

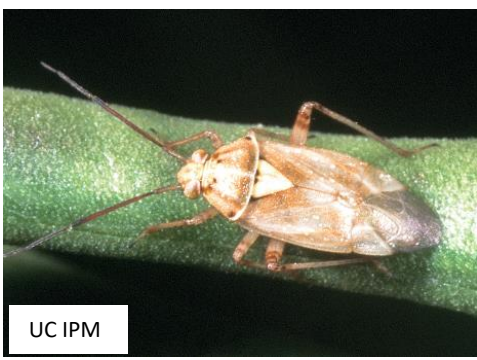


# Impact of neonicotinoid regulations on insecticide programs for management of insect-transmitted viruses

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**Agriculture and Natural Resources**

# Neonicotinoid restrictions & current treatment options



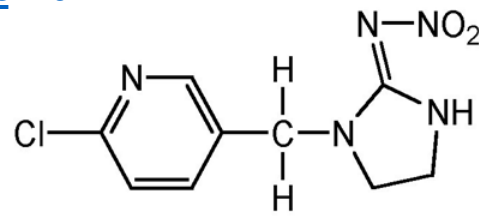
- CA regulations affecting Neonicotinoid chemistries in California
- Implications:
  - Beet leafhopper/beet curly top virus
  - Western flower thrips/tomato spotted wilt virus
- Discussion



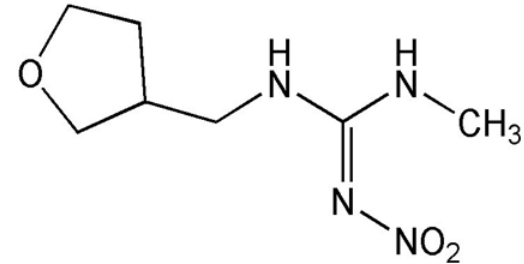
# Neonicotinoid CA DPR definition for purposes of this regulatory action

“Neonicotinoid” means a pesticide containing any of the following active ingredients in the **nitroguanidine insecticide** Class of neonicotinoids: clothianidin, dinotefuran, imidacloprid, and thiamethoxam.’

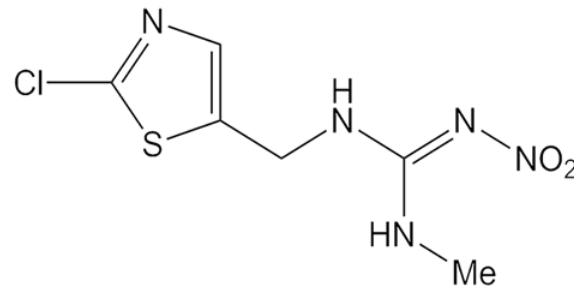
From: California Dept. of Pesticide Regulation, 22-001, Final  
[https://www.cdpr.ca.gov/docs/enforce/neonicotinoid/neonicotinoid\\_regulations.htm](https://www.cdpr.ca.gov/docs/enforce/neonicotinoid/neonicotinoid_regulations.htm)



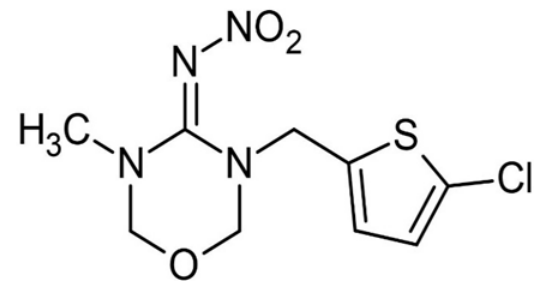
Imidacloprid



Dinotefuran



Clothianidin



Thiamethoxam

## Neonicotinoid limitations on rates and timing in fruiting vegetables

“Bloom” means the period from the onset of flowering until petal fall is complete.’

- (a) Application of a neonicotinoid is prohibited during bloom.
- (b) If both soil and foliar application methods are used on the same crop, or if multiple neonicotinoid active ingredients are applied to the same crop, a total maximum combined rate of 0.172 lbs. ai/A/season may be applied.
- (c) If managed pollinators will be used within the growing season, additional limitations apply.

From: California Dept. of Pesticide Regulation, 22-001, Final  
[https://www.cdpr.ca.gov/docs/enforce/neonicotinoid/neonicotinoid\\_regulations.htm](https://www.cdpr.ca.gov/docs/enforce/neonicotinoid/neonicotinoid_regulations.htm)



## Insecticide Comparison beet leafhopper (*Circulifer tenellus*) *beet curly top virus (BCTV)*

- Impact on beet curly top virus in tomato



Some insecticide programs included in experiments discussed in this presentation are not permitted under current regulations.

July 7, 2015  
Insecticide  
Comparison at UC  
West Side  
Research  
Extension Center



Admire Pro  
6.5 oz/A  
drip applied  
22 Jun

Verimark  
13.5 oz/A  
transplant  
drench

Admire Pro  
10 oz/A  
transplant  
water

Untreated

BCTV  
Incidence  
2015-22  
Insecticide  
Comparison  
at UC West  
Side  
Research  
Extension  
Center

Insecticide trade name, rate per acre and application method <sup>z</sup>	2015	2016	2018	2022
Admire Pro 10.5 fl oz Transplant Water (TW) <sup>y</sup>	+ +			
Admire Pro 4 fl oz TW with Sivanto 2 fl oz DIRECTED FOLIAR (DF) <sup>w</sup> at planting followed by (fb) Admire Pro 6.5 fl oz DRIP <sup>v</sup> (4 weeks) <sup>u</sup>	+ +			
Admire Pro 4.0 fl oz TW fb Verimark 10 fl oz DRIP (3 weeks) fb Verimark 10 fl oz DRIP (6 wks)		+ +		
Admire Pro 4.0 oz TW fb Platinum 3.67 oz DRIP (3 weeks)		+ +		
Admire Pro 4.0 oz TW fb Admire Pro 6.5 oz DRIP (2 weeks)				- <sup>s</sup>
Admire Pro 6.5 fl oz DRIP (4 weeks)	-			
Admire pro 8 fl oz DRIP (1 week)			+ +	
Admire Pro at 10 fl oz TW fb Radiant 10 fl oz (2 weeks) fb dimethoate 1 pt (5 weeks)				+ +
Admire Pro at 10 fl oz TW fb Radiant 10 fl oz (2 weeks) fb dimethoate 1pt (5 weeks) fb BeLeaf 4.28 oz DRIP (7 weeks) fb Exirel 20.5 fl oz (9 weeks)				-
Movento 5.0 fl oz (2 & 4 weeks)				-
Plinazolin 5.13 fl oz (3 & 5 weeks)				-
Plinazolin 6.16 fl oz (3 & 5 weeks)				-
Radiant 10.0 fl oz (1 week)			-	
Sequoia 2.5 fl oz + Radiant 6.0 fl oz (1 week)			-	
Sequoia 2.5 fl oz TRANSPLANT DRENCH (TD) <sup>r</sup>			-	
Sequoia 4.5 fl oz DS (1 week)			-	
Sequoia 4.5 fl oz TD			-	
Sivanto 2 fl oz DF fb Admire Pro 6.5 fl oz DRIP (4 weeks)	-			
Sivanto 10.5 fl oz (2 weeks) fb Platinum 3.67 oz DRIP (3 weeks) fb Venom 6.0 oz (6 weeks)		+ +		
Sivanto 7 fl oz & 21 fl oz DRIP (2 weeks)				-
Sivanto Prime 28 oz DRIP (2 weeks)				-
Verimark 13.5 fl oz TD	+ +	+ +	+ +	-
Verimark 13.5 fl oz TD fb Platinum 3.67 oz DRIP (3 wks)		+ +		
Verimark 13.5 fl oz TD fb Radiant 10 fl oz (2 wks) fb dimethoate 1pt (5 wks) fb BeLeaf 4.28 oz (7 wks) fb Exirel 20.5 fl oz (9 wks)				-
Verimark 13.5 fl oz TD fb Radiant 10 fl oz (2 wks) fb dimethoate 1 pt (5 wks) fb BeLeaf 4.28 oz DRIP (7 wks) fb Exirel 20.5 fl oz (9 wks)				+ +



BCTV  
Incidence  
2015-22  
Insecticide  
Comparison  
at UC West  
Side  
Research  
Extension  
Center

Insecticide trade name, rate per acre and application method <sup>z</sup>	2015	2016	2018	2022
Admire Pro 10.5 fl oz Transplant Water (TW) <sup>y</sup>	+	+		
Admire Pro 4 fl oz TW with Sivanto 2 fl oz DIRECTED FOLIAR (DF) <sup>w</sup> at planting followed by (fb)	+	+		
Admire Pro 6.5 fl oz DRIP <sup>v</sup> (4 weeks) <sup>u</sup>				
Admire Pro 4.0 fl oz TW fb Verimark 10 fl oz DRIP (3 weeks) fb Verimark 10 fl oz DRIP (6 wks)		+	+	
Admire Pro 4.0 oz TW fb Platinum 3.67 oz DRIP (3 weeks)		+	+	
Admire Pro 4.0 oz TW fb Admire Pro 6.5 oz DRIP (2 weeks)				- <sup>s</sup>
Admire Pro 6.5 fl oz DRIP (4 weeks)	-			
Admire pro 8 fl oz DRIP (1 week)			+	+
Admire Pro at 10 fl oz TW fb Radiant 10 fl oz (2 weeks) fb dimethoate 1 pt (5 weeks)				+
Admire Pro at 10 fl oz TW fb Radiant 10 fl oz (2 weeks) fb dimethoate 1pt (5 weeks) fb BeLeaf 4.28 oz DRIP (7 weeks) fb Exirel 20.5 fl oz (9 weeks)				-
Movento 5.0 fl oz (2 & 4 weeks)				-
Plina <sup>a</sup>				-
Plina <sup>a</sup>				-
Radia <sup>a</sup>			-	
Sequ <sup>a</sup>			-	
Sequ <sup>a</sup>			-	
Sequ <sup>a</sup>			-	
Sequ <sup>a</sup>			-	
Sivanto 2 fl oz DF fb Admire Pro 6.5 fl oz DRIP (4 weeks)	-			
Sivanto 10.5 fl oz (2 weeks) fb Platinum 3.67 oz DRIP (3 weeks) fb Venom 6.0 oz (6 weeks)		+	+	
Sivanto 7 fl oz & 21 fl oz DRIP (2 weeks)				-
Sivanto Prime 28 oz DRIP (2 weeks)				-
Verimark 13.5 fl oz TD	+	+	+	-
Verimark 13.5 fl oz TD fb Platinum 3.67 oz DRIP (3 wks)		+	+	
Verimark 13.5 fl oz TD fb Radiant 10 fl oz (2 wks) fb dimethoate 1pt (5 wks) fb BeLeaf 4.28 oz (7 wks) fb Exirel 20.5 fl oz (9 wks)				-
Verimark 13.5 fl oz TD fb Radiant 10 fl oz (2 wks) fb dimethoate 1 pt (5 wks) fb BeLeaf 4.28 oz DRIP (7 wks) fb Exirel 20.5 fl oz (9 wks)				+

Admire Pro at transplant (10.5 fl oz) or 1 week following transplant (8.0 fl oz) reduced BCTV incidence

BCTV  
Incidence  
2015-22  
Insecticide  
Comparison  
at UC West  
Side  
Research  
Extension  
Center

Insecticide trade name, rate per acre and application method <sup>z</sup>	2015	2016	2018	2022	
Admire Pro 10.5 fl oz Transplant Water (TW) <sup>y</sup>	+	+			
Admire Pro 4 fl oz TW with Sivanto 2 fl oz DIRECTED FOLIAR (DF) <sup>w</sup> at planting followed by (fb) Admire Pro 6.5 fl oz DRIP <sup>v</sup> (4 weeks) <sup>u</sup>	+	+			
Admire Pro 4.0 fl oz TW fb Verimark 10 fl oz DRIP (3 weeks) fb Verimark 10 fl oz DRIP (6 wks)		+	+		
Admire Pro 4.0 oz TW fb Platinum 3.67 oz DRIP (3 weeks)		+	+		
Admire Pro 4.0 oz TW fb Admire Pro 6.5 oz DRIP (2 weeks)				- <sup>s</sup>	
Admire Pro 6.5 fl oz DRIP (4 weeks)	-				
Admire pro 8 fl oz DRIP (1 week)			+	+	
Admire Pro at 10 fl oz TW fb Radiant 10 fl oz (2 weeks) fb dimethoate 1 pt (5 weeks)				+	+
Admire Pro at 10 fl oz TW fb Radiant 10 fl oz (2 weeks) fb dimethoate 1pt (5 weeks) fb BeLeaf 4.28 oz DRIP (7 weeks) fb Exirel 20.5 fl oz (9 weeks)				-	
Movento 5.0 fl oz (2 & 4 weeks)				-	
Plina <sup>a</sup>				-	
Plina <sup>a</sup>				-	
Radia <sup>a</sup>					
Sequoia 4.5 fl oz DS (1 week)					
Sequoia 4.5 fl oz TD					
Sivanto 2 fl oz DF fb Admire Pro 6.5 fl oz DRIP (4 weeks)	-				
Sivanto 10.5 fl oz (2 weeks) fb Platinum 3.67 oz DRIP (3 weeks) fb Venom 6.0 oz (6 weeks)		+	+		
Sivanto 7 fl oz & 21 fl oz DRIP (2 weeks)				-	
Sivanto Prime 28 oz DRIP (2 weeks)				-	
Verimark 13.5 fl oz TD	+	+	+	-	
Verimark 13.5 fl oz TD fb Platinum 3.67 oz DRIP (3 wks)		+	+		
Verimark 13.5 fl oz TD fb Radiant 10 fl oz (2 wks) fb dimethoate 1pt (5 wks) fb BeLeaf 4.28 oz (7 wks) fb Exirel 20.5 fl oz (9 wks)				-	
Verimark 13.5 fl oz TD fb Radiant 10 fl oz (2 wks) fb dimethoate 1 pt (5 wks) fb BeLeaf 4.28 oz DRIP (7 wks) fb Exirel 20.5 fl oz (9 wks)				+	+

Verimark 13.5 fl oz as transplant drench (13.5 fl oz) has been effective against BCTV

## Influence of insecticide applications on beet curly top virus incidence in tomatoes

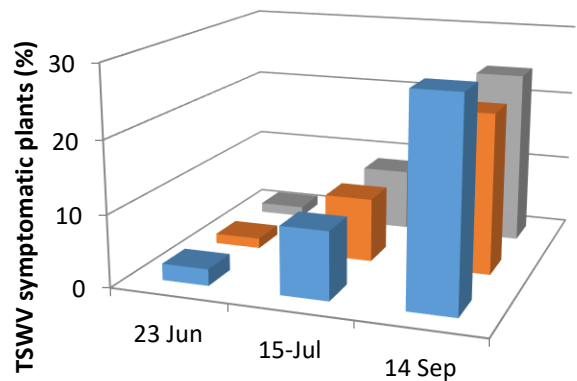
- Verimark (transplant treatments) consistently reduced curly top under low to moderate pressure early season. Increased yields were observed under moderate pressure
- Early applications of Admire Pro treatments reduced curly top incidence at low to moderate BCTV pressure.

# Tomato spotted wilt virus



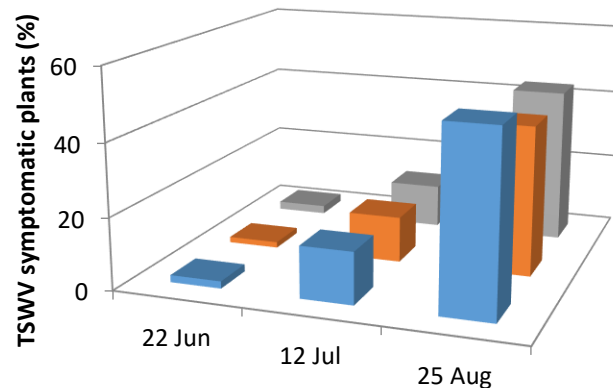
# Drip Injected Treatment Impact on TSWV Symptomatic Plant Incidence

**2009**



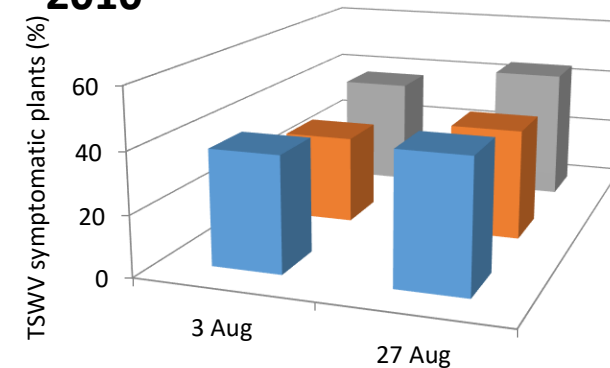
- thiamethoxam 193 g (3 Jun)
- thiamethoxam 193 g (3 Jun), dinotefuron 294 g (7 Jul)
- Untreated

**2011**



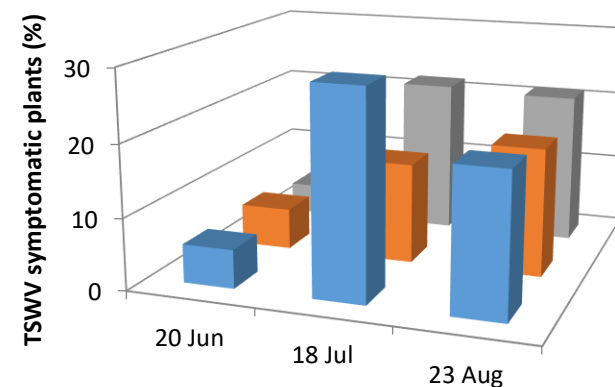
- thiamethoxam 193 g (22 Jun), dinotefuron 294 g (12 Jul)
- thiamethoxam 193 g (22 Jun), dinotefuron 294 g (22 Jul)
- Untreated

**2010**



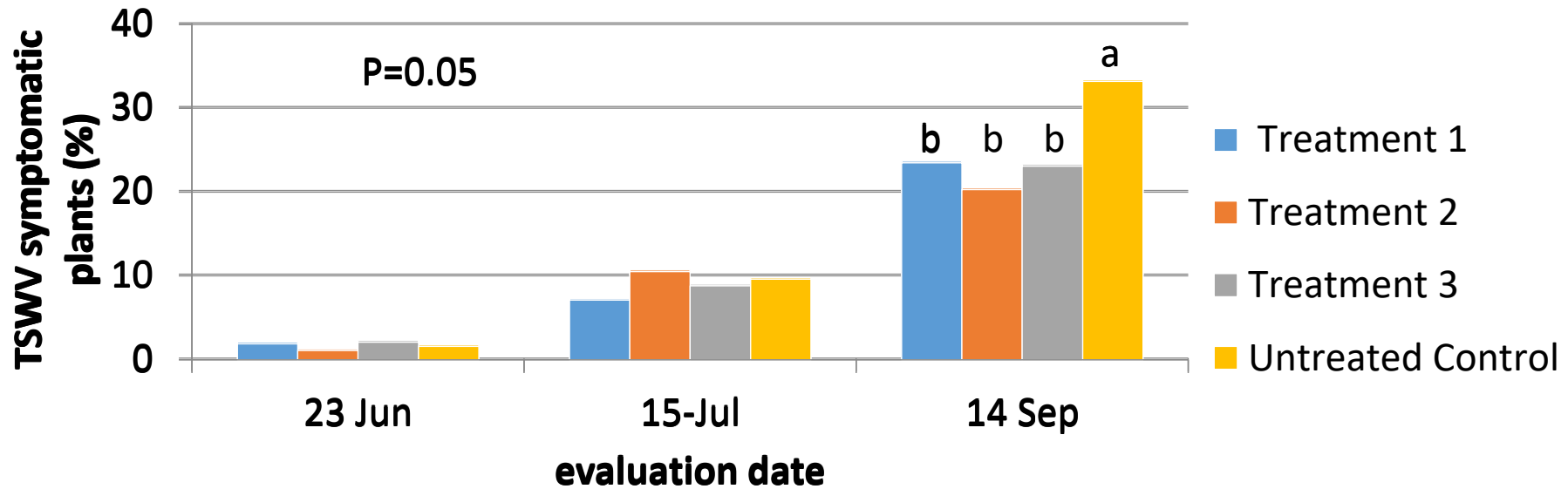
- thiamethoxam 193 g (25 May), dinotefuron 294 g (30 Jun)\*
  - thiamethoxam 193 g (25 May), dinotefuron 294 g (30 Jun)
  - Untreated
- \* Weekly injections of acibenzolar-s-methyl 35g/ha

**2012**



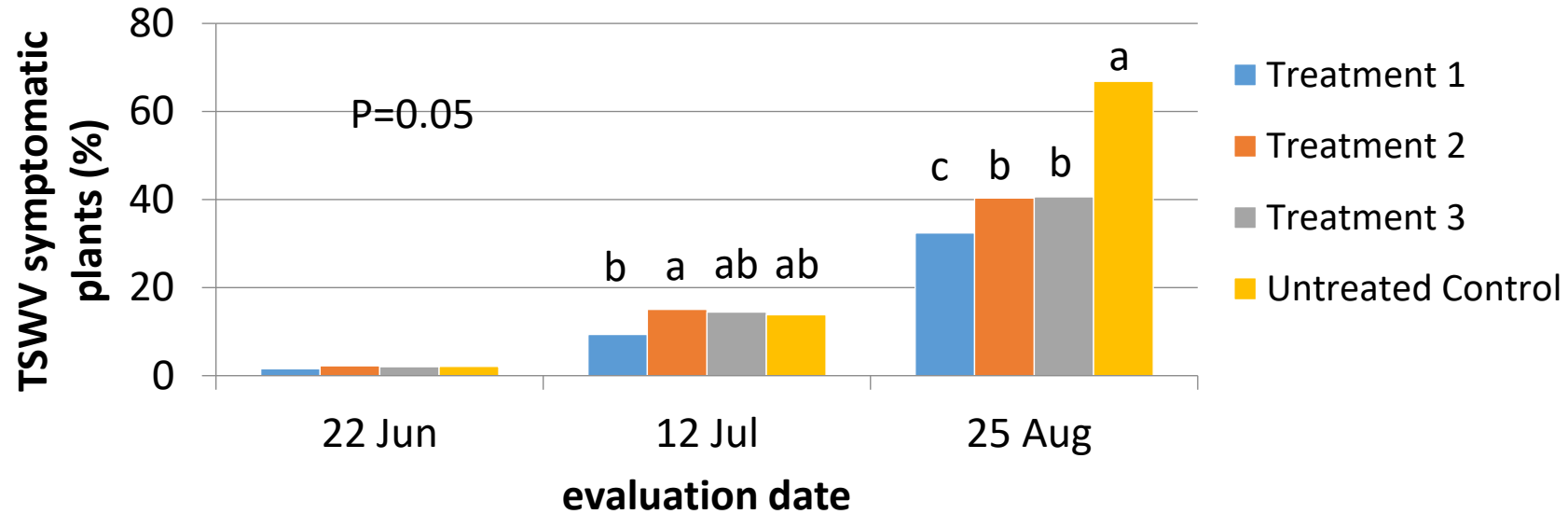
- thiamethoxam 193 g (7 Jun), dinotefuron 294 g (27 Jun)
- thiamethoxam 193 g (7 Jun), cytraniliprole 197 g (27 Jun)
- Untreated

# Foliar Treatment Impact on TSWV Symptomatic Plant Incidence 2009



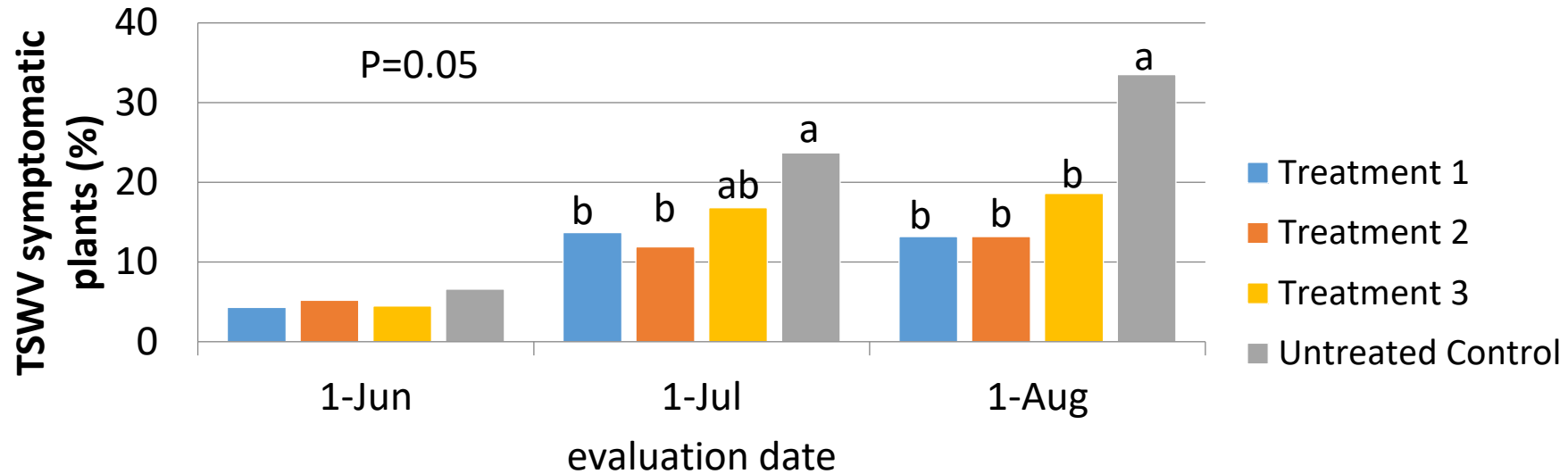
	date of application, rate		
	17 Jun	1 Jul	15-Jul
● Treatment 1	Radiant 10 fl oz	Dimethoate 4EL 1 pt	Radiant 10 fl oz
● Treatment 2	Radiant 10 fl oz	Dimethoate 4EL 1 pt	
● Treatment 3		Dimethoate 4EL 1 pt	Radiant 10 fl oz
● Untreated control			

# Foliar Treatment Impact on TSWV Symptomatic Plant Incidence 2011



	date of application, quantity ai/ha				
	Trans. drench	24-Jun	6-Jul	14-Jul	21-Jul
● Treatment 1	Verimark 13.5 fl oz	Radiant 10 fl oz	Dimethoate 4EL 1 pt	Radiant 10 fl oz	Dimethoate 4EL 1 pt
● Treatment 2		Radiant 10 fl oz	Dimethoate 4EL 1 pt	Radiant 10 fl oz	Dimethoate 4EL 1 pt
● Treatment 3		Radiant 10 fl oz	Dimethoate 4EL 1 pt		
● Untreated Control					

# Foliar Treatment Impact on TSWV Symptomatic Plant Incidence 2012



	date of application, quantity ai/ha					
	drench	12-Jun	22-Jun	29-Jun	9-Jul	18-Jul
● Treatment 1	Verimark 13.5 fl oz	Radiant 10 fl oz	Dimethoate 4EL 1 pt	Radiant 10 fl oz	Dimethoate 4EL 1 pt	Radiant 10 fl oz
● Treatment 2		Radiant 10 fl oz	Dimethoate 4EL 1 pt	Radiant 10 fl oz	Dimethoate 4EL 1 pt	Radiant 10 fl oz
● Treatment 3		Radiant 10 fl oz	Dimethoate 4EL 1 pt			
● Untreated Control						



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

## 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 per acre	6/9/2021 adults <sup>z</sup>	6/9/2021 nymphs	6/9/2021 total
Verimark 13.5 fl oz/a transplant drench <sup>y</sup>	13.75	0.75	14.5
Admire Pro 10.5 fl oz injected 2 Jun <sup>x</sup>	21.00	3.00	24.00
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

## Effect of Verimark applied to transplants one day prior to planting on thrips densities 12 days post-plant in Fresno County, CA 2022

Insecticide trade name, rate per acre	8 Jun, adults <sup>z</sup>
Verimark transplant drench at the equivalent of 13.5 fl oz/a 26 May	38.50
Admire Pro at 10 fl oz/a in transplant water 27 May	35.75
Admire Pro 4.0 oz/A in transplant water 27 May	37.25
Sivanto Prime 28 oz/A drip at the first irrigation 3 Jun	30.00
Sivanto Prime 7 oz/A in transplant water 27 May	35.25
Untreated	34.00
Treatment probability	0.12
Coefficient of Variation (%)	90.75

## Summary of thrip/TSWV management insecticide studies

- Early studies showed reduction in disease incidence with Radiant/dimethoate
- Neonicotinoids have not performed for thrips management and did not reduce TSWV incidence under the conditions of the studies in Central California.

## Impact of 2024 Neonicotinoid regulations on management of insect transmitted

- Management of *beet curly top virus* transmitted at early stages of crop development will be minimally affected.
- Additional risk exists for situations in which BCTV infection may occur at later stages of crop development.
- Where possible, manage weedy areas that may harbor vector populations prior to planting.



CTRI is funding 2024 research to investigate additional chemical control options that will include additional of materials such as (but not limited to) Assail, Sivanto, Exirel and Beleaf for BCTV and TSWV management.

Insecticide  
Resistance  
Action  
Committee  
Mode of  
Action Main  
and sub-  
group  
classifications

<b>4 Nicotinic acetylcholine receptor (nAChR) competitive modulators Nerve action {Strong evidence that action at one or more of this class of protein is responsible for insecticidal effects}</b>	4A Neonicotinoids	Acetamiprid, Assail Clothianidin, Belay Dinotefuran, Venom Imidacloprid, Admire Nitenpyram, Thiacloprid, Thiamethoxan, Platinum
	4B Nicotine	Nicotine
	4C Sulfoximines	Sulfoxaflor Sequoia
	4D Butenolides	Flupyradifurone Sivanto
	4E Mesoionics	Triflumezopyrim, Dicloromezotiaz
	4F Pyridylidenes	Flupyrimin
<b>28 Ryanodine receptor modulators Nerve and muscle action {Strong evidence that action at this protein complex is responsible for effect}</b>	<b>Diamides</b>	Chlorantranilipr, Exirel, Cyantraniliprole, Verimark Cyclaniliprole, Flubendiamide,
<b>29 Chordotonal organ nicotinamidase inhibitors Nerve action IRAC: MoA-classification, 2023</b>	<b>Flonicamid</b>	Flonicamid Beleaf

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- Bayer
- Corteva
- FMC
- Syngenta

## University of California West Side Research Center Staff

- Tyler Waltrip

## CDFA Beet Curly Top Control Board





Thank you