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

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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

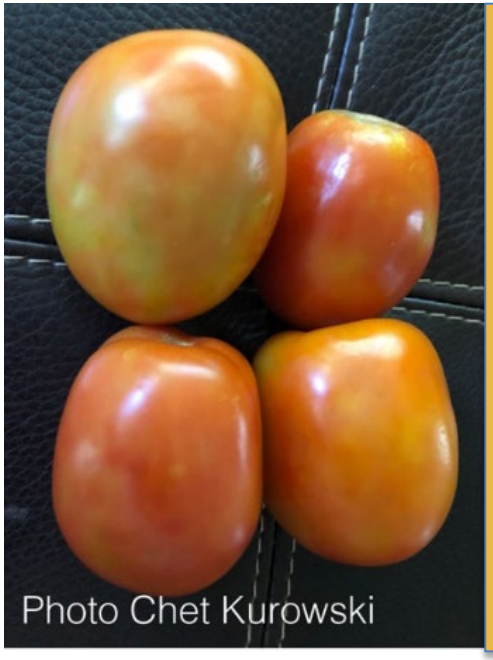
Alfalfa mosaic virus

Tomato necrotic spot virus

Tomato Brown Rugose Fruit Virus (ToBRFV)

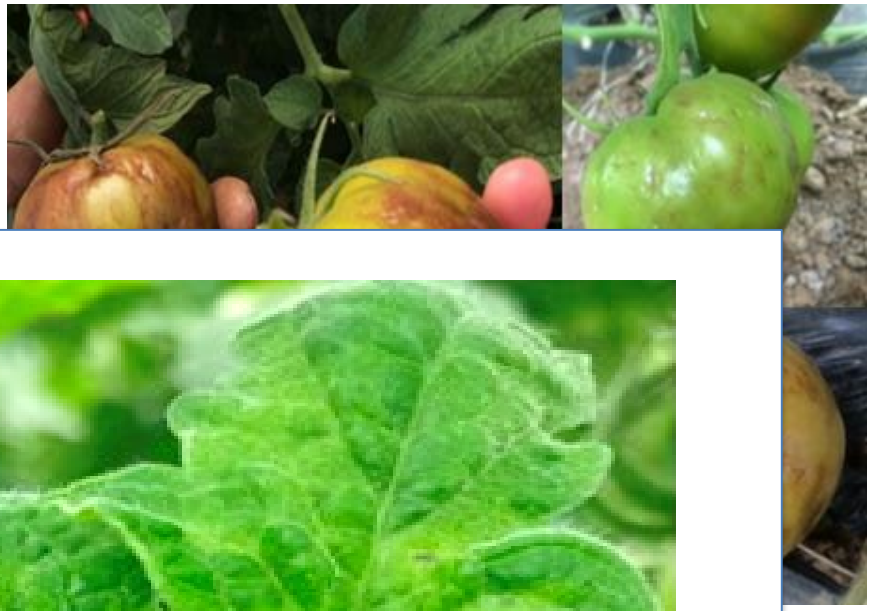
- ToBRFV is **NOT** currently established in California.
- ToBRFV is a threat to greenhouse and screenhouse tomatoes
- ToBRFV is spread by contact and can contaminate the seed coat.
- ToBRFV can survive for years in soil, in infected debris, or on contaminated equipment.

ToBRFV fruit symptoms. (photo: N. Salem)



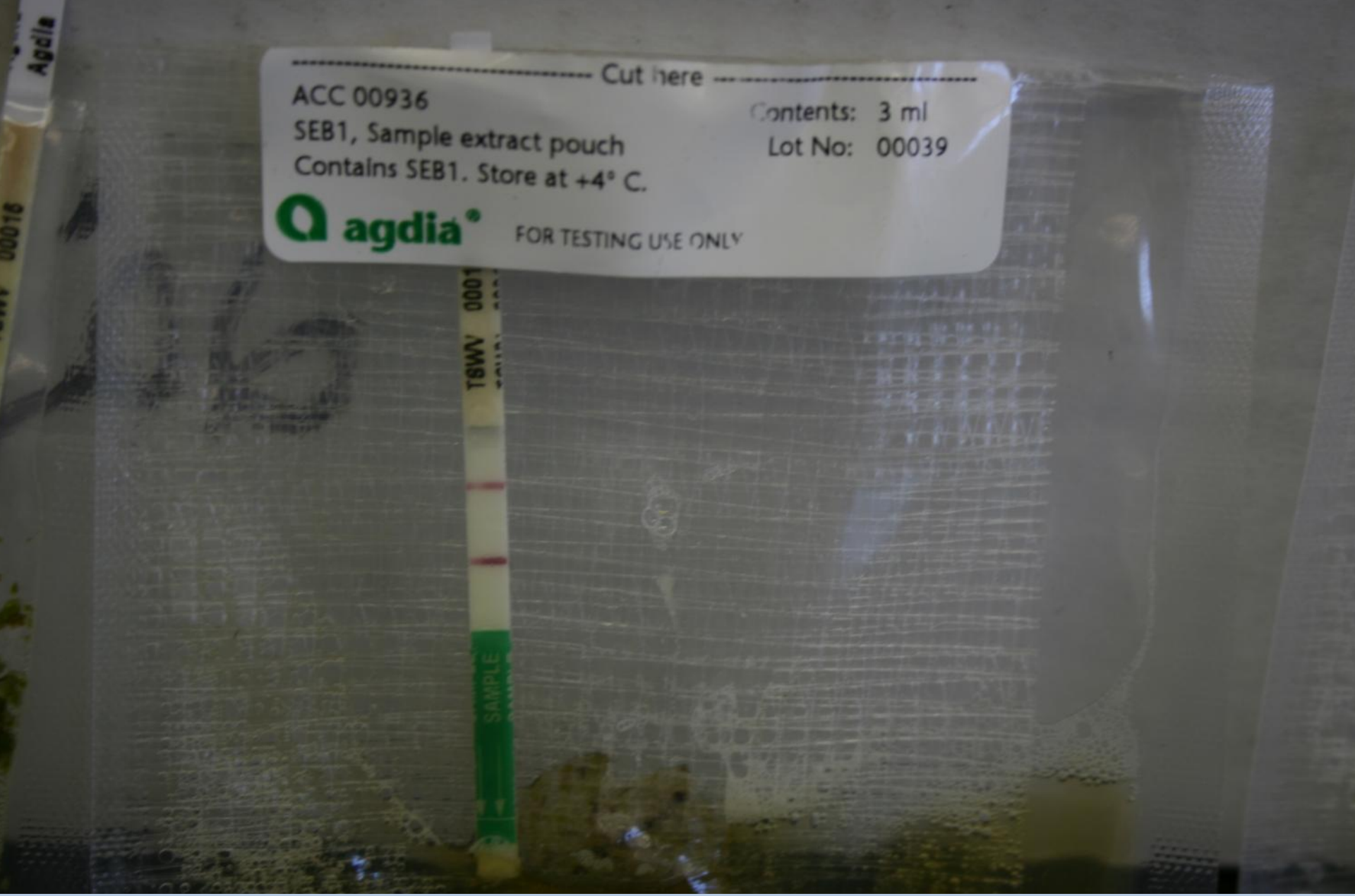
Gibertson and Bagley (2019) Tomato brown rugose fruit virus: A threat to California field grown tomatoes? UC Davis Plant Pathology and California Tomato Research Institute

Tomato Brown Rugose Fruit Virus (ToBRFV)



Photos: N. Salem

Foliar symptoms of *Tomato brown rugose fruit virus*



Immunostrips available from AgDia (www.agdia.com)

Overview

- Identification
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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

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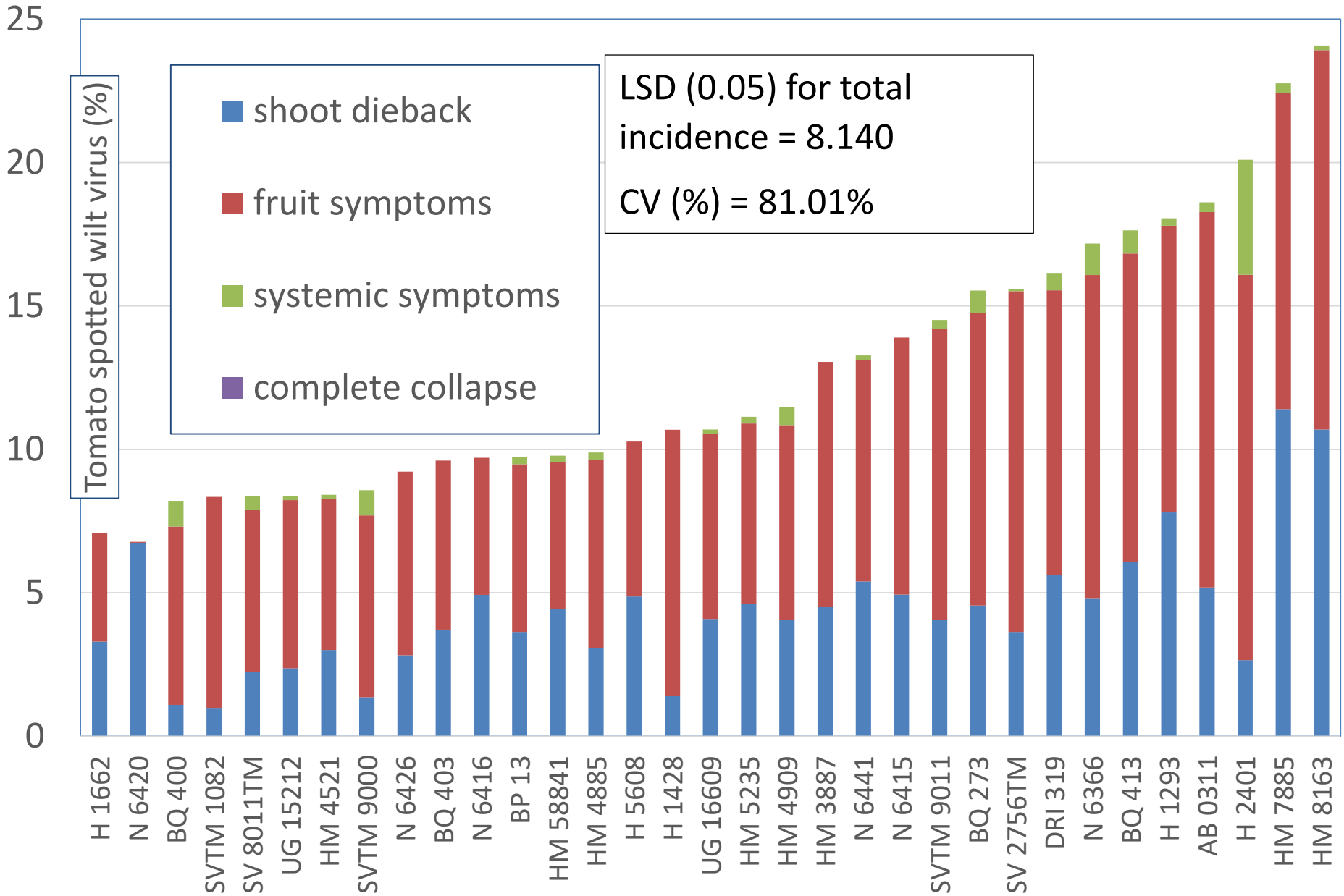
Poor coloring in fresh market tomatoes in July 2019. Positive for TSWV.

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

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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

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		Five Pts	Dos Palos	San Joaquin
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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

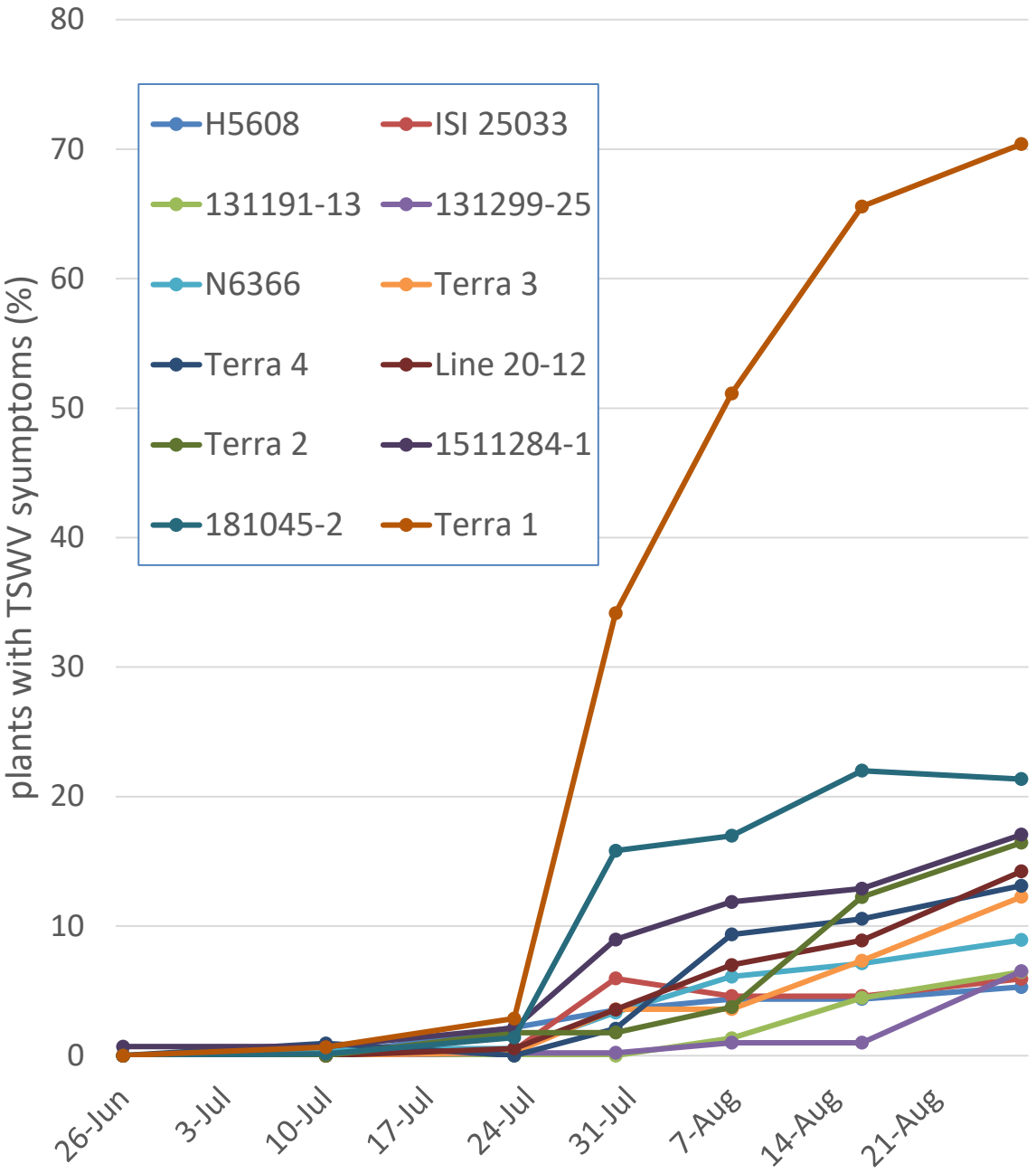
Response of varieties and breeding lines to TSWV at UC WSREC

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

Tomato spotted wilt virus symptom incidence on 30 July 2019 at variety/line comparison at UC WSREC



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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T8	Terra 2		RB	
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T12	6366	No TSWV resistance	RB	

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

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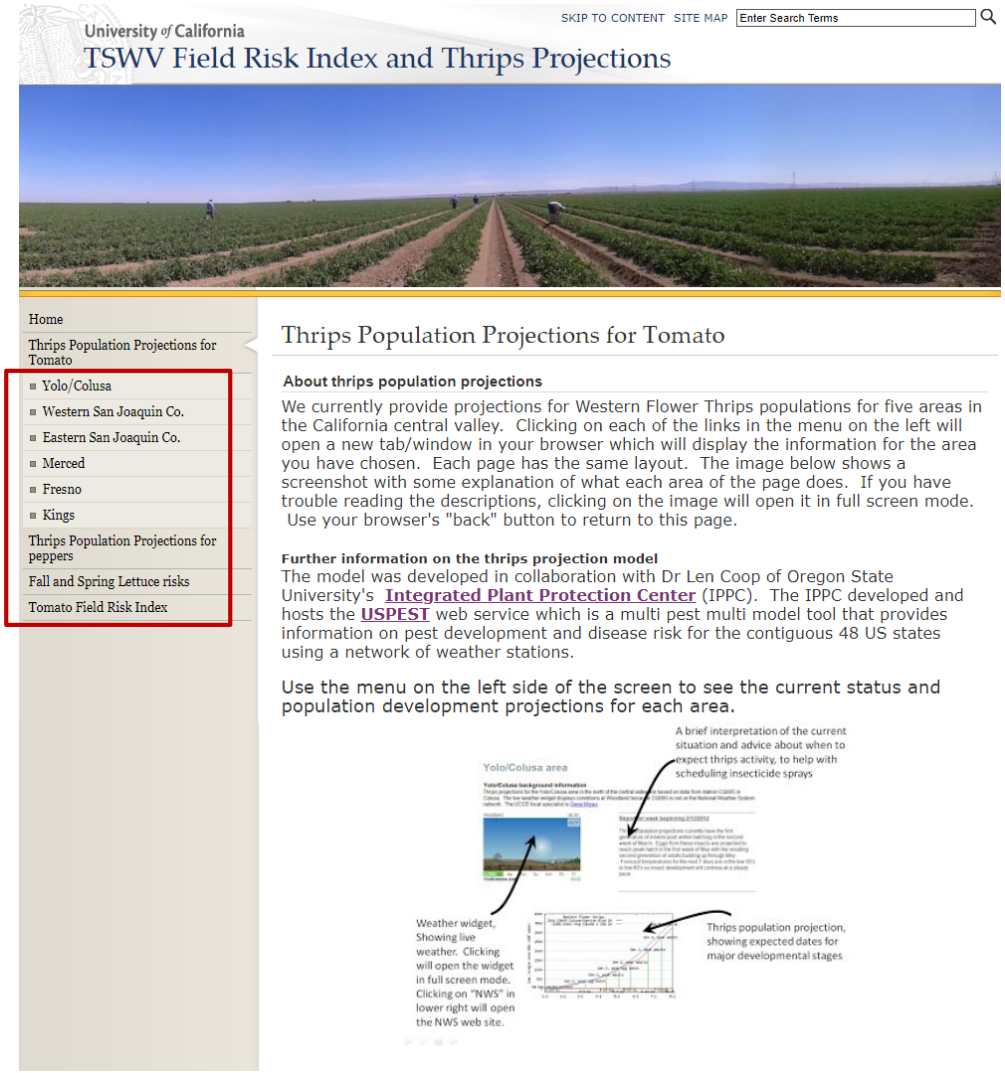
Current Management

- 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

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.



url: http://ucanr.edu/sites/TSWVfieldriskindex/Thrips_Population_Projections/

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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- Daniel Delgado

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