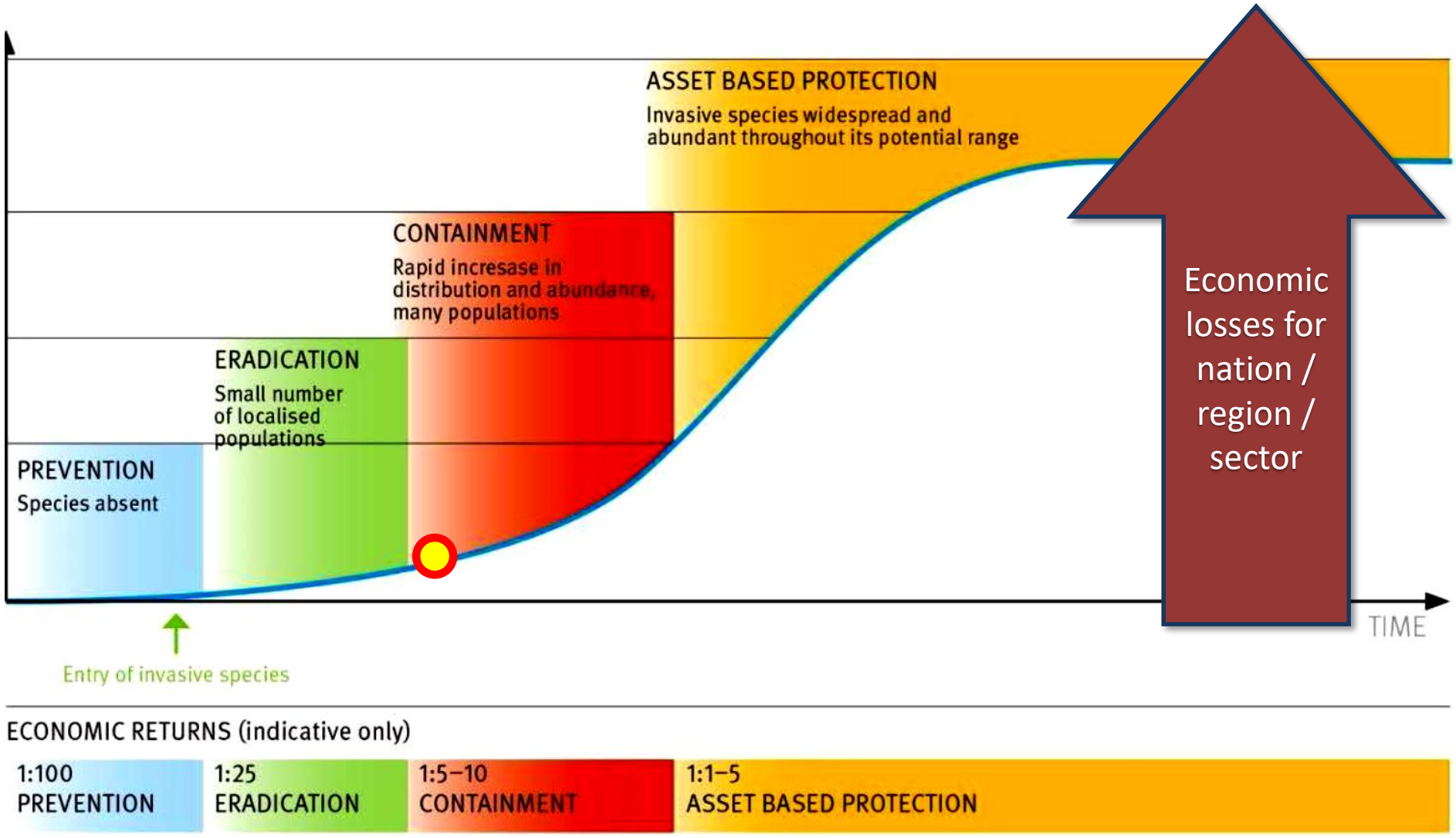
Early detection x rapid response

In Cambodia,…, we visited Holley Company in Rattana Kiri province, and observed typical mosaic disease of cassava widely. Roughly nearly 80% of cassava plants in several cassava lots in the farm showed mosaic with malformation.

Moreover, at one small cassava field nearby Holley Company farm, we observed several cassava plants with typical mosaic symptoms. This means the virus occurrence spreads not only in the Holley farm… but to neighboring fields.

Field report and photo taken by SATREPS in Rattanakiri, August 2016

A narrowing window of opportunity



SLCMV epidemiology

- **Sri Lanka cassava mosaic virus**
- Systemic pathogen
- Human-mediated spread
  - *Spread with freely traded planting material*
- Insect-mediated vectoring: *Bemisia tabaci*
  - *Spread virus for 7-38 km/yr*
  - *Trans-stadial but not transovarial virus transmission*

- Key epidemiological milestones:
  - The most important source of new infection in initially CMD-free plantings are surrounding plantings of cassava.
  - Environmental spread gradients were demonstrated in which both whitefly vectors and new CMD infections were aggregated on upwind borders of fields.
  - Rates of spread were shown to vary greatly between seasons, and most of this variation could be attributed to changes in whitefly abundance and temperature.
  - A decline in susceptibility of cassava plants to new infection was demonstrated as plants matured.
  - In India, demonstrated primary spread through the use of diseased planting material and secondary spread through the B. tabaci whitefly vector.

Multiple facets of CMV epidemic


Thanks
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