

Recent Changes in *Tomato spotted wilt virus*: management and research

Tom Turini

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Fresno County

Overview

- Identification
- Background
- 2019 research
- Management

Overview

- Identification

Symptoms of TSWV



TSWV



Tomato spotted wilt virus symptoms can be confused with other viruses



Beet curly top virus



Alfalfa mosaic virus



Tomato necrotic spot virus



Tomato Brown Rugose Fruit Virus (ToBRFV)

- ToBRFV is **NOT** currently established in California.
- ToBRFV is a threat to greenhouse and screenhouse tomatoes
- ToBRFV is spread by contact and can contaminate the seed coat.
- ToBRFV can survive for years in soil, in infected debris, or on contaminated equipment.



ToBRFV fruit symptoms. (photo: N. Salem)



Photo Chet Kurowski

Gibertson and Bagley (2019)
Tomato brown rugose fruit virus:
A threat to California field grown tomatoes?
UC Davis Plant Pathology and California Tomato Research Institute

Tomato Brown Rugose Fruit Virus (ToBRFV)



Photos: N. Salem

Foliar symptoms of *Tomato brown rugose fruit virus*

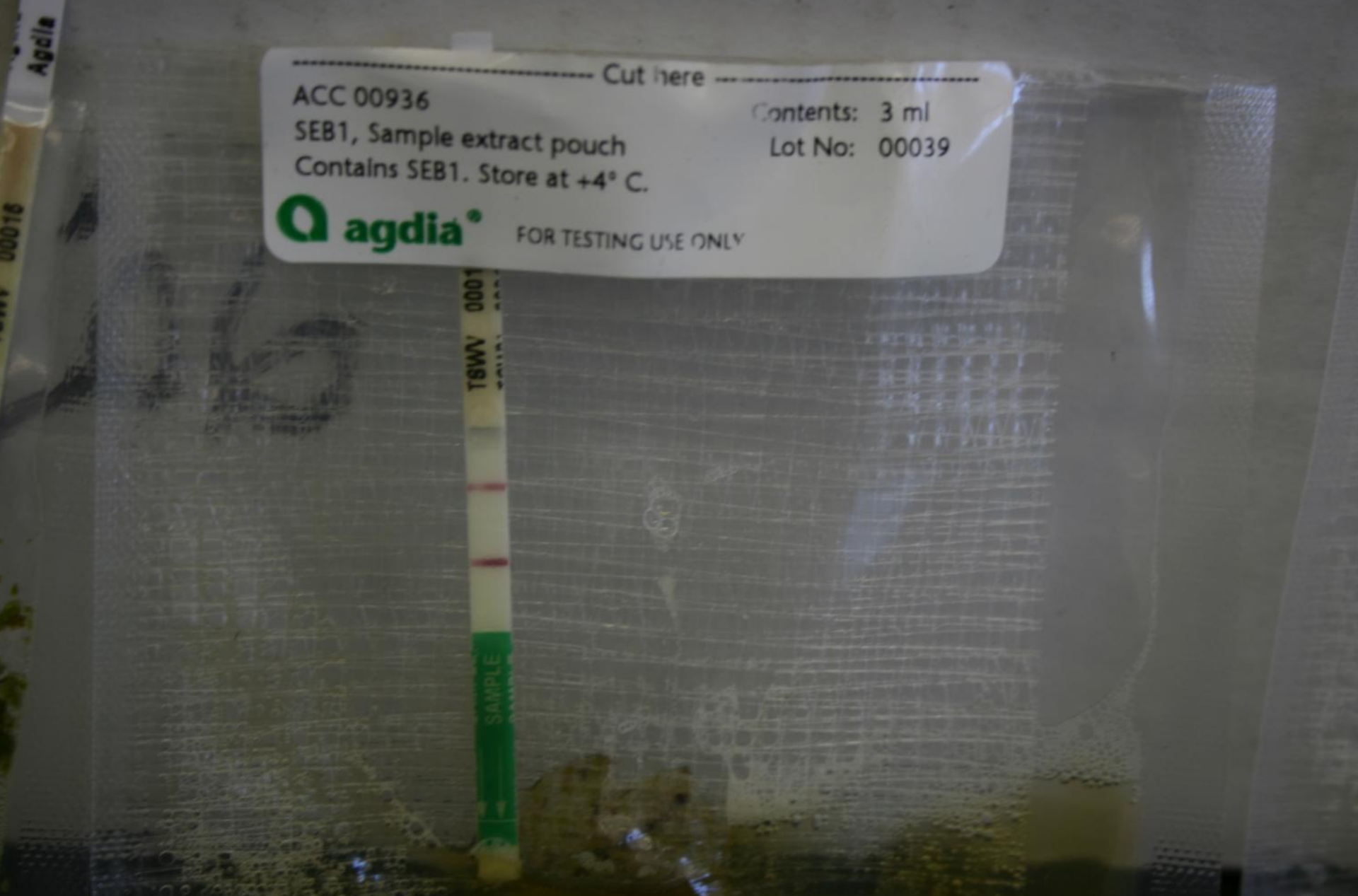
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----- Cut here -----
ACC 00936
SEB1, Sample extract pouch
Contains SEB1. Store at +4° C.
Contents: 3 ml
Lot No: 00039
Q agdia® FOR TESTING USE ONLY

T8WV 0001
SAMPLE

Immunostrips available from AgDia (www.agdia.com)

Overview

- Identification
- Background

Thrips vectors TSWV



Frankliniella occidentalis
(Western flower thrips)
Primary vector of TSWV in
Central California

Host Range of TSWV

Crop Hosts

- Lettuce
- Celery
- Radicchio
- Fava bean
- Tomato
- Pepper
- Eggplant
- Potato

Weed Hosts

- Prickly lettuce (*Lactuca serriola*)
- Sowthistle (*Sonchus spp.*)
- Little mallow (*Malva parvaflora*)
- Mustard (*Brassica spp.*)
- London rocket (*Sisymbrium irio*)
- Wild Radish (*Raphanus raphanistrum*)
- Pineappleweed (*Chamomilla suaveolens*)
- Rough-seeded *buttercup* (*Ranunculus muricatus*)
- Nightshade (*Solanum spp.*)
- Jimsonweed (*Datura stramonium*)
- Field bindweed (*Convolvulus arvensis*)

TSWV Resistance

- SW5: Single dominant gene
- In widespread use in the Central San Joaquin Valley for ~9 years
- No documentation of resistance-breaking strains in CA prior to 2016



Sw-5
Resistance-
breaking
strain



First detection mid-Apr 2016, Sw-5
fresh market tomatoes in Cantua
Creek (Fresno Co.), with other reports
in Firebaugh and Huron

Resistance-breaking TSWV distribution, 2019

- 2017: Additional reports in Fresno and Merced
- 2018: Continuing issues in Fresno and Merced with reports in Kern and Kings
- 2019: Lower overall but throughout Fresno Co.



Evaluation of
TSWV strains
present in
weeds in
January and
February—
2017 through
2019



- 2017 - resistance breaking (RB) TSWV strain was detected in sowthistle in Cantua Creek and in Huron
- 2018 – RB TSWV was detected in Mendota in sowthistle but only in lettuce in Cantua Creek
- 2019 – RB TSWV was not detected in weeds or crops

Overview

- Identification
- Background
- 2019 research



Poor coloring in fresh market tomatoes in July 2019. Positive for TSWV.

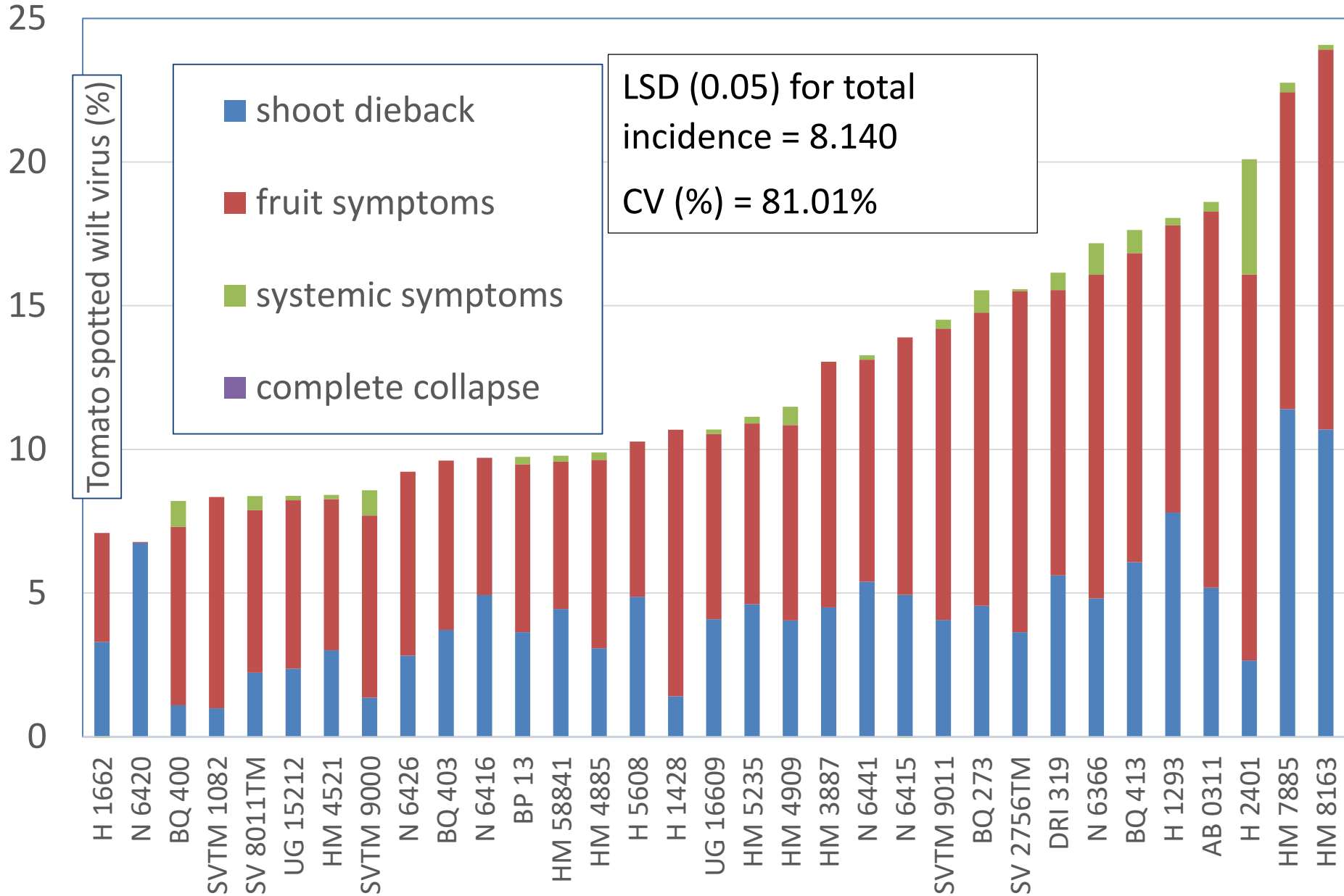
Collaboration with Ag Seeds and TS&L

Evaluation of
commercial variety trial
in area affected by
resistance-breaking
TSWV

- Company representatives provide trial maps
- UC personnel check fields for 10% incidence or more
- Advisors evaluate disease incidence
- In at least three trials, 3 shoots per variety in at least 6 varieties sampled and strain identified



Disease Incidence (33 entries x 13 sites), 2018-19



Disease Incidence (33 entries x 13 sites), 2018-19

resistance status	Variety	Use	incidence total
Sw5	H 1662	Thick	6.751
Sw5	N 6420	Pear	6.777
Sw5	BQ 400	Early	8.209
Sw5	SVTM 1082	Thin	8.340
Sw5	SV 8011TM	Inter	8.378
Sw5	UG 15212	Thick	8.387
Sw5	HM 4521	Inter	8.416
Sw5	SVTM 9000	Early	8.576
Sw5	N 6426	Thick	9.225
Sw5	BQ 403	Early	9.595
Sw5	N 6416	Early	9.692
Sw5	BP 13	Early	9.740
Sw5	HM 58841	Inter	9.784
Sw5	HM 4885	Thick	9.894
Sw5	H 5608	Thick	10.277
Sw5	H 1428	Thick	10.685
Sw5	UG 16609	Thin	10.695
LSD 0.05			8.140

resistance status	Variety	Use	incidence total
Sw5	HM 5235	Inter	11.138
Sw5	HM 4909	Inter	11.481
Sw5	HM 3887	Inter	13.034
Sw5	N 6441	Inter	13.278
Sw5	N 6415	Thick	13.864
Sw5	SVTM 9011	Thin	14.513
Sw5	BQ 273	Early	15.534
Sw5	SV 2756TM	Thick	15.574
Sw5	DRI 319	Thin	16.147
No Sw5	N 6366	Thin	17.175
Sw5	BQ 413	Early	17.637
Sw5	H 1293	Pear	18.056
Sw5	AB 0311	Thin	18.609
No Sw5	H 2401	Thick	20.096
No Sw5	HM 7885	Pear	22.763
Sw5	HM 8163	Pear	24.076
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Variety Trial: Strain Determination 2018

Variety	SW5	Strain detected (rb or wt)		
		Five Pts	Huron	Merced
S6366	-	Rb	Rb	Rb
UG19406	-	Rb	Rb	Rb
BQ413	+	Rb	Rb	Rb
UG16609	+	Rb	Rb	Rb
HM5900	+	Rb	Rb	Rb
H1293	+	Rb	Rb	Rb
N6420	+	Rb	Rb	Rb
BOS811	+	Rb	Rb	Rb
AB311	+	Rb	Rb	Rb

Strain identification

Sw-5 resistance breaking (Rb)

Wild type (wt)

Variety Trial: Strain Determination 2019

Variety	SW5	Strain detected (rb or wt)		
		Five Pts	Dos Palos	San Joaquin
S6366	-	Rb	---	Rb
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UG16609	+	Rb	---	Rb
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H1293	+	Rb	Rb	Rb
N6420	+	Rb	Rb	Rb
BOS811	+	Rb	Rb	Rb
AB311	+	Rb	Rb*	Rb**

Strain identification: Sw-5 resistance breaking (Rb) Wild type (wt)

* TSWV was weakly positive

** TSWV was detected in 1 of 3 samples

Response of varieties and breeding lines to TSWV at UC WSREC

Transplanted: 24 May
Plot size: single 60" bed by 75 ft
Plant spacing: 12"
Notes: Due to quantity of seed, as little as 5 ft per plot was used.

Response of tomato varieties and lines to Tomato spotted wilt virus 2019

code	designation	
T1	131191-13	AL6/AL10/Sw5/AS
T2	131299-25	AL6/Sw5/AS
T3	1511284-1	FA7/AS
T4	181045-2	CV17NBL
T5	ISI 25033	
T6	Line 20-12	
T7	Terra 1	
T8	Terra 2	
T9	Terra 3	
T10	Terra 4	
T11	5608	Sw5 resistance
T12	6366	No TSWV resistance

Cooperation from Martha Muschler Chu and private industry

Response of varieties and breeding lines to TSWV at UC WSREC	Entry ^z	TSWV Symptom Incidence (%) ^y						
		26-Jun	10-Jul	23-Jul	30-Jul	7-Aug	16-Aug	27-Aug
	H5608	0.000	0.000	2.161	3.512	4.368	4.368	5.299
	ISI 25033	0.000	0.000	0.413	5.951	4.596	4.596	5.920
	131191-13	0.000	0.000	0.000	0.000	1.337	4.461	6.456
	131299-25	0.000	0.000	0.210	0.210	0.989	0.989	6.512
	N6366	0.000	0.544	0.544	3.328	6.097	7.116	8.928
	Terra 3	0.000	0.000	0.244	3.569	3.589	7.326	12.259
	Terra 4	0.000	0.936	0.000	2.071	9.352	10.554	13.117
	Line 20-12	0.000	0.000	0.546	3.555	6.992	8.890	14.219
	Terra 2	0.000	0.000	1.769	1.769	3.741	12.243	16.432
	1511284-1	0.693	0.693	2.132	8.960	11.868	12.897	17.062
	181045-2	0.000	0.143	1.399	15.818	16.970	22.003	21.358
	Terra 1	0.000	0.646	2.859	34.158	51.124	65.577	70.393
	LSD (0.05) ^x	NS	NS	NS	2.467	2.494	2.957	3.623

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Strain of *Tomato spotted wilt virus* in variety/line comparison, 2019

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T2	131299-25	AL6/Sw5/AS		
T3	1511284-1	FA7/AS		
T4	181045-2	CV17NBL	RB	
T5	ISI 25033		RB	
T6	Line 20-12			
T7	Terra 1		RB	
T8	Terra 2		RB	
T9	Terra 3			
T10	Terra 4		RB	
T11	5608	Sw5 resistance	RB+WT	
T12	6366	No TSWV resistance	RB	

Strain identification: Sw-5 resistance breaking (Rb)
Wild type (wt)

Overview

- Identification
- Background
- 2019 research
- **Management**

Current Management

- Particularly in areas with history of high pressure:
 - management depends upon IPM
 - Insecticides may reduce incidence but should not be relied upon without other approaches.
- Resistant varieties with TSWV foliar symptoms present in more than 3% of plants should be tested (particularly in areas without previous report)

Management of Thrips

- Radiant, Lanate and dimethoate deliver relatively consistent control
- Drip or transplant water-applied neonicotinoids have not reduced TSWV incidence in most trials
- Verimark transplant treatment reduced TSWV incidence 3/7 trials
- Thrips degree day model is available online

TSWV Field Risk Index and Thrips Projections



- Home
- Thrips Population Projections for Tomato
- Yolo/Colusa
- Western San Joaquin Co.
- Eastern San Joaquin Co.
- Merced
- Fresno
- Kings
- Thrips Population Projections for peppers
- Fall and Spring Lettuce risks
- Tomato Field Risk Index

Thrips Population Projections for Tomato

About thrips population projections

We currently provide projections for Western Flower Thrips populations for five areas in the California central valley. Clicking on each of the links in the menu on the left will open a new tab/window in your browser which will display the information for the area you have chosen. Each page has the same layout. The image below shows a screenshot with some explanation of what each area of the page does. If you have trouble reading the descriptions, clicking on the image will open it in full screen mode. Use your browser's "back" button to return to this page.

Further information on the thrips projection model

The model was developed in collaboration with Dr Len Coop of Oregon State University's [Integrated Plant Protection Center](#) (IPPC). The IPPC developed and hosts the [USPEST](#) web service which is a multi pest multi model tool that provides information on pest development and disease risk for the contiguous 48 US states using a network of weather stations.

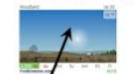
Use the menu on the left side of the screen to see the current status and population development projections for each area.

Clicking on each of the links in the menu on the left will open a new tab/window in your browser which will display the information for the area you have chosen.

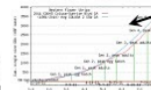


Yolo/Colusa area

Yolo/Colusa background information
Thrips populations for the Yolo/Colusa area in the south of the central valley are based on data from station 02060 in Colusa. The weather model displays conditions at this station level and the National Weather Service website. The USPEST tool operates in Google Maps.



Weather widget, Showing live weather. Clicking will open the widget in full screen mode. Clicking on "NWS" in lower right will open the NWS web site.



A brief interpretation of the current situation and advice about when to expect thrips activity, to help with scheduling insecticide sprays

Thrips population projections
The thrips population projections provide the first peak of thrips activity and indicate the timing of the second peak. Thrips population projections are generated through the USPEST tool. The model is based on the weather data from the Yolo/Colusa area. The model is based on the weather data from the Yolo/Colusa area. The model is based on the weather data from the Yolo/Colusa area.

Thrips population projection, showing expected dates for major developmental stages

Summary

- Resistance-breaking TSWV has been reported in the counties in the southern processing tomato production area
- Varieties differ in response to the new strain
- An integrated approach to management is most successful management in high risk areas
- Research into alternative resistance is ongoing

Acknowledgements

- CTRI
- Ag Seeds and TS&L

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Center Staff
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