

# Summary of the 16<sup>th</sup> International Symposium on Plant Virus Epidemiology São Paulo, Brazil, June 30-July 3, 2025

The 16<sup>th</sup> International Symposium on Plant Virus Epidemiology was held in São Paulo, Brazil at Cásper Líbero University in downtown São Paulo. The symposium was hosted by Marcelo Eiras, University of São Paulo, and Juliana de Freitas Astua of Embrapa. A total of 151 abstracts were accepted and published in the book of abstracts. The symposium was attended by 159 registered participants from 30 countries on six continents, and included seven keynote speeches, 47 oral presentations and 104 poster presentations. The lectures and presentations provided valuable information regarding recent advances in plant virus epidemiology research from throughout the world. The International Committee on Plant Virus Epidemiology and meeting organizers are grateful to the organizers and Cásper Líbero University for hosting the symposium and to the many sponsors.

## Session Highlights

**Opening Lecture: Alberto Fereres.** *Behavioural aspects influencing plant pathogen transmission by insect vectors.* Presented information that illustrated how vector behaviour, modulates transmission and spread of plant viruses as well as xylem and phloem-limited bacteria, including differences related to whether transmission is non-persistent or persistent, as well as many factors which influence vector behaviour and therefore indirectly influence transmission.

### **Session 1: General Epidemiology:**

**Renato B. Bassanezi (Keynote).** *Epidemiology-based management strategies for important vector-borne citrus diseases in Brazil: Leprosis and Huanglongbing.* Described factors associated with the epidemiology of leprosis, transmitted by the flat mite (*Brevipalpus yothersi*) and huanglongbing (HLB), transmitted by the Asian citrus psyllid (*Candidatus Liberibacter asiaticus*). Epidemiologically based approaches for control of both diseases and their vectors were presented.

**Augustine Gubba.** *Carrier (SC) trees: the effect on production and genetic differences between ASBVd SC related strains.* Discussed the impact of symptomless carrier trees in

the spread of ASBVd, evaluated genetic differences between strains of ASBVd, and application of findings for ASBVd management in avocado orchards.

**Piotr Trebicki. Dynamics of single and mixed yellow dwarf virus infections in cereal and grass hosts in Australia.** Examined the prevalence of single and mixed infections of yellow dwarf viruses in cereal crops, and discussed the complex epidemiology of these viruses and the associated challenges in breeding for virus resistance.

**Sudeep Bag. Emergence and re-emergence of viral pathogens in cotton: an enigmatic issue for cotton producers and researchers in Georgia, USA.** Discussed the emergence and characterization of viruses associated with diverse symptoms on cotton in Georgia including "CLRDV-induced bronze wilt."

## **Session 2: Pathogen-Vector Interactions**

**Kerry E. Mauck (Keynote). From vectors to victims: how pathogen acquisition changes vector biology.** Discussed how plant viruses can manipulate specific host traits in ways that enhance their own transmission, presented research on how virus effects on host chemistry and vector behavior vary depending on transmission mode, and how this may have impacted the evolution of manipulative traits.

**Clara Lago Blasco. Impact of the entomopathogenic fungus *Metharizium brunneum* on the feeding behavior of *Philaenus spumarius* on olive plants: Implications for *Xylella fastidiosa* management.** Studies evaluated changes in spittlebug probing and feeding behavior, and the potential of *M. brunneum* as a biocontrol agent and suggests its application in integrated pest management (IPM) programs targeting *P. spumarius*.

**Renate Krause Sakate. Population dynamics of whiteflies and transmitted viruses in Sao Paulo, Brazil.** Examined differences in virus transmission among four populations of *Bemisia tabaci* MED and one of MEAM1. Results found that MED is not a good vector of the begomoviruses examined, but it is an excellent vector of the crinivirus, tomato chlorosis virus, and the carlavirus, cowpea mild mottle virus. This highlights the importance of understanding the differential transmission of viruses by whitefly species.

**Marilyne Uzest. Matching keys to locks: the role of different stylins in the transmission of cauliflower mosaic virus (CaMV) and turnip mosaic virus.** Used CRISPR-Cas9 knockout aphid lines disrupting Stylin-01, a cuticular protein in the aphid acrostyle, and showed that the absence of Stylin-01 prevented retention and transmission of CaMV, illustrating it is the main receptor of CaMV.

## **Session 3: Virus Discovery and Role of Metagenomics in Epidemiology**

**Nicolas E. Bejerman (Keynote). Data mining in the new era of virus discovery.**

Discussed the value of public databases as a resource for virus discovery, and that using these databases will both aid in the discovery of novel, distantly related viruses, and deepen understanding of virus emergence and spread.

**Hervé Vanderschuren. A novel nanopore-based method enabling in-depth profiling of DNA virus populations by unambiguous identification of low abundant variants and partial genomic components.** Developed a pipeline to identify and characterize full-length sequence variants of monopartite and multipartite circular viral DNA genomes, and discussed use of the pipeline in overcoming the limitations of short-read sequencing for in-depth analysis of plant virus populations.

**Marleen Botermans. A quarantine species hiding in plain sight for decades?** Presented the discovery of a quarantine pathogen, American plum line pattern virus (APLPV) in two reference collections of ornamental *Prunus* spp. in the Netherlands, and highlighted the importance of HTS for investigating reference collections.

**Jenyfer J. Polo. Solving the frogskin mystery: single infections by a torradovirus explain cassava frogskin disease in the Americas.** Used sentinel plants to acquire virus in fields and demonstrated using high throughput sequencing that single infection by a torradovirus was associated with frogskin disease, and also identified a second torradovirus associated with the disease.

**Chrysoula Orfanidou. Application of high-throughput sequencing for monitoring insect-transmitted viruses in zucchini crops and the role of weeds as reservoirs.** High-throughput sequencing was used to evaluate collected samples of zucchini and weeds and illustrated the importance of both weed and crop hosts in the epidemiology of aphid-transmitted viruses in Greece.

## **Session 4: Disease Management and Resistance**

**Ozgur Batuman (Keynote). Proposed integrated huanglongbing (HLB) management for citrus in Florida.** The development of practical tools for control of Huanglongbing (HLB) disease in Florida was discussed in relation to their application for integrated pest management (IPM).

**Rudolph R. Shirima. Optimal planting window: Evaluating the response of CBSD-tolerant and CBSD-susceptible cassava varieties in coastal Tanzania.** Studies with Cassava brown streak disease (CBSD)-resistant and susceptible varieties in different

production areas demonstrated the importance of planting date to achieve improved yields, particularly with farmer-preferred susceptible varieties.

**Stephan Winter. Characterizing the RNA silencing pathway in cassava mosaic virus resistance.** Evaluation of RNA silencing pathways in different types of resistant cassava genotypes provided novel insights into cassava mosaic resistance mechanisms and underscored the critical role of RNA silencing pathways in antiviral defense in cassava.

**Madison Flasco. Investigating the impacts of sugarcane yellow leaf virus (SCYLV) on Louisiana sugarcane and its implications regarding virus management.** Studies compared the titer of SCYLV in sugarcane and compared chlorophyll levels in diseased and healthy plants. Research is focused on improving knowledge of SCYLV interactions among cultivars.

**Vasimalla Celia Chalam. Impact of diagnostics and phytosanitary regulations on biosecurity against transboundary plant viruses.** Discussed the importance of early, sensitive and accurate detection of quarantine viruses and the risks of introductions due to established populations of potential vectors and favorable conditions for spread.

## **Session 5: Virus Ecology and Evolution**

**Santiago Elena (Keynote). Changing environments and variations in the rates of plant virus evolution.** Using turnip mosaic virus as a model, presented research demonstrating that rates of evolution proceeded faster in less susceptible host plants than in those that were highly susceptible, and that the most restrictive plant genotypes led to selection of more generalist viruses, while more permissive genotypes led to the selection of more specialist viruses.

**Laura Rossetto Pereira. Natural reassortment in citrus leprosis virus C modulates viral load dynamics: Epidemiological implications for citrus leprosis disease.** Mixed infections of two lineages of citrus leprosis virus C (CiLV-C) occur in Brazil, and a natural reassortant isolate was identified. Vector transmission to *Arabidopsis* plants and subsequent evaluation of differential RNA accumulation illustrated how segment reassortment contributed to CiLV-C diversification, including altering replication dynamics and potential viral fitness.

**Solomon Maina. Analysis of 40 new isolates of bean yellow mosaic virus reveal important new insights into its phylogeny, evolutionary dynamics and biology.** Compared 40 Australian isolates of bean yellow mosaic virus collected over a 73-year period. Results identified ten distinct phylogenetic groups including a new, previously

unrecognized group with greater genetic divergence than other phylogenetic groups, as well as new information regarding the role of recombination in the genetic diversity and evolutionary dynamics of BYMV.

**Vasileia Gavrili. Study of the genetic composition and epidemiology of poleroviruses related to pepper yellows disease in Greece.** Samples were collected between 2020 and 2023 from pepper plants with pepper yellows disease and evaluated by high-throughput sequencing. Results detected genetically differentiated isolates of pepper vein yellowing virus and evidence of recombination and strain selection. Four aphid species were evaluated as vectors, with *Aphis gossypii* determined to be the most efficient vector.

**Cecile Desbiez. Search for factors involved in the emergence of tomato leaf curl New Delhi virus (ToLCNDV) in France.** Sequencing of ToLCNDV isolates from France identified two serotypes of DNA A and four of DNA B. Weed reservoirs were identified in wild cucurbit species, and mixed infections of ToLCNDV with watermelon mosaic virus were found with symptoms more severe than those with either virus alone.

## **Session 6: Other Vector-Borne Diseases**

**Judith K. Brown (Keynote). Biological and functional genomics interrogation of psyllid vector-“Ca” *Liberibacter* interactions in divergent coevolved pathosystems.** The application of functional genomics to understand cellular and molecular interactions involved in *Liberibacter*-psyllid vector circulative invasion and acquisition was discussed in relation to how these types of studies can be used to advance knowledge of biological interactions.

**Nicola Bodino. Olive resistant cultivars significantly reduce transmission efficiency of *Xylella fastidiosa* ST53 by the main European vector, *Philaenus spumarius* (Hemiptera: Aphrophoridae).** The efficiency of *X. fastidiosa* ST53 transmission by *P. spumarius* from and to resistant olive trees was investigated. Results demonstrated that both resistant olive varieties used were inefficient sources for vector acquisition of *X. fastidiosa* ST53, and that the cultivation of these resistant olive cultivars reduced the rate of spread and the incidence of infections by suppressing the bacterial inoculum and therefore the infectivity of the vector populations.

**Rodrigo P. P. Almeida. Evidence of adaptation to temperature in a vector-borne plant pathogen.** A set of 188 *Xylella fastidiosa* genomes from diseased grapevines collected over a range of latitudes in California, USA were evaluated to study the potential for pathogen adaptation to a temperature gradient. Gene by environmental association found that the

vast majority of climate-associated variants were of recombinant origin and suggested that risk assessments should consider potential for pathogen adaptation.

**Cecilia Tamborindeguy. Does water deficit promote ‘*Candidatus Liberobacter solanacearum*’ (Lso) spread?** Studies demonstrated that water deficit did not affect Lso haplotype B infection, but improved tomato tolerance to Lso haplotype A infection. Water deficit contributed to Lso accumulation and distribution within the plant.

## **Session 7: Climate and Epidemics**

**Anders Kvarngheden (Keynote). Challenges with insect-transmitted viruses infecting crop plants in a changing climate.** Discussed the importance of understanding factors influencing host infection, transmission, and spread of viruses toward predicting future disease outbreaks.

**Alexandra Schoeny. Weather-based aphid flight forecasting: Estimating virus risk and enhancing management.** Results of an eight-year field experiment demonstrated that abundance of *A. gossypii* during the first two weeks after planting was a good predictor of cucurbit aphid borne yellows virus (CABYV) disease dynamics suggesting that early aphid control could mitigate disease onset and progress in melon crops. Data is being applied to development of predictive modeling of aphid flights.

**Piotr Trebicki. Climate change effects: Elevated CO<sub>2</sub> modifies wheat canopy temperature, water use and virus plant interactions.** Studies demonstrated that environmental CO<sub>2</sub> significantly increases plant canopy temperature by reducing water use, and wheat plants infected with the barley yellow dwarf virus had higher canopy temperatures than virus-free plants, suggesting that rising CO<sub>2</sub> levels may reshape virus interactions in agricultural ecosystems, potentially impacting crop productivity and sustainability.

## **Field Trips:**

**Vegetable Diseases Field Trip:** Sakata Seed Experimental Station, Braganca Paulista, SP. (July 3)

**Citrus Diseases in Commercial Orchards Field Trip:** Citrus Research Center “Sylvio Moreira” (CCSM), Aguai, SP. (July 3)

**Selection of the site for the 17<sup>th</sup> ISPVE:**

Two sites presented excellent proposals to host the 17<sup>th</sup> International Symposium of Plant Virus Epidemiology (ISPVE) during the business meeting on July 2. Following discussions, Sydney, Australia was selected as the site for next ISPVE in 2028. The ISPVE is expected to be held either before or after the International Congress of Plant Pathology (ICPP), which will occur in Gold Coast, Australia in August 2028.