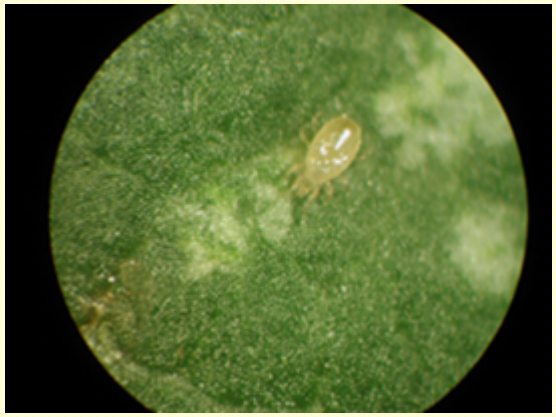
MICHIGAN STATE UNIVERSITY EXTENSION

Managing Mites and Mite Flaring in Tree Fruits



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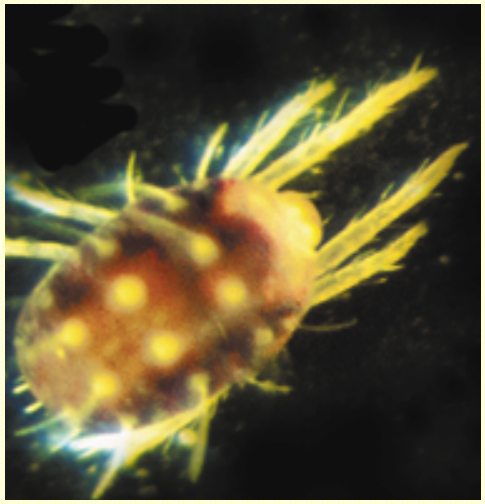
The Primary Pest Mites in Michigan Tree Fruits:

Two-spotted spider mite

European red mite



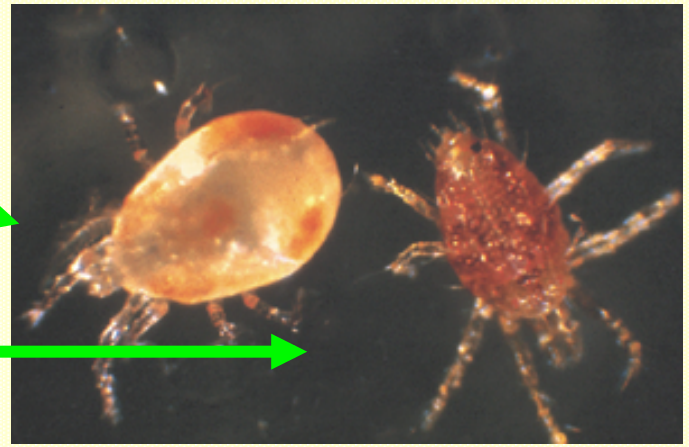
Predacious Mites

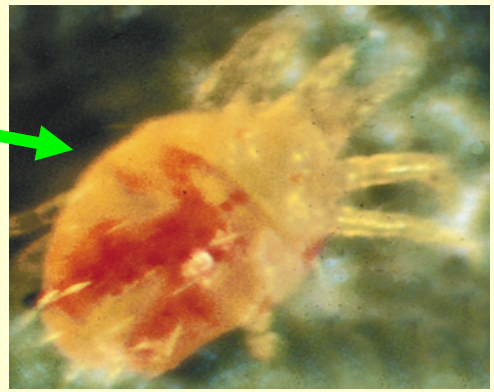
– ***Neoseiulus (=Amblyseius) fallacis*** (phytoseiid mite)

– ***Agistemus fleschneri*** (stigmaeid mite)

– ***Zetzellia mali*** (stigmaeid mite)

– ***Typhlodromus pyri*** (phytoseiid mite)





Mechanisms Responsible for Flaring Secondary Pests

- Selective toxicity: pest vs natural enemy (Croft and Whalon 1982)
- Resistance to compounds targeting direct pests (Croft and Hoyt 1978)
- Indirect effect of eliminating competitive arthropods.
- Hormoligosis - the reproductive stimulation after exposure to sublethal doses of an synthetic insecticide (Luckey 1968).
  - Carbaryl on T. urticae (Dittrich 1974)
  - Pyrethroids on T. urticae (Gerson and Cohen 1989)
  - Imidacloprid on T. urticae (James and Price 2002)
- Trophobiosis – enhanced reproduction of herbacious arthropods resulting from altered biochemical state of the plant (ie; health effects) (Chabussou 1970)
  - Carbaryl on T. urticae (Dittrich 1974)
  - Imidacloprid (Ford et al 2009)

Insecticides Registered in US Fruit Crops - 2016

20th Century Insecticides

- Chlorinated Hydrocarbons (1)
- Organophosphates (3)
- Carbamates (2)
- Synthetic Pyrethroids (6)

21st Century Insecticides

- Insect Growth Regulators (5)
- Spinosyns (2)
- Avermectins (2)
- Neonicotinoids (5)
- Oxadiazines (1)
- Diamides (4)
- Particle Film (1)
- Pyrizoles (1)
- Pyridine Carboxamides (1)
- Microbials/Botanicals (7+)

Study Objectives

- To determine if insecticides have lethal effects on mite predators, thus contributing to mite flaring.
  1) Mite flaring field trial
  2) Direct spray toxicity trial
  3) Residual toxicity trial

Study Objectives

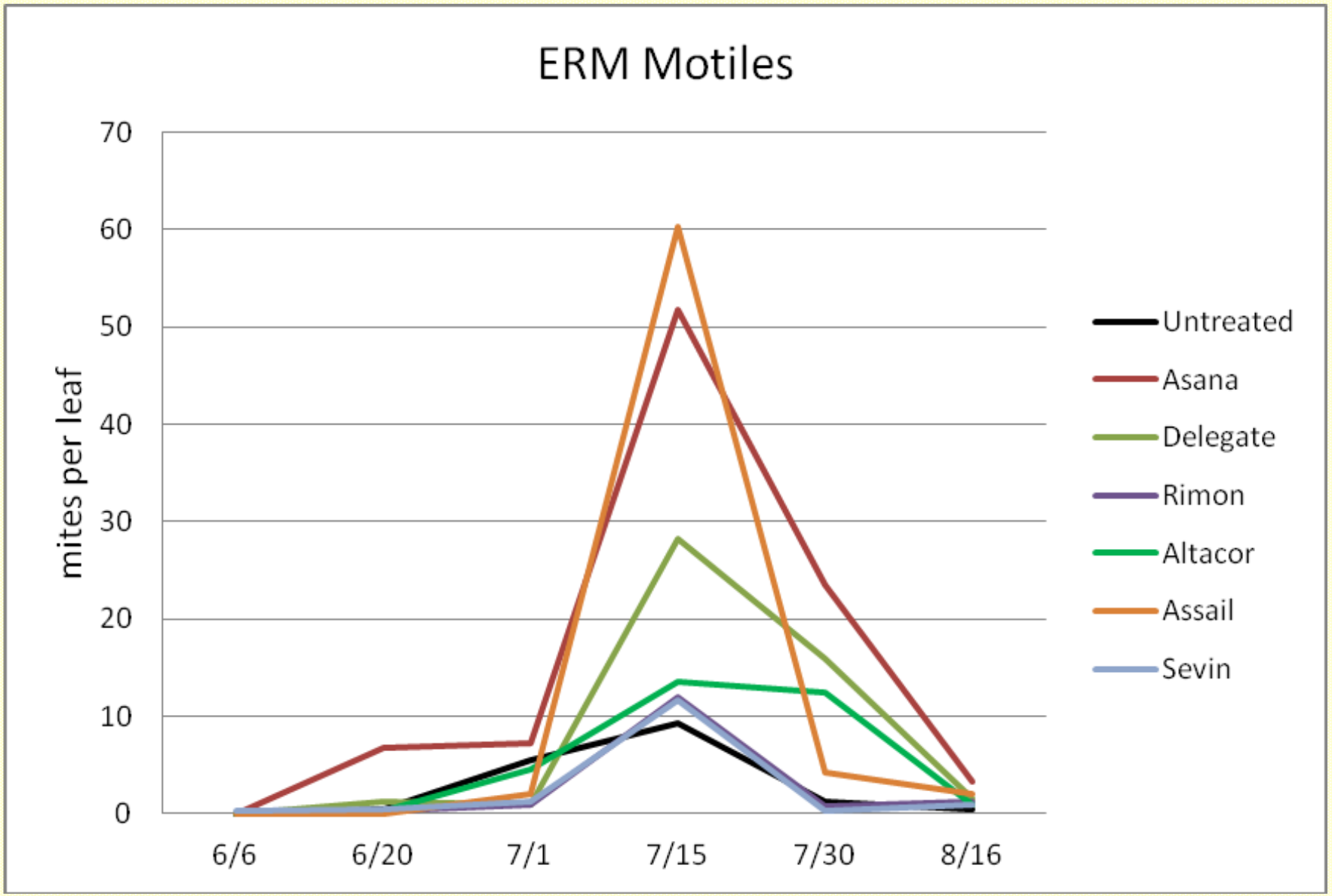
- To determine toxicity of registered insecticides on predacious mites.
- Demonstrate mite flaring of European Red Mite (ERM), *Panonychus ulmi* (Koch) under field conditions.

Chemical Name	Trade Name, Formulation and Rate
Esfenvalerate	Asana 0.66 EC 9.6 oz/acre
Spinetoram	Delegate 25 WG 5.2 oz/acre
Novaluron	Rimon 0.83 EC 20 oz/acre
Chlorantroniliprole	Altacor 35 WG 3 oz/acre
Acetamiprid	Assail 30 SG 6 oz/acre
Carbaryl	Sevin XLR 1 qt/acre

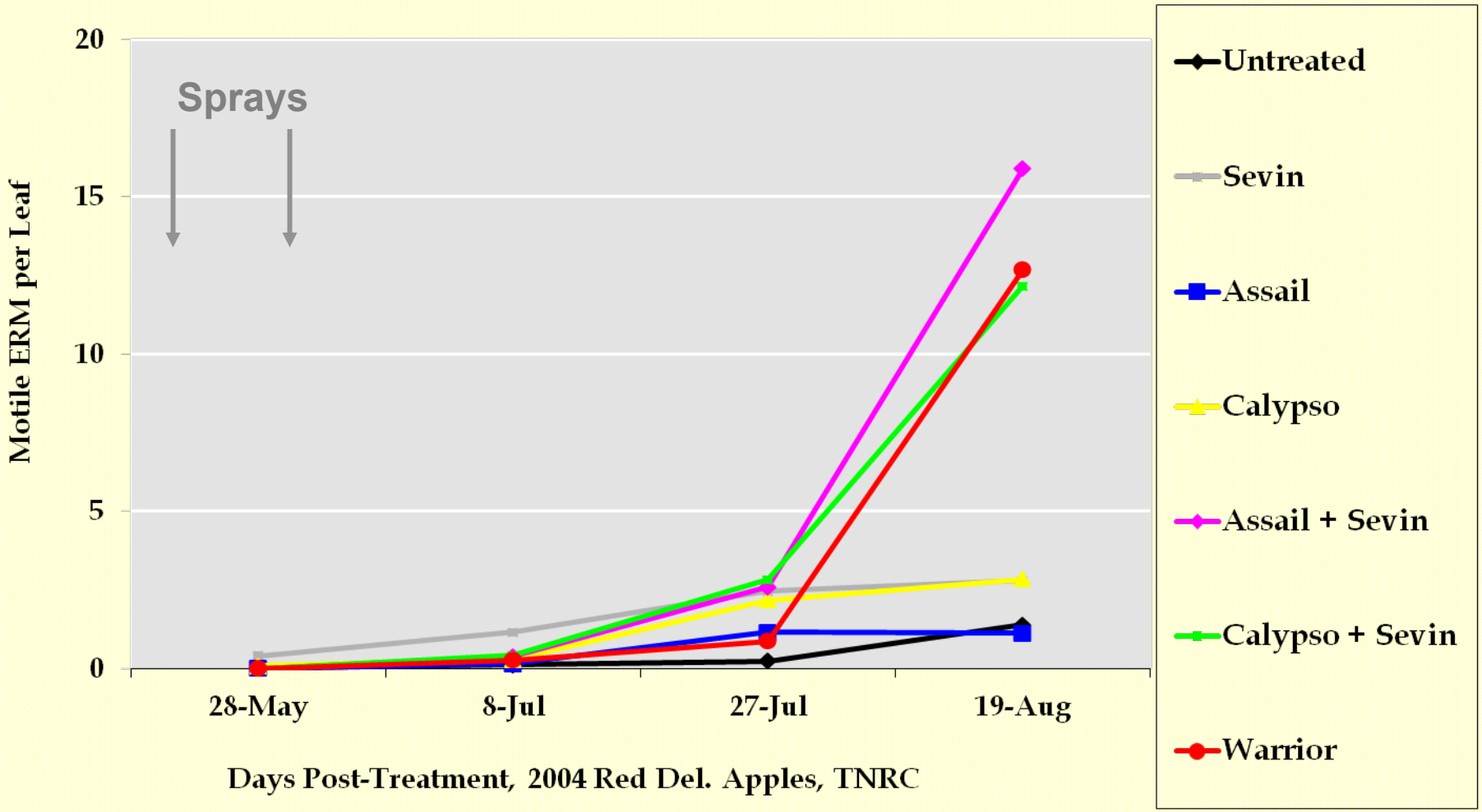
Mite Flaring Field Trial

- Apply compounds in the field with airblast sprayer (2 apps during normal 1st Gen CM).
- Collect mature apple leaves on 14 day interval.
- Brush mites from leaves in lab.
- Quantify ERM and predacious mites across treatments.

Motile ERM Flaring Patterns in Apple, 2011



Mite Flaring From Tank-Mix Treatments



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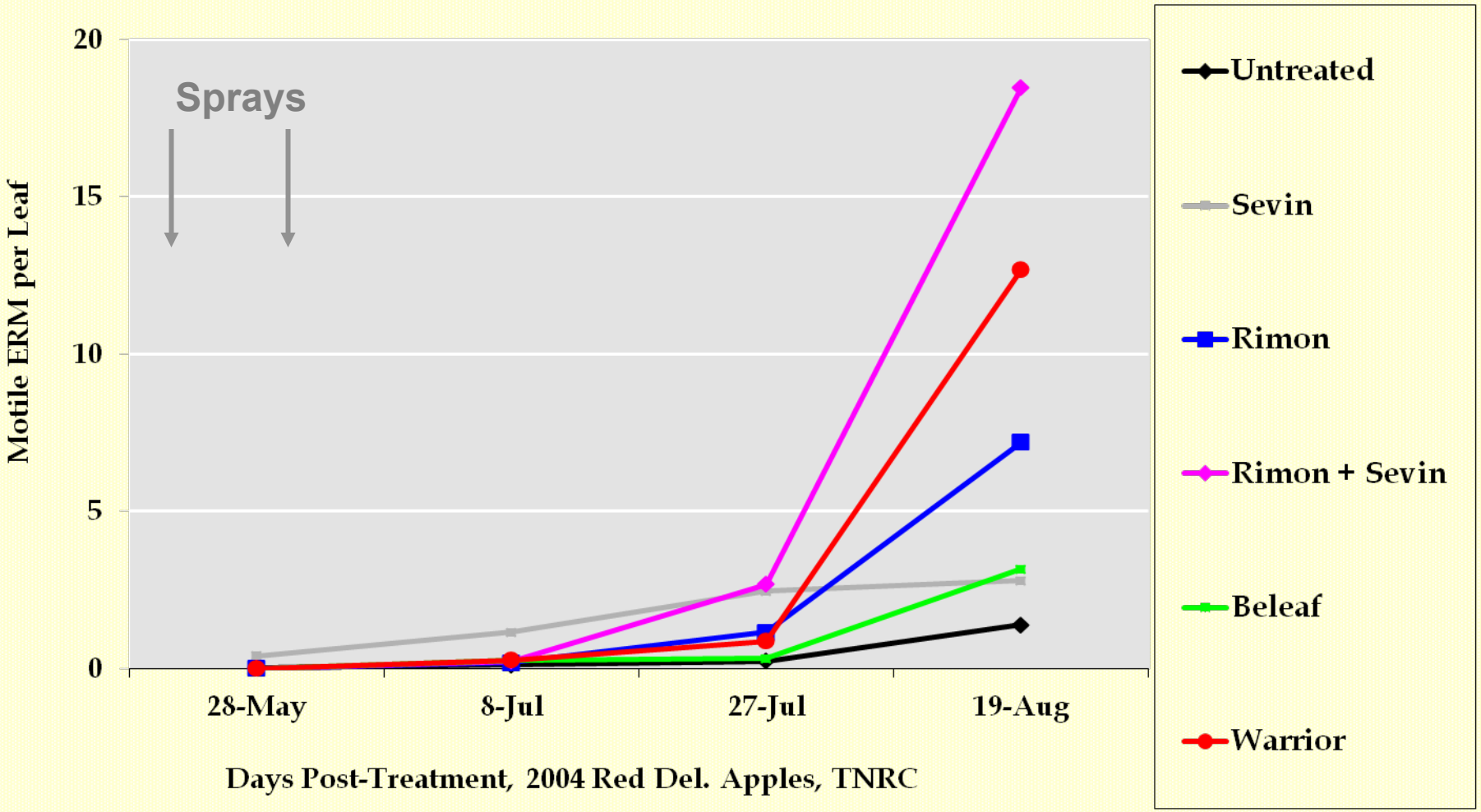
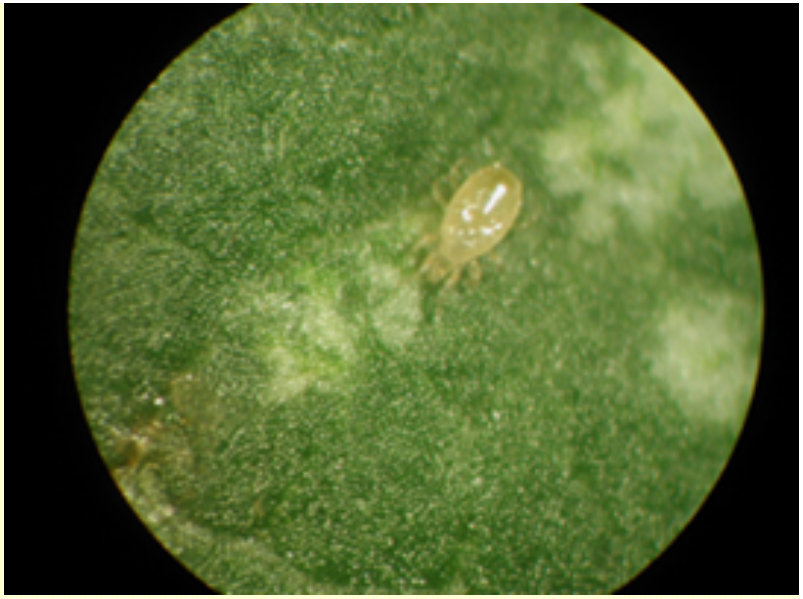


Predator Mite Toxicity Bioassays

Neoseiulus (=Amblyseius) fallacis (AF)
(Acarina: Phytoseiidae)

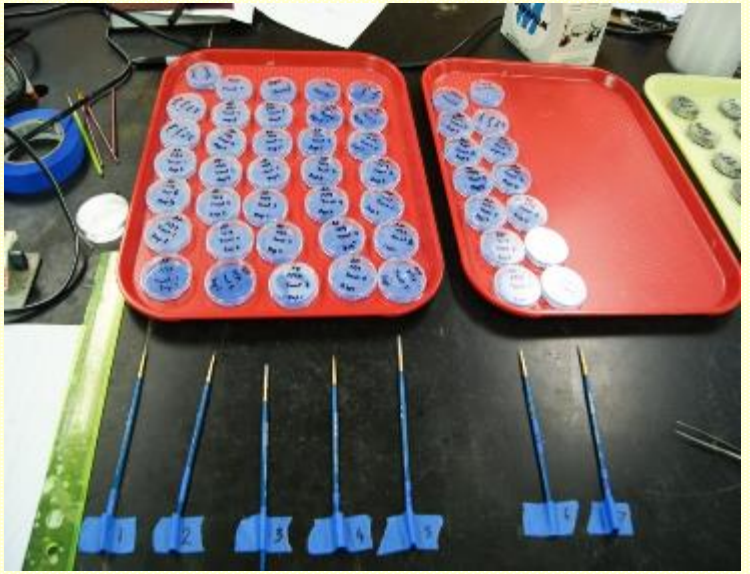


- Evaluate the toxicity of individual compounds to AF predacious mite resulting from:
  - Direct topical exposure trial
  - Residual contact exposure trial

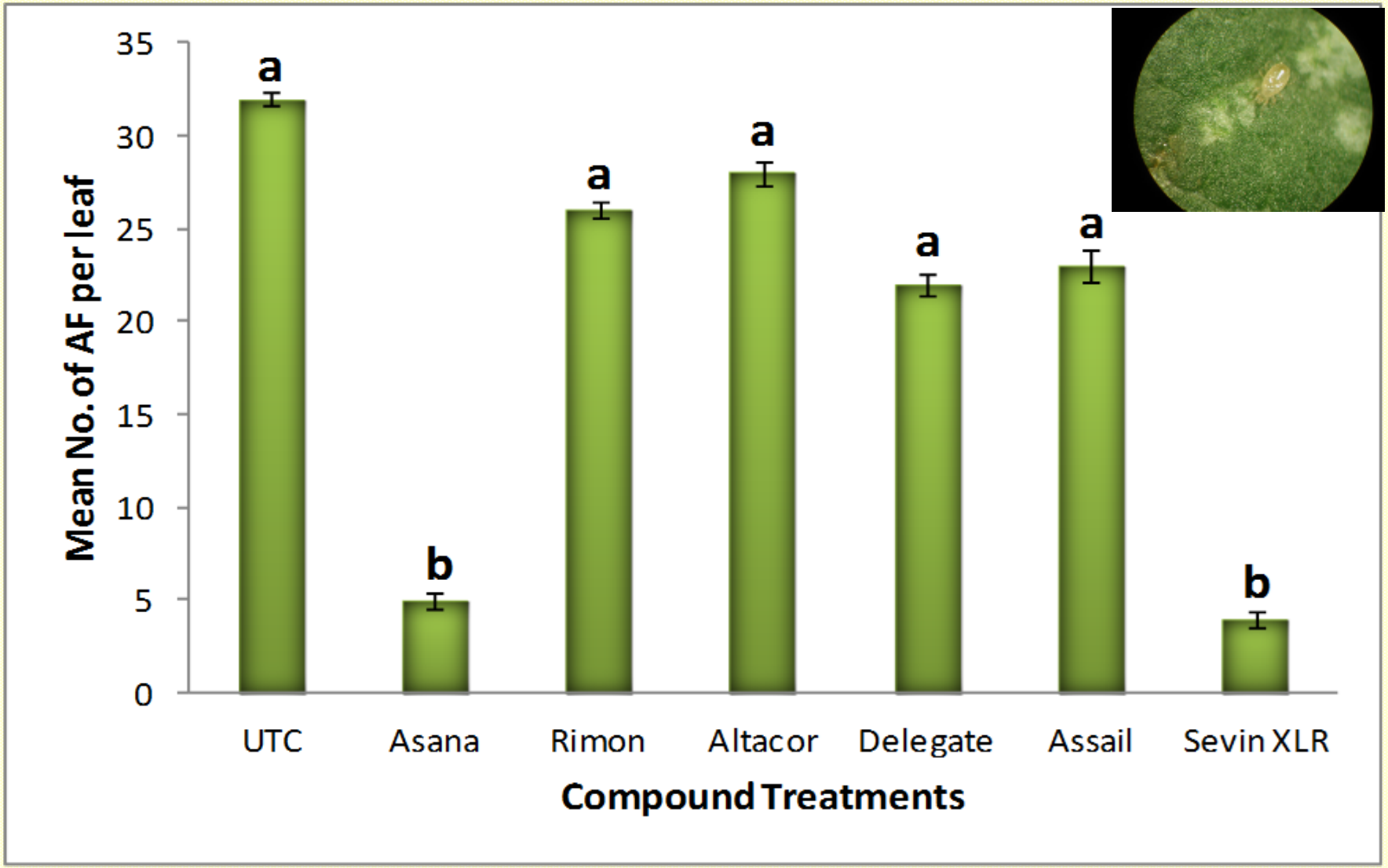
Direct Topical Exposure Bioassay

Sample Method

- Ten AF were used per replicate (total 7 reps)
- Direct spray w/ Potter Spray Tower 2 mL sample at 20 psi
- Hold on apple leaf w/ ERM eggs for 96 hours
- Measure live/dead AF every 24 h
- Data were subjected to ANOVA statistical analysis (GLM procedures; SAS Institute, 2002)



Direct Spray Toxicity of Insecticides to AF predator Mite



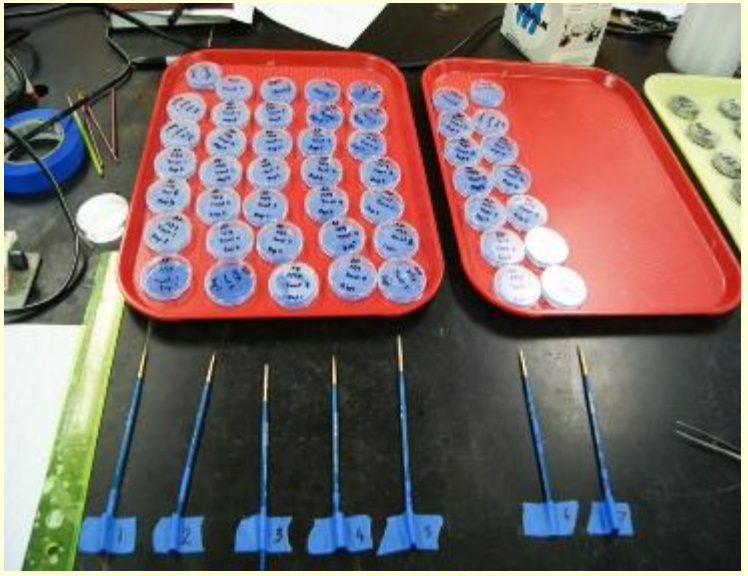
Means with the same letter are not significantly different at $P \leq 0.05$ after ANOVA

Residual Contact Exposure Bioassay

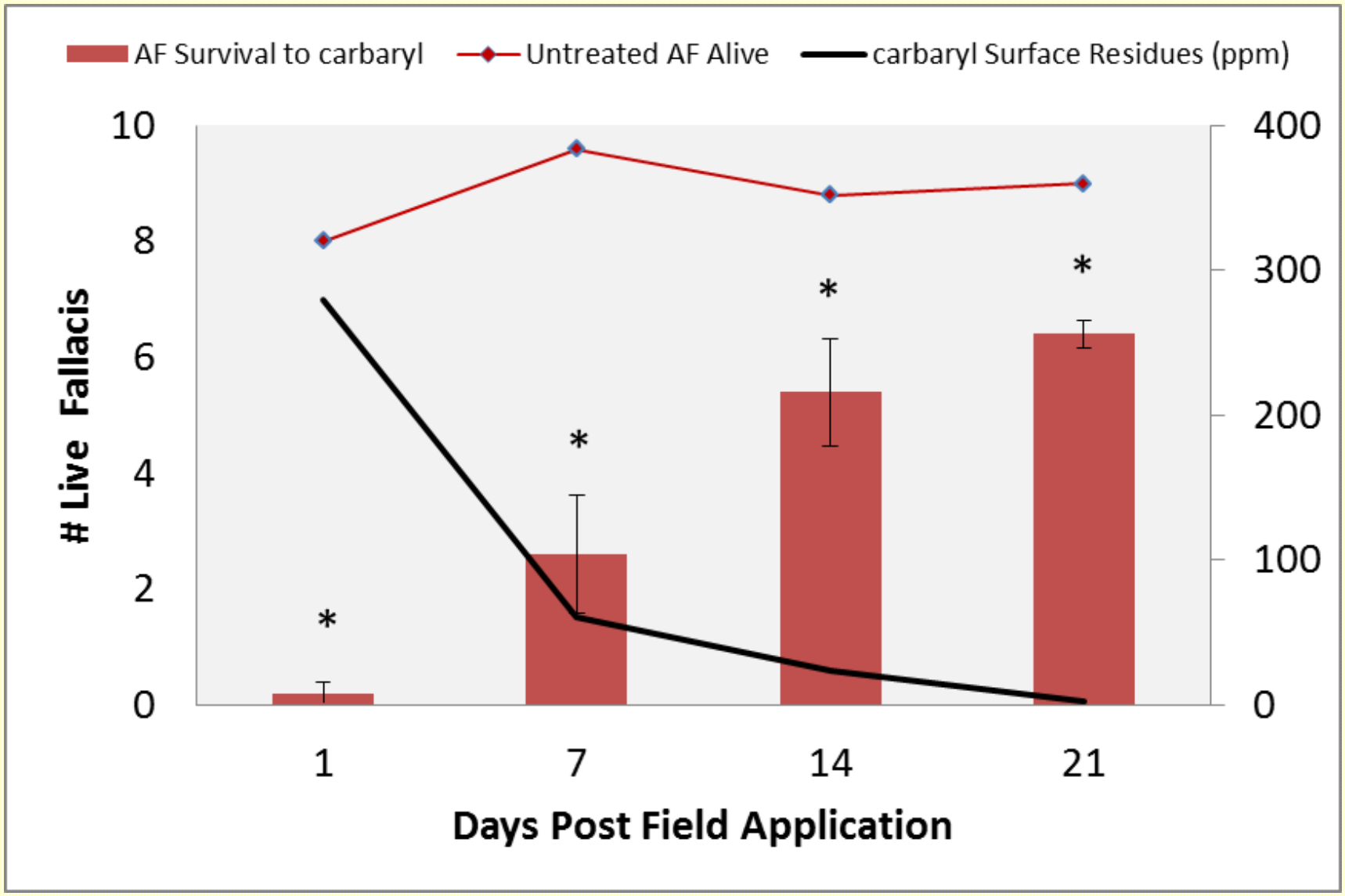
cont

Sample Method

- Ten AF were used per replicate (total 7 reps)
- Field spray w/ airblast sprayer at labeled rates.
- Expose ten AF to apple leaves at 1, 7, 14, 21 post application
- Measure live/dead AF after 48h
- Data obtained was subjected to dunnett's analysis (SAS institute 2002)

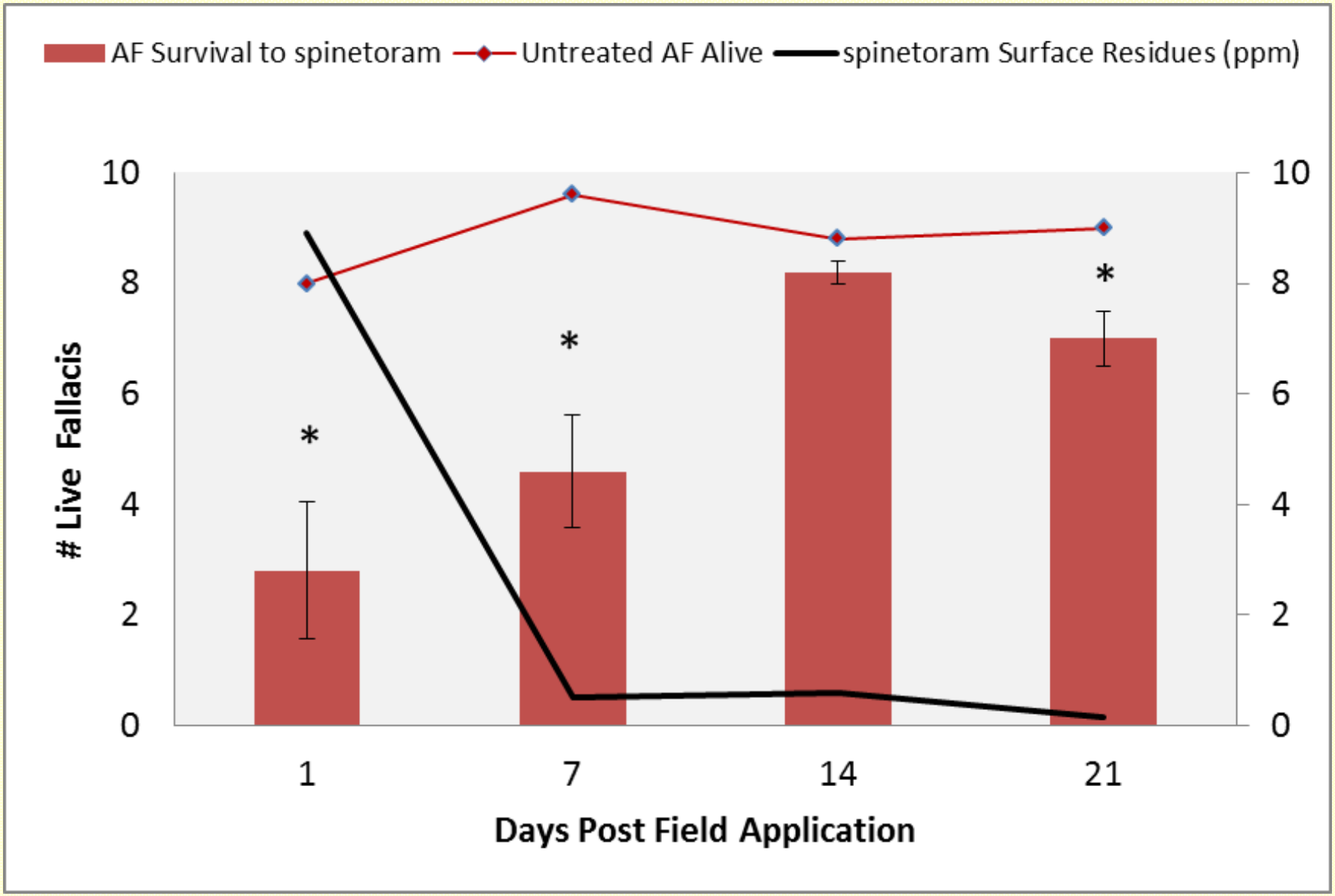


Residual Toxicity of Sevin to AF predator Mite



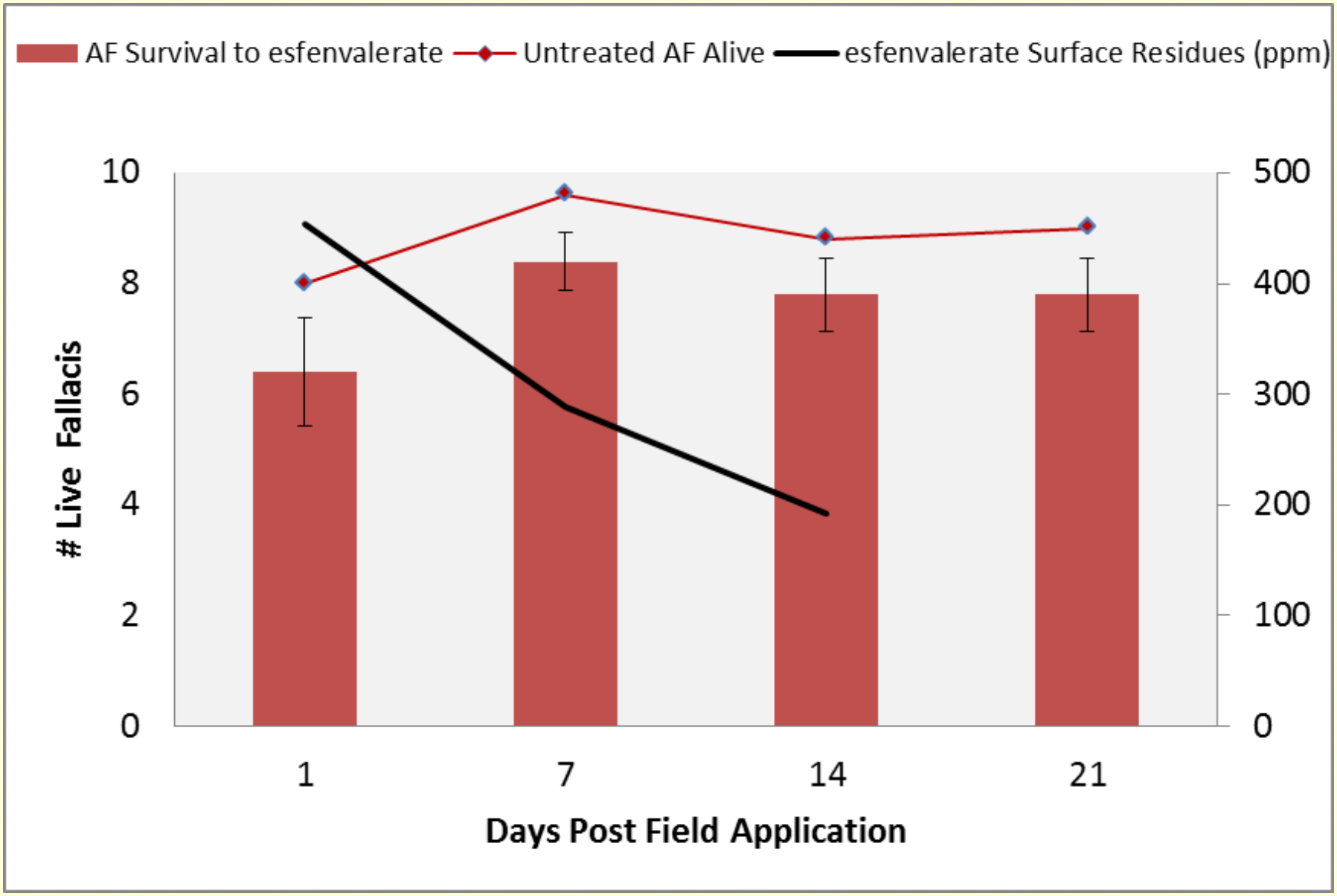
* designates significance difference from untreated control ($\alpha < 0.05$).

Residual Toxicity of Delegate to AF predator Mite



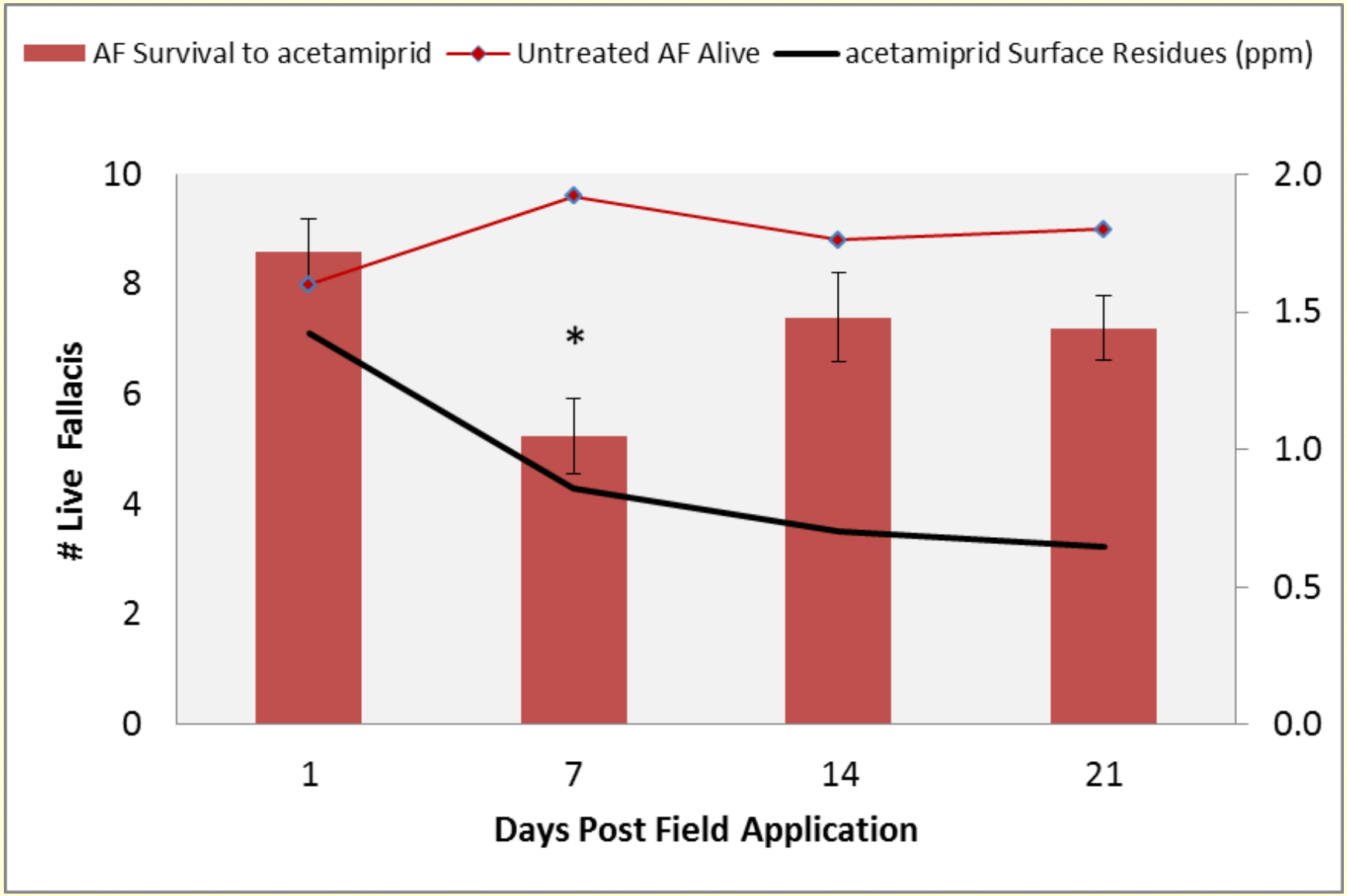
* designates significance difference from untreated control (α <0.05).

Residual Toxicity of Asana to AF predator Mite



* designates significance difference from untreated control ($\alpha < 0.05$).

Residual Toxicity of Assail to AF predator Mite



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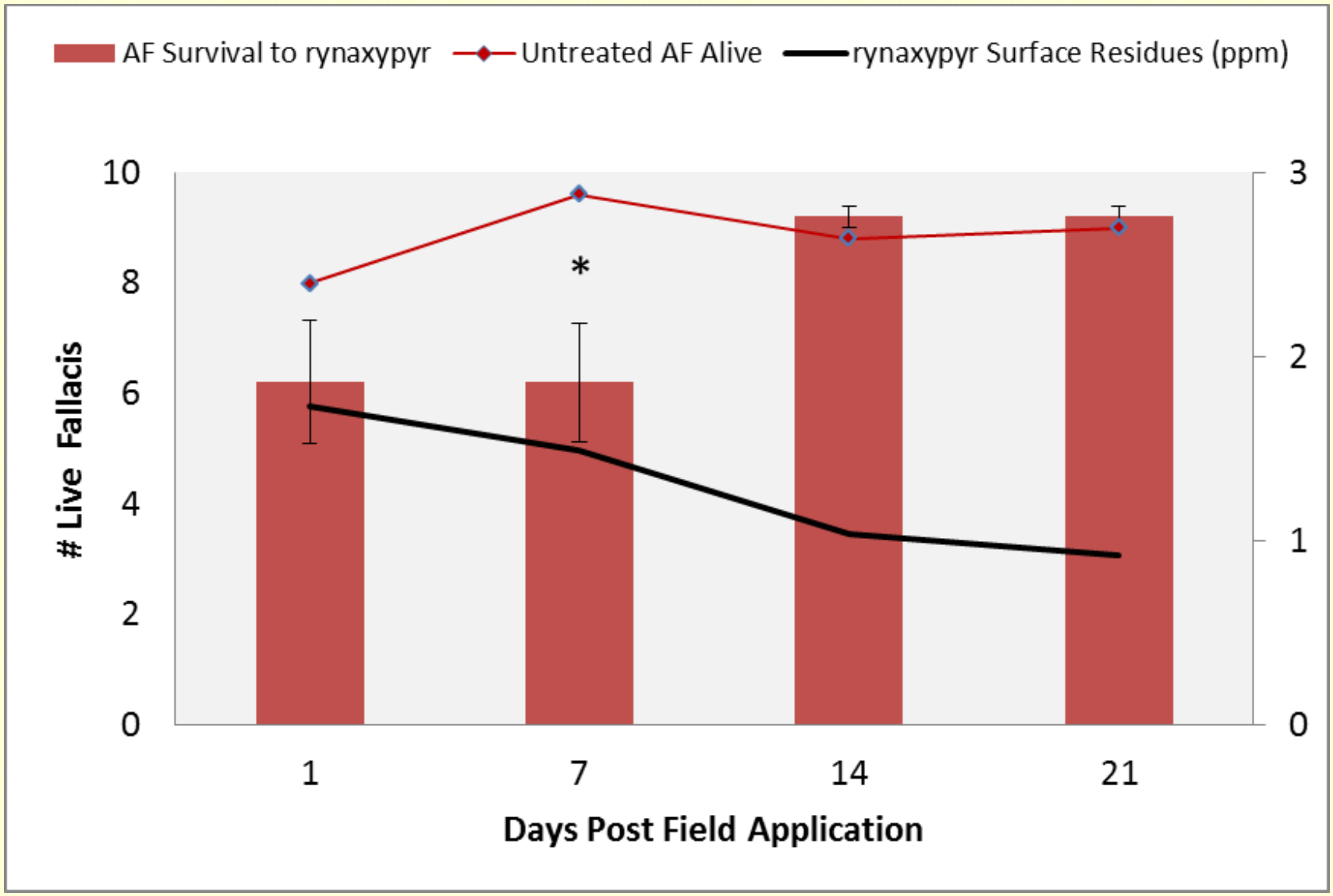
Residual Toxicity of Altacor to AF predator Mite



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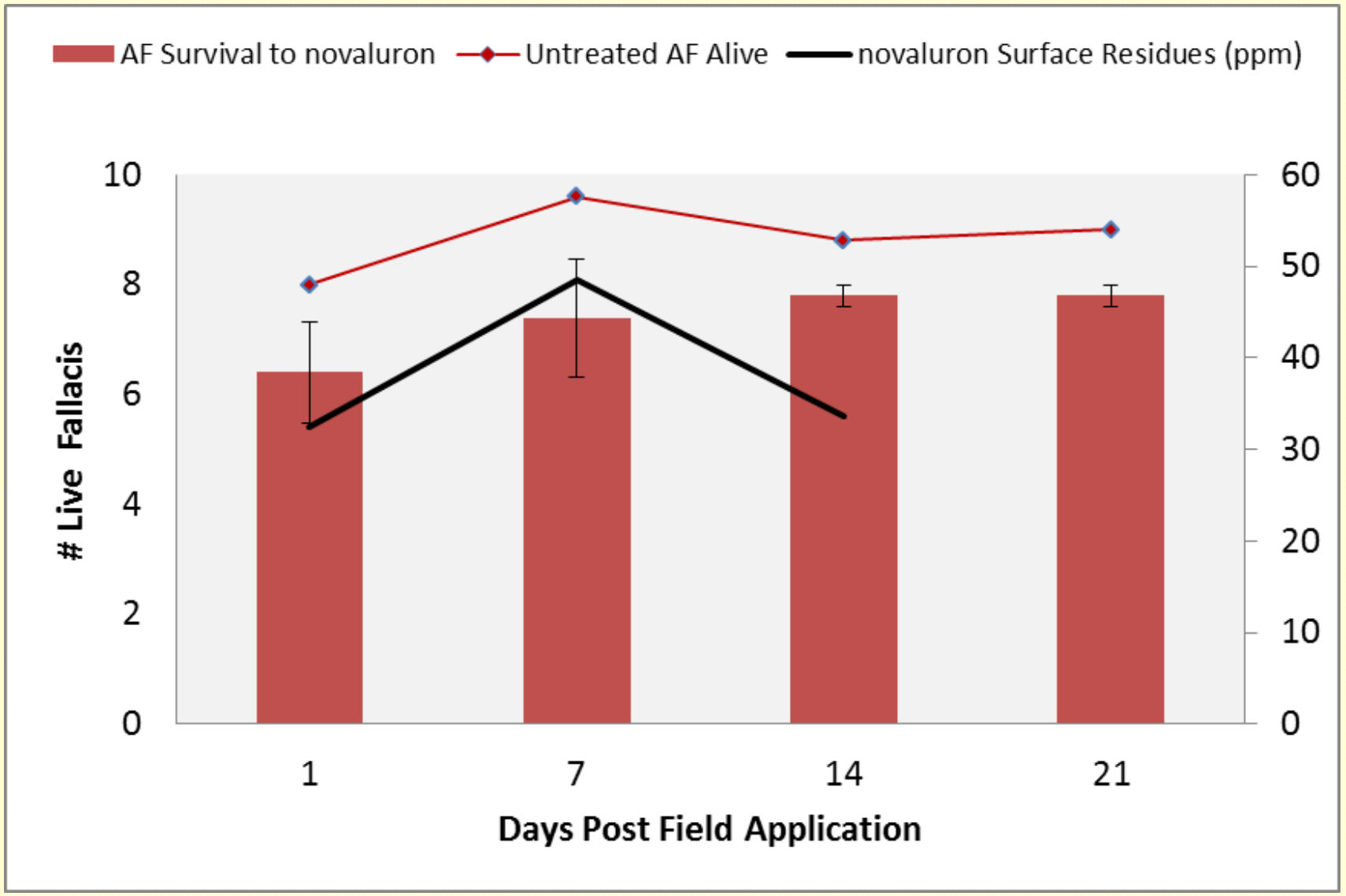
Residual Toxicity of Rimon to AF predator Mite



* designates significance difference from untreated control ($\alpha < 0.05$).

Performance Characteristics of Miticides

Compound	Evidence of Hormoligosis	Toxic to Mite Predators	Mite Flaring Potential
Pyrethorids	yes	H	H
Assail/Admire	yes	L	M
Sevin	yes	H	M
Diamides	no	L	L
Beleaf	no	L	L
Rimon	no	L	M
Rimon + Sevin	yes	M	M
Neonic + Sevin	yes	M	H

H – high, M – moderate, L – low

Chemical Control of Mite Pests

Conventional Miticides

Carzol

Vydate

Kelthane

Vendex

Lime-Sulfur

Oil

New Miticide Classes

Avermectins

Agri-Mek

Gladiator (*abamectin* + *zeta-cypermethrin*)

Agri-flex (*abamectin* + *thiamethoxam*)

Electron Transport Inhibitors

Nexter

Portal

Nealta

Kanemite (METI III)

Magister

Mite Growth Inhibitors

Apollo

Savey/Onegar

Zeal

Tetronic Acids

Envidor

Carbazates

Acramite/Banter

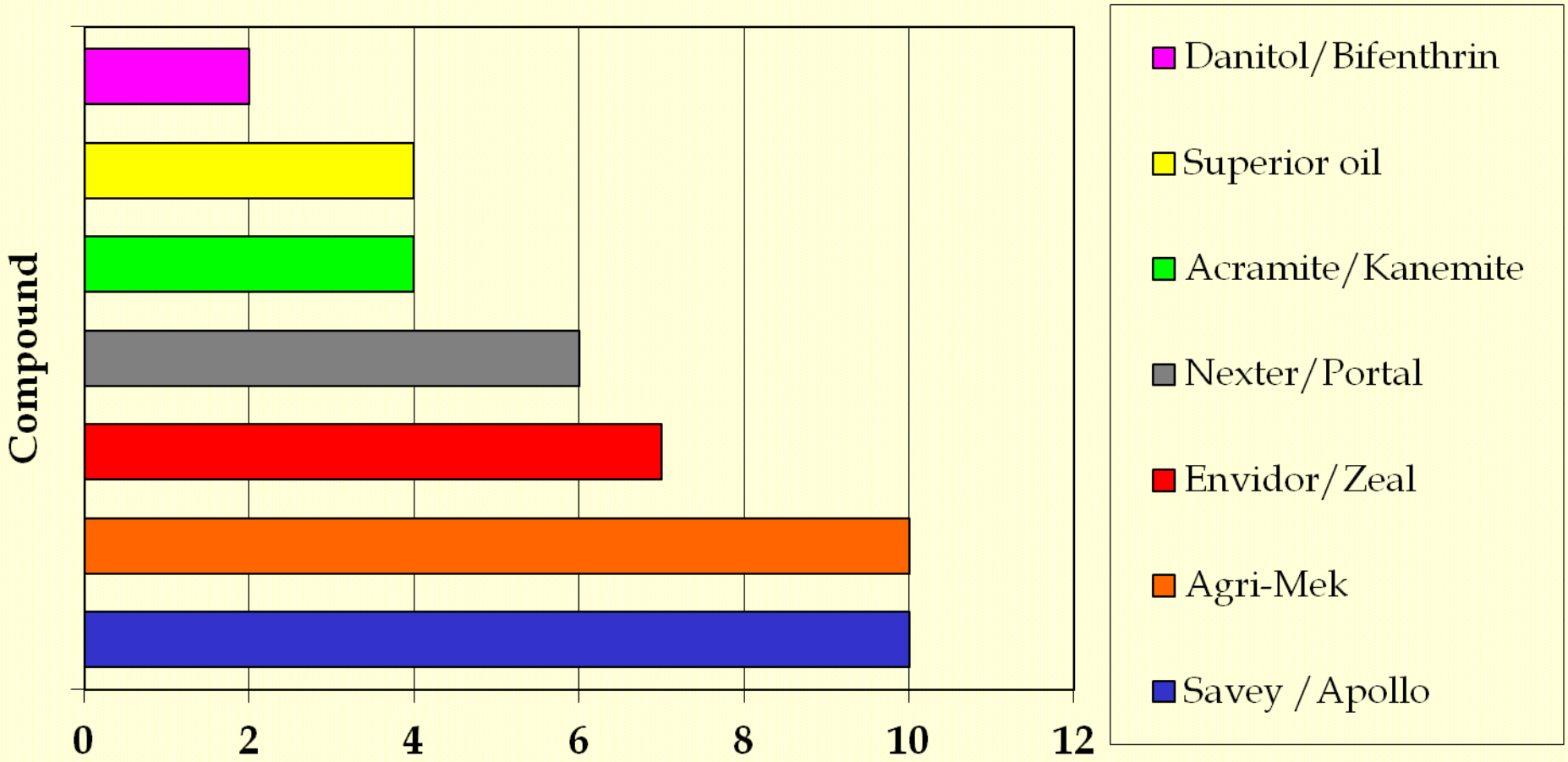
Pyrethroids

Danitol, Bifenthrin

Mite Management

- Timing decision depends upon factors such as:
  - orchard history
  - Seasonal thresholds
  - resistance management strategies
  - other pests (ie. STLM, WALH)
  - Miticide duration of control activity
  - Miticide life-stage activity

Miticide Duration of Control on ERM



Performance Characteristics of Miticides

Compound	**Life-stage Activity**	**Mode of Exposure**	**Speed of Activity**
Oil	egg	Complete coverage	-
Apollo Savey/Onegar	egg	contact	slow
Zeal	egg, nymphs	contact	slow
Agri-mek	motiles	ingestion	moderate
Envidor	motiles	ingestion	slow
Nexter/Portal Nealta/Magister	motiles	contact	fast
Acramite/Banter Kanemite	motiles	contact	fast
Danitol/Bifenthrin	motiles	contact	fast

Miticide Timing for ERM in Apples

Compound	**Optimal Application Timing**
Oil	Pre-bloom
Apollo Savey/Onegar	Pre-bloom
Zeal	Petal fall, threshold
Agri-mek	Petal fall – 2nd Cover
Envidor	Petal fall, threshold
Nexter/Portal Nealta	Threshold
Acramite/Banter Kanemite	Threshold
Danitol/Bifenthrin	Threshold (late season)

Miticide Timing for TSSM in Cherries

Compound	**Optimal Application Timing**
Oil	Pre-bloom
Apollo Savey/Onegar	Early season threshold, post-harvest
Zeal	threshold, pre/post harvest
Kanemite	Threshold, pre/post harvest
Envidor	Threshold, pre/post harvest
Portal/Magister Nexter	Threshold Post-harvest
Acramite/Banter	Threshold, pre/post harvest
Danitol/Bifenthrin	Threshold (late season)

Implications for Mite Pest Management

- Scouting and orchard history provide critical information for effective mite pest management.
- Risks of mite flaring can be minimized by protecting mite predators.
- For optimal resistance management, no miticide of common MOA should be applied more than once per year.

The TNRC staff say thank you to the
Michigan Apple Committee
for making this research possible