December 2024

THE INTERNATIONAL ORGANIZATION OF CITRUS VIROLOGISTS - IOCV

Message from the Chair

Dear IOCV members,

I am looking forward to welcoming you to the XXIII IOCV conference in Australia – a great opportunity for you to update your knowledge, gain feedback on your work and have laughs with friends. There is great value in connecting in person, cementing relationships and sparking new collaborations.

The conference will be held in Mildura, located on the Murray River in the major citrus growing region of the Sunraysia. The conference will include sessions on huanglongbing, citrus viruses, citrus viroids and other citrus diseases. We will also be hosting discussions sessions covering requested topics such as 'popular' names for high-profile diseases, updates in virus taxonomy and the practicalities of in-field diagnostic tools. During the mid-conference tour, we will visit the headquarters of the Auscitrus propagation scheme and learn about citrus field trials at the Dareton Primary Industries Institute.

The post-conference tour will travel to Sydney to visit a commercial citrus nursery, the Elizabeth Macarthur Agricultural Institute and a sanctuary for native injured wildlife. We will also be checking out some south coast beaches and travelling along the coast road up to the centre of Sydney for a city and harbour tour.

Remember that your membership expires at the next conference, so in the lead up to next March, please renew your IOCV membership for the 2025-28 period at http://journalofcitruspathology.com/iocv_membership.html . Conference registration is discounted for IOCV members.

Please continue to support your Journal of Citrus Pathology by submitting manuscripts for consideration at https://escholarship.org/uc/iocv_journalcitruspathology .

In this issue of the newsletter, we introduce some future leaders in citrus pathology and provide some interesting technical and country updates.

If you have any contributions to future editions of the newsletter, please email iocvsecretary@gmail.com.

Best wishes and take care,

Nerida

IOCV Business

XXII conference of the IOCV

The XXII conference of the IOCV was held online over four sessions in September 2022. We had more than 200 participants in the conference who listened to presentations by 23 speakers from 10 countries on the topics of huanglongbing, citrus viral diseases, citrus viroids and other citrus diseases including emerging pathogens. Here's the link to the recordings: https://www.youtube.com/playlist?list=PLbY_N6-dbI4U9TWqqb8mLsazr6jcesUXJ

The virtual format was convenient but not as fun or productive as meeting in person. We look forward to the next face-to-face conference of the IOCV in Australia in March 2025.

IOCV Business meeting

A business meeting of the IOCV will be held at the IOCV conference in March 2025.

During the meeting, we will propose additions to the By Laws surrounding membership. The current By Laws can be found at https://iocv.ucr.edu/laws-iocv.

Secretary / Treasurer's Report

A detailed report will be given at the next business meeting in March 2025.

Membership dues of $60.00 US (or $30.00 for students) cover the 3-year interval between IOCV conferences, as defined in the IOCV by-laws (https://iocv.ucr.edu/laws-iocv). This period begins at the start of each 3-year conference cycle and requires continuous membership to remain active. Members who skip a 3-year period should note that their next payment does not automatically cover missed cycles, and clarification of their membership status may be necessary.

For more information or to renew your membership, please visit the following link:

http://journalofcitruspathology.com/iocv_membership.html

Chair-Elect nominations

Please start thinking about your nominations for the next Chair-Elect of the IOCV and keep an eye out for the nomination ballot which will be sent to you via email from iocvsecretary@gmail.com.

Newsletter contributions

Thank you to those who have contributed to the current and past editions of the IOCV newsletter.

Please don't be shy. If you have something that you would like published in the newsletter, please send your contribution to iocvsecretary@gmail.com .

If you know of an IOCV member who has retired or is no longer with us, please email their name and, if possible, a tribute to iocvsecretary@gmail.com so that we can honor their contribution to IOCV.

What's new in your journal?

Whole genome analysis of spontaneous antimicrobial resistance in Liberibacter crescens suggests long-term efficacy for antimicrobial treatment of citrus greening disease
Paula Rios Glusberger, Jordan T. Russell, Alexa R. Cohn, Joseph R. Petrone, Kin-Kwan Lai, and Eric W. Triplett
http://dx.doi.org/10.5070/C411262263

Applying volumetric electron microscopy to visualize xylem tissue impacted by citrus tristeza virus-induced stem pitting
DJ Aldrich, J Kriel, R Bester, JT Burger and HJ Maree
http://dx.doi.org/10.5070/C411262569

Two distinct viral suppressors of RNA silencing encoded by citrus tatter leaf virus
Shih-hua Tan, Sohrab Bodaghi, Arunabha Mitra, Stacey Comstock, Amy Huang, Sarah Hammado, Jinliang Liu, Shurooq Abu-Hajar, Paulina Quijia-Lamina, German Rafael Villalba-Salazar, Greg W. Douhan, Irene Lavagi-Craddock, Abigail Marie Frolli, Ashraf El-Kereamy, and Georgios Vidalakis
http://dx.doi.org/10.5070/C411262591

Abstracts from the 7th International Research Conference on Huanglongbing, 2024, Riverside California United States
http://dx.doi.org/10.5070/C411163652

Access your journal and submit your manuscripts at https://escholarship.org/uc/iocv_journalcitruspathology

Review

Further investigation on citrus phantom disorders of unconfirmed viral etiology
Vicken Aknadibossian, Juliana Freitas-Astúa, Georgios Vidalakis, Jean-Pierre Thermoz, Grazia Licciardello, Antonino Catara, Lochy Batista, Juana M. Pérez, Inés Peña, Victoria Zamora, and Svetlana Y. Folimonova

This brief report expands upon the original review article published in Journal of Citrus Pathology in 2023 on citrus "phantom" disorders of presumed virus and virus-like etiology and addresses five additional disorders: citrus seed-borne virus disorder in New Zealand, bergamot vein yellowing in Greece, bergamot gummosis in Italy, bud knot in Italy, and a disorder resembling citrus crinkly leaf in Cuba. Each disorder is characterized by distinct symptoms and transmission patterns yet remains unresolved in terms of causative agents or conditions. By providing comprehensive information on these phantom citrus disorders, this report aims to serve as an additional reference for the citrus research community, industry stakeholders, and regulatory offices.

Coming soon

Abstracts from the

XXII conference of the IOCV.

If you have not yet returned your abstract, please email it as soon as possible to nerida.donovan@dpi.nsw.gov.au.

Technical update

2024/213 Binomial nomenclature for virus and viroid species

For many years, proposals to use binomial names to name virus species have been debated among the virology community. In 2021, the International Committee on Taxonomy of Viruses (ICTV) approved a uniform system of formal virus names which follows the binomial 'genus-species' format with or without Latinized species epithets. For example, the virus species which is causing rose rosette is now called *Emaravirus rosae*. This new rule is being implemented and new names are gradually being proposed by ICTV.
As a user of taxonomy, the EPPO Secretariat has started to implement these changes for virus names (mainly plant viruses) in the EPPO Global Database. In 2022, the first changes were made for a number of genera (EPPO RS 2022/207) and continued in 2023 and 2024 (RS 2023/177, RS 2024/031, RS 2024/125). In September 2024, ICTV released an updated list, and as a consequence, changes were made in the EPPO Global Database for the virus and viroid species belonging to families and genera listed below:

	Family	**Genus**	**EPPO code**
Viruses	Metaxyviridae	Cofodevirus	1COFVG
	Solemoviridae	Enamovirus	1ENAMG
		Polerovirus	1POLVG
		Sobemovirus	1SOBEG
	Partitiviridae	Alphapartitivirus	1ACRYG
		Betapartitivirus	1BCRYG
		Deltapartitivirus	1DCRVG
		Gammapartitivirus	1GCRYG
Viroids	Avsunviroidae	Avsunviroid	1AVSUG
		Elaviroid	1ELAVG
		Pelamoviroid	1PELAG
	Pospiviroidae	Apscaviroid	1APSCG
		Cocadviroid	1CCADG
		Coleviroid	1KOLEG
		Hostuviroid	1HOSTG
		Pospiviroidae	1POSPF

The EPPO Secretariat has summarized in the table below the list of citrus viruses and viroids which are included in the EPPO A1 and A2 Lists of pests recommended for regulation as quarantine pests with their new names.

Viruses and viroids	New binomial nomenclature	EPPO Code	EPPO List
American plum line pattern virus	*Ilarvirus APLPV*	APLPV0	A1
Andean potato latent virus	*Tymovirus latandigenum*	APLV00	A1
Andean potato mild mosaic virus	*Tymovirus mosandigenum*	APMMV0	A1
Andean potato mottle virus	*Comovirus andesense*	APMOV0	A1
Bean golden mosaic virus	*Begomovirus costai*	BGMV00	A1
Bean golden yellow mosaic virus	*Begomovirus birdi*	BGYMV0	A1
Beet leaf curl virus	-	BLCV00	A2
Beet necrotic yellow vein virus	*Benyvirus necrobetae*	BNYVV0	A2
Blueberry leaf mottle virus	*Nepovirus myrtilli*	BLMOV0	A1
Blueberry scorch virus	*Carlavirus vaccinii*	BLSCV0	A2
Cherry rasp leaf virus	*Cheravirus avii*	CRLV00	A1
Chrysanthemum stem necrosis virus	*Orthotospovirus chrysanthinecrocaulis*	CSNV00	A1
Chrysanthemum stunt viroid	*Pospiviroid impedichrysanthemi*	CSVD00	A2
Citrus bark cracking viroid	*Cocadviroid rimocitri*	CBCVD0	A2
Citrus blight agent	-	CSB000	A1
Citrus leprosis disease*	-	CILV00	A1
Citrus tristeza virus	*Closterovirus tristezae*	CTV000	A2
Citrus yellow mosaic virus	*Badnavirus tessellocitri*	CMBV00	A1

Technical update

Viruses and Viroids	New binomial nomenclature	EPPO Code	EPPO List
Coconut cadang-cadang viroid	*Cocadviroid cadangi*	CCCVD0	A1
Cucumber vein yellowing virus	*Ipomovirus cucumisvenaflavi*	CVYV00	A2
Cucurbit yellow stunting disorder virus	*Crinivirus cucurbitae*	CYSDV0	A2
Grapevine red blotch virus	*Grablovirus vitis*	GRBAV0	A1
Impatiens necrotic spot virus	*Orthotospovirus impatiensnecromaculae*	INSV00	A2
Lettuce infectious yellows virus	*Crinivirus lactucaflavi*	LIYV00	A1
Peach mosaic virus	*Trichovirus persicae*	PCMV00	A1
Peach rosette mosaic virus	*Nepovirus persicae*	PRMV00	A1
Pepino mosaic virus	*Potexvirus pepini*	PEPMV0	A2
Plum pox virus	*Potyvirus plumpoxi*	PPV000	A2
Potato black ringspot virus	*Nepovirus solani*	PBRSV0	A1
Potato deforming mosaic virus (Argentina)	-	PDMV00	A1
Potato spindle tuber viroid	*Pospiviroid fusituberis*	PSTVD0	A2
Potato virus T	*Tepovirus tafsolani*	PVT000	A1
Potato yellow dwarf virus	*Alphanucleorhabdovirus tuberosum*	PYDV00	A1
Potato yellow vein virus	*Crinivirus flavisolani*	PYVV00	A1
Potato yellowing virus	-	PYV000	A1
Raspberry leaf curl virus	-	RLCV00	A1
Raspberry ringspot virus	*Nepovirus rubi*	RPRSV0	A2
Rose rosette emaravirus	*Emaravirus rosae*	RRV000	A1
Satsuma dwarf virus	*Sadwavirus citri*	SDV000	A2
Squash leaf curl virus	*Begomovirus cucurbitapeponis*	SLCV00	A2
Strawberry latent C virus	-	STLCV0	A1
Strawberry vein banding virus	*Caulimovirus venafragariae*	SVBV00	A2
Tobacco ringspot virus	*Nepovirus nicotianae*	TRSV00	A2
Tobacco streak ilarvirus potato strain	-	TSVP00	A1
Tomato brown rugose fruit virus	*Tobamovirus fructirugosum*	TOBRFV	A2
Tomato chlorosis virus	*Crinivirus tomatichlorosis*	TOCV00	A2
Tomato infectious chlorosis virus	*Crinivirus contagichlorosis*	TICV00	A2
Tomato leaf curl New Delhi virus	*Begomovirus solanumdelhiense*	TOLCND	A2
Tomato mottle virus	*Begomovirus solanumvariati*	TOMOV0	A1
Tomato ringspot virus	*Nepovirus lycopersici*	TORSV0	A2
Tomato spotted wilt virus	*Orthotospovirus tomatomaculae*	TSWV00	A2
Tomato yellow leaf curl Sardinia virus	*Begomovirus solanumflavusardiniaense*	TYLCSV	A2
Tomato yellow leaf curl virus	*Begomovirus coheni*	TYLCV0	A2
Watermelon silver mottle virus	*Orthotospovirus citrullomaculosi*	WMSMOV	A1

* Citrus leprosis disease is associated with at least 7 viruses:
- Citrus leprosis virus C (Cilevirus leprosis);
- Citrus leprosis virus C2 (Cilevirus colombiaense);
- Hibiscus green spot virus 2 (Higrevirus waimanalo);
- Strains of Orchid fleck virus (Dichorhavirus orchidaceae);
- Citrus leprosis virus N (Dichorhavirus leprosis);
- Citrus chlorotic spot virus (Dichoravirus citri);
- Citrus bright spot virus (Dichoravirus australis).

Source: EPPO Secretariat (2024-10)

For further information on naming viruses, refer to Zerbini et al. 2022. https://doi.org/10.1007/s00705-021-05323-4

Regional updates

Brazil

Twenty years of combating Huanglongbing in Brazil

By Renato Beozzo Bassanezi

Scientific researcher at Fund for Citrus Protection (Fundecitrus), Brazil

In 2024, 20 years have passed since the first report of citrus Huanglongbing (HLB), caused by Candidatus Liberibacter asiaticus (CLas), in Brazil. After the disease was detected in the central region of the State of São Paulo, the country's main citrus belt and the largest orange producer in the world, HLB continued to spread, reaching all other citrus regions of São Paulo State and the states of Minas Gerais (2005), Paraná (2007), Mato Grosso do Sul (2019), Santa Catarina (2022) and Goiás (2024). In the citrus belt of São Paulo and South/Southwest Minas Gerais, despite all efforts to control the disease, the incidence of sweet orange trees with symptoms of the disease has gradually increased, rising from 0.61% in 2008 to 44.35% in 2024.

From the beginning, in the absence of effective and economically viable curative measures, preventive measures were recommended, including the planting of healthy nursery trees produced in insect-proofed nurseries, the elimination of diseased plants and the control of the insect vector, the Asian citrus psyllid (*Diaphorina citri*). From 2005 to 2010, the Plant Protection Agency of the State of São Paulo, together with Fundecitrus (a private institution maintained by orange growers and juice industries) conducted an HLB eradication program, which helped immensely in suppressing the disease inoculum and reducing its rate of progression in those early years. However, with the difficulty in adopting preventive control practices and the increase in the incidence of HLB, especially in orchards of small and medium-sized growers, these growers began to question the effectiveness of the program and no longer adopt the immediate elimination of diseased trees, especially adult trees that were still productive, weakening the eradication program and beginning to live with diseased trees within their orchards. As the lack of adherence to the inoculum reduction program increased, including by large producers, the need to intensify preventive measures to control the insect vector increased significantly to result in a satisfactory reduction in the rate of disease progression. Initially, preventive control of the psyllid was carried out with the same rigor in both non-bearing and bearing orchards. However, due to the increase in the cost of increasingly frequent applications of insecticides, greater rigor in control was given to prevent infections in young orchards, which are more susceptible to early infections and whose productive potential is lost more quickly than in adult plants. Another measure adopted by growers since 2011, and which has been strongly encouraged by Fundecitrus was the reduction of inoculum in abandoned and non-commercial orchards, pastures, forests and residential areas surrounding the citrus properties. This regional management of the disease, with control measures being adopted both inside and outside commercial citrus properties by all growers in the region, has proven effective in containing the disease, but unfortunately not all growers are willing to participate and organize themselves into regional management groups. The adoption of all these measures in some regions of the citrus belt managed to keep the average incidence of the disease in the citrus belt almost stable at around 18% from 2015 to 2019.

In the search to increase the productivity of the orchards, knowing that over the years the contamination of plants by the HLB bacteria would cause the loss of planting stands and/or that the production of infected plants would decrease with the increase in the severity of the disease, producers began to adopt cultural practices such as increased fertilization, irrigation and higher planting density. The irrigated area in the citrus belt increased from less than 5% to 36% and the planting density rose from around 375 plants per hectare to 590 plants per hectare in the last 20 years, forcing producers to carry out tree pruning operations earlier and earlier. These changes in orchard cultivation meant that the plant sprouting pattern was no longer sporadic, dependent only on rainfall, but increasingly continuous throughout the year, leaving the trees more exposed to psyllid breeding and CLas infection, since the sprouts are the preferred

Brazil cont.

sites for the development of psyllid nymphs and for their feeding (acquisition and inoculation of the bacteria).

From 2019 onwards, together with the increase in the costs of inputs and insecticides during the Covid-19 pandemic, there was an increase in restrictions on the use of insecticide molecules, mainly organophosphates, by the European Community, the main consumer of orange juice from Brazil. As a result, the rotation of insecticides with different modes of action was less adopted by citrus growers, who made successive applications of pyrethroids and neonicotinoids, quickly selecting psyllid individuals resistant to these two chemical groups. In addition, failures in the quality of insecticide application, both on very tall trees and in very dense orchards and in newly planted orchards, and the adoption of long intervals of insecticide application in adult orchards during new flushing were observed on many properties. This created the perfect storm for the explosion of the vector population and, consequently, for the rapid increase of the disease: continued citrus sprouting, a high number of inoculum sources within commercial orchards and failures in psyllid control. The disease, which had taken 15 years to reach 19% incidence, jumped to 44% in 5 years.

In some regions of the citrus belt with climate conditions favorable to the psyllid and the bacteria, with a large number of citrus orchards and a high percentage of small properties, the incidence of the disease has already exceeded 70% of the trees, with more than 80% of the trees over 5 years old being diseased and more than 40% of the trees up to 5 years old, which has made it impossible to reset the orchards and plant new orchards. On the other hand, the regions in the extreme northwest and north of the State of São Paulo still have an incidence below 4%. In these regions, the climate with longer periods of water deficit and warmer temperatures induces more sporadic sprouting and accelerates its maturation, in addition to directly impacting the multiplication of the bacteria in the new shoots and its acquisition by the psyllid, significantly reducing the transmission rate. In addition, the greater isolation between properties in these regions has helped reduce the spread of the disease. In the Matão region (central São Paulo State), where the disease was first reported and regional management of HLB has been carried out for the longest time, the incidence of HLB remains below 20%, while in neighboring regions it has already exceeded 40%.

As a result of the increased incidence and severity of HLB in São Paulo orchards, the average rate of premature fruit drop caused only by HLB increased from 1.4% in 2016 to 8.4% in 2024. In regions with the highest incidence and severity of the disease, this rate of premature fruit drop by HLB already exceeds 15%. In these 20 years, more than 65 million orange trees were eliminated in commercial orchards and more than 5 million in non-commercial orchards, pastures, forests and residential areas around commercial citrus properties. There was also a reduction in the citrus belt planted area from 600 thousand hectares to 400 thousand hectares and in the number of commercial properties from approximately 19 thousand to 6 thousand.

Due to the high risk of establishing new orchards in the regions that were heavily affected, evasion has become a useful measure to control HLB. Growers are looking for regions that are free or have a low incidence of the disease, including going to other states such as Minas Gerais, Mato Grosso do Sul, Goiás, Bahia and Sergipe. In these regions, based on the lessons learnt, it is important to maintain all HLB prevention measures, especially the elimination of diseased trees inside and outside the commercial orchards until research can develop effective and economical curative treatments or sweet orange varieties that are resistant to HLB bacteria. Several treatments aimed at mitigating the damage caused by HLB in infected trees have been and are being evaluated in Brazil, but to date none of them have proven effective in restoring the health of infected trees or reducing the progression of the severity of symptoms and damage to fruit production and quality. In this sense, research is underway by the Fundecitrus team and partner research institutions around the world aimed at obtaining plants that repel psyllids, plants that are attractive and lethal to the vector (to be used as trap crop), and plants that are resistant to CLas.

United States - California

The fight to keep Huanglongbing away from commercial citrus continues

By Georgios Vidalakis

University of California, Riverside

The Asian citrus psyllid (ACP) was first discovered in Southern California in San Diego in August 2008. By 2019, ACP had been detected in the northern part of the state, in the Sacramento area. Outside of Southern California, where ACP is endemic and present in high populations, finds of ACP in the Central Valley—the main citrus-producing area in California—are sporadic. These finds typically consist of single adult psyllids in yellow sticky traps and rarely involve breeding colonies on trees. Monitoring of ACP populations, coordinated area-wide treatments, and the rearing and release of parasitic wasps (*Tamarixia radiata*) remain ongoing. Temperature extremes, the seasonality of tree flushing (spring and fall), and native ACP predators, such as the hoverfly (*Allograpta obliqua*), appear to also influence ACP population levels and natural spread. Human activity is a major factor in ACP spread, with most finds associated with transport corridors and urban center trees.

Huanglongbing (HLB) was first detected in 2012 in Los Angeles in a multi-grafted backyard lemon-pummelo tree (with 23 different grafts). HLB continues to spread in urban areas, with a total of 8,981 positive trees as of October 2024. To date, no HLB-positive trees have been detected in commercial citrus anywhere in California. When HLB is found in urban areas, mandatory tree removal is triggered, along with the application of insecticides, testing of all plant hosts within a 250-meter radius, and the release of biocontrol agents. HLB-positive finds also trigger the establishment of quarantine zones. As of October 2024, 6,229 km^2 of quarantine zones have been established across six counties in Southern California. When commercial orchards fall within quarantine zones, farmers follow specific mitigation protocols, including preharvest insecticide treatments, fruit cleaning (to remove green parts), and use of enclosed transport vehicles to reduce the risk of spreading ACP and HLB. However, if the fruit is moving within a contiguous HLB quarantine zone or one of the seven regional zones for bulk citrus fruit movement to nearby packing houses, these mitigation measures are not required.

Nursery production continues under the mandatory 2009 state law, SB-140 Citrus Nursery Stock Pest Cleanliness Program. This program requires that all mother trees be originated or tested by the Citrus Clonal Protection Program (CCPP), housed in insect-exclusion structures, and periodically tested for HLB and other graft-transmissible pathogens, such as citrus tristeza virus and citrus viroids. While the law does not mandate that all stages of plant production be conducted within insect-exclusion structures, nurseries are progressively moving all functions indoors. Since the implementation of the 2009 program, the number of commercial citrus propagation nurseries in California has decreased by 50%, with only 20 licensed nurseries currently in operation. However, the CCPP has recorded an over 5,000% increase in the use of pathogen-tested budwood since 2009. Out of 11,594 users in the CCPP budwood distribution system, only 110 are commercial users, highlighting the importance of taking into consideration non-commercial entities in anti-HLB programs. California has been divided into three regional zones, allowing for the unrestricted movement of nursery stock within each zone. If nursery materials (plants or budwood) cross HLB quarantine or regional zone boundaries, they must follow specific mitigation protocols, such as insecticide treatments and transport in enclosed vehicles.

Research continues across all areas of the pathosystem, including conventional citrus breeding, genetic engineering for tolerance and resistance, evaluation of rootstocks and scions showing signs of tolerance, development and application of antimicrobial compounds, area-wide HLB testing, ACP monitoring and treatment, and cultivation practices to mitigate the impact of both ACP and HLB.

United States – California cont.

For updates on HLB and ACP status in California, as well as information on the CCPP, you can visit the Citrus Pest & Disease Prevention Program's *Citrus Insider* (https://www.citrusinsider.org/) and the CCPP Reports page (https://ccpp.ucr.edu/about/index.html#report). For more details on California's Action Plan for ACP and HLB, check publications in the *IOCV Journal of Citrus Pathology* (https://escholarship.org/uc/item/5zh6m715) and the HLB and ACP research abstracts from the IRCHLB VII conference (https://escholarship.org/uc/item/33r648r0).

Congratulations

Congratulations to the IOCV members Drs. Deborah Pagliaccia, Sohrab Bodaghi, and Arunabha Mitra of the Vidalakis-Citrus Clonal Protection Program Lab who received $1.5 million in grants from the California Department of Food and Agriculture to lead three interconnected projects aimed at advancing sustainable agriculture and citriculture. The projects focus on youth engagement, sustainable waste management, and the application of advanced agricultural technologies. One initiative, *Seeding Success*, will train high school and college students in sustainable farming practices, while *Closing the Loop* aims to turn agri-food waste into carbon-based fertilizers, promoting soil health and sustainability. The third project, *Sustainable Citrus*, will enhance controlled environment agriculture for citrus growers, improving plant growth and disease resistance. These initiatives, running from 2024 to 2027, will be connected through *LabtoFarm.org*, a platform that bridges the gap between research and practical farming applications, offering students and underserved farmers valuable learning opportunities. For more information see the UC Riverside news article by Iqbal Pittalwala at https://news.ucr.edu/articles/2024/10/25/ucr-awarded-15m-sustainable-agriculture-initiatives

Citrus yellow vein clearing virus

Ray Yokomi
USDA-ARS, Parlier California

Citrus yellow vein clearing virus (CYVCV) has been detected in numerous residential properties in citrus and citrus relatives in Tulare in central California, and in one property in Hacienda Heights in southern California. The whole genome sequence of three Tulare CYVCV isolates and the one from Hacienda Heights was obtained. Sequence alignments of California isolates were compared to 54 isolates from abroad in the NCBI database and results showed that the Tulare isolates of CYVCV were grouped with those from South Asia (India and Pakistan) and the Middle East (Türkiye), while the Hacienda Heights isolate shares the most recent common ancestor with a South Korean lineage which derives from Chinese isolates. Together, these data suggest a diverse geological origin of CYVCV isolates in California.

Sun Y-D, Yokomi R. 2024. The Discovery of a Citrus Yellow Vein Clearing Virus Hacienda Heights Isolate Diversifies the Geological Origins of the Virus in California, United States. Viruses 2024, 16, 1479. https://doi.org/10.3390/v16091479

South Africa

By Glynnis Cook

Citrus Research International, South Africa

South Africa mostly produces fresh fruit citrus, which is dynamic with consumer preferences driving demand for new cultivars. This fast-paced environment has brought about a change in approach to orchard establishment practices in South Africa. Tree removal and replacement with nursery trees remains the standard for orchard renewal, but growers wanting to re-work younger orchards, of which the existing cultivars were not performing, regularly opt to top-work a new scion cultivar to the existing rootstock. The well-established root system supports accelerated growth of the new scion. In economically challenging times, this is a sensible option. There is no need for land preparation and full production can be achieved earlier. However, the success of top-working is reliant on the skills of the top-workers and importantly on the health status of the existing orchard. The effect of virus and viroid infections on scion growth is entirely dependent on the sensitivity of the scion. Latent infections in the existing scion can be detrimental to the new scion. Thankfully, the southern African citrus industry has been established on a sound foundation with pathogen-free budwood having been supplied by the South African Citrus Improvement Scheme (CIS) since 1984, which changed the graft-transmissible disease landscape over the years to a healthy industry. Most top-worked orchards have therefore been successful and has motivated growers to adopt this practice more widely.

However, as a further cost-cutting measure, some farmers opt to cut budwood from field trees rather than purchase the budwood from the CIS. Orchard trees acquire pathogens over time, either by insect transmission or mechanically by orchard practices such as pruning and girdling. Once a tree is well established, infections with some pathogens may not have a significant influence on tree health; however, these same pathogens may restrict the growth of a new top-worked scion or the new scion may be specifically sensitive to specific pathogens. Therefore, if field-cut budwood is used for top-working, the risk of detrimental infections is doubled. To minimise this risk, we encourage our farmers to purchase disease-free budwood for their top-works and additionally encourage growers to screen orchards for citrus viroids prior to top-working, as a gauge of the orchard health status. This service is provided by CRI at a minimal cost.

We are monitoring this ever-changing environment and expect that we will see a change in the health status of our industry if warnings are not respected.

Australia

<u>Citrus tristeza virus in Australia</u>

Citrus tristeza virus (CTV) is one of the oldest threats to Australian citrus. Quick decline from CTV is rarely seen due to rootstock choice, but stem pitting is observed in grapefruit, sweet orange and lime, with the economic impact from CTV largely unrecognised. Mild strain cross protection is used commercially to protect grapefruit in Australia from severe stem pitting disease but there are no mild strains available for oranges or limes. Little work has been undertaken on CTV in Australia over the past twenty years, but a new industry-supported project, led by the University of Queensland, aims to improve our understanding of the diversity of CTV in Australia, and to identify the major pathogenic genotypes. The work also aims to develop or identify mild CTV strains to protect against orange stem pitting disease, which is currently only reported from Queensland. To fast track the identification or engineering of mild strains of CTV for cross protection, work has begun to create infectious clones of local isolates of CTV, as quarantine rules prevent the importation of infectious clones from overseas. The project commenced in April 2024, and already mild and stem pitting strains of CTV from grapefruit have been characterised by high throughput sequencing, with only 47 amino acid differences observed between the two strains across all viral proteins.

Young Scientists in the Spotlight

Zali Mahony
PhD Candidate in Plant Pathology
University of Queensland, Australia

Zali Mahony is a PhD candidate at the Queensland Alliance for Agriculture and Food Innovation at the University of Queensland, Australia. She is currently working with her PhD supervisors Professor Andre Drenth and Dr Nga Tran at the University of Queensland and Dr Nerida Donovan from the New South Wales Department of Primary Industries and Regional Development. Prior to her PhD project, Zali worked with key stakeholders of the Australian vegetable industry to improve the awareness of biosecurity threats and increase the adoption of farm hygiene practices and response mechanisms among industry.

Zali's current research is building the citrus industry's understanding of black core rot, a fungal disease that impacts citrus production in Australia, with the aim of improving disease management and limiting disease spread. The impact of black core rot on the Australian citrus industry is varied due to the sporadic nature of the disease and the limited understanding of it. Multi-locus analyses of isolates obtained from black core rot affected fruit confirmed their placement in the *Alternaria alternata* clade. However, this clade appears to be polyphyletic and does not resolve the pathogen identity differences between the black core rot and the Emperor brown spot pathogen – another Alternaria disease on citrus with distinct symptom differences to black core rot, yet reported to be caused by the same pathogen. Zali is looking further into mycotoxins to see if it is possible to distinguish the two Alternaria pathogens.

To elucidate the black core rot disease cycle in Australian citrus orchards and evaluate disease control options, a multi-year field trial with a time-staggered application of chemical products is in its third year. This involves sampling of citrus foliage and fruit at different physiological growth stages to pinpoint sources of inoculum. An additional experiment using artificial inoculations of black core rot Alternaria isolates *in situ* to identify the timing of infection is also underway. With this research, Zali aims to improve the understanding of black core rot which may allow for more effective control of the disease and reduced economic losses.

Background: Black core rot is caused by the fungus Alternaria and is considered an erratic disease that impacts fruit quality and yields. The disease is characterised by pre-harvest fruit drop and internal black rot with often little to no external symptoms which makes it a tricky disease to study. Effective control of the disease is hampered by a lack of information about the aetiology and epidemiology, and this has left the Australian citrus industry with limited capacity to manage it.

Young Scientists in the Spotlight

Rachelle Bester
Biotechnology Researcher
Citrus Research International, South Africa

Rachelle Bester is a Biotechnology Researcher at Citrus Research International (CRI) in South Africa, with a focus on citrus disease research and developing innovative detection methods. She graduated in 2016 with a PhD in Genetics from Stellenbosch University, South Africa. Her current work focuses on understanding and combating graft-transmissible diseases (GTD) in citrus plants, where she uses the latest biotechnological tools to study plant-pathogen interactions. With a strong background in molecular plant virology and bioinformatics, Rachelle specializes in virus detection and metagenomics to explore how viruses and viroids impact plant health.

During her postdoctoral fellowships at the Agricultural Research Council and Stellenbosch University, she's developed tools and assays to identify new pathogens, manage disease, and ensure sustainable, healthy fruit crops. Passionate about sharing her knowledge and as part of her extraordinary appointment as a lecturer at Stellenbosch University, Rachelle mentors postgraduate students and lectures on plant viruses, ensuring a new generation of researchers is ready to tackle plant health challenges.
Rachelle is currently leading efforts to evaluate the interplay between citrus tristeza virus (CTV) and '*Candidatus* Liberibacter africanus' (CLaf) and to understand how different RNA extraction methods influence pathogen detectability, aiming to improve accuracy in virus, viroid and bacteria detection. Additionally, she is involved in projects that focus on molecular characterization of Liberibacter species diversity in Africa to prepare for the incursion of the more severe liberibacter, '*Candidatus* Liberibacter asiaticus' (CLas) associated with Huanglongbing (HLB) or citrus greening disease. Rachelle's research utilised primarily high-throughput sequencing to gather as much sequence data from plant and insect vectors to enhance citrus disease diagnostics and ultimately manage pathogen spread.

Background:
High-throughput sequencing (HTS) is a cutting-edge tool for detecting viruses and viroids in plants, offering an unbiased and comprehensive approach to pathogen identification. By sequencing all genetic material in a sample, HTS allows for the detection of both known and novel viruses, including those at low abundance. It can utilise RNA sequencing, metagenomics, or amplicon-based methods depending on the pathogen type. Bioinformatic analyses then compare sequences to known databases or assemble novel sequences. HTS enhances sensitivity, broadens detection scope, and enables the discovery of new pathogens, making it essential for advancing plant health diagnostics and management.

In Memoriam

Tribute to Eduardo Sanches Stuchi

Eduardo Sanches Stuchi was a researcher at Embrapa Cassava and Fruits and worked at the Mixed Research and Technology Transfer Unit in Bebedouro-SP, located at the Coopercitrus Credicitrus Foundation, where he previously worked when it was called the Bebedouro Citrus Experimental Station. His academic background and research line were focused on citrus horticulture, notably on the development of citrus scion and rootstock varieties, in addition to the evaluation of cultural practices. He graduated in Agricultural Engineering from ESALQ/USP and obtained his master's and doctorate degrees at FCAV/UNESP under the guidance of Prof. Luiz Carlos Donadio. He had a specialization degree in citriculture from the Polytechnic University of Valencia, Spain.

During his career, Eduardo Stuchi published 97 scientific articles in national and international indexed journals, 19 books and chapters, 74 technical articles and circulars, in addition to giving more than 80 lectures at events. The service provided to citrus growers and technicians exceeded 10,000 registered consultations. He advised 48 students at various levels, connected to the Graduate Program in Genetics and Plant Breeding at FCAV/UNESP. He was a CNPq 1D research productivity scholarship holder. Among Eduardo Stuchi's main contributions, the studies on citrus management in the Brazilian Cerrado conditions, whether irrigated or dryland, using planting density, pruning, seedling patterns and the use of various nutritional programs stand out. He participated in the registration of 24 citrus cultivars, with four highlights below.

The Flying Dragon trifoliate orange rootstock is a dwarfing variety originally from Asia to which Eduardo Stuchi devoted extensive study, notably for grafting with Tahiti lime. His pioneering work demonstrated the viability of this combination in the tropical and subtropical conditions of Brazil, and by 2023, approximately 25% of the seedlings were already grafted with this variety in the State of São Paulo. Its use with sweet oranges and mandarins is already beginning on a commercial scale and could be a fundamental factor for sustainability in the coming decades.

The BRS IAC EECB Alvorada Sweet orange is early-season and produces colorful fruits with virtually no seeds and a high concentration of sugars, which can be used both as fresh fruit and for processing NFC juice. It performs excellently in regions with milder climates or with irrigation under proper plant maintenance and has already surpassed 1% of commercial orchards in São Paulo. Another cultivar is Navelina XR, an early navel orange that is the only sweet orange variety in the world proven to be resistant to Xylella fastidiosa, the causal agent of citrus variegated chlorosis.

The Tahiti BRS EECB IAC Ponta Firme lime was selected in Bebedouro from material introduced by Embrapa in Cruz das Almas, Bahia. It stands out for its excellent productivity of high-quality fruits, less vigorous size and good production out of season in irrigated orchards. Its performance in combination with the Flying Dragon trifoliate rootstock is exceptional, and this pair should predominate in Brazilian orchards, and the cultivar is requested by producers from several states and countries.

Although he worked with all groups of citrus, including scions and rootstocks, Stuchi was passionate about the culture of Tahiti, which brought him closer to the profile of the family farmer than any other. It was there that he found himself at his most natural and spontaneous, attributes that were so characteristic of him. The work with Tahiti, in addition to the selection of clones and rootstocks, extended to the important contribution in the identification of viroids and viruses present in clones with the potential to control the size of the plant.

Tribute to Eduardo Sanches Stuchi cont.

Eduardo Stuchi's relevant technical contributions to the development of the sector and his unique capacity for relationships have allowed Eduardo Sanches Stuchi to become one of the most important citrus researchers in Brazil, having received two top honors: the Outstanding Agricultural Engineer in Citriculture Award/Centro de Citricultura Sylvio Moreira in 2005 and the Brazilian Citrus Industry Hall of Fame/GCONCI in 2021. He leaves behind his wife and daughter, Ivete and Isadora, and an orchard of friends from the citriculture across the world.

Tribute written by Eduardo Augusto Girardi and Juliana Freitas-Astúa

Upcoming Events

Advertise your event in the IOCV newsletter
email iocvsecretary@gmail.com

March 2025

XXIII IOCV Conference

Mildura, Victoria, Australia

16-20 March 2025

IOCV Australia 2025

June-July 2025

16th International Symposium of Plant Virus Epidemiology

Sao Paulo, Brazil

ispve2025.com

August 2025

International Society of Citrus Nurseries Conference

Valparaiso, Chile

17-21 August 2025

International Congress 2025 - International Society

Conference update

The next face-face IOCV conference will be held in AUSTRALIA.

We look forward to welcoming you to Mildura, on the banks of the Murray River in the Sunraysia citrus growing region. Mildura is a vibrant regional city surrounded by wineries and fruit growing farms. This will provide an ideal location for our IOCV family to reconnect, share knowledge and discuss how best to protect our global industry from citrus diseases.

Key messages

Abstract deadline: 22 Dec 2024

Submit to iocv2025@gmail.com

Conference: 16-20 March 2025

For conference information see: www.iocvaustralia2025.org.au

Mid-conference tour: Auscitrus propagation scheme and government research facilities

Auscitrus propagation scheme

NSW Primary Industries Institute

Travel to Mildura: there are direct flights to Mildura from major capital cities within Australia.
Travel to venue: there are accommodation options within walking distance of the conference venue.
Weather: in March the average daily temperature is 28°C, minimum 14°C
Post-conference tour: Sydney, featuring a visit to the Elizabeth Macarthur Agricultural Institute and a commercial nursery then making our way back to the city centre via the coast road.

Consider taking a holiday after the conference – COME AND SAY G'DAY https://www.australia.com/en