Spider Mite Ecology and Management in Walnuts

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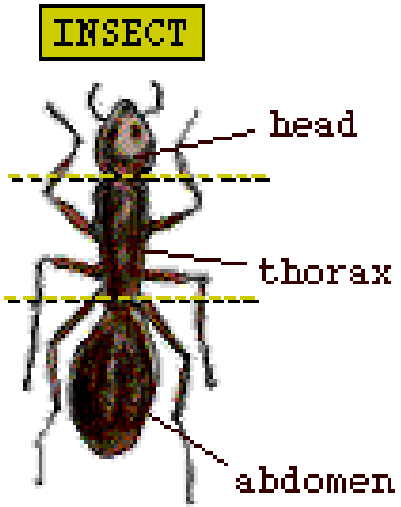
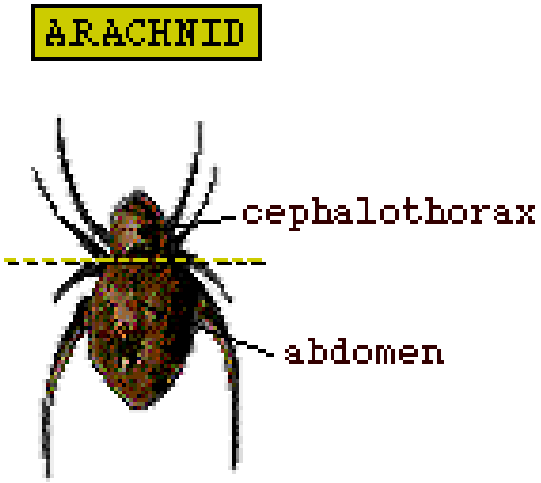
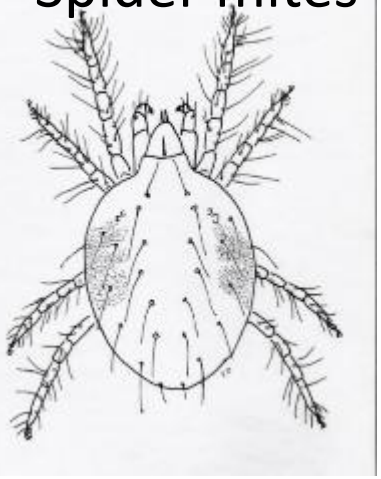
Mite basics

- Mites are tiny arthropods related to spiders and ticks
- Different types (some infest plants, other affect humans)
- Other mites include predatory mites





Spider mites



Dust mites

Predatory mites

Spider mites in walnuts

Walnut orchards in the Sacramento Valley have at least three spider mite species:

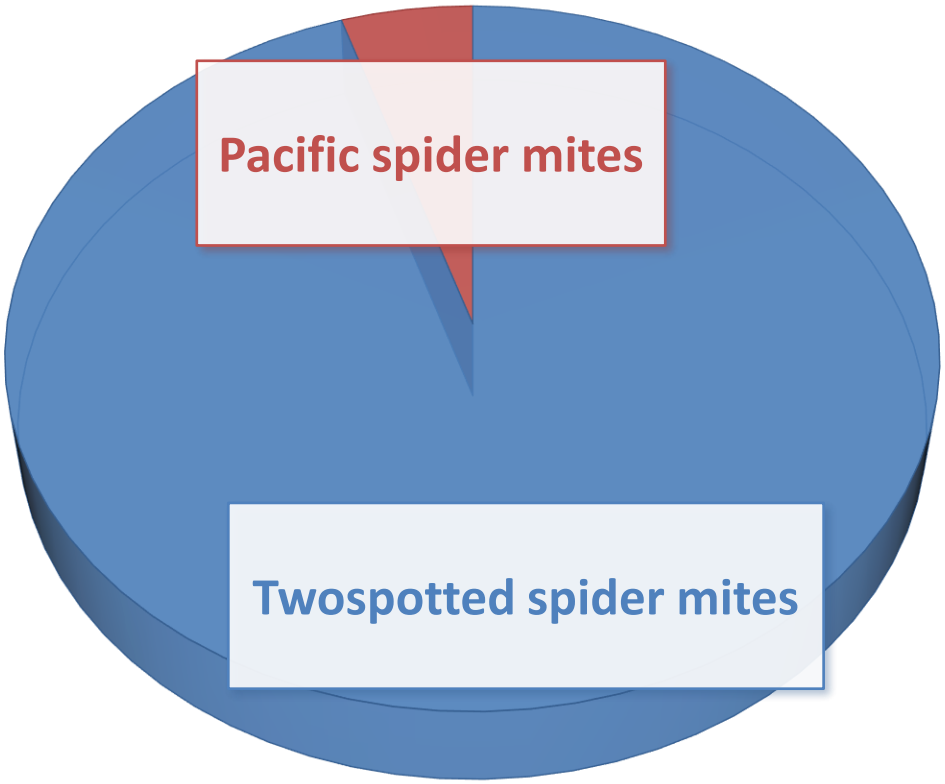
- **Twospotted spider mite** (*Tetranychus urticae*)
- **Pacific spider mite** (*Tetranychus pacificus*)
- **European red mite** (*Panonychus ulmi)*

European red mite

Twospotted spider mite

Pacific spider mite

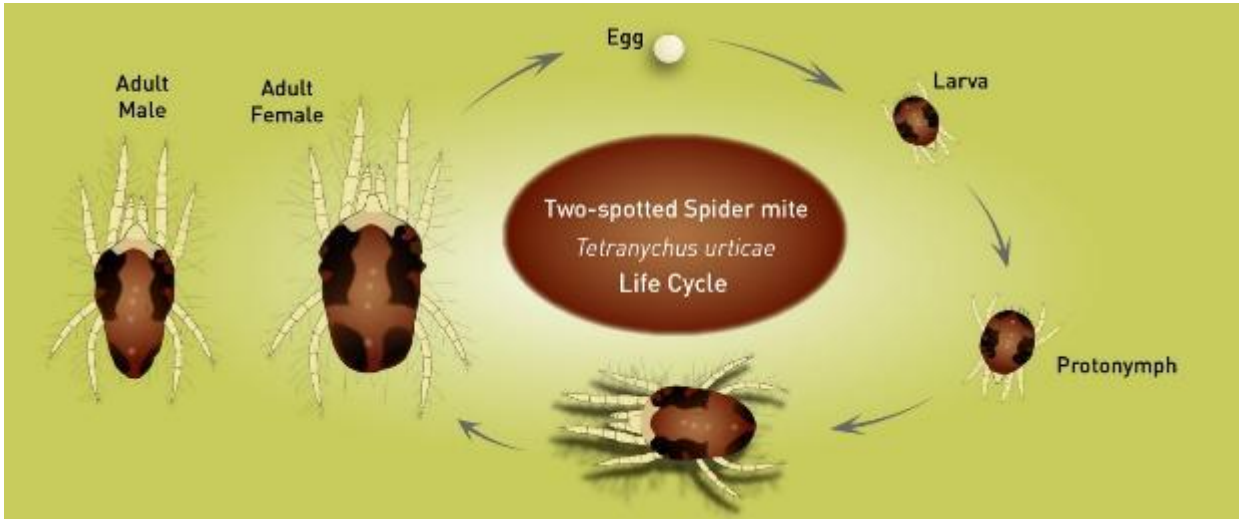
Twospotted spider mite is the most common webspinning spider mites in our region



Relative abundance of the different web-spinning mite species found in walnut orchards in the Sacramento Valley

Twospotted spider mites: Identification and biology

- Adults have a dark spot on each side of the body during periods of active feeding
- Three nymph stages: the first stage mites have six legs; later stages and adults have eight legs



Spider mite overwintering and dispersal

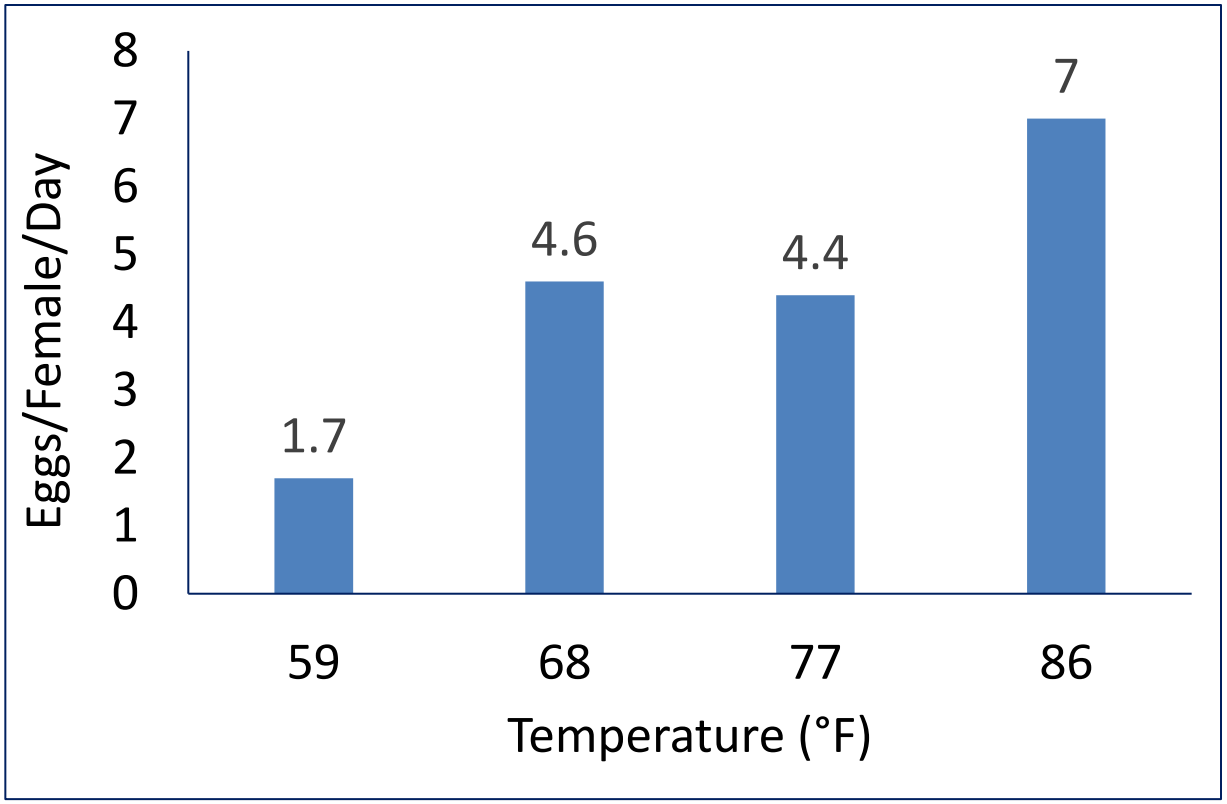
- Overwinter as **reddish orange, mature females** in protected areas (in leaf litters, tree barks or weed hosts)
- Overwintered females begin feeding at the bottom of the plant and move upward as the season progresses
- Spider mites disperse by walking short distances or through wind dispersal

Webspinning spider mites produce silk webbing that enhances their fitness

- Help with molting, and maximize leaf surface for use
- Web protects eggs from low and high humidity
- Shields from predators but attracts specialists
- May provides protection from pesticides

Hot and dry weather favors spider mites

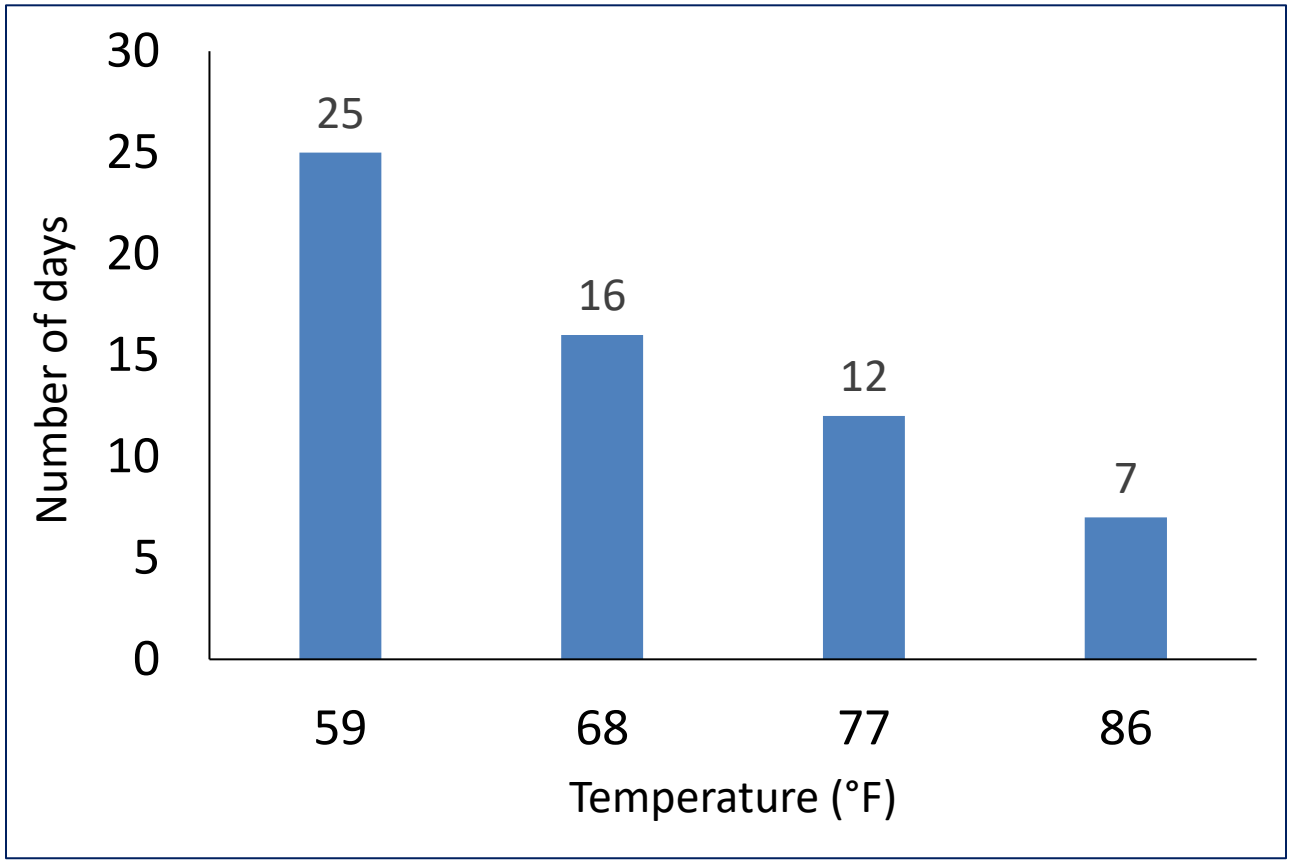
Spider mite females lay approximately 4 times more at eggs 86°F than at 60°F



Ovipositional rates for females of twospotted spider mites as affected by temperatures

Hot and dry weather favors spider mites

- Spider mites develop ~4 times faster at 86 degree than at 60 degree



Total developmental duration in days for twospotted spider mite as affected by temperature

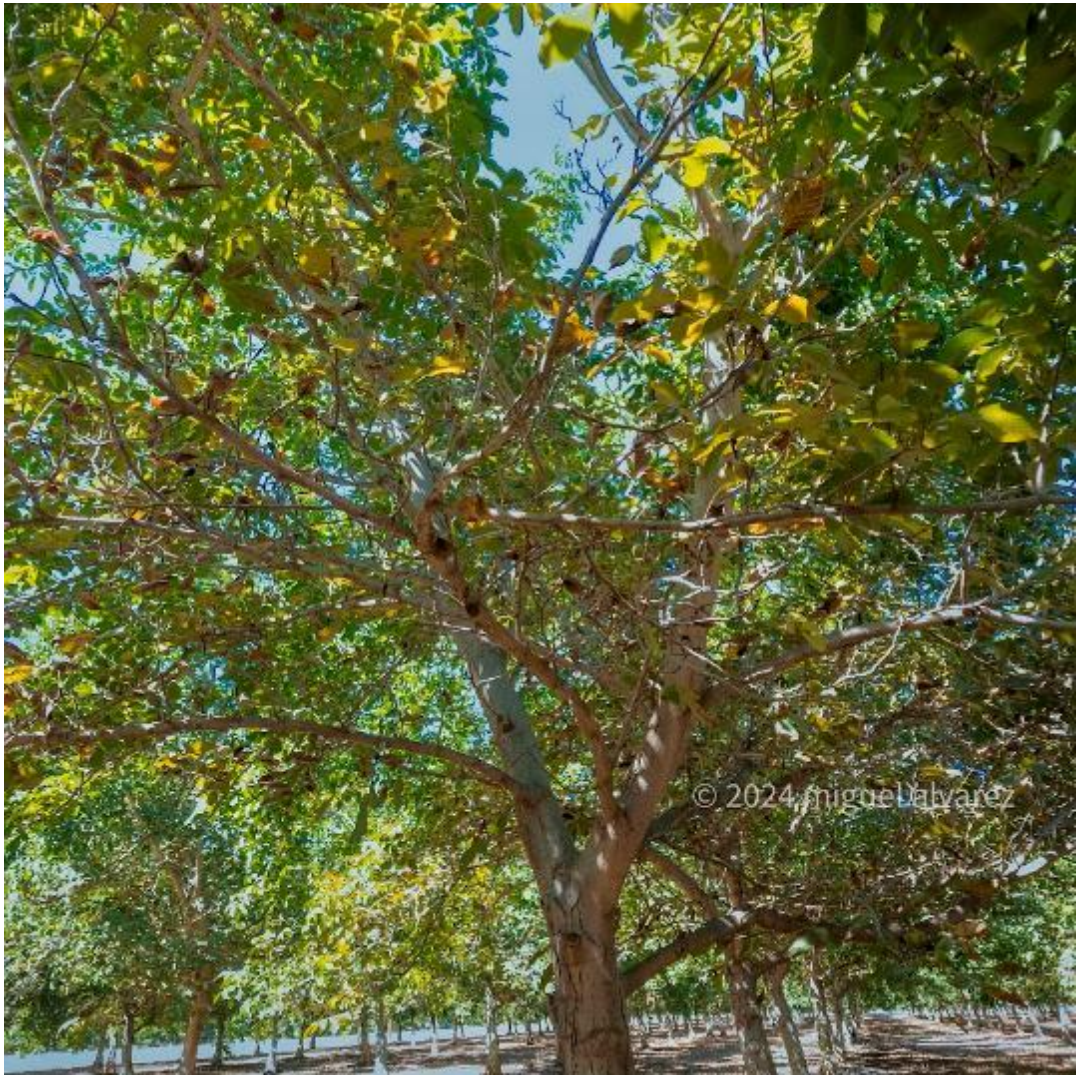
Spider mite infestation and impact on walnuts

Infest and puncture cells and suck out content killing the cells resulting in stippling

Infestations can result in leaves becoming pale and brown

Spider mites feeding injury on walnuts

Severe mite infestations can lead to extensive browning



Spider mites damage in walnut

Severe infestations cause heavy webbing and defoliation

So what!
What do they do to walnut yield and quality?

- Mites pierce epidermal cells with their sucking mouthparts, removing cell contents and reducing photosynthesis
- In walnuts, severe mite infestations and defoliation early in the season can cause a 25% reduction in yield
- The loss of leaves exposes nuts to sunlight resulting in sunburned poor-quality nuts

Excessive leaf drop can interfere with harvest operations

Managing spider mites

Cultural control

- Minimize dust by oiling orchard roads and maintaining a ground cover
- Well-irrigated, vigorous trees are less troubled by mite infestations
- Choose selective pesticides when controlling other pests and try to avoid pyrethroids until later in the season

Photo: Nocal Ag Service

Stressed tree

Healthy tree

Photos: Sac Valley Orchard Source

Managing spider mites

Biological control

- Several species of spider mite predators are present in walnuts
- Some are specialized to feed on the spider mites

Western predatory mites

Spider mite destroyer

Sixspotted thrips

Managing spider mites

Use practices that are friendly to beneficials

- Avoid broad-spectrum pesticides (e.g., pyrethroids) at critical times
- Avoid applying prophylactic spider mite treatments before economic thresholds are reached

Relative toxicities of insecticides used in walnuts to natural enemies

Active Ingredients	Products	*Neoseiulus californicus*	Western predatory mites	Generalist predators
Bifenthrin	Brigade			
Acetamiprid	Assail			--
Chlorantraniliprole	Altacor			
Permethrin	Perm Up			
Spirotetramat	Movento			--
Lambda-cyhalothrin	Warrior			
Methoxyfenozide	Intrepid			
Imidacloprid	Admire Pro			--
Spinetoram	Delegate			
Beta cyfluthrin	Leverage	--	--	
Esfenvalerate	Asana			
Emamectin Benzoate	Proclaim	--	--	--
Phosmet	Imidan			
Clothianidin	Belay	--	--	--

Red= High toxicity, Yellow= Moderate toxicity, Blue= Low toxicity, -- unknown

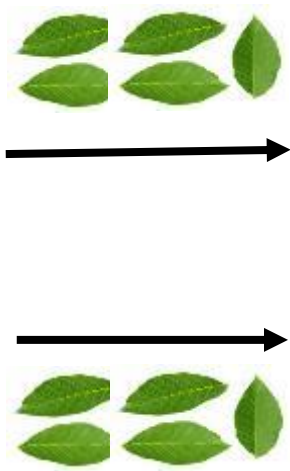
Managing spider mites

Monitoring and treatment decision

Monitor spider mites and natural enemy populations

Sample minimum of 10 tree per block

Collect 10 leaflets per tree (5 from high and 5 from low branches)



Managing Spider Mites

Treatment Decision is based on presence/absence sampling

Orchards with No pyrethroid or organophosphate use

Predators on mite-infested leaves	**Action**
Less than 10%	✅ Spray if 30–40% of leaves have spider mites
20–50%	✅ Spray if 40–50% of leaves have spider mites
More than 50%	❌ Don't spray

Managing Spider Mites

Treatment Decision is based on presence/absence sampling

Orchards with pyrethroid or organophosphate applications

Predators on mite-infested leaves	**Action**
Less than 10%	✅ Spray when 10% of leaves have spider mites
More than 10%	✅ Spray when 20% of leaves have spider mites

Miticides for spider mite control

Trade Name	Activity type	Life stages affected	Mode of Action and or IRAC Designation
Acramite	C	Eggs, juveniles, adults	METI (20D)
Agri-Mek	C and T	Juveniles, adults	GABA Chloride Channel Activator (6)
Magister	C	Eggs, juveniles, adults	METI (21A)
Nealta	C	Eggs, juveniles, adults	METI (25)
Omite	C	Juveniles, adults	Mitochondrial ATP synthase Inhibitor (12C)
Envidor	C and T	Eggs, juveniles, females	Lipid Biosynthesis Inhibitor (23)
Zeal Miticide	C and T	Eggs, juveniles	Chitin Synthesis Inhibitor(10B)
Onager	C and T	Eggs, Juveniles	Growth and Embryogenesis Inhibitor (10A)
FujiMite	C	Eggs, juveniles, adults	METI (21A)

Miticides for spider mites control

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Acramite	C
Agri-Mek	C and T
Magister	C
Nealta	C
Omite	C
Envidor	C and T
Zeal Miticide	C and T
Onager	C and T
FujiMite	C

Miticide activity type

- Most miticides work on contact (C)
- Some have translaminar effects (T)

Miticides for spider mites control

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Agri-Mek		GABA Chloride Channel Activator (6)
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Envidor		Lipid Biosynthesis Inhibitor (23)
Zeal Miticide		Chitin Synthesis Inhibitor(10B)
Onager		Growth and Embryogenesis Inhibitor (10A)
FujiMite		METI (21A)

Mode of Action

- Some miticides target METI
- Some target other target site
- Some are growth regulators

Miticides for spider mites control

Trade Name	Life stages affected	Mode of Action and or IRAC Designation
Acramite	• Miticides with METI: affect all life stages • Growth Regulators: typically, do not affect adults • Other MOA: typically, juveniles and adults	METI (20D)
Agri-Mek		GABA Chloride Channel Activator (6)
Magister		METI (21A)
Nealta		METI (25)
Omite		Mitochondrial ATP synthase Inhibitor (12C)
Envidor		Lipid Biosynthesis Inhibitor (23)
Zeal Miticide		Chitin Synthesis Inhibitor(10B)
Onager		Growth and Embryogenesis Inhibitor (10A)
FujiMite		METI (21A)

Available miticides are effective against spider mites (lab study)

Active ingredient	Mode of action	Example brand names	% Adult mortality	% Egg hatch	# of live larvae
Abamectin	6	Agri-Mek SC	100±0a	50.0±16.7c	0±0c
Hexythiazox	10A	Savey 50DF	56.0±7.1bc	0.3±0.3e	0±0c
Etoxazole	10B	Zeal Miticide	22.4±6.0d	0±0e	0±0c
Fenbutatin-oxide	12B	Vendex 50 WP	72.0±6.4b	81.6±6.0b	4.08±0.89b
Acequinocyl	20B	Kanemite 15 SC	100±0a	44.4±29.4cd	0±0c
Bifenazate	20D	Acramite 50WS	98.0±2.0a	30.2±14.3d	0.06±0.06c
Fenpyroximate	21A	Portal XLO	100±0a	88.9±11.1ab	0±0c
Cyflumetofen	25	Nealta	100±0a	0±0e	0±0c
Control	NA	NA	6.0±3.4e	98.8±0.9a	14.2±1.26a

Result based on twospotted spider mites treated as adult females (Bergeron and Schmidt-Jeffris 2020)

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Control	NA	NA	6.0±3.4e	98.8±0.9a	14.2±1.26a

Result based on twospotted spider mites treated as adult females (Bergeron and Schmidt-Jeffris 2020)

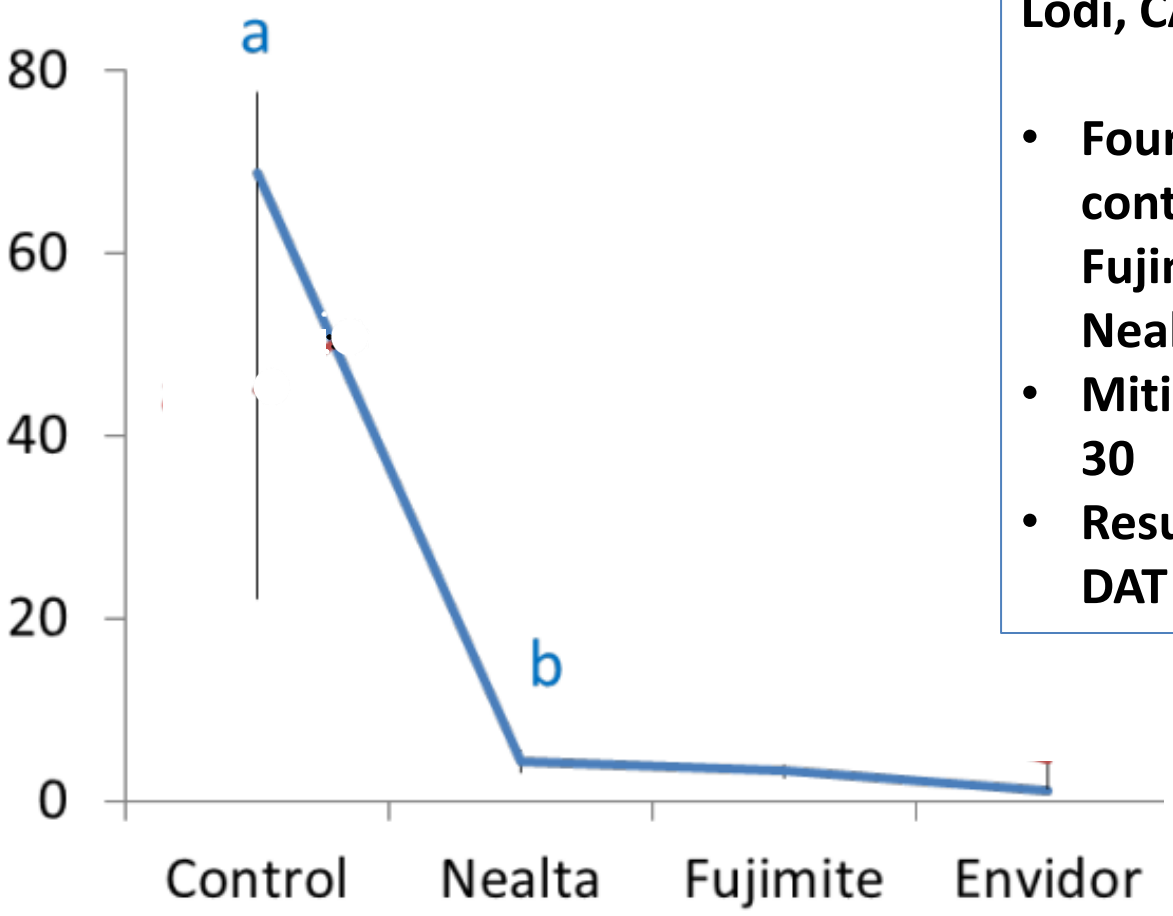
Field study- Farmington

Product Lb/Acre	July 22	July 29	Aug 5	Aug 12
Acramite .75	1.0a	0.8a	0.3a	7.4a
Acramite 1.0	2.8a	0.2a	0.9a	6.3a
Envidor 1.125	2.6a	3.2a	0.7a	7.5a
Envidor 1.250	2.7a	0.5a	0.9a	1.4a
Onager 1.0	1.7a	0.5a	1.0a	3.2a
Onager 1.25	1.3a	0.5a	0.8a	2.1a
Zeal 0.09	1.1a	0.9a	1.5a	0.7a
Zeal 0.125	0.68a	0.7a	1.4a	1.9a
Untreated control	56.5b	134.7b	126.6c	116.9c

Farmington, CA- (Benny Fouché et al. 2003)

- **Single tree plot study**
- **Miticides applied on July 14**

Field Study- Lodi



Lodi, CA (Mills 2016)-Howard

- **Four treatments: an untreated control, Envidor at 30 oz./acre, Fujimite at 2 pts./acre, and Nealta at 13.6 fl.oz./acre**
- **Miticides were applied on July 30**
- **Result showing spider mites 3 DAT**

But some miticides are also toxic to predatory spider mites

Active ingredient/Product	Mode of action	% Adult mortality	% Egg hatch	Live larvae
Abamectin/Agri-Mek	6	100±0a	100±0a	0±0f
Hexythiazox/Onager	10A	10.0±4.3d	99±0.8a	3.04±0.35a
Etoxazole/Zeal Miticide	10B	26.0±6.3c	10.1±5.4e	0.06±0.03ef
Acequinocyl/Kanemite	20B	81.6±5.6b	26.9±12.2d	0.08±0.04ef
Bifenazate/Acramite	20D	28.0±6.4c	100±0a	0.24±0.09de
Fenpyroximate/FujiMite	21A	100±0a	0±0e	0±0f
Cyflumetofen/Nealta	25	41.8±7.0c	93.4±5.4ab	0.64±0.15c
Control	NA	1.89±0.23b	91.9±3.6b	1.64±0.22b

Red= High toxicity, Yellow= medium toxicity, Blue= Low toxicity

(Bergeron and Schmidt-Jeffris 2020)

Spider mite management: final thoughts

- ✓ Reduced efficacy of some miticides??
  - Spray coverage is critical: provide good spray coverage
  - Rotate miticides classes

    - ✓ Know your material and consider the trade offs
      - Consider restricted entry interval
      - Conserve beneficials

- ✓ Monitor and use threshold for management decision making

Thank You

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