Pepper Virus Research 2025

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Peppers in California may be affected by diseases caused by numerous viruses

- Multiple virus diseases affect CA pepper production
- The importance and prevalence varies
  - -Major virus-TSWV
  - -Minor viruses-AMV, BCTV, CMV, PVY, TEV
- New concerns about exotic seed-transmitted viruses (ToBRFV and ToMMV) and whitefly-transmitted begomoviruses from Mexico (PHYYV and PGMV)
- Symptoms often not sufficient for identification and molecular tests are necessary
- Rapid ID is critical for effective IPM

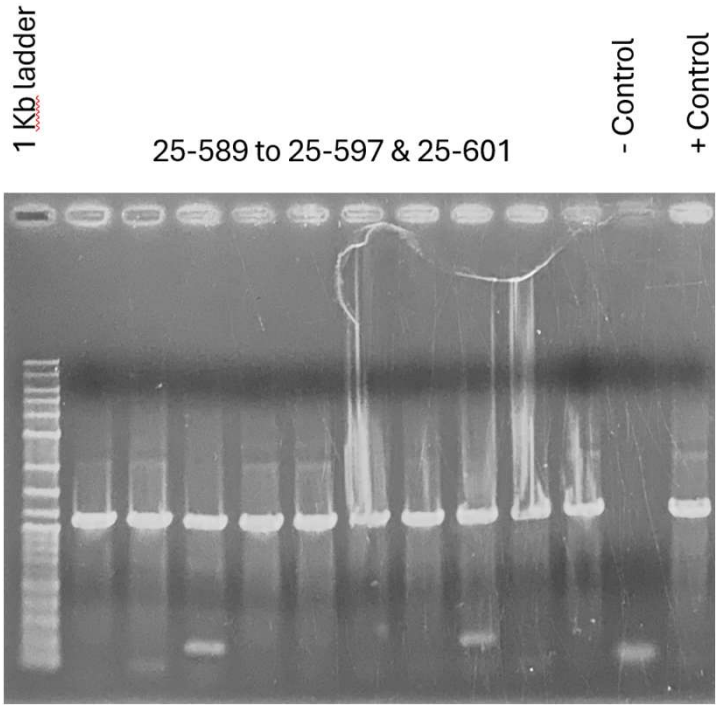
Number of pepper samples collected or received in 2025 and results of virus tests

County	Total	TSWV	AMV	Poty	CMV	BCTV	TMV	PMMoV	Other*
Yolo	126	92(+)	15(+)	12(+)	6(-)	1(-)	6(-)	NT	0
San Joaquin	16	11(-)	NT	5(-)	5(-)	5(+)	NT	NT	0
Ventura	26	7(-)	NT	7(-)	4(-)	13(-)	4(-)	7(-)	6
San Diego	1	1(+)	NT	NT	NT	NT	NT	NT	0
San Benito	11	6(+)	5(-)	5(-)	5(-)	NT	NT	NT	0
Yuma	2	2(-)	NT	NT	NT	NT	NT	NT	2
Total	182	99(+) 20(-)	15(+) 5(-)	12(+) 9(-)	0(+) 20(-)	5(+) 14(-)	0(+) 10(-)	0(+) 7(-)	8

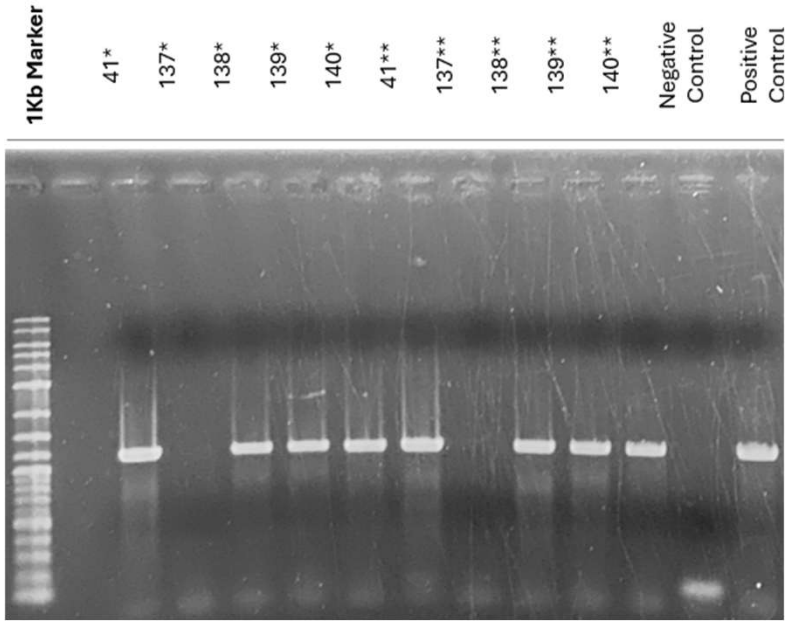
Identification of an outbreak of psyllid yellows (PY) in peppers in Ventura Co in 2025

- In late August 2025, we received photos and samples of pepper plants with upcurled and strong yellowing of leaves in Ventura (Oxnard Plain, OP) from Max Babylon
- Somewhat like CTD but negative for BCTV and phytoplasma
- Psyllids observed on the plant samples and on yellow sticky cards around fields on OP
- Could be an outbreaks of psyllid yellows?
- Plants and psyllids were tested for Candidatus *Liberibacter solanacearum* (CLso), a phloem-limited bacterium associated with PY

The phloem-limited bacterium Candidatus Liberibacter solanacearum (CLso) was detected in all leaves samples with the PY-like symptoms and in psyllids from yellow sticky cards around pepper fields with these symptoms



PCR detection of CLso from pepper plants with PY

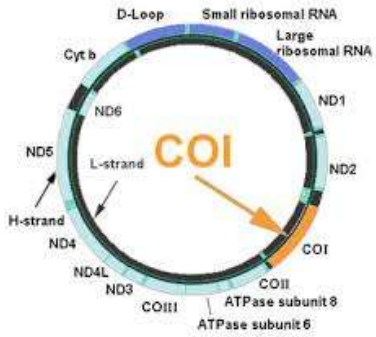


PCR detection of CLso from psyllids

High populations of two psyllid species with CLso were detected on yellow sticky cards from around pepper field with PY on the Oxnard Plain

Date	YSC	Station	Psyllids	Lso
06/02/25	38	1	0	-
06/02/25	39	2	0	-
06/02/25	40	3	1	-
06/02/25	41	5	9	+
06/02/25	42	6	21	-
06/02/25	43	9	0	-
06/02/25	44	10	8	-
06/02/25	45	11	8	-
06/02/25	46	12	15	-
08/28/25	137	11	550	-
08/28/25	138	12	300	+
08/28/25	139	13	125	+
08/28/25	140	14	43**	+

Sample ID	Collected from	Psyllids	Lso	Species	%ID
25-599-Psy	Pepper plant	**6**	+	*Bactericera cockerelli*	100
Psy-137	YSC-137	**550**	-	-	-
Psy-139	YSC-139	**125**	+	*Aphalarinae* sp.	97.3
Psy-140	YSC-140	**43**	+	*Aphalarinae* sp.	100



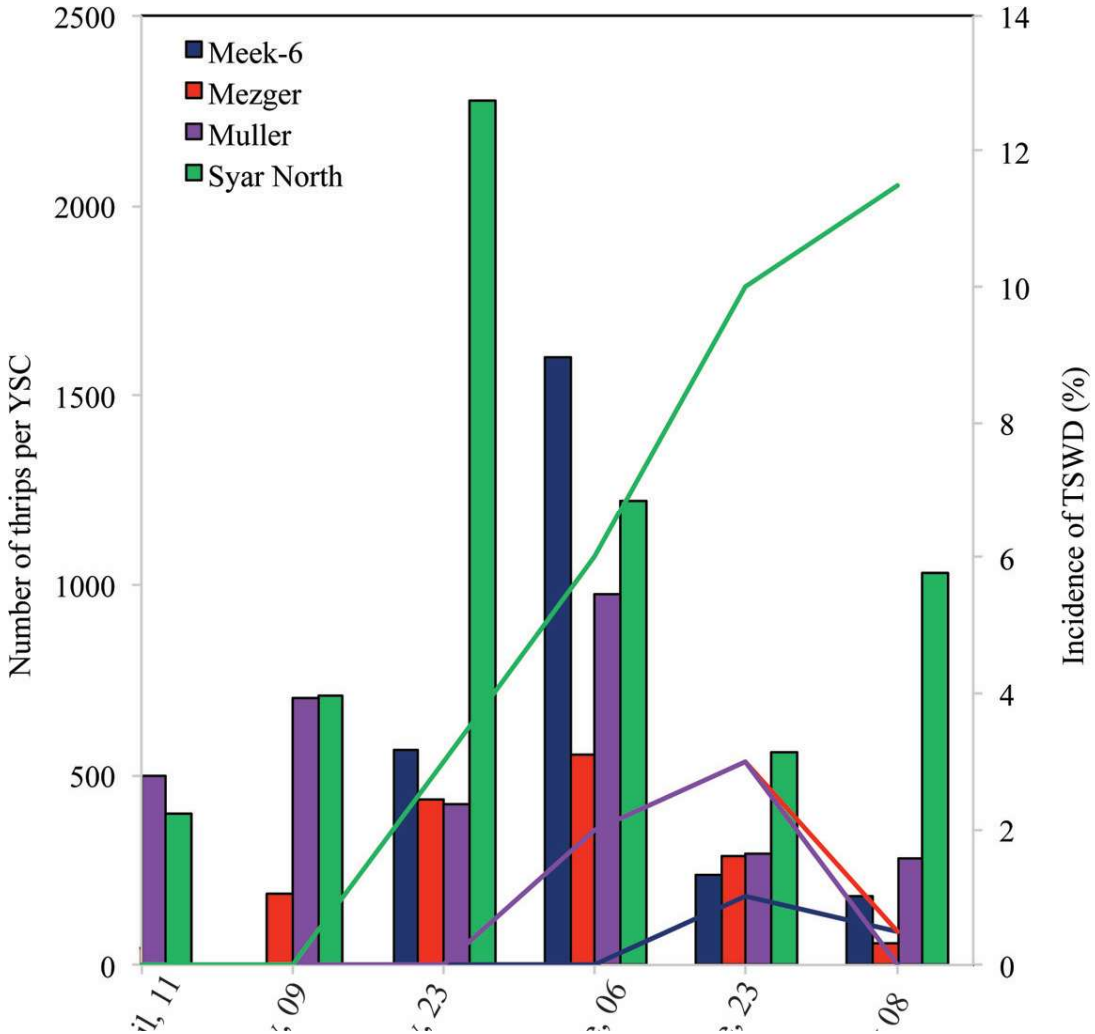
What is the cause of PY and is it a concern for pepper

- Available evidence indicates a toxin in the saliva of psyllid nymphs induces PY, with CLso enhancing the effect
- We investigated this by grafting a healthy pepper branch onto one of the plants with PY from the Oxnard Plain
- The grafted branch survived* and did not develop PY symptoms, but CLso was readily detected in leaves of the grafted branch
- These results support the hypothesis that the psyllid toxin plays an important role in PY development

Properties of beet curly top virus (BCTV), cause of curly top disease (CTD) and tomato spotted wilt virus (TSWV), cause of spotted wilt disease (TSWD)

Property	BCTV	TSWV
Nucleic acid	ssDNA	daRNA
Particle	Twinned virus particles	Spherical with membrane
Vector	Beet leafhopper	Western flower thrips
Transovarial transmission	NO	NO
Replication in the insect	NO	YES
Seed transmission	NO	NO?
Mechanical transmission	NO	YES
Resistant varieties	NO	YES (Tsw*)

Monitoring of thrips populations and tomato spotted wilt disease In commercial pepper fields in Yolo County in 2025

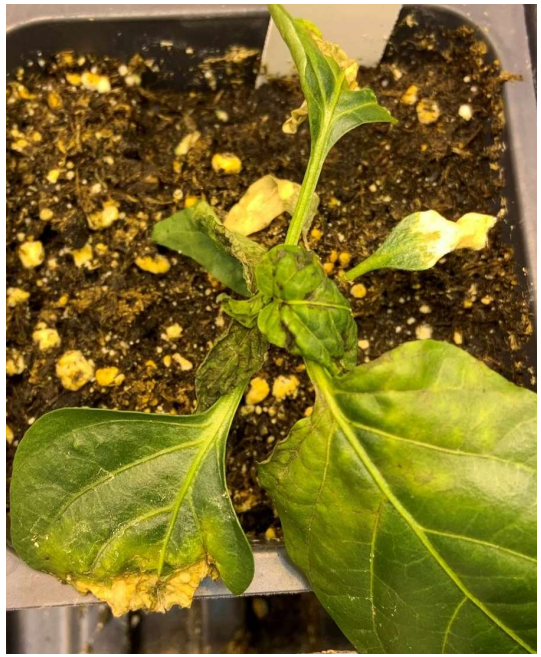


Frankliniella occidentalis was the predominant thrips species captured on yellow sticky cards (YSCs) around the four monitored pepper fields in Yolo County in 2025 along with small numbers of *Thrips tabaci*

Field	Total number of YSCs	Number of YSCs with Frankliniella occidentalis	Number of YSCs with Thrips tabaci
Meek-6	21	21	2
Mezger	24	24	4
Muller-12	24	24	2
Syar North	24	24	0
Total	63	63	8

Confirmation of pepper RB strains

- **Mechanical inoculation of Cal Wonder and Huntington plants to identify RB pepper isolates/strains of TSWV**



Characterization of TSWV isolates infecting pepper in Yolo County in 2025 revealed the continued emergence of the super RB (SRB) strain

Major resistance-breaking (RB) tomato spotted wilt strains in California and their infection of differential species/varieties

	Pepper	Pepper	Tomato	Tomato	Tobacco
TSWV strain	Susceptible	Resistant Tsw gene	Susceptible	Resistant Sw-5 gene	*N. benthamiana*
Wild-type	+	-	+	-	+
RB pepper	+	+	+	-	+
RB tomato	+	-	+	+	+
Super RB	+	+	+	+	+

Number of pepper samples with spotted wilt symptoms tested for tomato and pepper RB-TSWV strain(s) in 2025

County	TSWV	TSWV-RB Strains				Reaction in pepper cv. Huntington
		CPN	YPT	Mix (CPN/YPT)	Negative (CPN/YPT)	
Yolo	92(+)	30(+)	34(+)	6(+)	22	**WT(2+) RB(13+) (87%)**
San Diego	1(+)	0	1(+)	0	0	NT
San Benito	6(+)	0	3(+)	0	3	NT
Total	99	30	38	6	25	15

Serving as a resource for pepper RB TSWV

- TSWD is the most common and potentially damaging virus disease of peppers in California and many other parts of the world
- This RNA virus changes (mutates) rapidly and has overcome broken the major resistance genes in pepper and tomato
- It is important to identify sources of resistance to these emerging RB TSWV strains, especially the SRB strain
- In 2025 we continued to be a RB TSWV resource by:
  - -Providing information and isolates
  - -Conducted a high-throughput screening of materials from the UCD Pepper Breeding Program for resistance to pepper RB TSWV

Conclusions

- Low overall incidence of virus diseases in peppers in 2025
- Another cool wet winter/spring
- Uptick in detection of aphid-transmitted viruses in Yolo Co.
- Demonstrated that an outbreak of CTD-like symptoms in peppers on the Oxnard Plain was psyllid yellows
- Thrips/TSWD monitoring in Yolo County revealed delayed appearance of TSWV and correlation with thrips numbers
- Most TSWV isolates/strains were super RB
- Resource for RB TSWV strains and resistance screening

Proposed Research for 2026

Objective 1. Continue surveillance for pepper virus (and other) diseases in California peppers in 2026 through our collaboration with Matt Terra (Eckhard) and our Farm Advisor/PCA network

Objective 2. Continue monitoring of hot-spots and characterizing of associated pathogen isolates involved

a. Pepper fields in Yolo County for TSWD and thrips

b. Pepper fields in Ventura for beet leafhoppers/curly top disease and psyllids/psyllid yellows in collaboration with Max Babylon and Jeanmarie Harty (Bayer)

Objective 3. Continue to serve as a resource for pepper RB TSWV isolates/strains and for screening for resistance

THANK YOU!

Pepper-TSWV Team

- **UC Davis**
  - Tomas Melgarejo
  - Maria Rojas
  - Margaret Cespedes
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  - Tom Turini
  - Scott Stoddard
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