Recent Research on Management of *Tomato spotted wilt virus*

Tom Turini Vegetable Crops Advisor Fresno County



Symptoms of TSWV







ral Resources

TSWV









Resources

Thrips vectors TSWV



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



Weed Hosts of TSWV



Uncultivated Field on 29 Mar 2009 near tomatoes 7% sowthistle and 2% englishes to a field of the sources Agriculture and Natural Resources

Host Range of TSWV

Crop Hosts

- Lettuce
- Celery
- Radicchio
- Fava bean

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)

- Tomato
- Pepper
- Eggplant
- Potato
- Nightshade (Solanum spp.)
- Jimsonweed (Datura stramonium)
 - Field bindweed (Convolvulus arvensis)

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
- 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.

TSWV Resistance

- SW5: Single dominant gene
- In widespread use in the Central San Joaquin Valley for nearly 10 years
- Documentation of resistance-breaking strains in CA 2016





Sw-5 Resistancebreaking strain



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

Resistancebreaking 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.
- Since 2020, verified in northern California



Relative Susceptibility of Processing Tomato Varieties to TSWV (2019 - 2021)

- Quantify response of commercial varieties to TSWV
- Document strain present



Ag Seeds and **TS&L** commercial field trials (Fresno, Kings and Merced)

Company representatives provided maps of commercial trials UC Advisors evaluate trials with substantial TSWV levels w/in 3 weeks of harvest (6-9 trials/year)

Representative samples of at least six entries from at least three trials per year are tested for resistance breaking status (R. Gilbertson lab)

Varieties Compared (2019 - 2021)

resistance	variety	resistance	variety	resistance	variety
Sw5	AB0311	No Sw5	H2401	Sw5	N6441
Sw5	BP13	Sw5	H5608	Sw5	SV8011TM
Sw5	BQ273	Sw5	HM4521	Sw5	SVTM1082
Sw5	BQ413	Sw5	HM5235	Sw5	SVTM9000
Sw5	DRI319	No Sw5	HM7885	Sw5	SVTM9007
Sw5	H1293	Sw5	HM8163	Sw5	SVTM9011
Sw5	H1428	Sw5	N6415	Sw5	UG27713
Sw5	H1662	Sw5	N6420	Sw5	UG29814
Sw5	H1776	Sw5	N6426	Sw5	UG4014





1 shoot dieback

Symptom Categories





3 systemic symptoms through leaves and fruit

2 fruit symptoms with few foliar symptoms



4 collapse



Immunostrips available from AgDia (www.agdia.com)

righteunture and Matural Resources

Disease Incidence (27 entries x 18 sites) 2019-21



Disease Incidence (27 entries x 18 sites) 2019-21

entry	Use	TSWV <u>(</u> %)
BP13	early	7.38398	e ^z
SV8011TM	inter	7.75929	de
SVTM1082	thin	8.34033	cde
UG29814	inter	8.57453	cde
H1662	thick	10.107	bcde
BQ413	early	10.2285	bcde
UG27713	thin	10.5225	abcde
H1428	thick	10.5777	abcde
SVTM9000	early	11.5547	abcde
SVTM9007	thick	11.67	abcde
N6441	inter	11.7315	abcde
HM4521	inter	11.8613	abcde
H1776	thick	12.7992	abcde
H5608	thick	13.151	abcde

entry	Use	TSWV (%)		
N6426	thick	13.2468	abcde	
UG4014	early	13.5282	abcde	
HM5235	inter	13.5476	abcde	
N6415	thick	14.2621	abcde	
H2401	thick	14.7516	abcde	No Sw5
BQ273	early	14.9422	abcde	
DRI319	thin	17.1124	abcde	
HM8163	pear	20.5663	abcde	
SVTM9011	early	21.4305	abcde	
AB0311	thin	21.7692	abcd	
N6420	pear	22.3952	abc	
H1293	pear	25.0618	ab	
HM7885	pear	25.8357	а	No Sw5

Testing for Sw5 Resistance Breaking TSWV (R. Gilbertson lab)

- From two to three locations per year
- At least six entries
- Three shoots per entry

Insecticides for Thrips Management

- Limitations:
 - Limited efficacy
 - Thrips high reproductive rates
 - Contact is difficult
 - resistance

- Practical Uses
 - Manage population
 densities at critical stages
 of seasonal development
 - If there is high TSWV pressure, insecticide treatments will not provide commercially acceptable control.

Insecticide Modes of Action

Group #	Chemical sub- group	Primary target site of action	Trade name	Active ingredient
1A	Carbamate	Acetylcholine esterase inhibitors	Lannate LV	methomyl
1B	Organophosphate		Dimethoate 4EL	dimethoate
5	Spinosyns	Nicotinic acetylcholine receptor allosteric activators	Radiant Entrust	spinetoram spinosad
28	Diamide	Ryanodine receptor modulators Nerve and muscle action	Cyazypyr, Exeril, Verimark	cyantraniliprole

From IRAC,

Influence of Drip-Applied Insecticides



thiamethoxam 193 g (3 Jun)
thiamethoxam 193 g (3 Jun), dinotefuron 294 g (7 Jul)

Untreated



thiamethoxam 193 g (22 Jun), dinotefuron 294 g (12 Jul)
thiamethoxam 193 g (22 Jun), dinotefuron 294 g (22 Jul)
Untreated



thiamethoxam 193 g (25 May), dinotefuron 294 g (30 Jun)*

thiamethoxam 193 g (25 May), dinotefuron 294 g (30 Jun)

Untreated

* Weekly injections of acibenzolar-s-methyl 35g/ha

2012



thiamethoxam 193 g (7 Jun), dinotefuron 294 g (27 Jun)
 thiamethoxam 193 g (7 Jun), cytraniliprole 197 g (27 Jun)
 Untreated

Foliar Treatment Impact on TSWV Symptomatic Plant Incidence 2009



	date of application, quantity ai/ha				
	17 Jun	1 Jul	15-Jul		
• Treatment 1	spinetoram 87 g	dimethoate 560 g	spinetoram 87 g		
• Treatment 2	spinetoram 87 g	dimethoate 560 g			
 Treatment 3 Untreated control 		dimethoate 560 g	spinetoram 87 g		

Foliar Treatment Impact on TSWV Symptomatic Plant Incidence 2011



Effect of Verimark applied to transplants one day prior to planting on thrips densities 14 days post-plant in Fresno County, CA 2021.

Insecticide trade name,	6/2/21
rate per acre ^z	adults ^y
Verimark 13.5 fl oz/a	
transplant drench	4.25
Untreated control	19.00
Treatment probability	0.0030
Coefficient of Variation (%)	80.42

^z On 18 May, Verimark was applied to the trays in the equivalent of 13.5 fl oz per acre based on a plant density of 8712 plants per acre.

^y On 2 Jun (15-days post-treatment), three plants per plot of the Verimark treatment and in the untreated control were carefully covered with a zip-lock bag, the plant was cut, and the bag was sealed. Then, samples were frozen, rinsed with water over a 150 mesh/inch screen, poured over the top of the screen into petri plates and thrips were counted under a 40x dissecting scope.



Effect of Verimark applied to transplants one day prior to planting on thrips densities 21 days post-plant in Fresno County, CA 2021.

Insecticide trade name, rate	6/9/2021	6/9/2021 nymphs	6/9/2021
per acre	adults ^z		total
Verimark 13.5 fl oz/a	13.75	0.75	14.5
transplant drench ^y			
Admire Pro 10.5 fl oz injected 2	21.00	3.00	24.00
Jun ^x			
Untreated control	19.00	1.25	20.25
Treatment probability	0.4041	0.1331	0.294
Coefficient of Variation (%)	21.54	105.90	23.09

- ² On 9 Jun, three plants per plot from the plots treated with Admire, Verimark and from the untreated control were carefully covered with a zip-lock bag, plants were cut, and the bag was sealed. Then, samples were frozen, rinsed with water over a 150 mesh/inch screen, poured over the top of the screen into petri plates and thrips were counted under a 40x dissecting scope.
- ^y On 18 May, Verimark was applied to the trays in the equivalent of 13.5 fl oz per acre based on a plant density of 8712 plants per acre.
- Admire Pro 10.5 fl oz/acre was injected into the sub-surface drip system on 2 Jun.

Effect of insecticides on thrips densities in Fresno County, CA 2021.

	thrips counts per 10 flowers ^z						
Insecticide trade name,	22 Jun			28 Jun			cumulative
Formulated product per acre ^y	adult	nymph	total	adult	nymph	total	total
Admire Pro 10.5 fl oz							
injected [×]	7.00 ^w	1.00	8.00	9.75	2.00	10.00	18.00
Verimark 13.5 fl oz/a ^w +							
Radiant 6 fl oz	9.75	0.75	10.50	12.25	1.75	12.25	22.75
Movento 5.0 fl oz/acre	13.25	1.00	14.25	10.75	0.00	14.25	28.50
Dimethoate 400 16 fl oz	14.00	0.75	14.75	9.25	1.25	16.00	30.75
Movento 3 fl oz and							
Agrimek 3.5 fl oz	15.50	0.50	16.00	13.75	1.00	17.00	33.00
Radiant 6 fl oz	14.75	1.00	15.75	10.75	1.75	17.50	33.25
Exirel 20.5 fl oz/acre	14.25	1.00	15.25	12.25	3.00	18.25	33.50
Success 6.0 fl oz/acre	14.75	1.25	16.00	13.00	3.00	19.00	35.00
Sivanto 14.0 fl oz	16.75	0.50	17.25	7.50	3.25	20.50	37.75
Untreated control	18.00	2.25	20.25	14.25	2.50	22.75	43.00
Agrimek 3.5 fl oz/acre	21.00	0.75	21.75	11.75	1.00	22.75	44.50
Sefina 14 fl oz/acre	19.00	1.50	20.50	10.75	3.75	24.25	44.75
Verimark 13.5 fl oz/aw	23.75	1.75	25.50	9.50	3.00	28.50	54.00
Treatment Probability	0.0884	0.7650	0.0983	0.2542	0.1818	0.3591	0.1575
Coefficient of variation							
(%)	48.02	102.13	46.66	33.62	106.16	30.15	31.57

TSWV Management After Loss of Resistance

- Sanitation : start with clean transplants, manage weeds inside the field and outside
- When possible, avoid planting near uncontrollable sources of virus
- Thrips management : Generally, dimethoate and Radiant have a level of efficacy
- Avoid use of highly susceptible varieties in high-risk areas
- Late in the production season, TSWV levels are higher

Acknowledgements

- CTRI
- California Melon Research Board
- Ag Seeds and TS&L

UC DAVIS

- Dr. Robert Gilbertson
- Dr. Ozgur Batuman
- Dr. Maria Rojas
- Dr Mônica Macedo

UC Coop. Ext.

- Scott Stoddard
- Brenna Aegerter



- Dr. William Wintermantel
- University of California West Side Research Center Staff

Questions

Tom Turini UC Cooperative Extension, Fresno County <u>taturini@ucanr.edu</u> 559-375-3147

