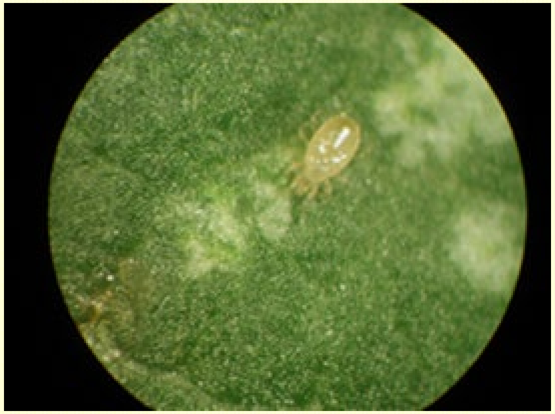
MICHIGAN STATE UNIVERSITY EXTENSION

Managing Mites and Mite Flaring in Tree Fruits



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The Primary Pest Mites in Tree Fruits:

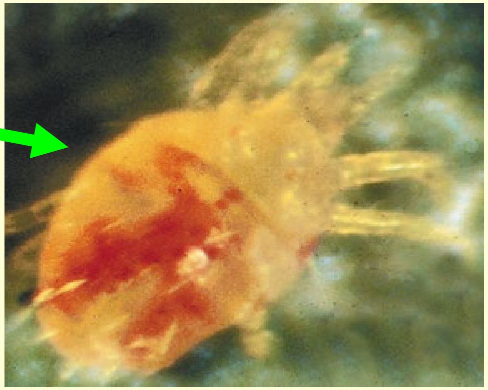
Two-spotted spider mite

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 a 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 - 2023

20th Century Insecticides

- Organophosphates (2)
- Carbamates (2)
- Synthetic Pyrethroids (6)

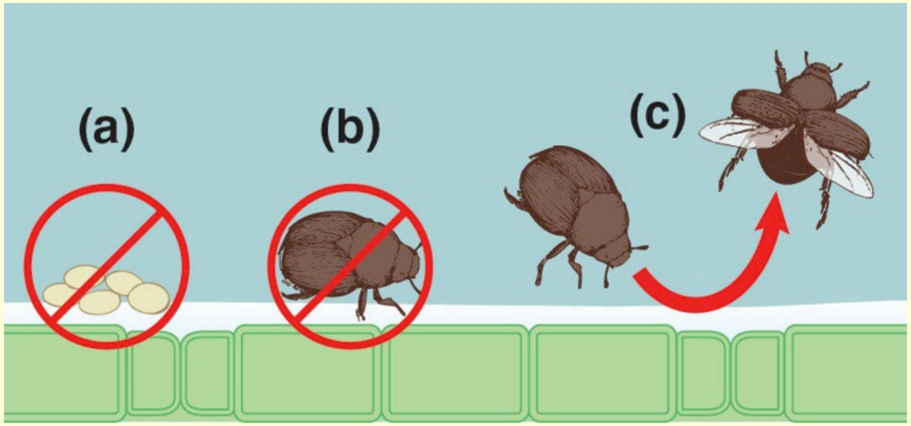
21st Century Insecticides

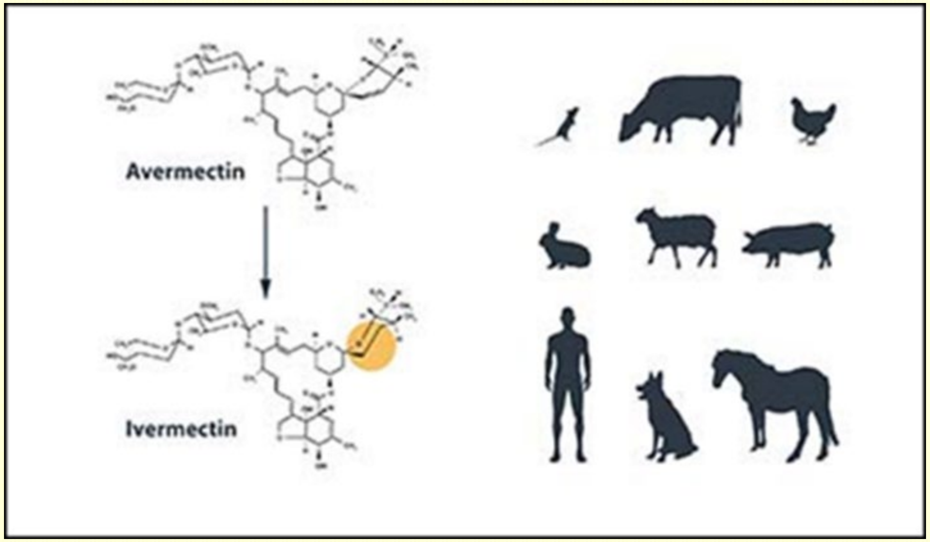
- Insect Growth Regulators (5)
- Spinosyns (2)
- Avermectins (2)
- Neonicotinoids (5)
- Oxadiazines (1)
- Diamides (4)
- Particle Film (1)
- Pyrizoles (1)
- Pyridine Carboxamides (1)
- Tetronic acid derivatives (1)

Expansion of Available Biopesticides in 21st Century

Biopesticides

- Fermentation by-products
  - *Bts*
  - Grandevo & Venerate
- Botanical / Animal extracts
  - Azadirachtin (Neem)
  - Pyrethrins (Pyganic)
  - Sabadilla (Veratran)
  - Spider venom peptides (Spear-T)
- Fungal agents
  - *Beauvaria bassiana* (BoteGHA)
- Virus
- Inorganic
  - Potassium silicate (Sil-Matrix)





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

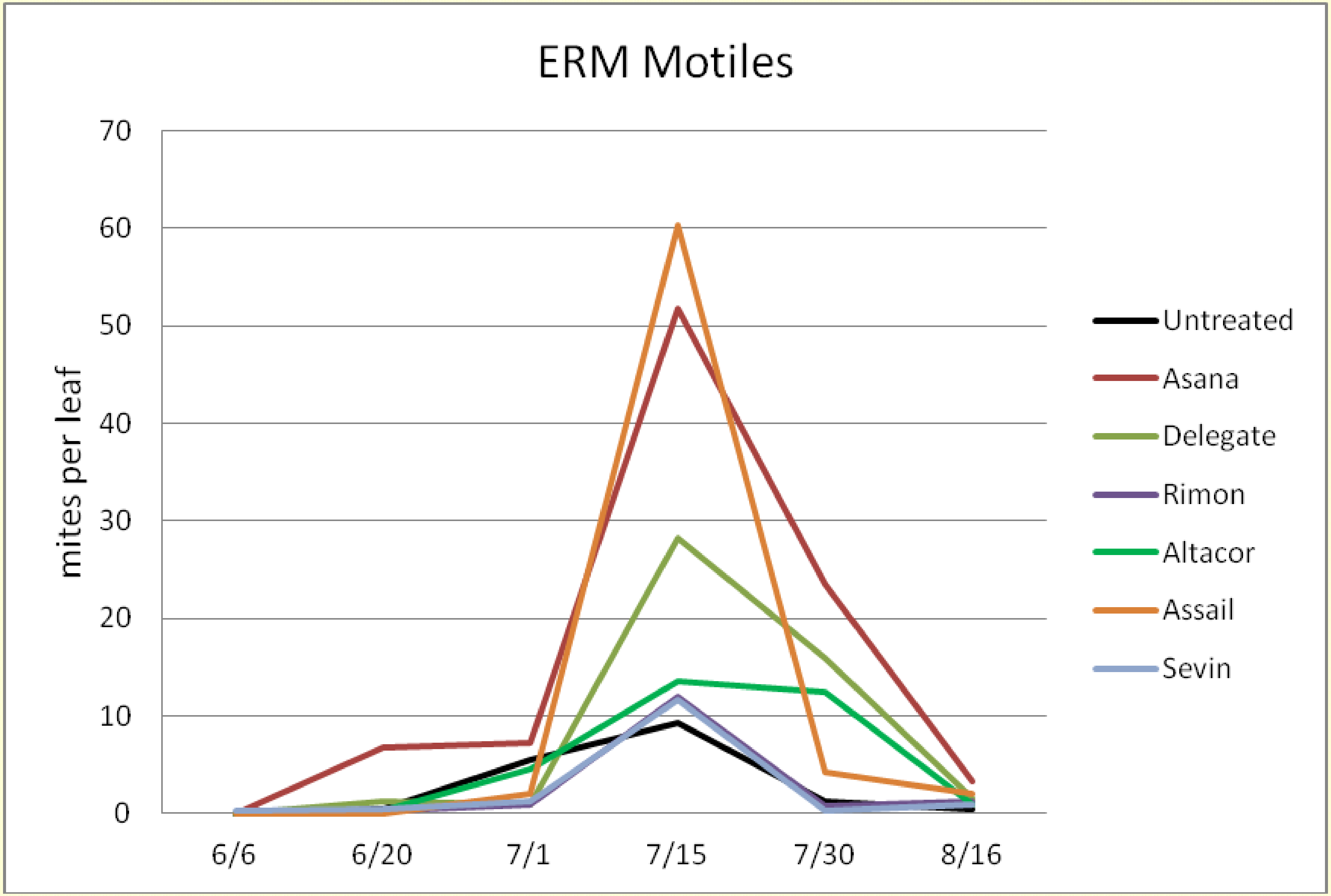
- To determine toxicity of registered insecticides on predacious mites.
- Demonstrate mite flaring of European Red Mite (ERM), *Panonychus ulmi* (Koch) under field conditions.

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

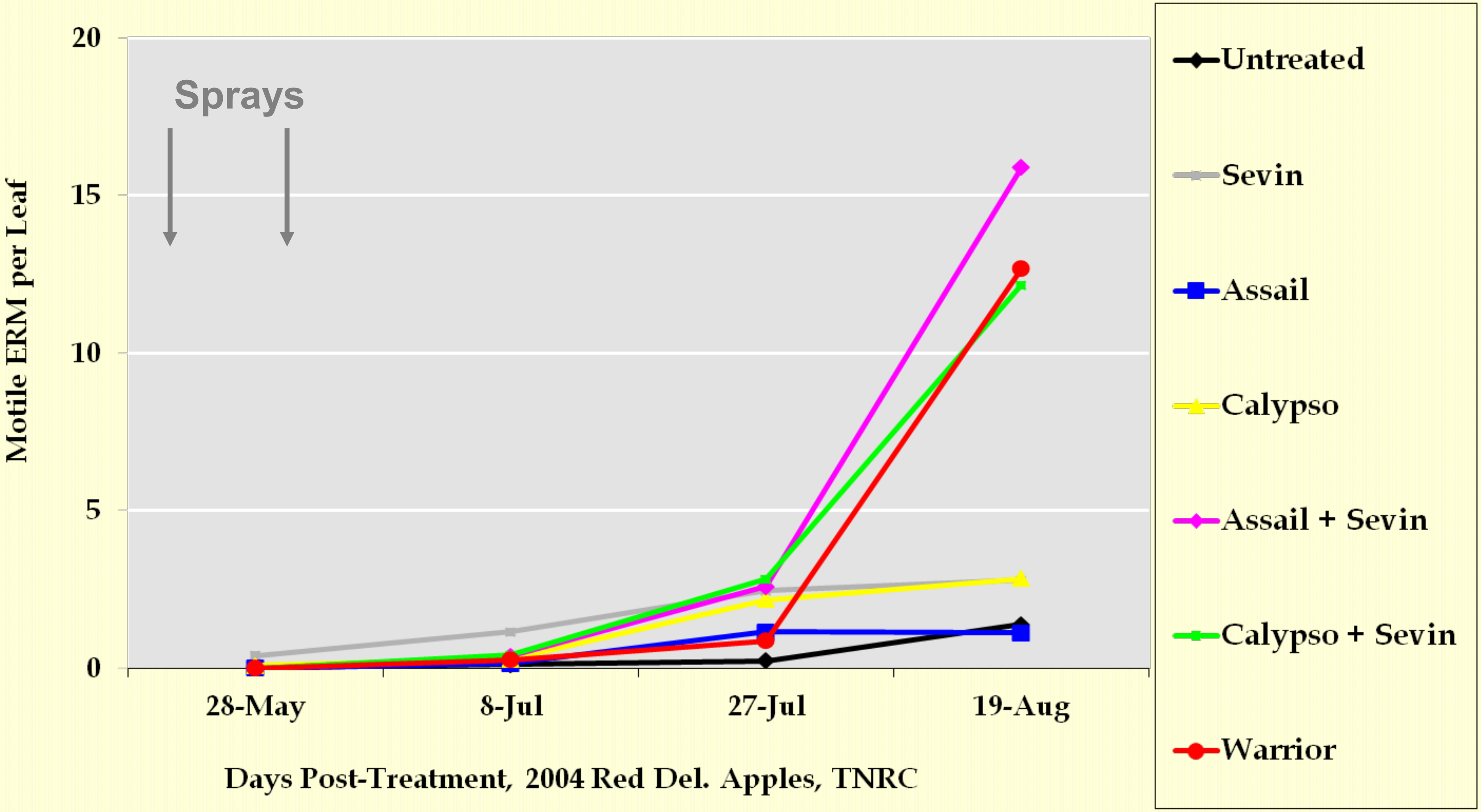
Mite Flaring Field Trial

- 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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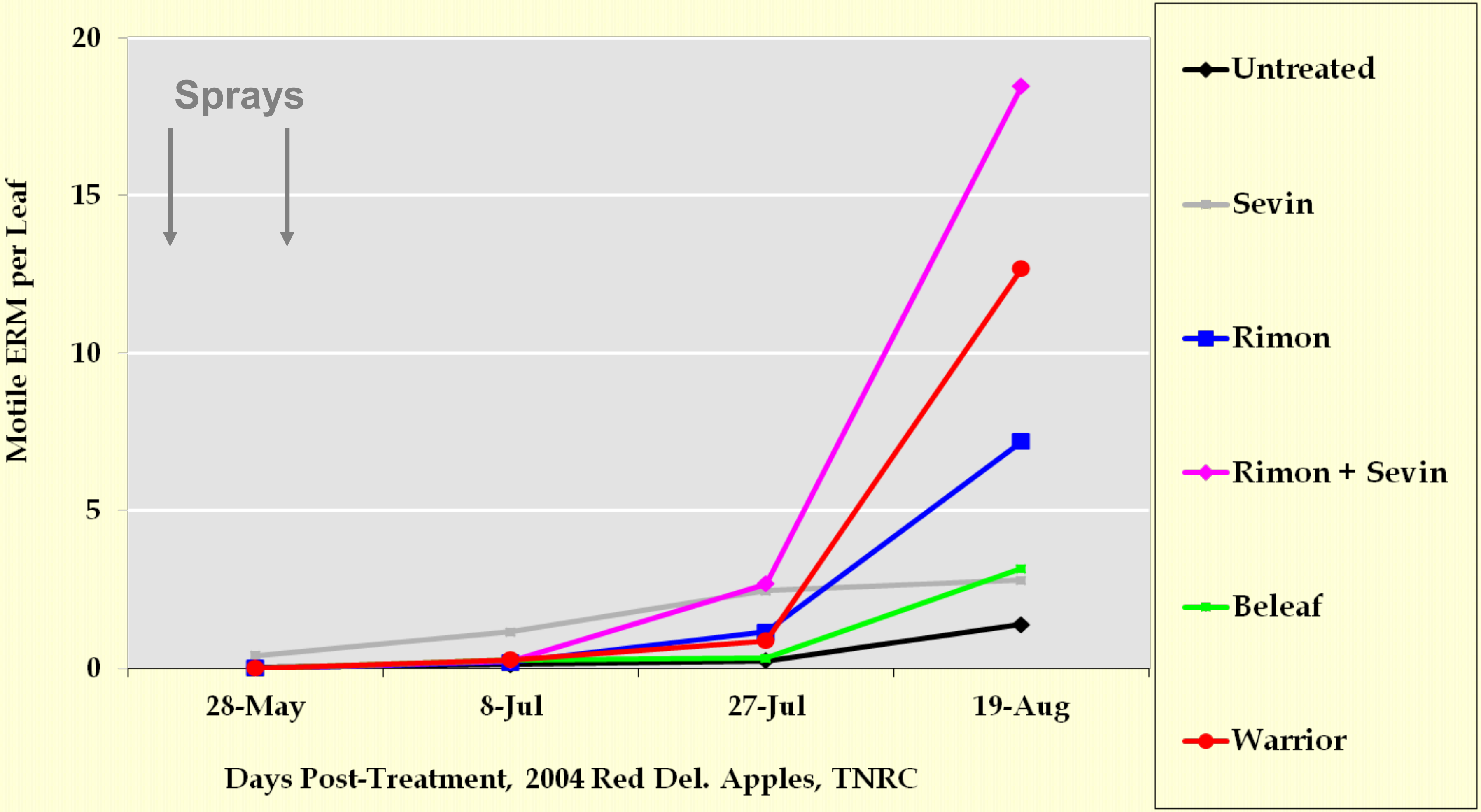


Predator Mite Toxicity Bioassays

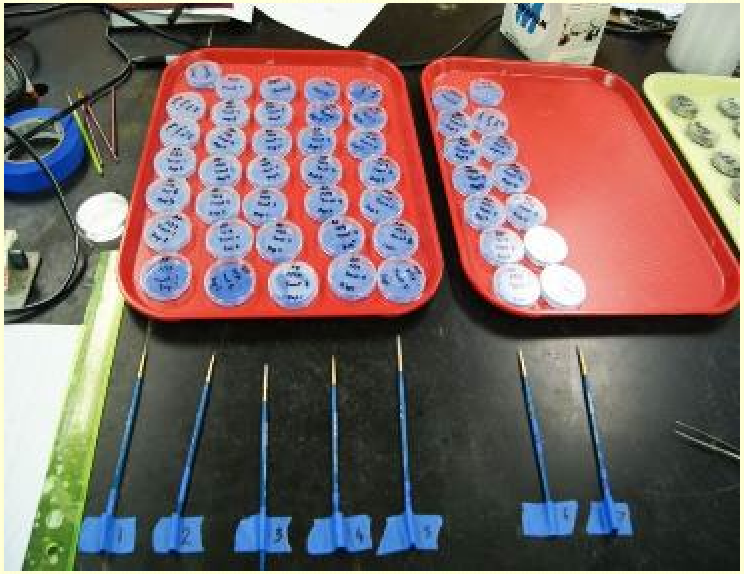
Neoseiulus (=Amblyseius) fallacis (AF)
(Acarina: Phytoseiidae)

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

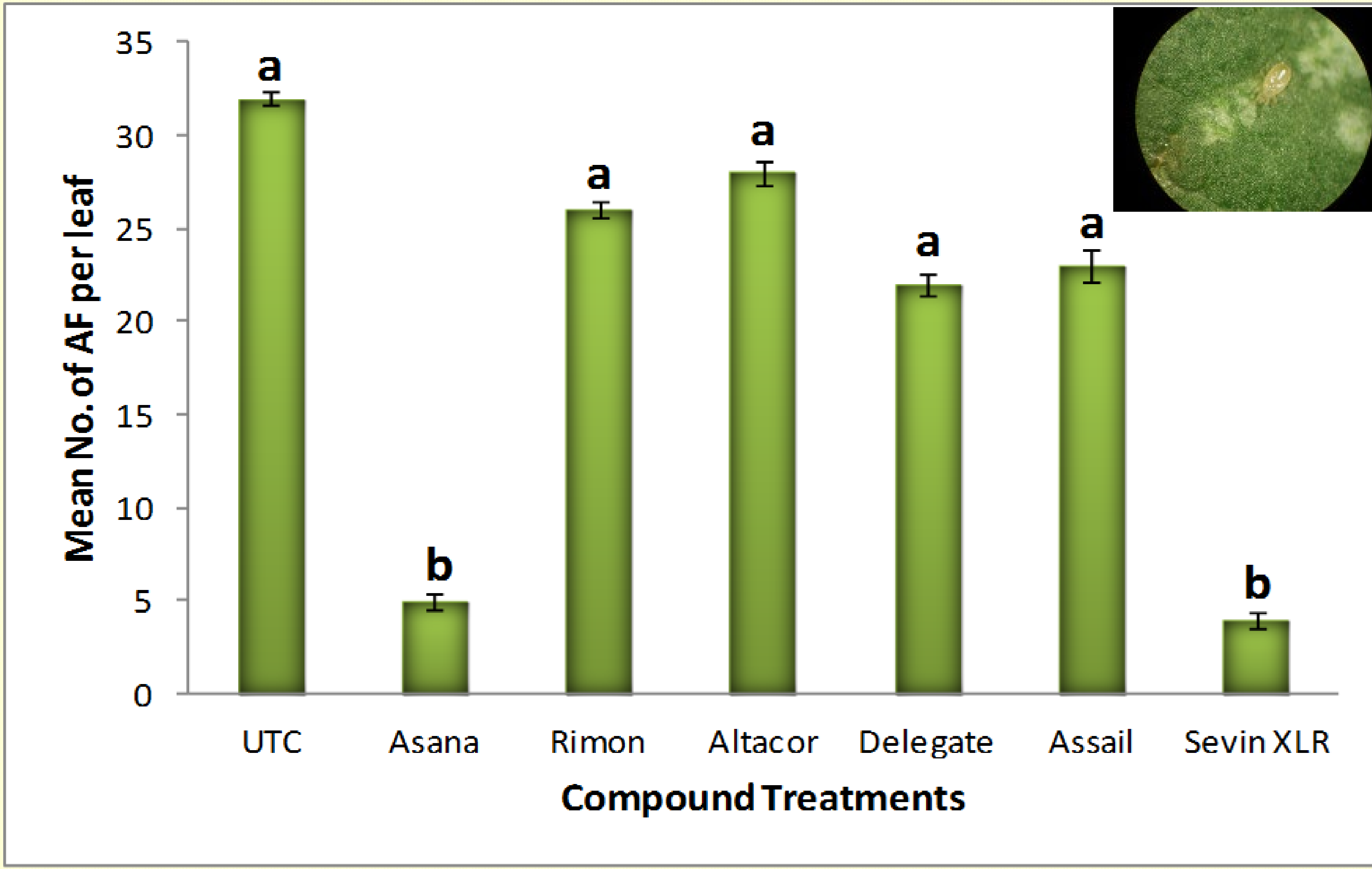
Direct Topical Exposure Bioassay

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

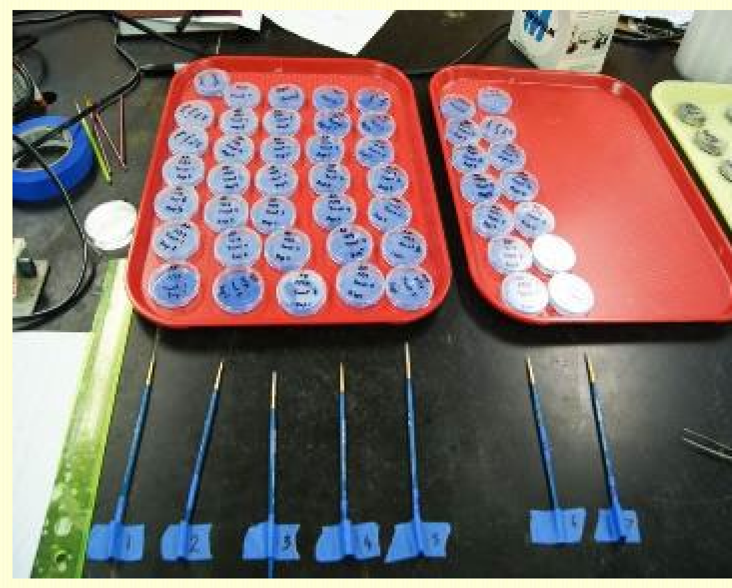


Means with the same letter are not significantly different at $P \leq 0.05$ after ANOVA

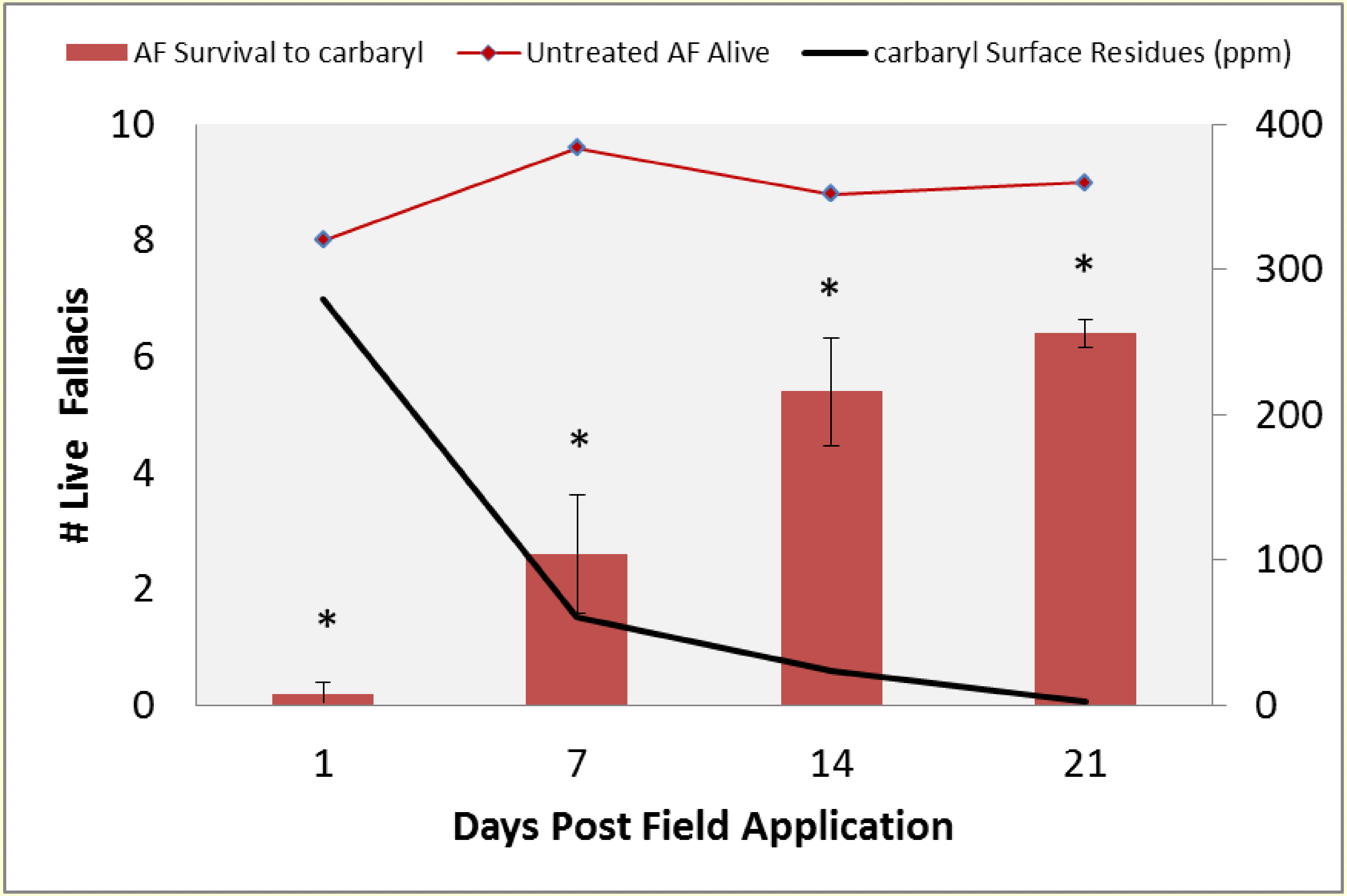
Residual Contact Exposure Bioassay cont

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)

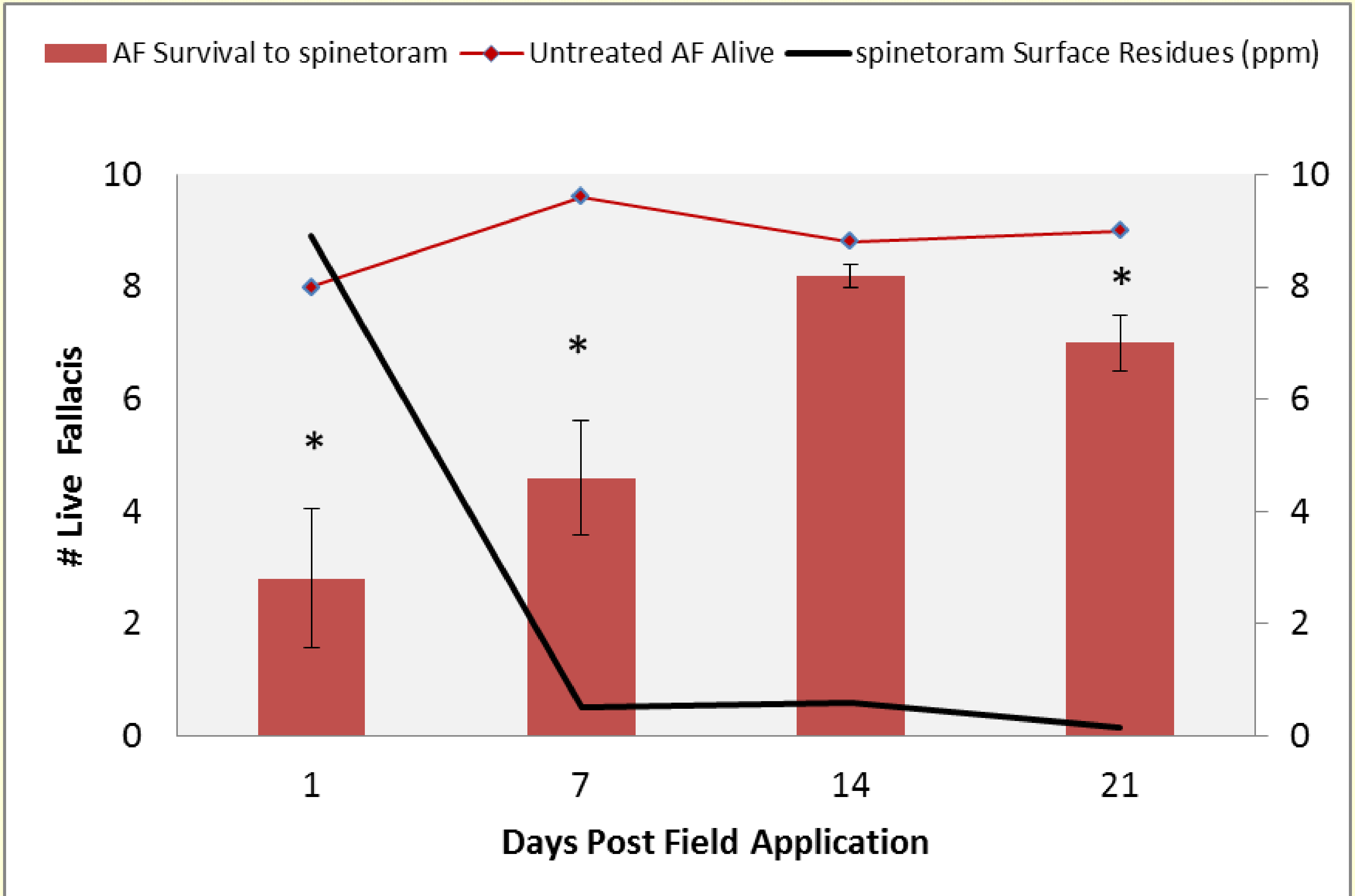


Residual Toxicity of Sevin to AF predator Mite



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

Residual Toxicity of Delegate to AF predator Mite



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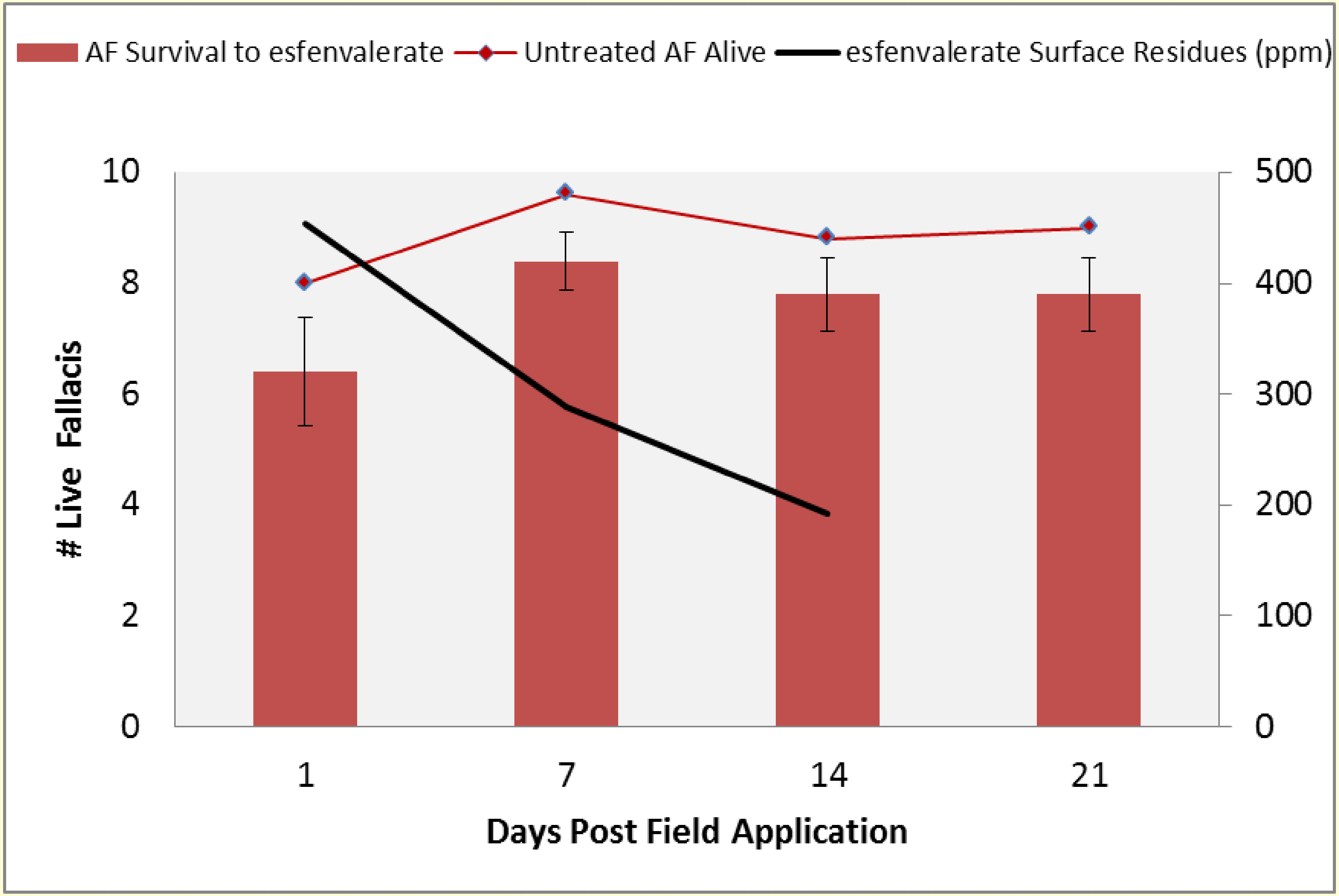
Residual Toxicity of Asana to AF predator Mite



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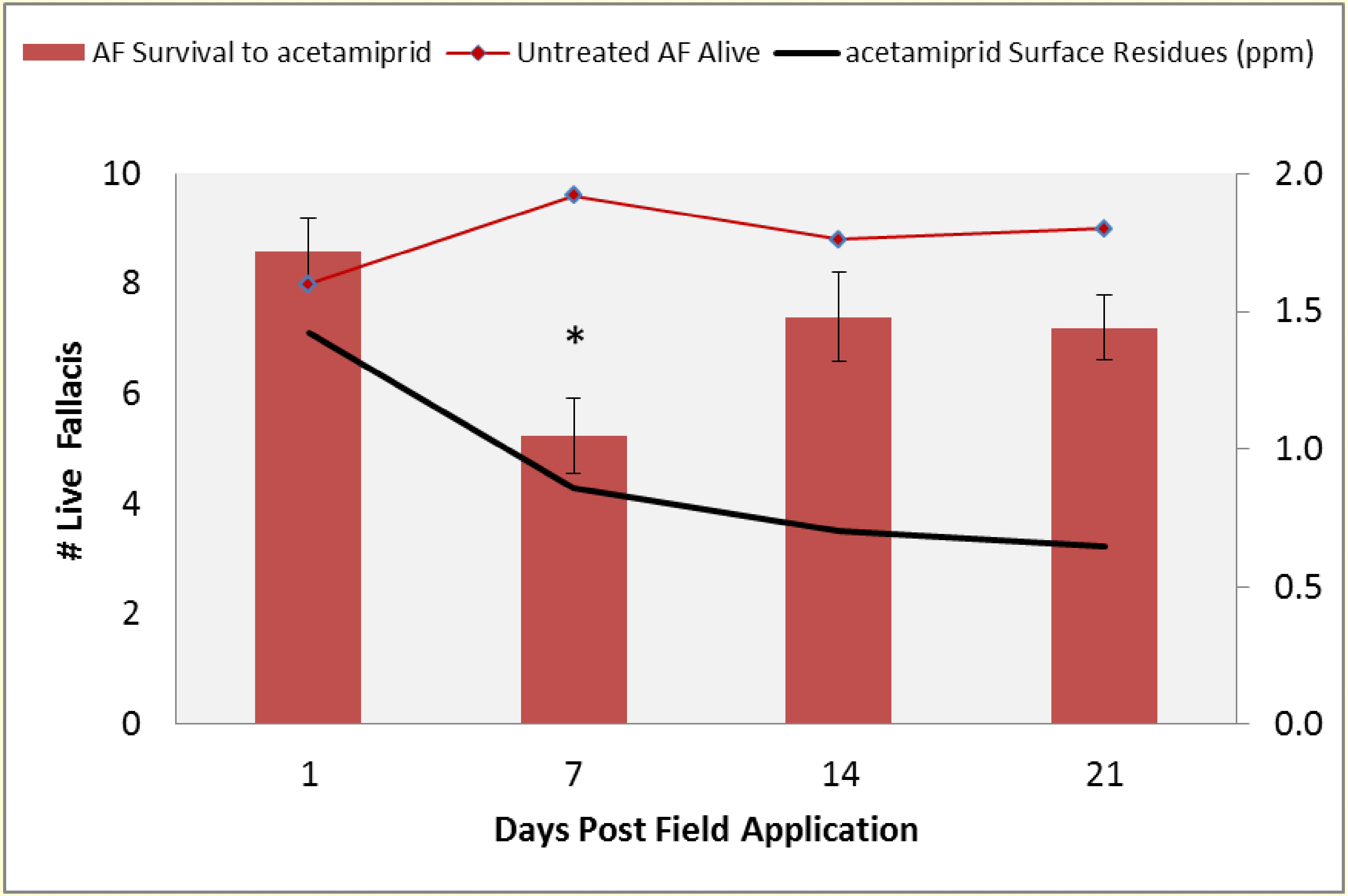
Residual Toxicity of Assail to AF predator Mite



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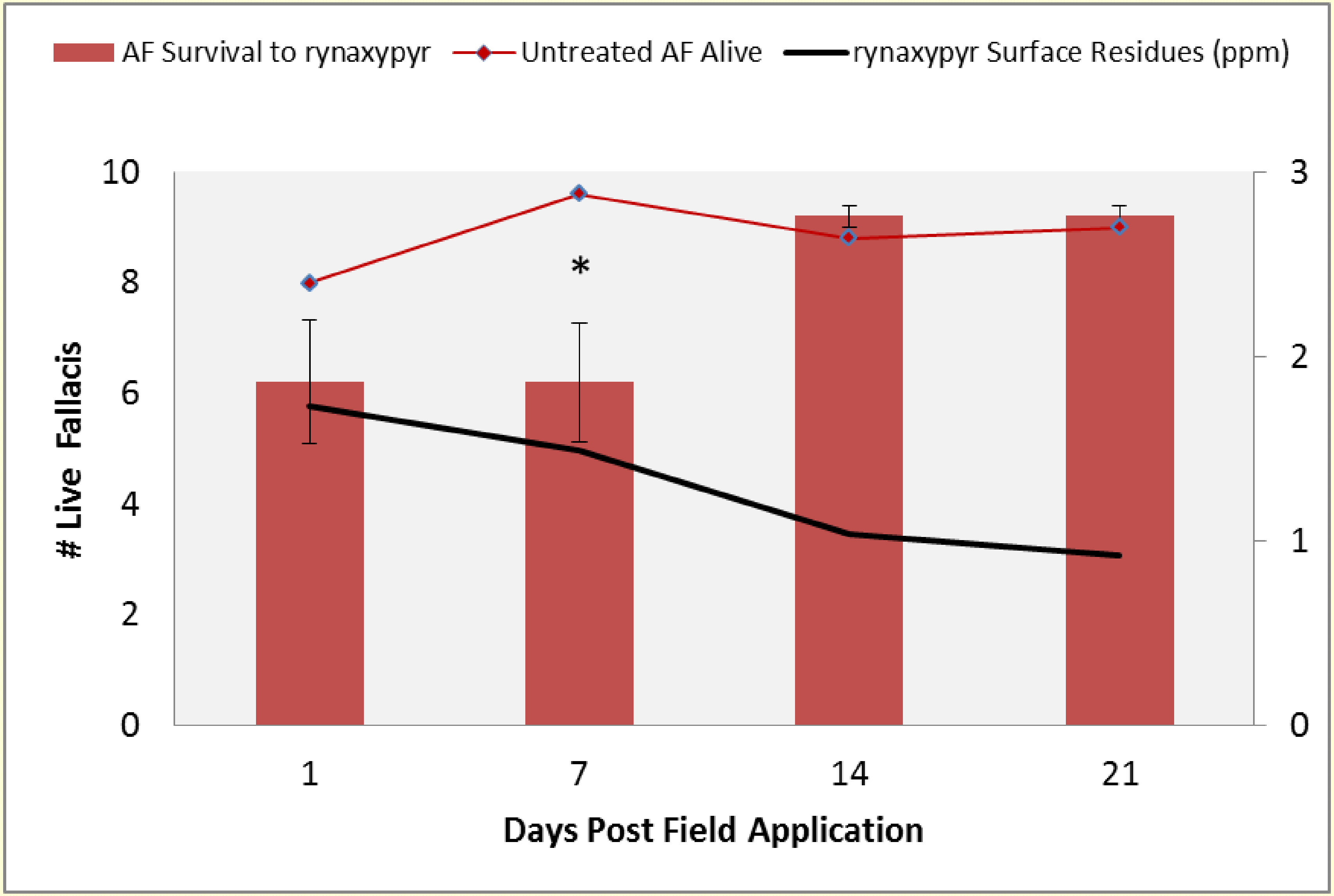
Residual Toxicity of Altacor to AF predator Mite



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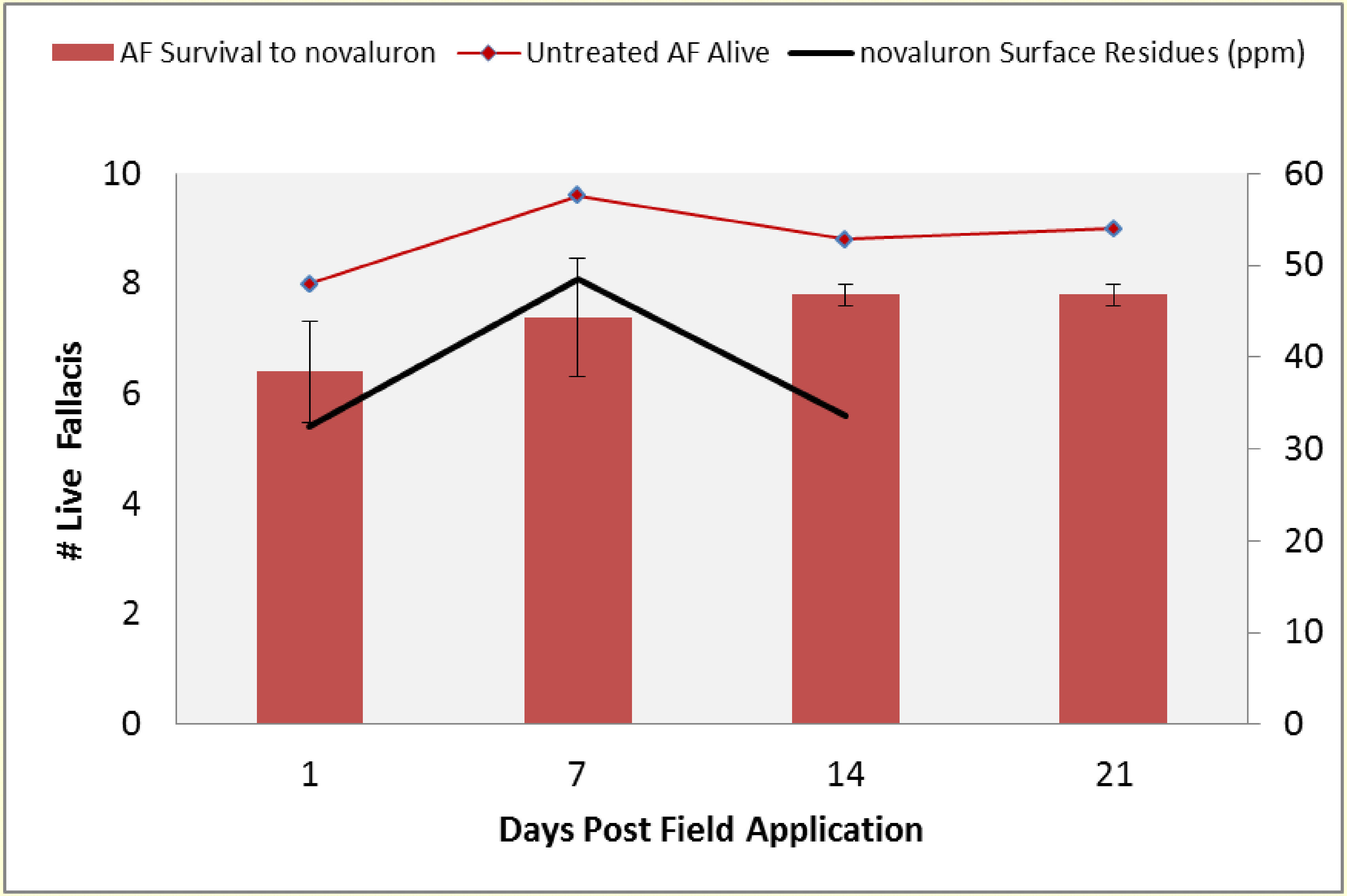
Residual Toxicity of Rimon to AF predator Mite



* designates significance difference from untreated control (α <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

Miticide Classes

Avermectins

Agri-Mek

Gladiator (*abamectin + zeta-cypermethrin*)

Agri-flex (*abamectin + thiamethoxam*)

Tetronic Acids

Envidor

Electron Transport Inhibitors

Nexter

Kanemite (METI III)

Portal

Magister

Nealta

Peptides

Spear T

Potasium Silicate

Sil-Matrix

Mite Growth Inhibitors

Apollo

Savey/Onegar

Zeal

Carbazates

Acramite/Banter

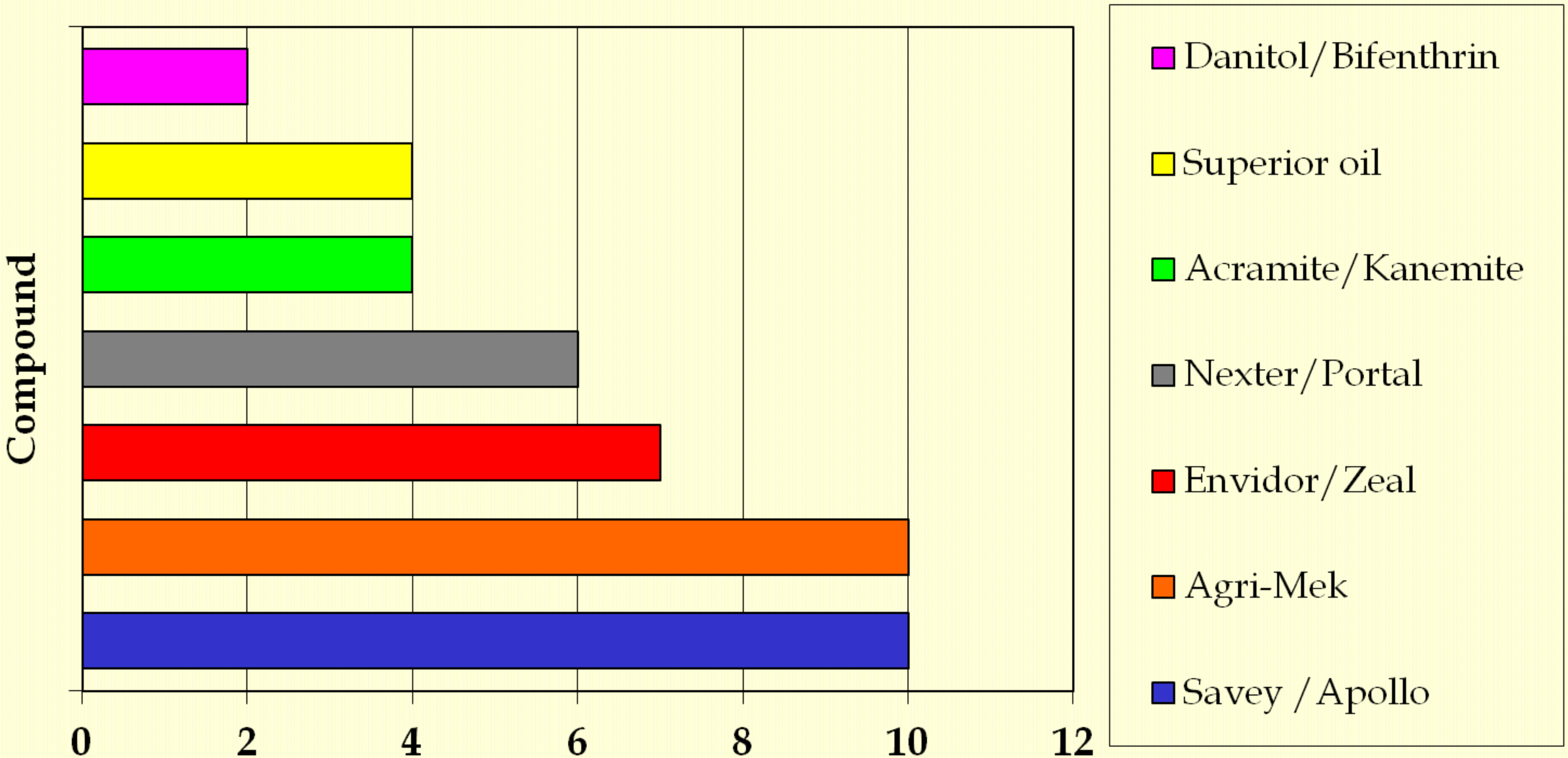
Pyrethroids

Danitol, Bifenthrin

Mite Management

- Timing decisions depend 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
Spear T	motiles	ingestion	fast
Sil-Matrix	motiles	contact	slow

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 – 2^{nd} Cover
Envidor	Petal fall, threshold
Nexter/Portal Nealta	Threshold
Acramite/Banter Kanemite	Threshold
Danitol/Bifenthrin	Threshold (late season)
Spear T	Threshold
Sil-Matrix	Threshold

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)
Spear T	Threshold
Sil-Matrix	Threshold

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