El Dorado County Grape Day
Placerville, CA, June 5, 2008

Conventional and Organic Mite Management in Winegrape Vineyards

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Spider Mites

Willamette Spider Mite

Pacific Mite Injury

Pacific Spider Mite

Spider Mites

Pacific Spider Mite

Tetranychus pacificus McGregor

- Broad host range
- Usually thought of as the greater problem in warm growing areas

Eggs - spherical and may be laid in webbing

Newly hatched larva (6 legs) - food spots on dorsum

Adults vary in color from slightly amber to greenish or reddish; usually 2 larger spots forward, 2 rear

Spider Mites

Pacific Spider Mite

Tetranychus pacificus McGregor

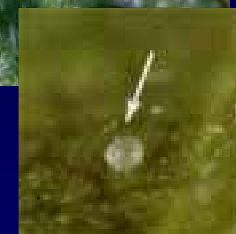
- Prefers the warmer upper canopy (sunny areas)
- Generally does better during the hotter, drier part of the season
- Produces more webbing and tends to aggregate

Damage begins as yellow spots, then dead (necrotic) areas appear on the leaves. High populations can render the leaves nonfunctional with leaf burning and heavy webbing.

Spider Mites

Willamette Spider Mite

Eotetranychus willamettei (McGregor)



- Cultivated and wild grapes are the main hosts
- Typically the species of concern in the coastal valleys and the Sierra Nevada foothills

Eggs spherical, slightly smaller than Pacific mite, and has a fine papilla (hair) that tapers at the top

Newly hatched larva (6 legs) - food spots on sides

Adults tend to be yellow with food spots on sides

Spider Mites

Willamette Spider Mite

Eotetranychus willamettei (McGregor)

- Considered an early-season mite
- Prefers the cooler (shady) parts of the plant
- More dispersed over leaf surfaces

Feeding in mid or late season causes foliage to turn yellowish bronze, and can open canopies. High densities (> 30-50 per leaf) reduces brix.

Distribution and abundance of Pacific and Willamette mite seems to be changing (there is increased pest status of Pacific mite in a number of areas):

- Pacific mites present earlier season
- Pacific mites becoming a problem in coastal valleys and into September
- Willamette mites remaining at damaging levels into August

Distribution and abundance of Pacific and Willamette mite seem to be changing. Why?

- pesticide use
- irrigation practices that promote water stress
- large-scale planting of wine varieties in new areas
- changes in insecticide and fungicide use patterns
- *What about newer products?*

Distribution and abundance of Pacific and Willamette mite seem to be changing. Why?

- pesticide use
- irrigation practices that promote water stress
- large-scale planting of wine varieties in new areas
- changes in insecticide and fungicide use patterns
- *What about newer products?*

Do they effect six-spotted thrips, lacewings, hemipterans, predaceous beetles, or predator mites?

What about effects on spider mite development?

Acaricides - Status

- Older products had extended preharvest intervals or worker re-entry intervals that often dictated when they had to be applied, leading to preventative use
- Many new products representing an assortment of modes of action are registered
- These new products provide flexibility:

  preharvest intervals
  impacts upon beneficials
  resistance management

Grape Acaricide IRAC Classification

Product	Active ingredient	Primary target site of action	IRAC #
Agri-Mek	Abamectin	Chloride channel activators (GABA agonist)	6
Onager	Hexythiazox	Unknown mode of action (mite growth inhibitor)	10A
Zeal	Etoxazole	Unknown mode of action (mite growth inhibitor)	10B
Vendex	Fenbutatin oxide	Oxidative phosphorylation inhibitor/uncoupler	12B
Omite	Propargite	Inhibitor of oxidative phosphorylation; iinhibitor of ATP synthase	12C
Kanemite	Acequinocyl	Mitochondrial complex III electron transport inhibitor	20B
Fujimite	Fenpyroximate	Mitochondrial complex I electron transport inhibitor	21
Nexter	Pyridaben	Mitochondrial complex I electron transport inhibitor	21
Envidor	Spirodiclofen	Inhibitor of lipid synthesis	23
Acramite	Bifenazate	Neuronal inhibitor (unknown mode of action)	25
Kelthane	Dicofol	Unknown	unc

Grape Acaricide IRAC Classification

Product	Active ingredient	IRAC #
Neem	Azidirachtin	18B
Organic JMS Stylet Oil	Paraffinic oil	na
M-pede	Potassium salts of fatty acids	na
Ecotrol	Rosemary & peppermint oil	na
GC-Mite	Cottonseed, clove & garlic oil	na

Location and design - 2006

- 96 acre commercial cabernet sauvignon vineyard
- East of Lodi, San Joaquin Co.
- vines drip irrigated
- 4 replicates for each treatment and untreated control
- each treatment replicate was 5 vines in size.
- treatments arranged in a completely randomized design

Special thanks to Steve Quashnick, Wilbur-Ellis Co. and
Cliff Ohmart, Lodi-Woodbridge Winegrape Commission

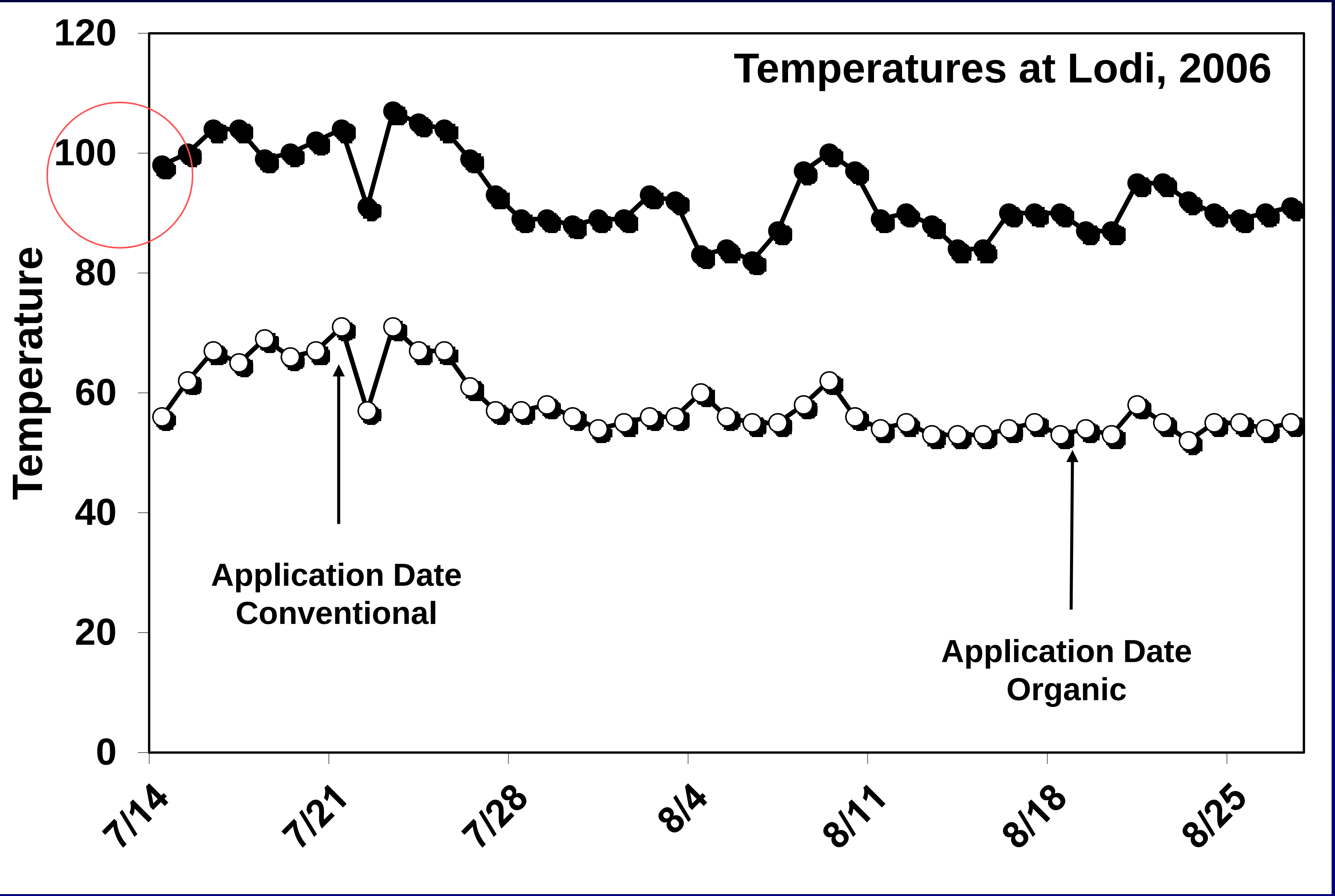
Methods - (both 2006 and 2007)

- applications made with an Echo mister/duster air assist sprayer
- 72 gallons per acre volume - conventional treatments
- 150 gallons per acre volume - organic treatments
- water buffered to pH 6.5

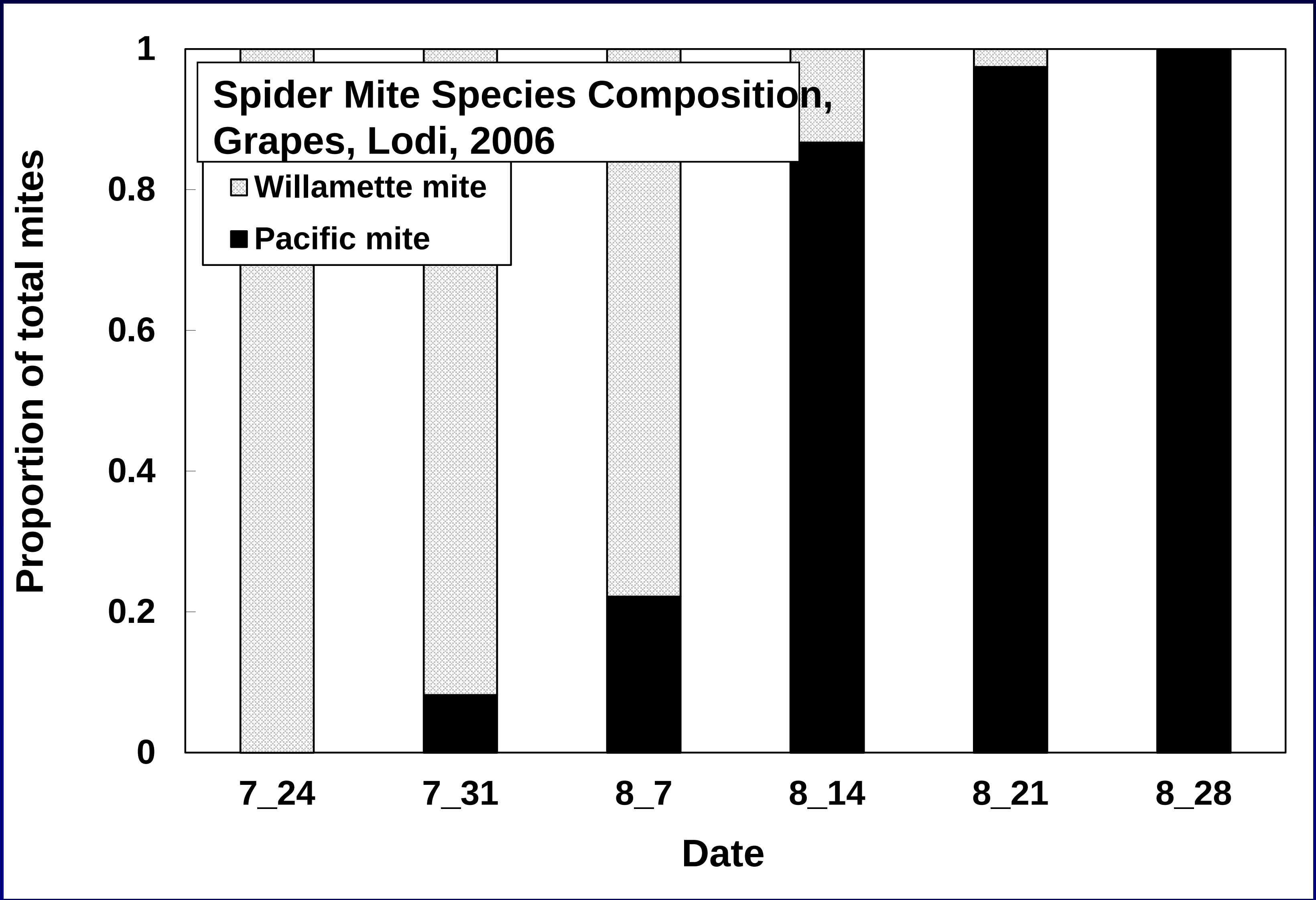
Sampling -

- 5 leaves from center 3 vines of each plot
- mite-brushed and counted under microscope

Daily maximum and minimum temperatures (ºF) during the period of the experiment.



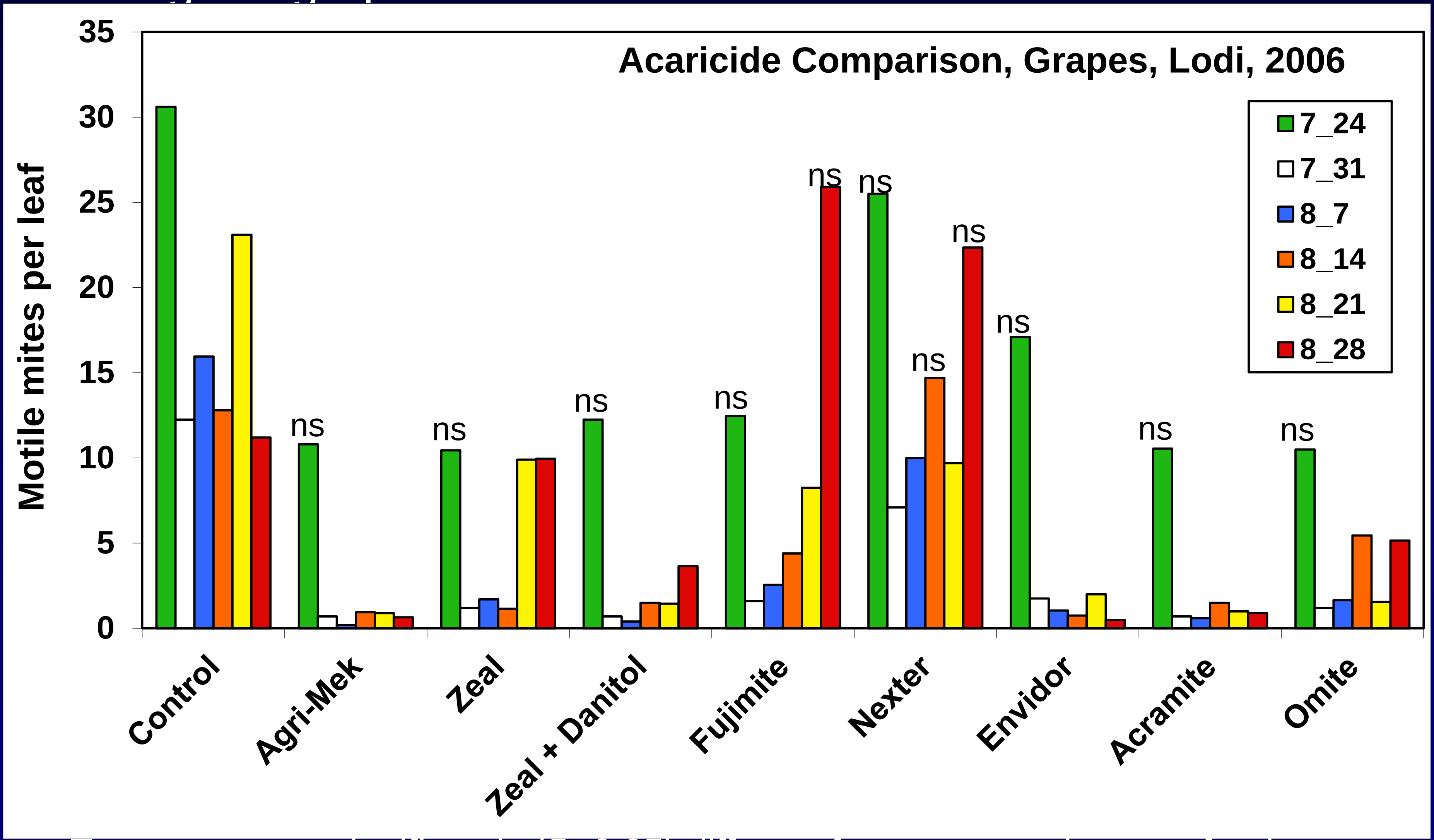
Proportion of Willamette and Pacific spider mites among all spider mites present in untreated control plots



Conventional acaricide study - treatments applied on July 20, 2006, to cabernet sauvignon grape vines

Product	Active ingredient	Rate per acre
Agri-Mek 0.83EC	Abamectin	16 oz
Zeal	Etoxazole	3 oz.
Zeal + Danitol (V-10141)	Etoxazole + Fenpropathrin	18 oz
Fujimite 5EC	Fenpyroximate	2 pts.
Nexter	Pyridaben	10.67 oz.
Envidor 2SC	Spirodiclofen	18 oz.
Acramite 50WS	Bifenazate	1 lb.
Omite 30WP	Propargite	8 lb.
Untreated	Untreated	--

Comparison of acaricides applied on July 20 to cabernet sauvignon grape vines

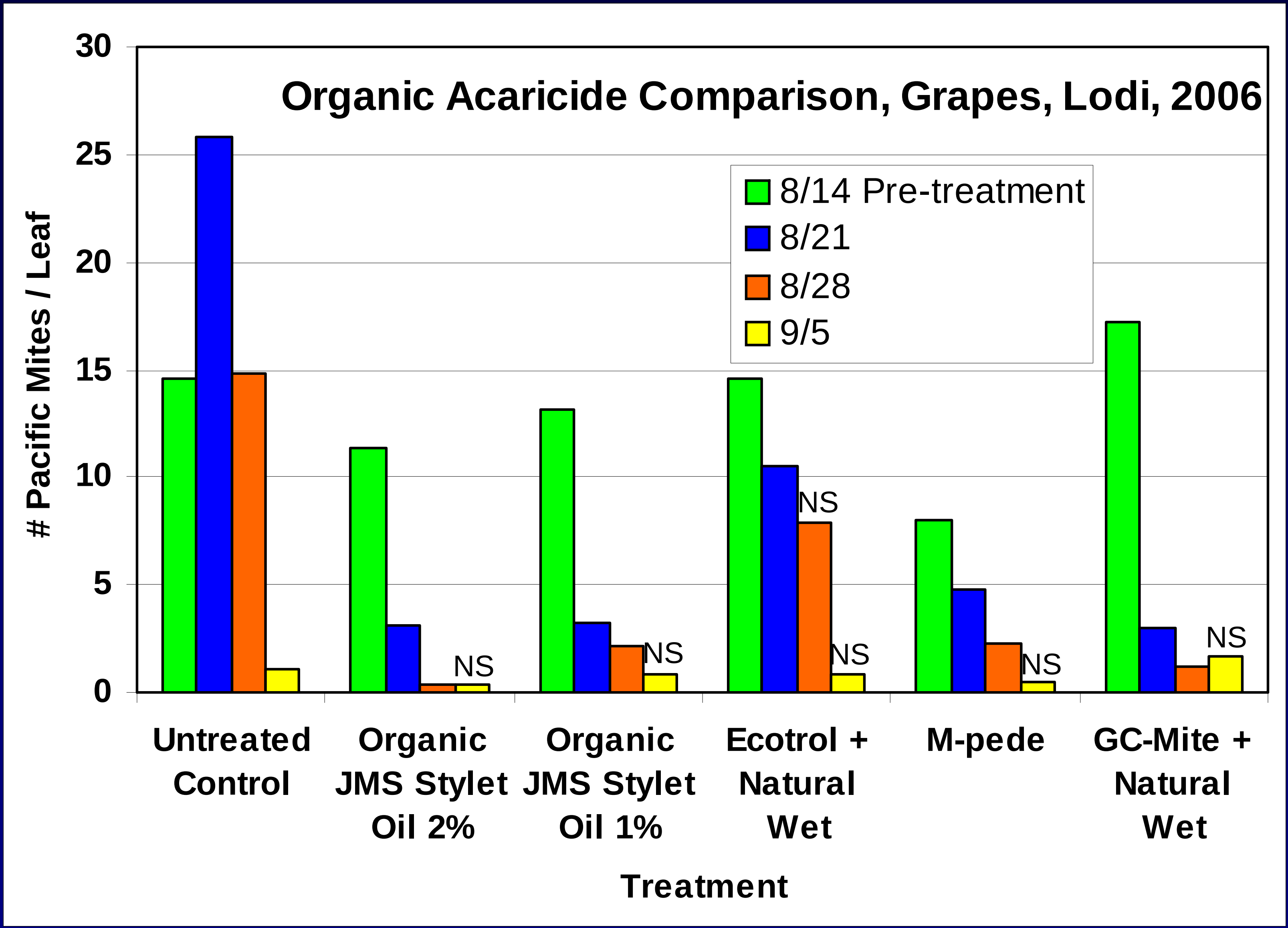


Treatments are significantly (*P*<0.05) different from untreated except for those indicated by 'ns'.

Organic acaricide study - treatments applied on August 19, 2006, to cabernet sauvignon grape vines near Lodi

Treatment	Active ingredient	Rate
Untreated Control	na	na
Organic JMS Stylet Oil	Paraffinic Oil	2% v/v
Organic JMS Stylet Oil	Paraffinic Oil	1% v/v
Ecotrol + Natural Wet	Rosemary Oil + Saponin	0.75 qts + 0.125% v/v
M-pede	Potassium salts of fatty acids	2% v/v
GC-Mite + Natural Wet	Cottonseed, Clove and Garlic oil + Saponin	1% v/v + 0.125% v/v

Comparison of organic acaricides applied on August 19 to cabernet sauvignon grape vines

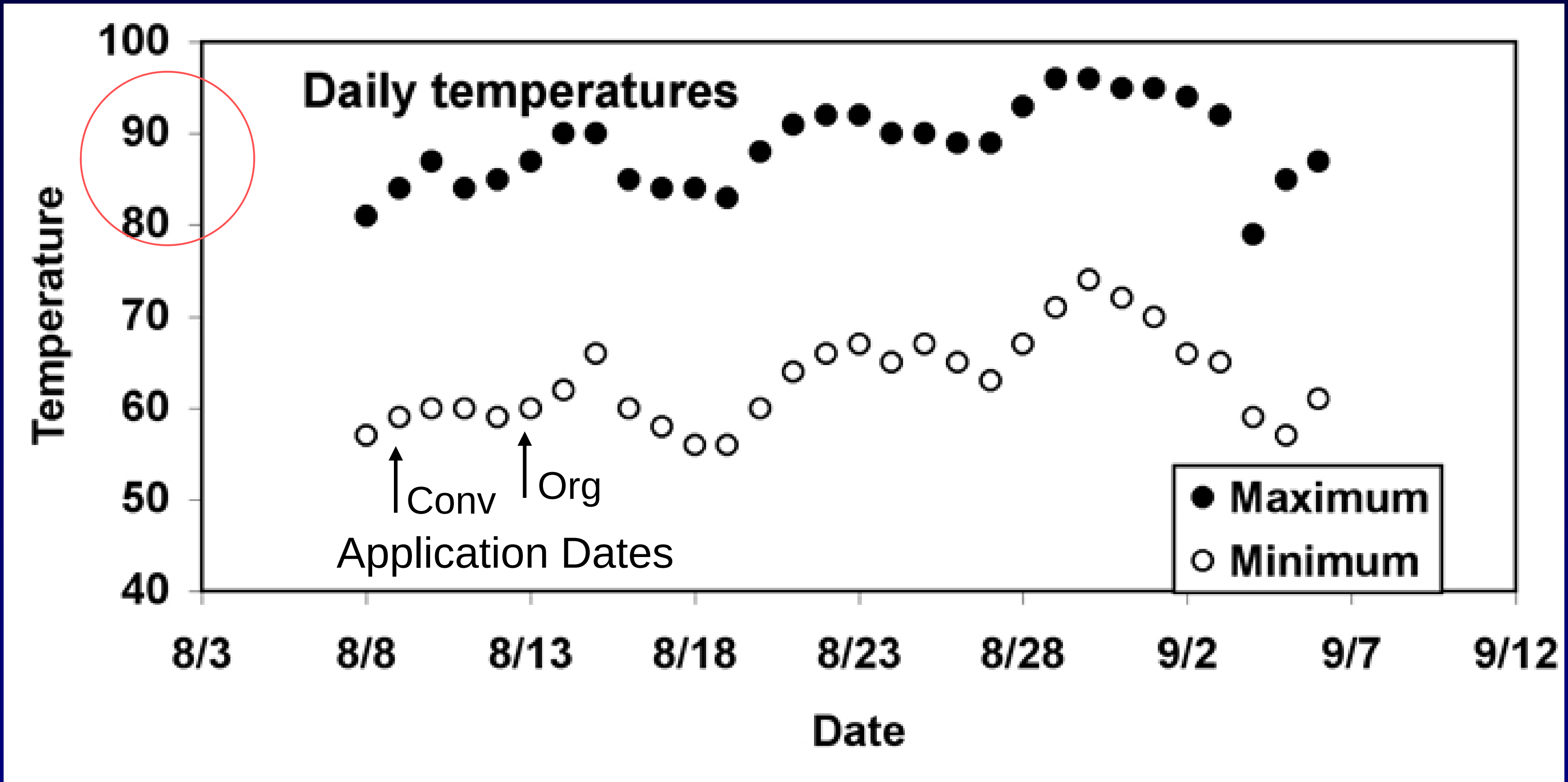


Location and design - 2007

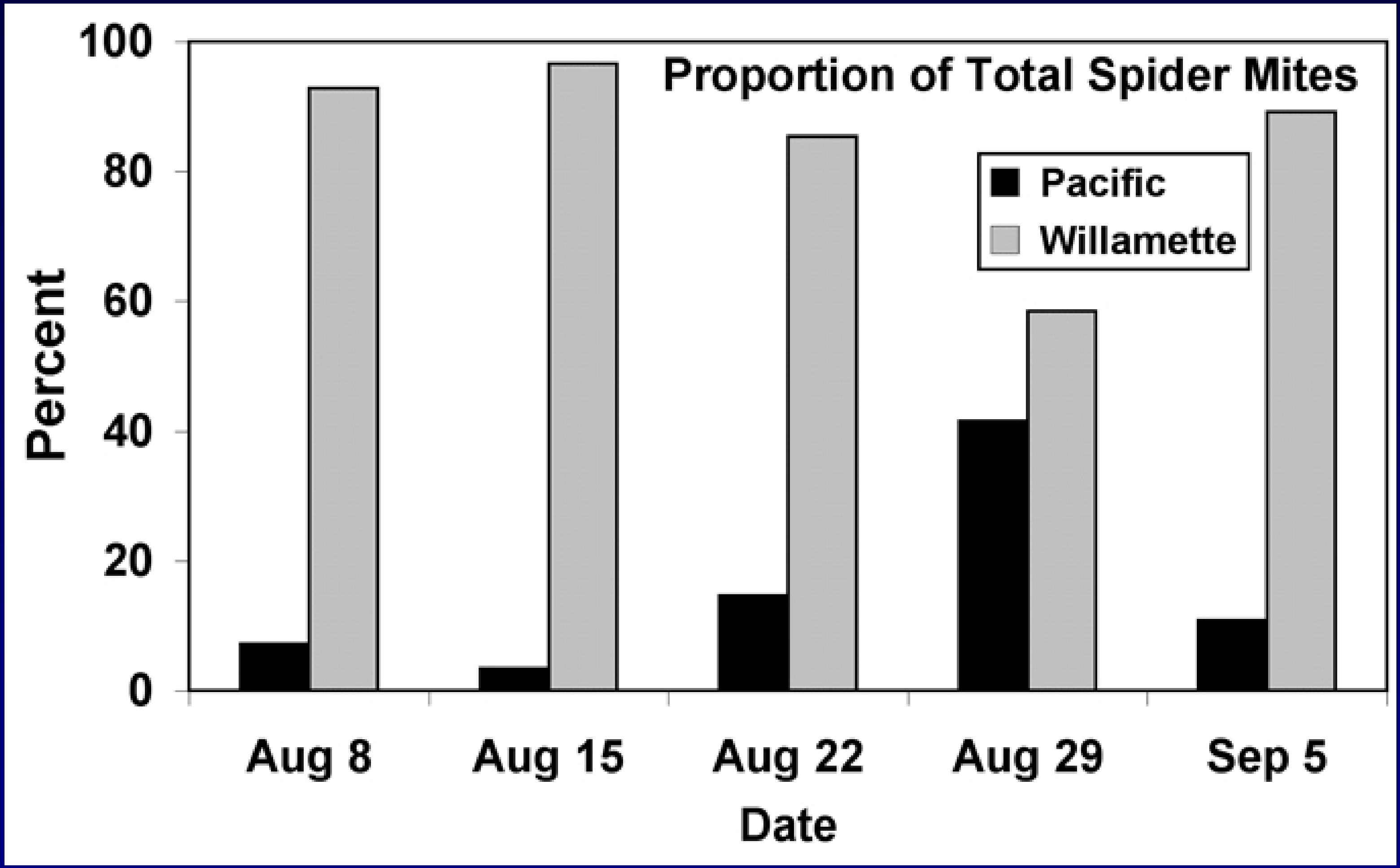
- commercial merlot vineyard
- south of Pilot Hill, El Dorado Co.
- vines drip irrigated
- 4 replicates for each treatment and untreated control
- each treatment replicate was 5 vines in size
- treatments arranged in a randomized complete block design

Special thanks to Benjamin Falk of Safari Vineyards and Lynn Wunderlich, UCCE, El Dorado Co.

Daily maximum and minimum temperatures (ºF) during the period of the experiment.



Proportion of Willamette and Pacific spider mites among all spider mites present in untreated control plots, 2007.

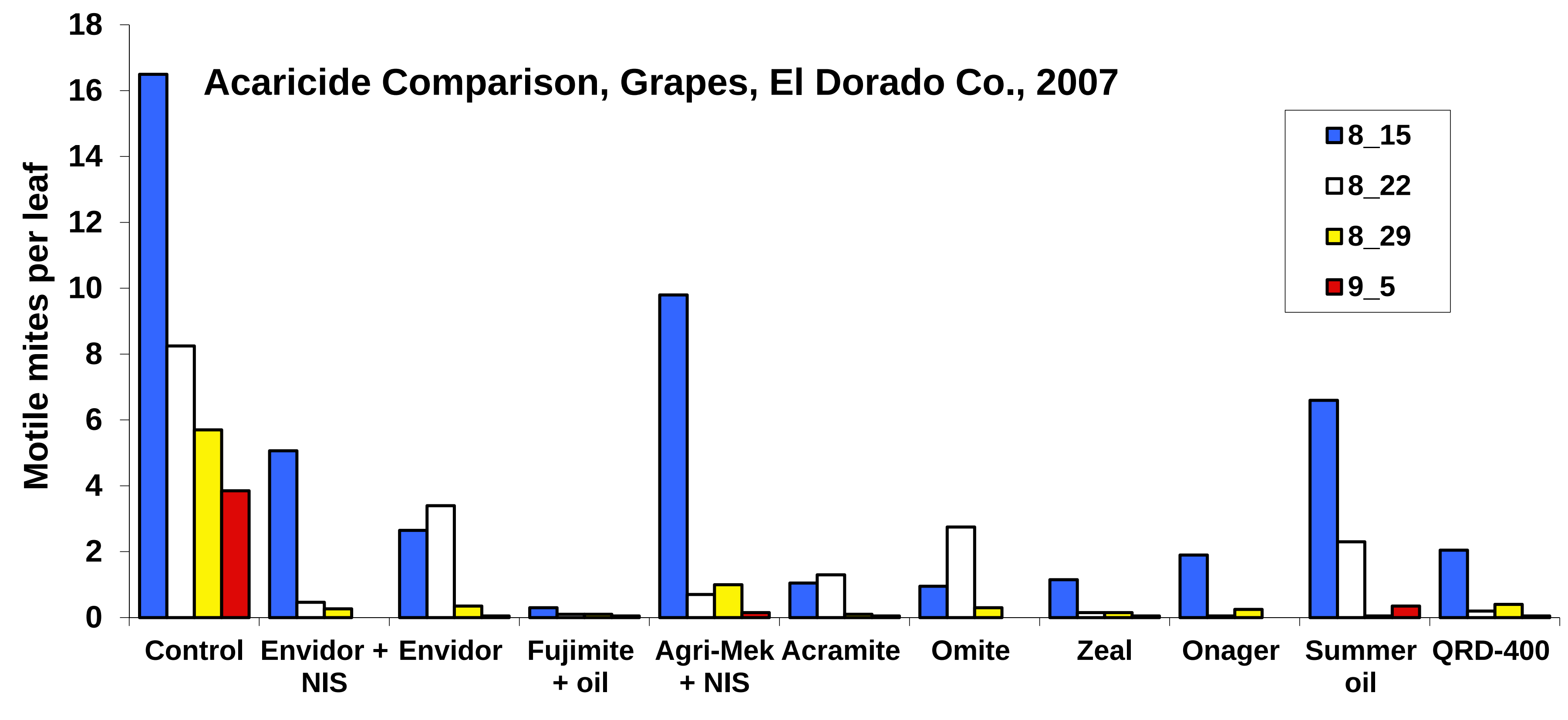


Pretreatment count (August 8) = 67.4 mites per leaf

Conventional acaricide study - treatments applied on August 9, 2007, to merlot grape vines

Product	Active ingredient	Rate per acre
Agri-mek + Dyne-amic	Abamectin + surfactant	12 oz + 0.25% v/v
Zeal	Etoxazole	3 oz.
Fujimite + summer oil	Fenpyroximate	2 pts. + 1% v/v
Onager	Hexythiazon	19.2 oz.
Envidor	Spirodiclofen	18 oz.
Envidor + Bond	Spirodiclofen + surfactant	18 oz. + 0.25% v/v
Acramite	Bifenazate	1 lb.
Omite	Propargite	8 lb.
Orchex 796	Summer oil	1% v/v
QRD-400	*Chenopodium ambrosiodes*	4 qts.
Untreated	Untreated	--

Comparison of acaricides applied on August 9 to merlot grape vines

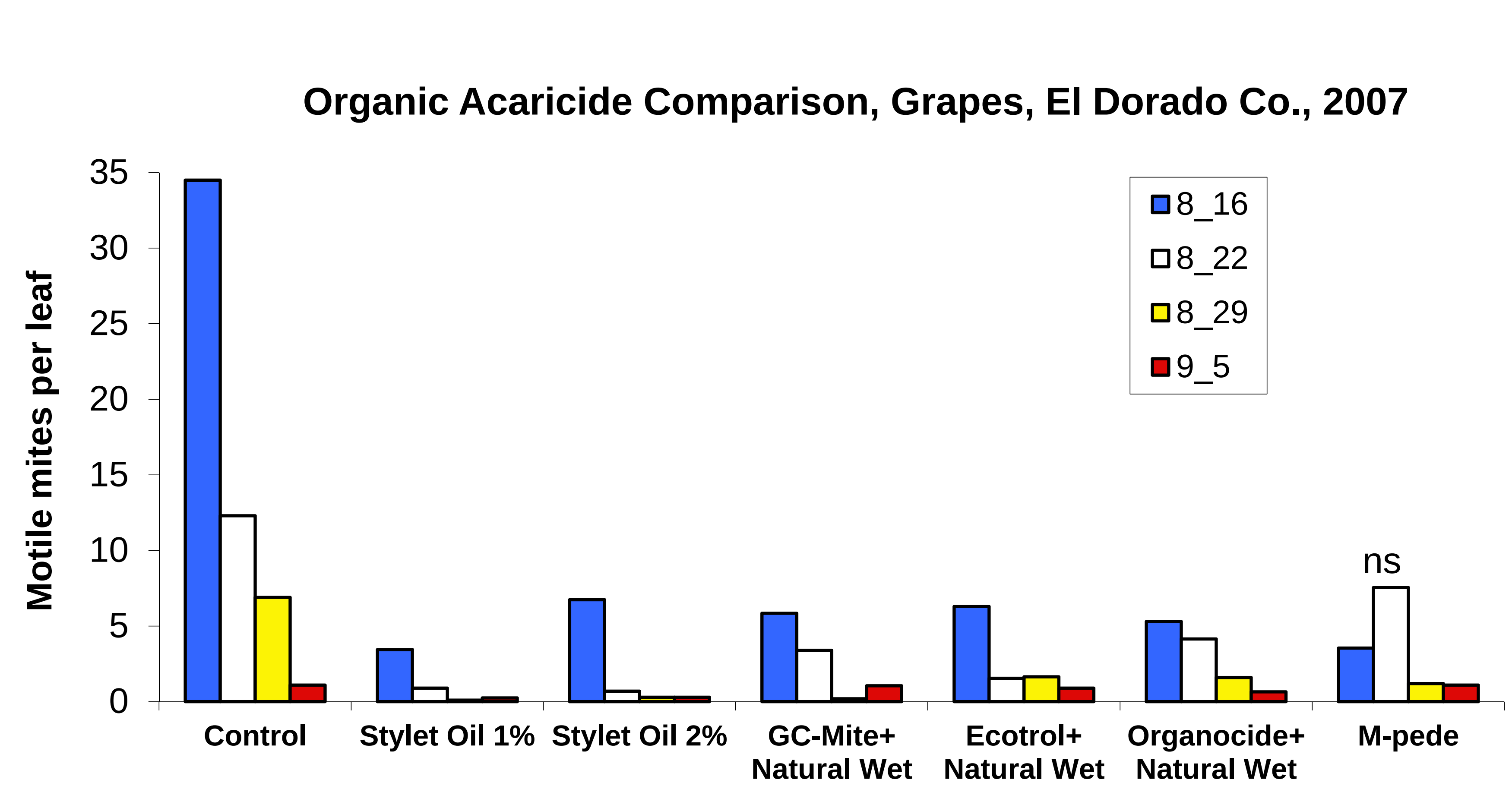


Treatments are significantly (P<0.05) different from untreated except for August 22 sampling date, F=1.9719, df = 10,42, P=0.0710.

Organic acaricide study - treatments applied on August 13, 2007, to merlot grape vines

Product	Active ingredient	Rate per acre
Untreated	na	na
Organic JMS Stylet Oil 1%	Parafinic Oil	1% v/v
Organic JMS Stylet Oil 2%	Parafinic Oil	2% v/v
GC-Mite + Natural Wet	Cottonseed, Clove and Garlic Oil + Saponin	1% v/v + 0.125% v/v
Ecotrol + Natural Wet	Rosemary Oil + Saponin	4 pts/acre + 0.125% v/v
Organocide + Natural Wet	Sesame Oil + Saponin	2 oz./gal + 0.125% v/v
M-pede	Potassium salts of fatty acids	2% v/v

Comparison of organic acaricides applied on August 13 to merlot grape vines



Treatments are significantly (P<0.05) different from untreated except for September 5 sampling date and those labeled ns.


Integrating Control of Leafhoppers and Spider Mites with Powdery Mildew Treatments in Organic Vineyards

Dual function products for organic production

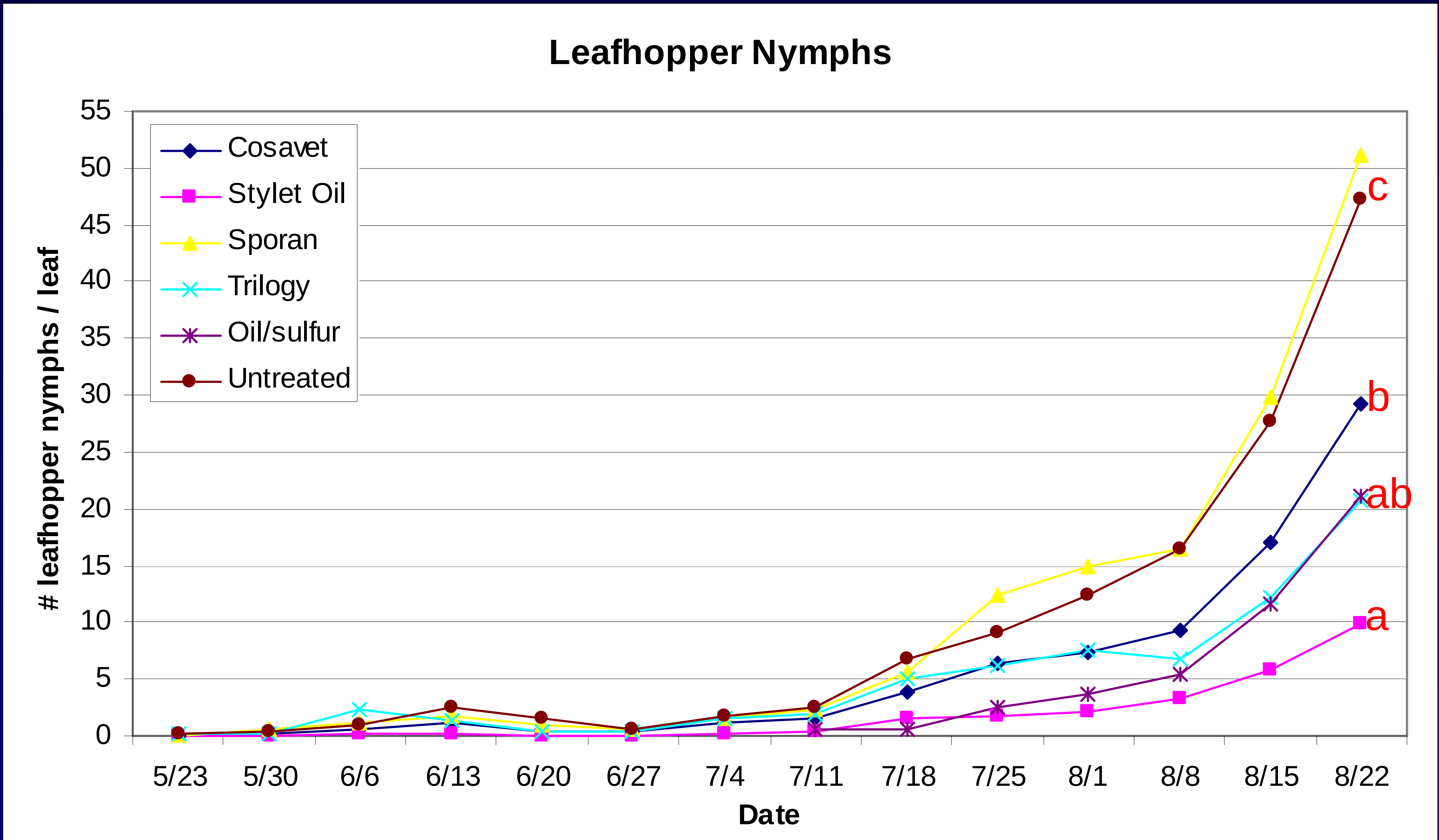
Applied in the equivalent of 100 gpa

- Untreated
- Cosavet- micronized sulfur
- JMS Organic Stylet Oil – paraffinic oil
  - Sub-plot treatment Stylet oil > Cosavet
- Trilogy- neem oil
- Sporan- rosemary, clove and thyme oil

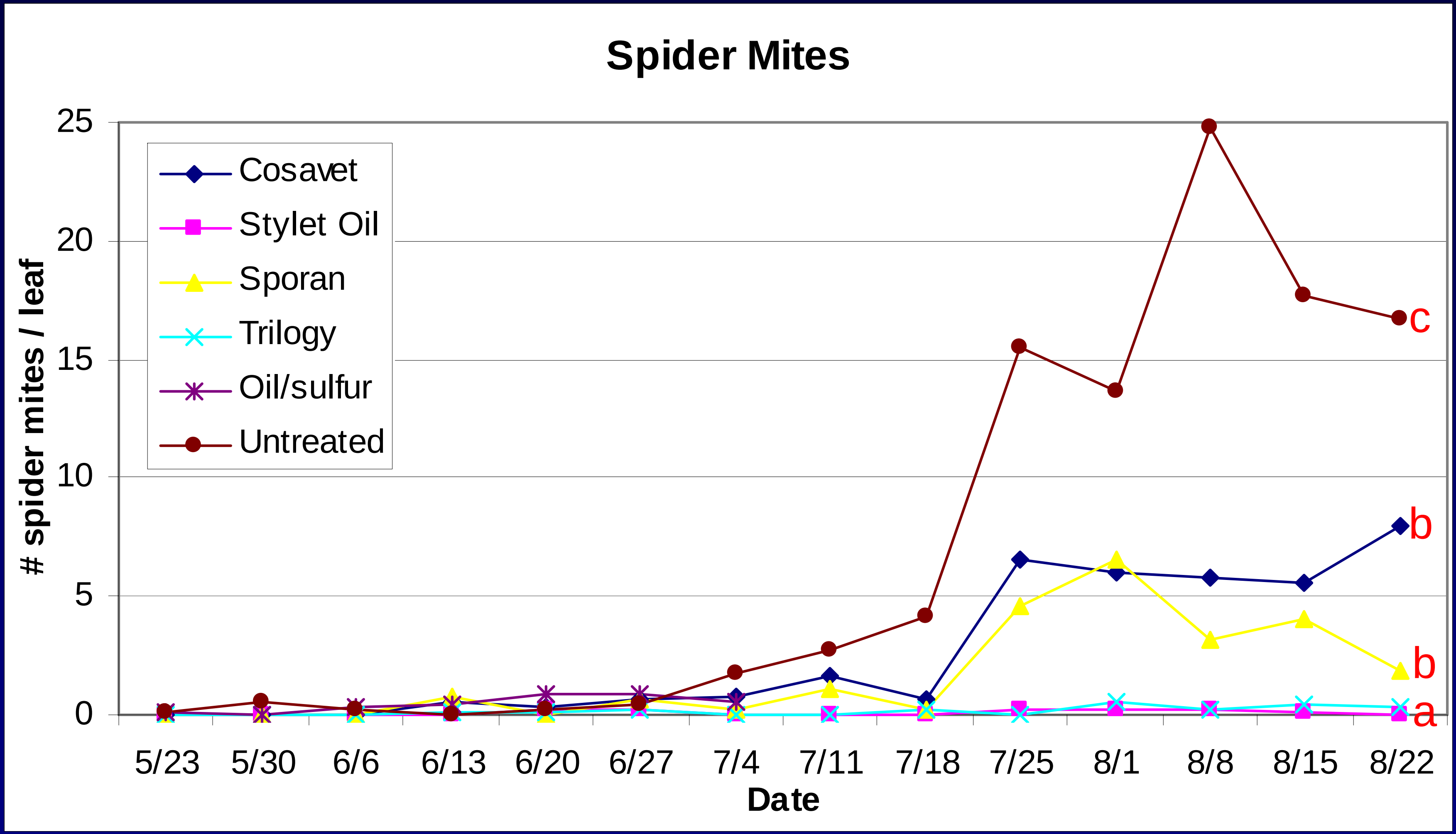
Methods

- Fantasy seedless organic table grapes
- 15-vine main-plots, 4 replicates
- 5-vine subplots
- Treatments applied every 10-14 days
- Leafhoppers: 12 leaf turns per plot
- Mites: 5 leaf samples per plot
- Powdery Mildew: 20 bunches examined per plot

Leafhopper nymph densities on fantasy seedless, 2006



Willamette Spider Mite densities on fantasy seedless, 2006



Powdery mildew - results

Mean ± SEM powdery mildew incidence and severity in main plots, 2006

	Powdery Mildew					
	Incidence [a]			Severity [b]		
Treatment	Mean	± SEM		Mean	± SEM	
Untreated	0.99	±0.01	a	0.84	±0.05	a
Cosavet	0.96	±0.02	a	0.20	±0.02	bc
Stylet Oil	0.83	±0.01	b	0.10	±0.00	d
Sporan	0.99	±0.01	a	0.32	±0.02	b
Trilogy	0.94	±0.03	ab	0.16	±0.01	cd

[a] Proportion of grape bunches with powdery mildew infection

[b] Proportion of grape berries with powdery mildew infection

Means followed by the same letter are not significantly different (Tukey's HSD, $p < 0.05$)

Means were arcsine transformed prior to analysis, means presented here are untransformed.

Powdery mildew - results

Mean ± SEM powdery mildew incidence and severity in stylet oil sub-plots, 2006

	Powdery Mildew							
	Incidence [a]				Severity [b]			
Subplot Treatments	Mean	±	SEM		Mean	±	SEM	
Stylet Oil	0.83	±	0.01	a	0.10	±	0.00	a
Stylet Oil then Cosavet [c]	0.85	±	0.04	a	0.10	±	0.01	a

[a] Proportion of grape bunches with powdery mildew infection

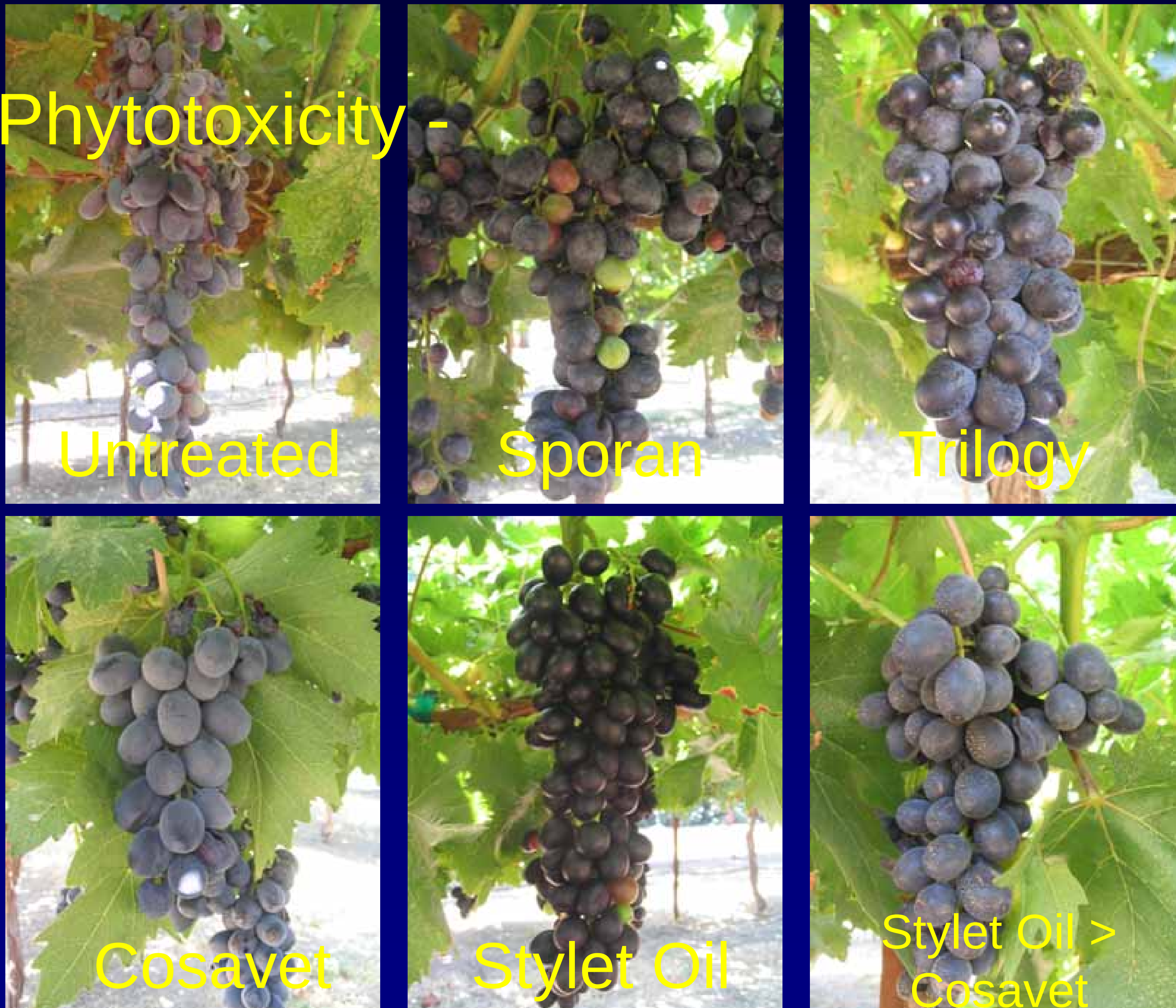
[b] Proportion of grape berries with powdery mildew infection

[c] Stylet Oil applied 5/17-6/26, Cosavet applied 7/10-8/7

Means followed by the same letter are not significantly different (Tukey's HSD, $p < 0.05$)

Means were arcsine transformed prior to analysis, means presented here are untransformed.

Phytotoxicity -



Predaceous Mites on Winegrapes

Galendromus (*Metaseiulus) occidentalis* (Nesbitt)
Neoseiulus (Amblyseius) californicus (McGregor)

also

Neoseiulus fallacis (Garman) - Lodi
Typhlodromus pyri Scheuten - north coast
Amblyseius andersoni Chant- north coast
Typhlodromus caudiglans Schuster- north coast
Metaseiulus johnsoni (Mahr)- north coast
Euseius stipulatus (Athias-Henriot) - central coast
Metaseiulus mcgregori (Chant) - central valley

Predaceous mites on winegrapes

- Adult females are typically narrowly oval
- Most are shiny white to slightly yellow or reddish
- Tend to move much more quickly than do spider mites

- Eggs are elliptical and perhaps 3 to 4 times larger than the spherical eggs of spider mites
- Overwinter primarily under the buds of grapevines as mated, adult females

Sampling and decision rules in "Grape Pest Management"

Pesticide Toxicity Measurements

Acute toxicity - percent mortality
LD50 or LC50 - dose response
Sublethal effects - fecundity, fertility, immature development
Total effects -
Persistence -
Behavioral modification -

Predator mite bioassays - analysis

Mortality, fecundity and fertility analyzed by ANOVA with means separated by LSD ($p < 0.05$)

Total effects of pesticides - E

E (%) = 100% - (100% - M) x R

Where

M = Abbott corrected mortality (Abbott, 1925)

R = reproduction per treated female (eggs/female x % fertility) / reproduction per untreated female

Predator mite bioassays - direct contact

G. occidentalis survival, fecundity and fertility after treatment of adult females with label rates of five different acaricides.

Active ingredient	Contact spray			
	% Survival	Total eggs/ female	Fertility (% hatch)	*E*
Control	100 0a	12.4 0.8a	100 0a	-
Acequinocyl	100 0a	9.2 0.6b	96.0 4.9a	28.5
Bifenazate	100 0a	9.4 0.5b	92.3 3.4a	30.2
Etoxazole	98.3 2.2a	9.4 0.7b	0 0b	100
Spiromesifen	98.3 2.2a	8.6 0.5b	96.1 4.0a	34.0
Fenpyroximate	0 0b	0 0c	0 0b	100

Means followed by the same letter are significantly different at $p<0.05$ by LSD.

Predator mite bioassays - residues

G. occidentalis survival, fecundity and fertility after treatment of leaves with label rates of five different acaricides.

Active ingredient	Surface residue			
	% Survival	Eggs laid	Fertility	*E*
Control	98.3 2.2a	11.2 1.0a	100 0a	-
Acequinocyl	93.4 3.0a	9.6 0.5a	92.2 4.9a	25.1
Bifenazate	95.1 2.7a	9.6 0.9a	96.0 4.0a	20.1
Etoxazole	93.4 3.0a	9.0 0.5a	0 0b	100
Spiromesifen	91.7 3.2a	5.0 0.7b	92.6 4.3a	61.7
Fenpyroximate	0 0b	0 0c	0 0b	100

Means followed by the same letter are significantly different at p<0.05 by LSD.

IOBC Classifications - (Sterk et al., 1999)

Leaf surface residues

Acequinocyl
Bifenazate → Harmless (class 1)

Spiromesifen → Slightly harmful (class 2)

Etoxazole
Fenpyroximate → Harmful (class 4)

Direct contact spray

Acequinocyl
Bifenazate
Spiromesifen → Harmless (class 1)

Etoxazole
Fenpyroximate → Harmful (class 4)

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