What We Have Accomplished in Twospotted Spider Mite Management & Where We Are Going

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Outline

- Background
  - Twospotted spider mite (TSSM)
  - injury/damage
  - Susceptibility of strawberry varieties to TSSM
  - Relationship between TSSM infestation and yield
  - Site specific management of TSSM
  - Monitoring for TSSM
    - conventional and modern techniques
  - Integration of biological control with chemical tactics

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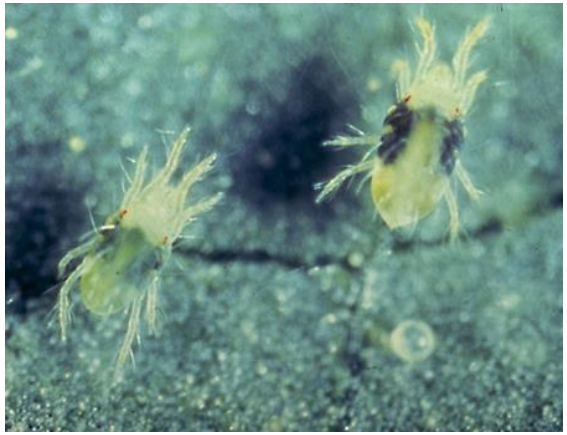
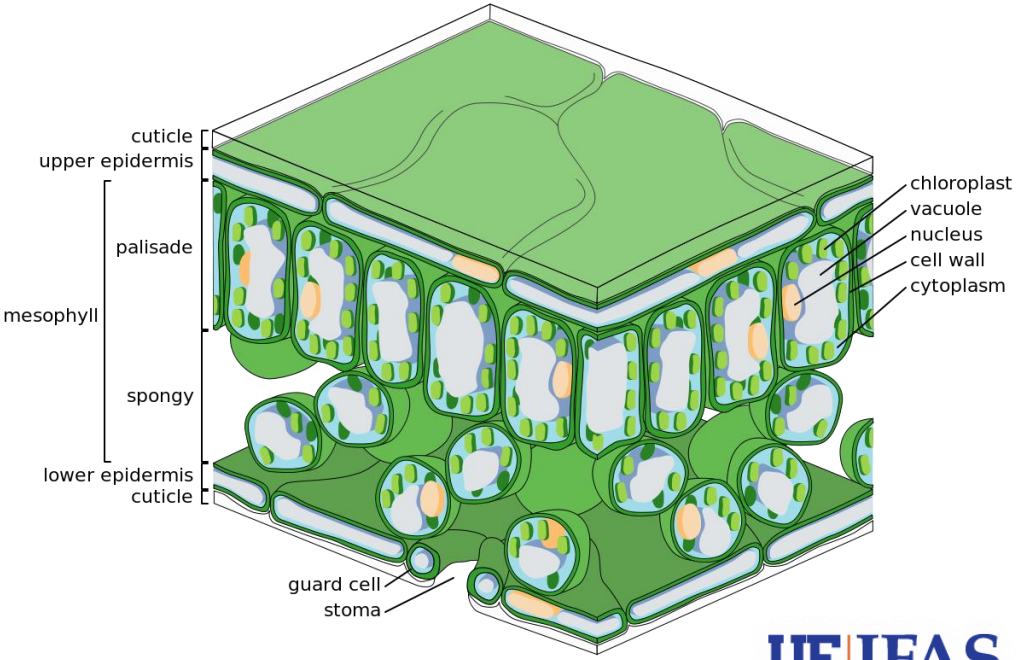
Twospotted spider mite (TSSM)injury on strawberry



uninfested field



Mite infested field

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Twospotted spider mite (TSSM), *Tetranychus urticae* Koch a key pest of strawberries in FL

Tiny arthropods ~ 0.25 to 1 mm long

Found on undersides of leaves

Two large spots on both sides of the body

Color is variable greenish, yellowish, shades of orange

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Research Questions

- How do TSSM infestation rates affect marketable yields of strawberries
- Can we use predatory mites to effectively control TSSM in strawberry fields?

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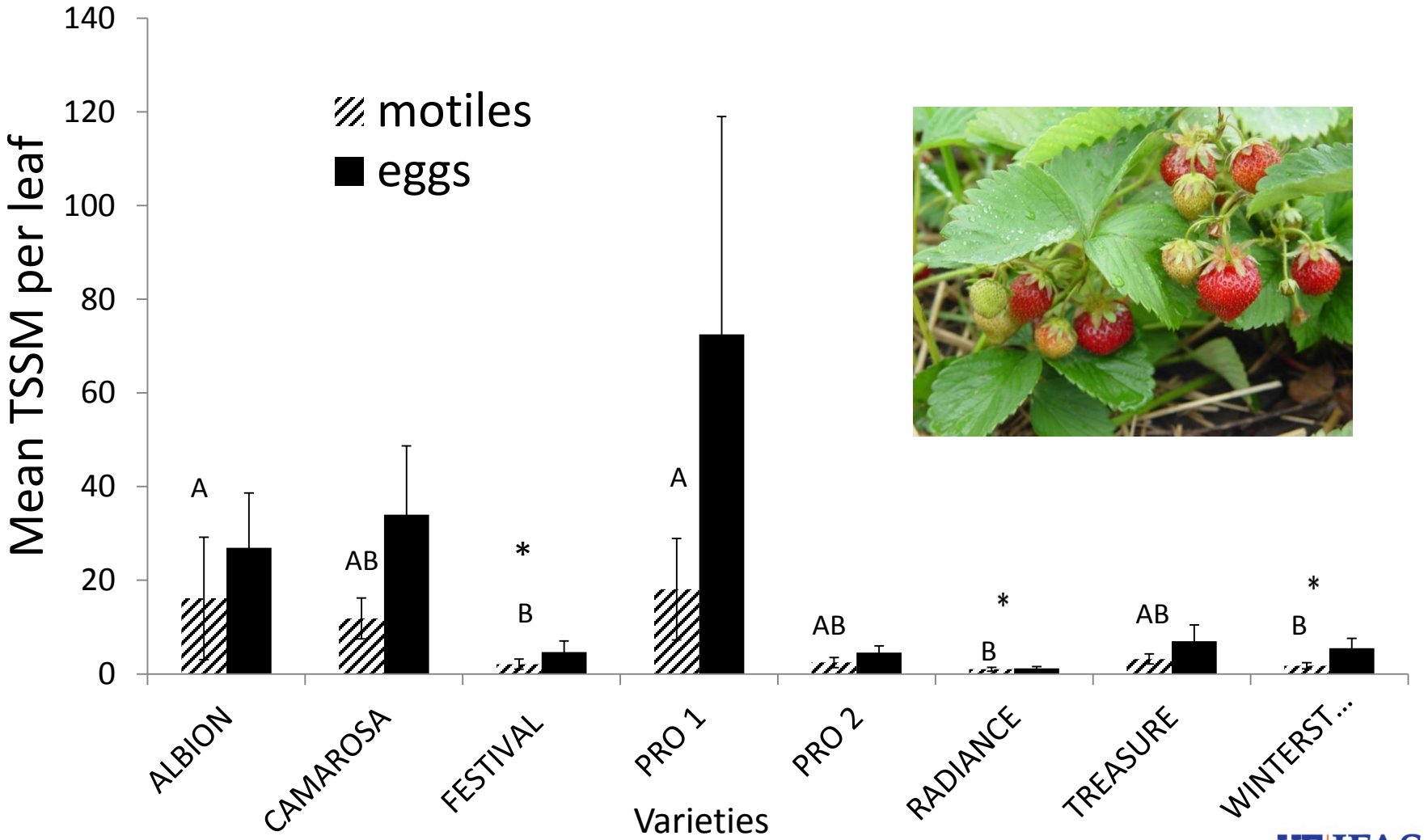
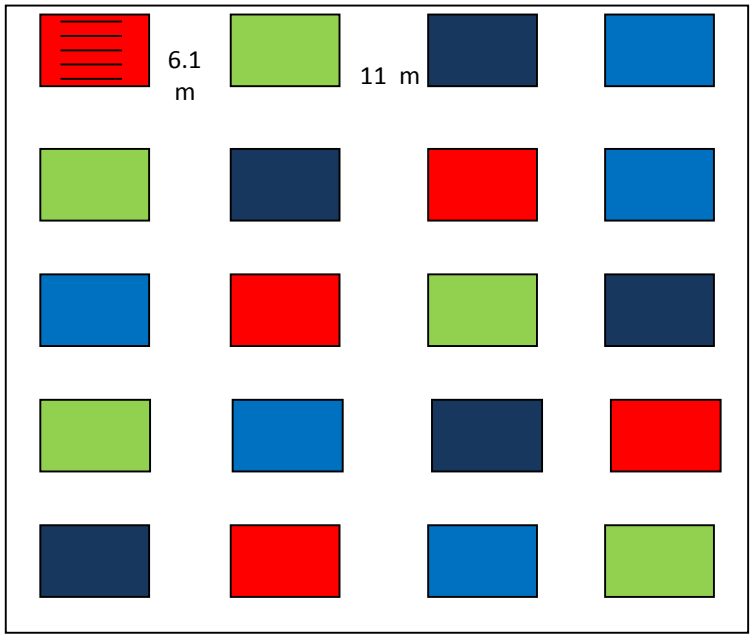
Population of TSSM in open field strawberry in Citra Florida (2013-2014)



QN.1

Methods: How do infestation rates affect marketable yields of strawberries?



- Treatments:
  - 5 mites per leaf
  - 10 mites per leaf
  - 20 mites per leaf
  - Control (bifenazate)
- 4 trts and 5 reps
- Strawberry variety – Florida Festival

- Field site: UF PSREU at Citra, Marion County
- Experimental Design: RCBD
- Each week, 10 mature trifoliate leaves from 10 randomly selected plants in each replicate

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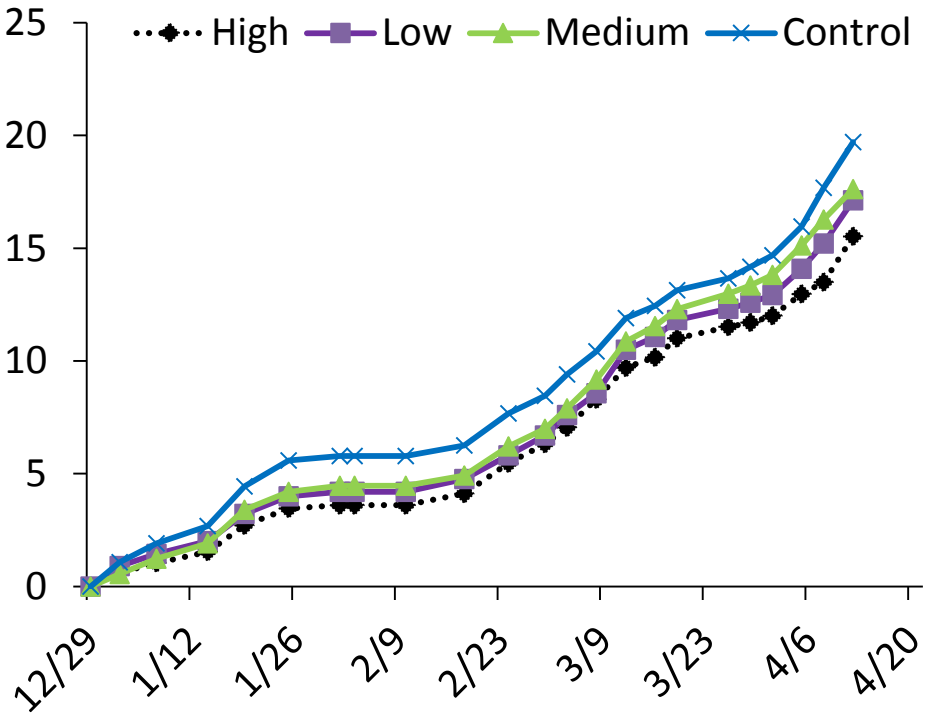
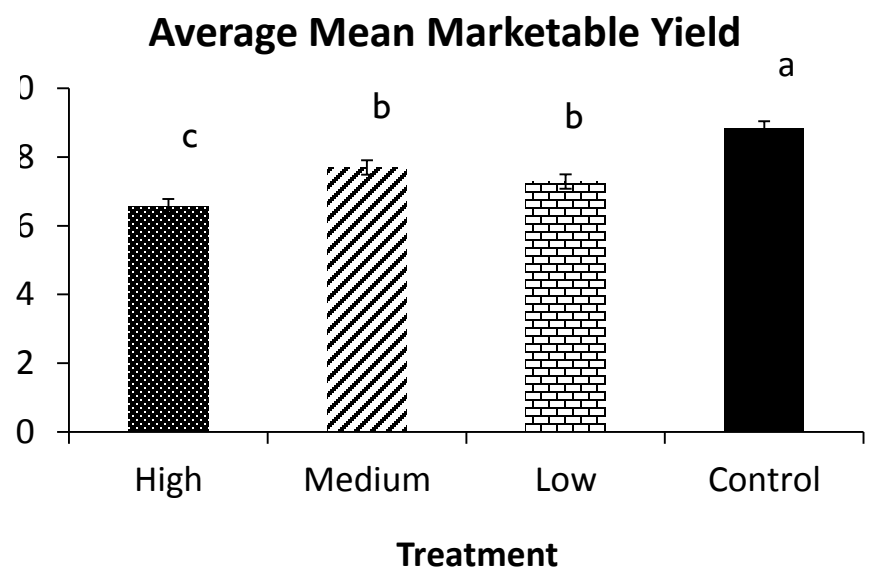
Strawberry marketable yields 2009/2010



Accumulated marketable yields (Kgs)



F = 20.12; df = 3, 192; P = <0.0001

Columns with same letters are not sig. diff. P = 0.05

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Evaluation of predatory mites & a reduced-risk miticide on TSSM population in strawberries

Plots were sampled weekly by collecting 6 trifoliate leaves per plot (36 trifoliate per trt)

applications of Acramite®

Releases of *N. californicus*
Phytoseiulus persimilis

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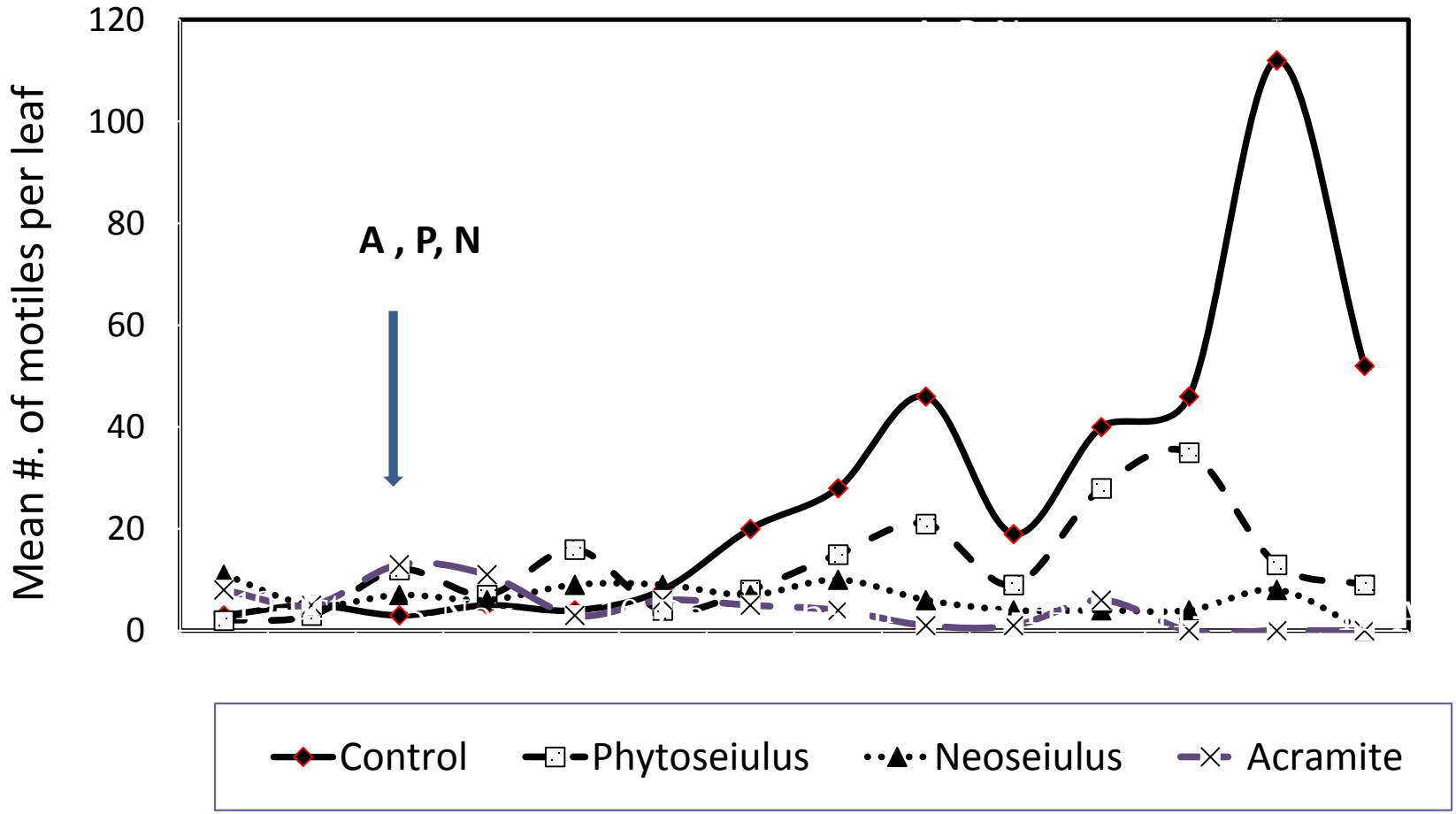
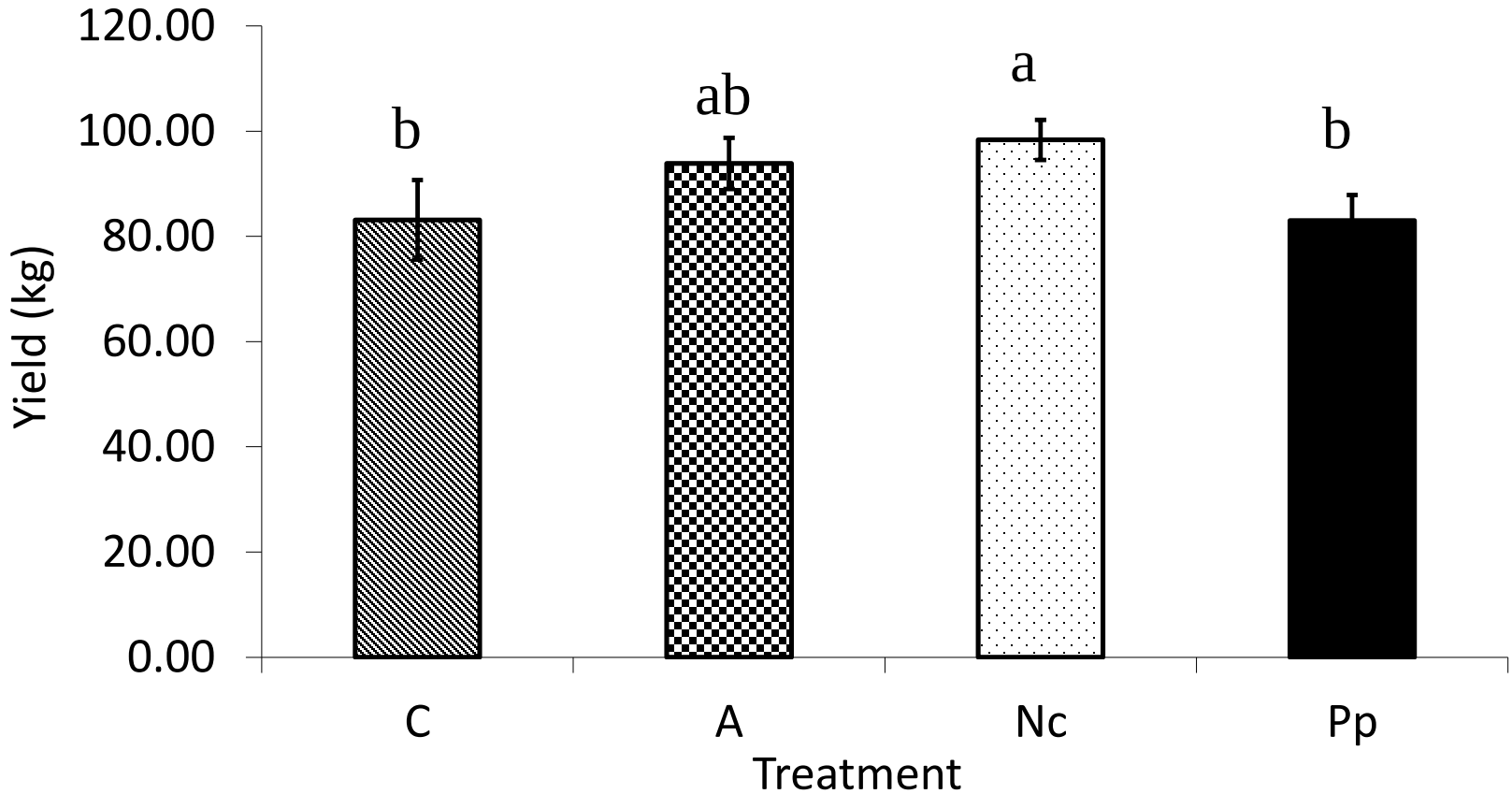
Evaluation of predatory mites & Acramite® on TSSM population in strawberries



What are the effects of releasing predatory mites on TSSM populations and marketable yields of strawberries?



C = Control A = Acramite N = *N. californicus* P = *P. persimilis*

Rhodes and Liburd (2007)
J. Econ. Entomol. 1291-1298.

QN-1

Findings: How do infestation rates affect marketable yields of strawberries

- High spider mite infestation rates of 20 or more mites per leaf can significantly reduced marketable yields of strawberries.
- Mite management decisions should be based on mite numbers, prevailing weather conditions, time of mite infestation and variety cultivated
- *N. californicus* can be used to used to regulate TSSM populations in strawberry fields

Nyoike & Liburd (2013) Effect of *T. urticae* on marketable yields of field-grown strawberries. J. Econ. Entomol. 106: 1757-1766.

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Site-specific management tactics versus whole plot treatment for TSSM

QN -2.

- Hypotheses
  - we can achieve comparable levels of control for TSSM in strawberry using site-specific management (SSM) tactics as oppose to whole-field application
  - there will be no reduction in marketable yield as a result of site-specific management (SSM) tactics

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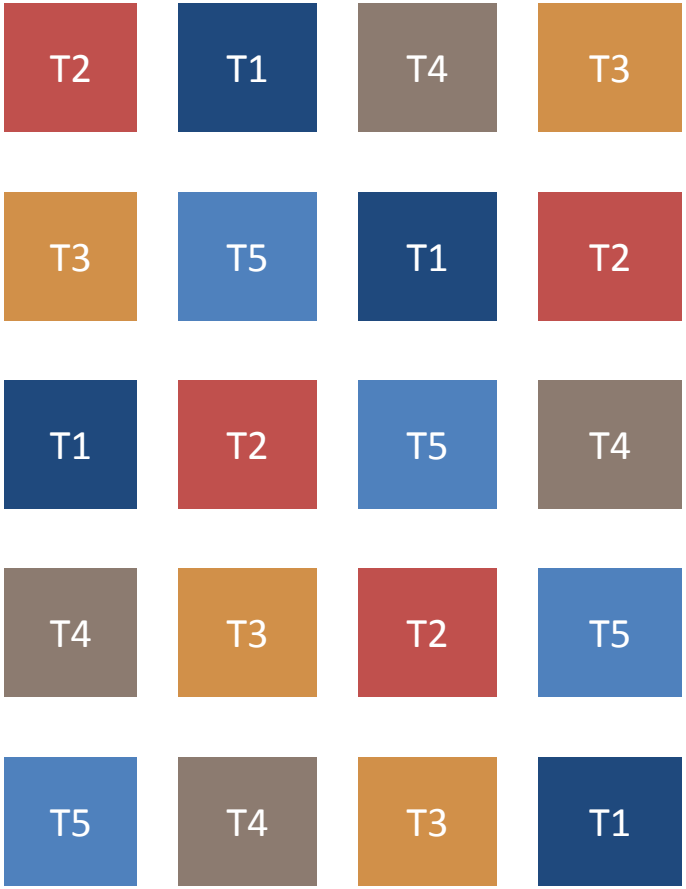
Methods: Field SSM Evaluation



- Treatments:
  - T1- *N. californicus*
  - T2- SSM-*N. californicus*
  - T3 - Acramite®
  - T4 – SSM- Acramite®
  - T5 - Untreated (control)
- Variety: Florida Festival
- Replicates: 4

SSM=Site-specific Management

- Field site: UF PSREU at Citra, Marion County
- Experimental Design: RCBD

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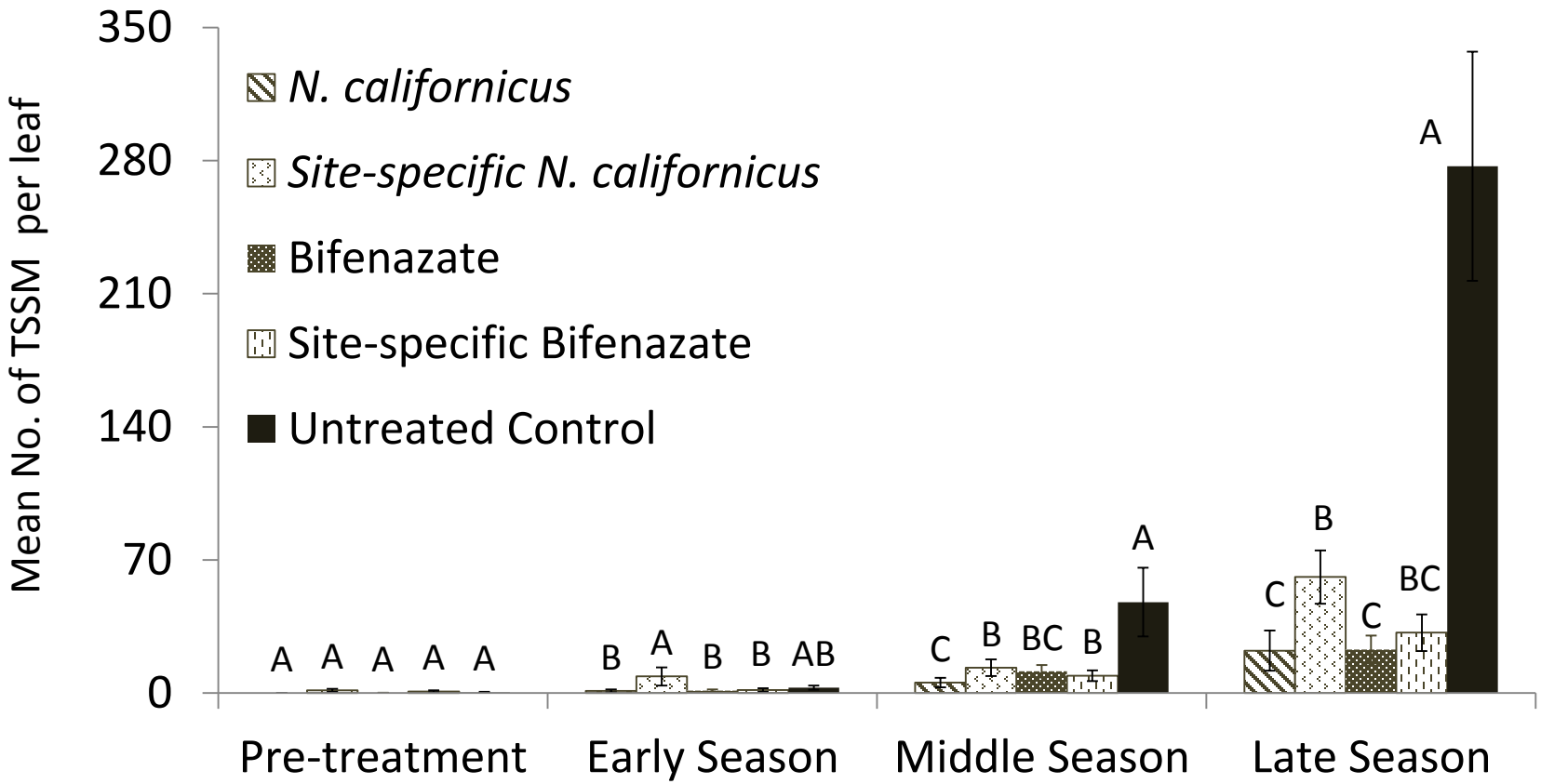
Site-specific management tactics versus whole plot treatment for TSSM



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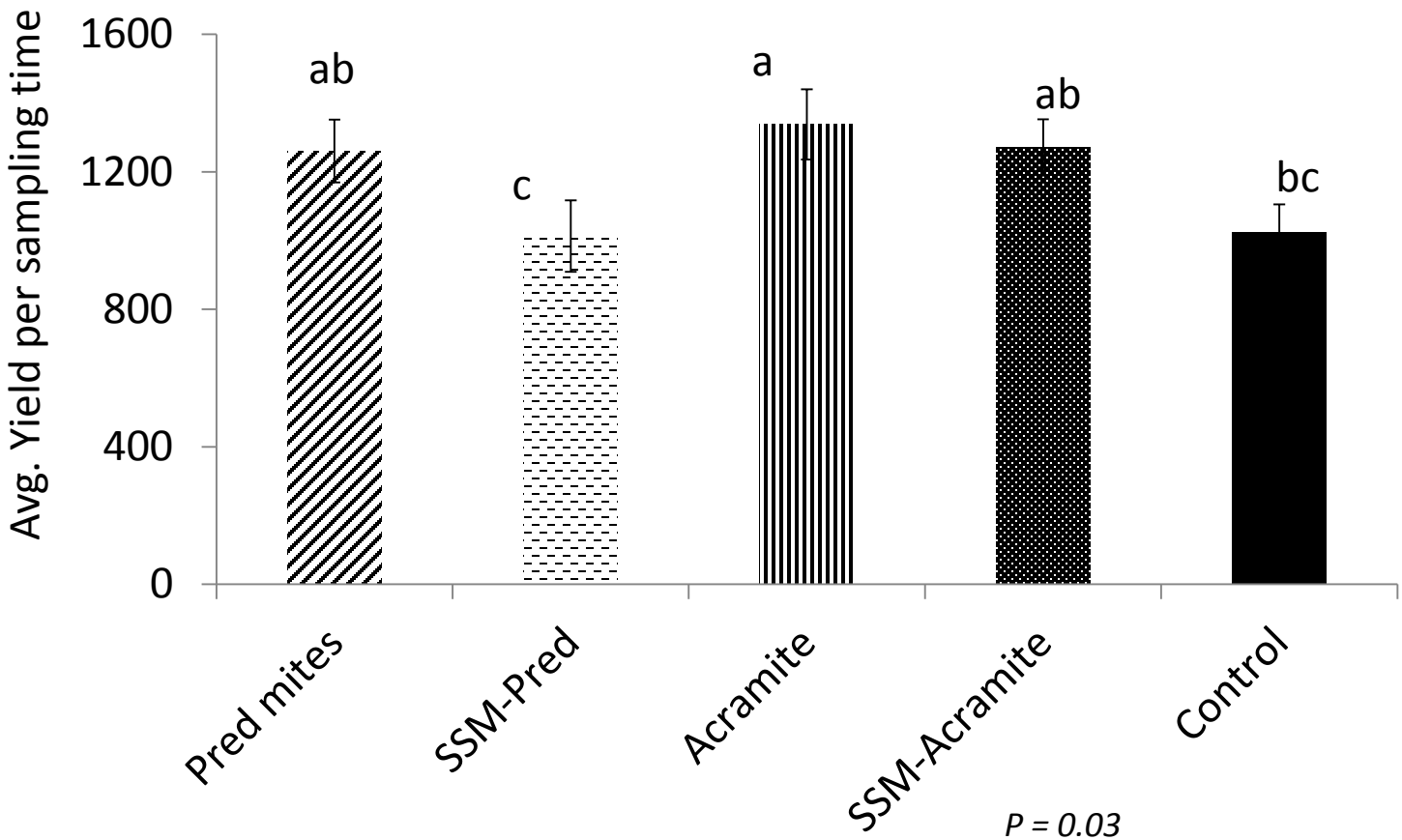
Strawberry yield comparisons



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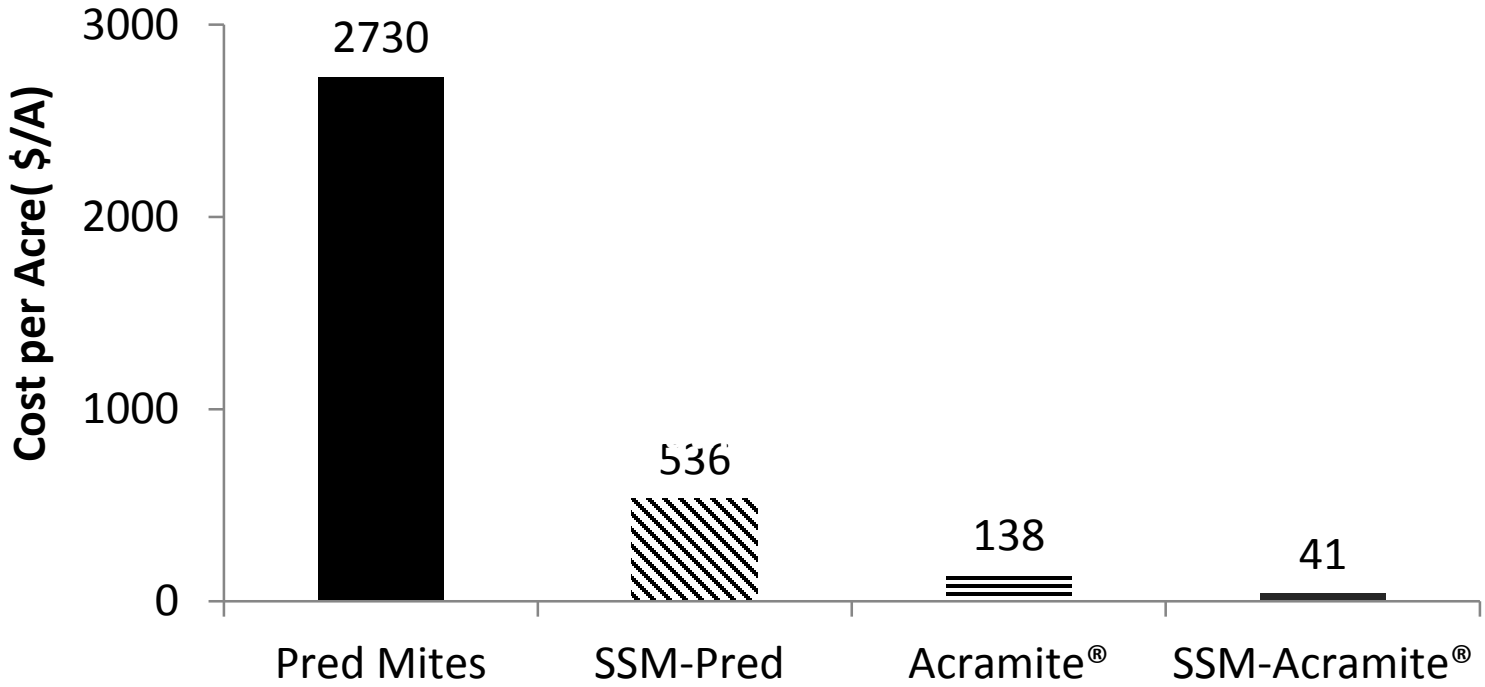
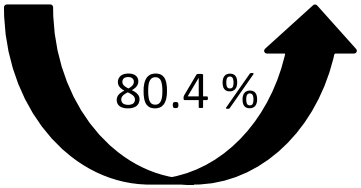
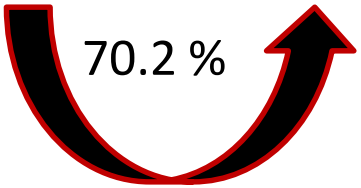
Economic Costs Comparison



Reduction in treatment costs





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QN- 2

Findings – Site-specific Mite Management

- Equal levels of control were achieved whether SSM tactics or whole plot treatments were used
- Site-specific application significantly reduced TSSM treatment costs without yield loss
- SSM leads to:
  - more efficient use of inputs
  - reduction in environmental contamination

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Remote Sensing/Imagery

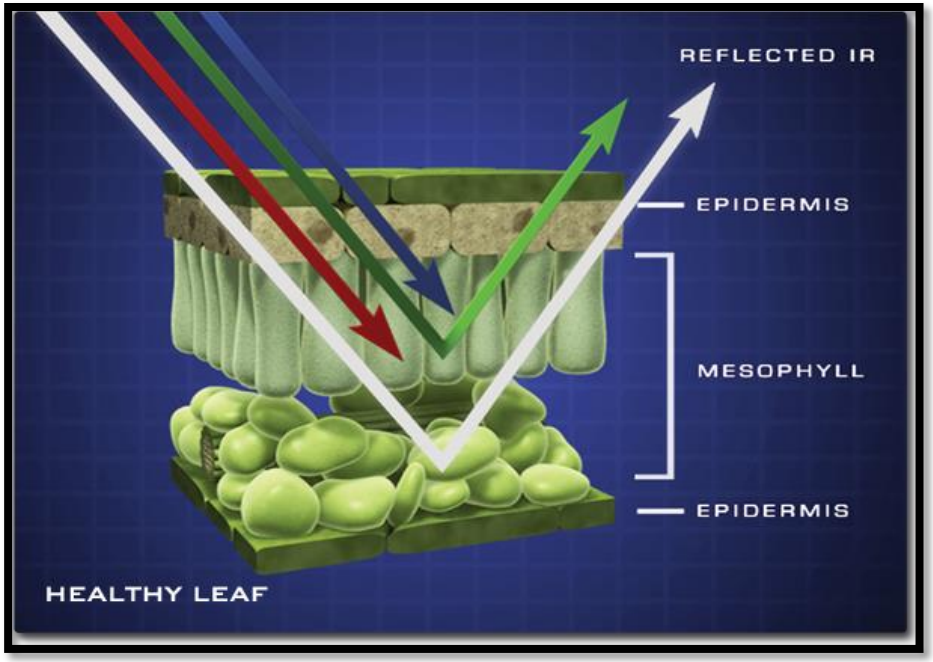
QN 3.

a) Can vegetation indices in strawberry be correlated with mite infestation

b) Are there differences in leaf reflectance among varieties in response to TSSM infestation

Remote Sensing for TSSM Monitoring

- As light strikes a plant leaf a portion of the light is reflected and some is absorbed
- Reflectance is controlled by plant structure and biochemical makeup
- In healthy plants red and blue light reflectance is lower
- more NIR light is reflected and less visual light (VIS)



Jeff Carns, NASA

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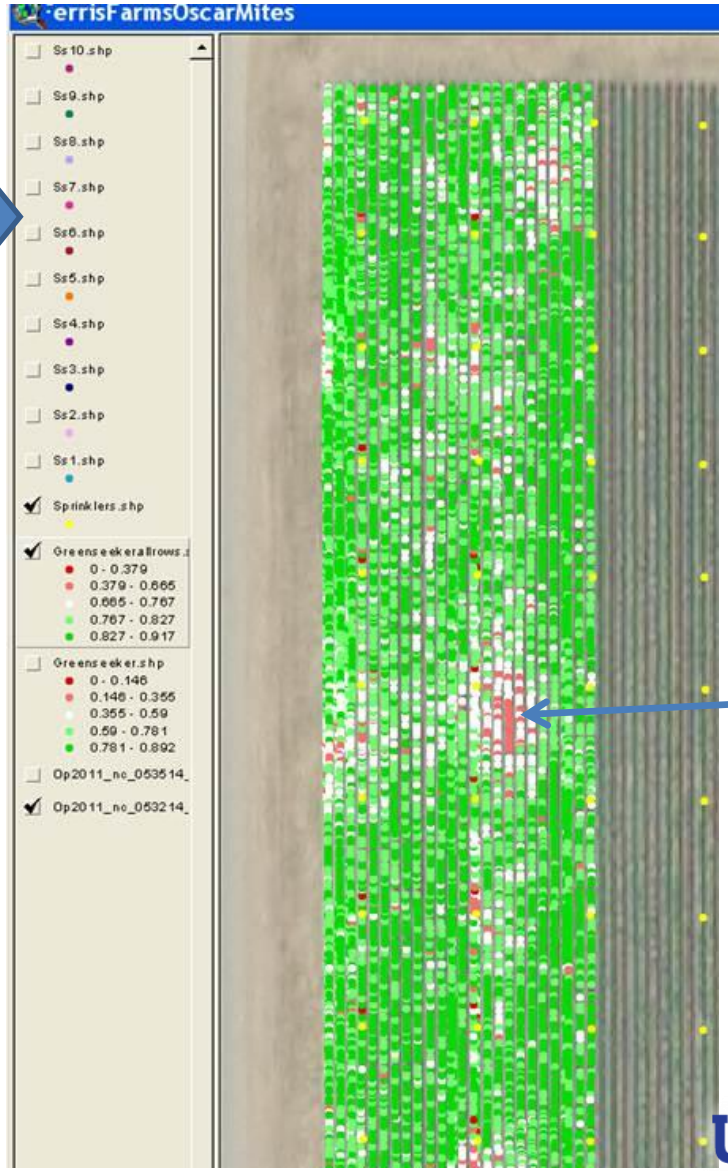
Remote Sensing for TSSM Monitoring



Severe
Mite infes

NDVI (Normalized Difference Vegetation Index) values using GreenSeeker®

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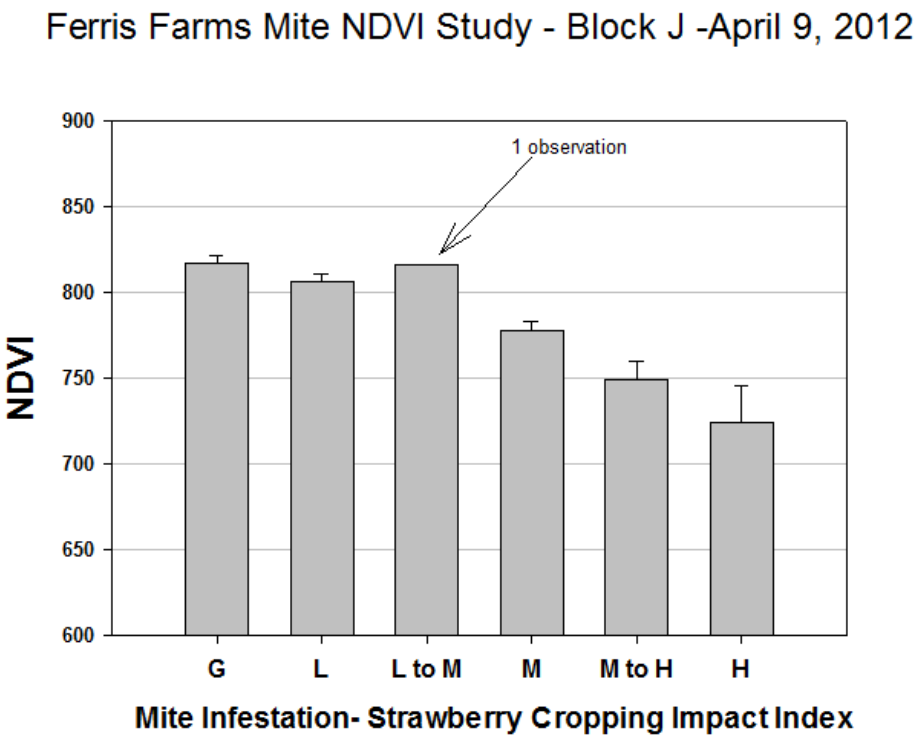
NDVI Threshold (2012-2013)



NDVI reflectance data for multiple TSSM infestation levels

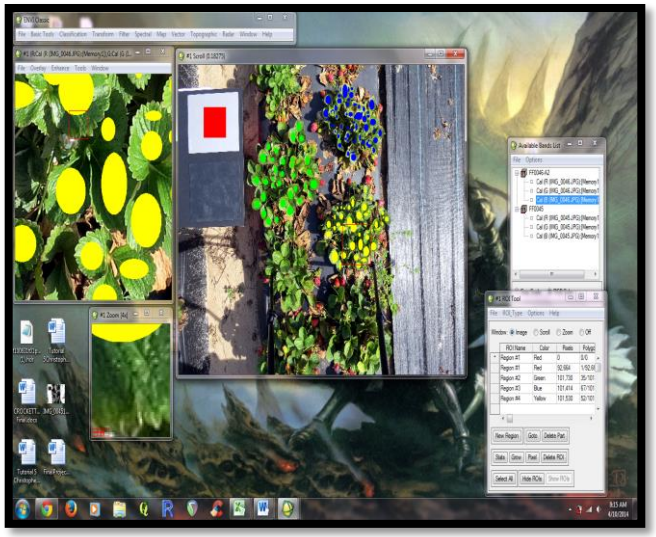
G=Green, L=Light infection, L to M=Light to Medium infestation, M=Medium infestation, M to H=Medium to High infestation, and H=High infestation

Methodology

Canon Powershot SX50 HS

$$GRVI = \frac{Green - Red}{Green + Red}$$

$$NDVI = \frac{NIR - Red}{NIR + Red}$$



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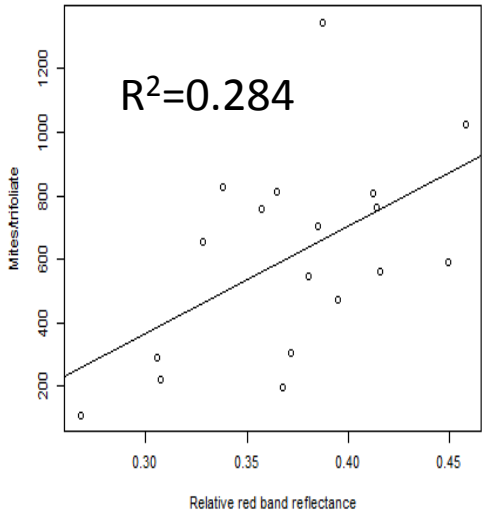
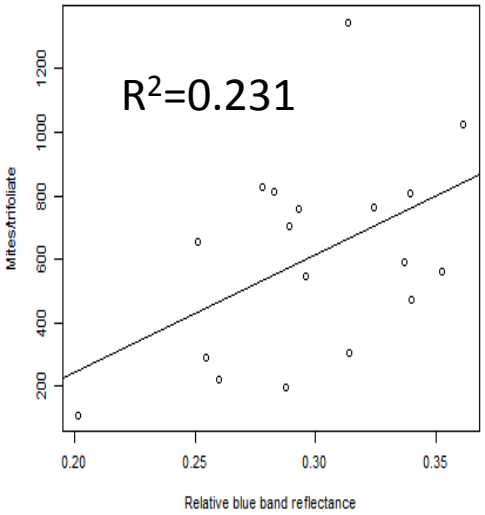
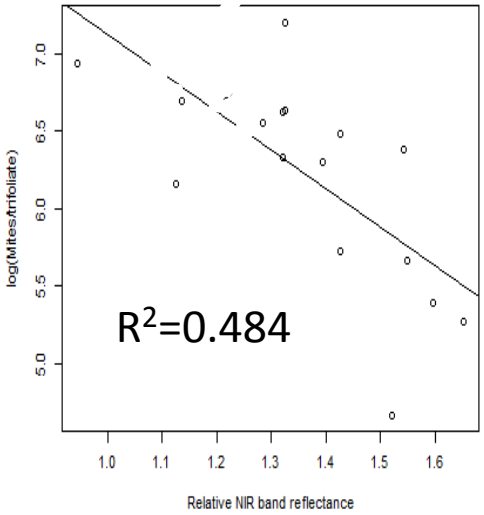
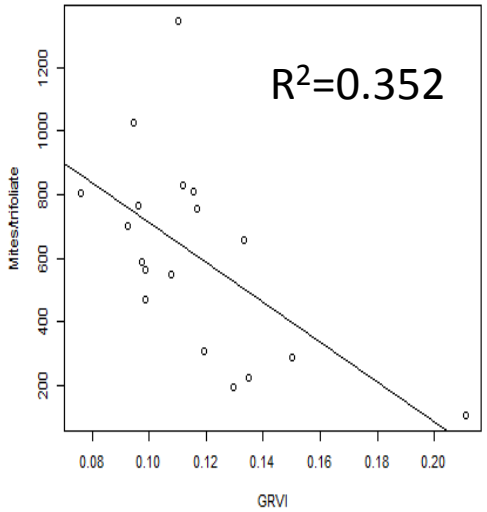
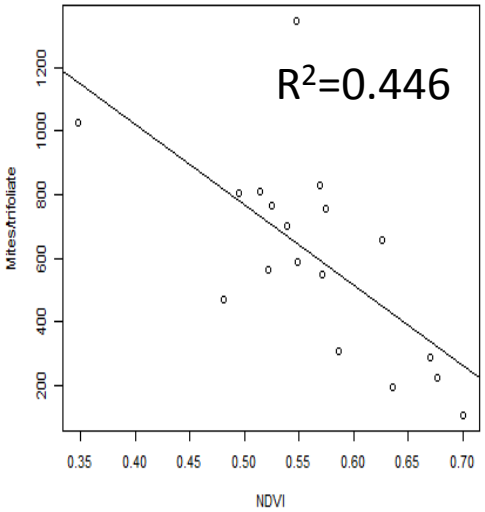
2015: Winterstar











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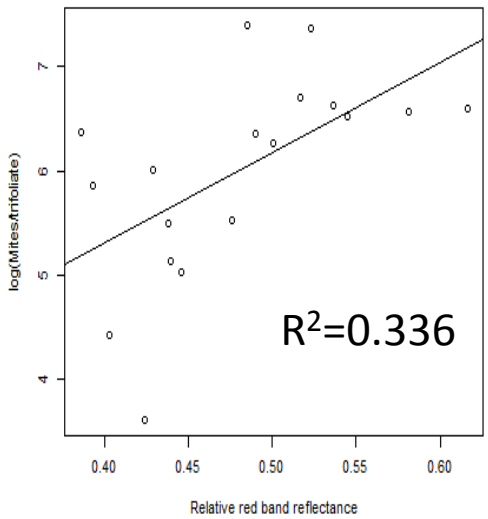
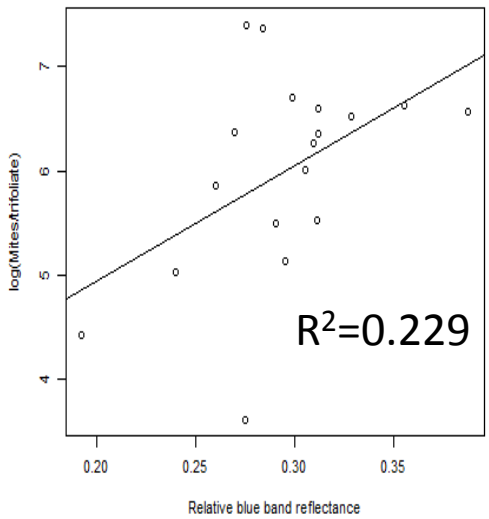
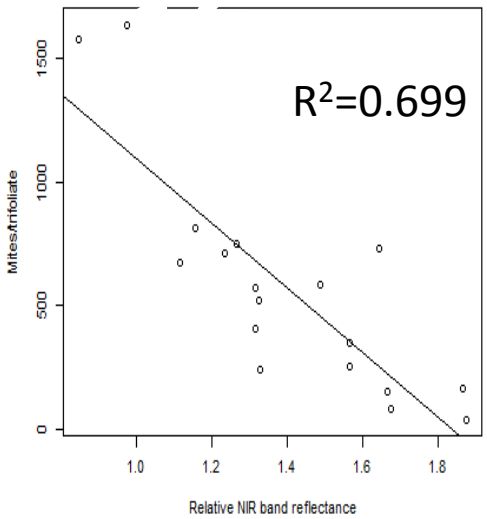
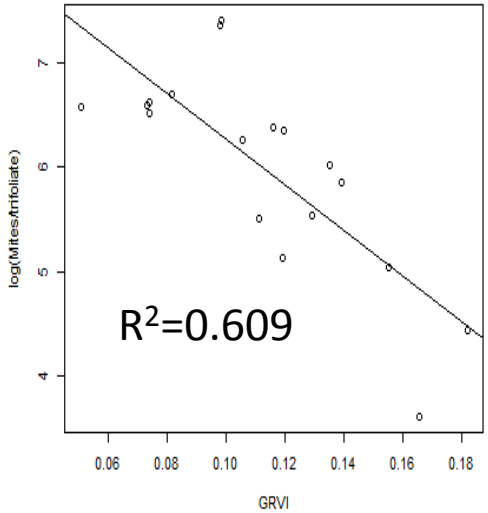
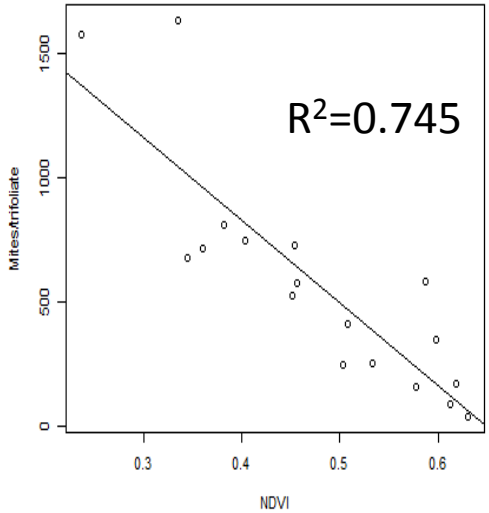
2015: Radiance











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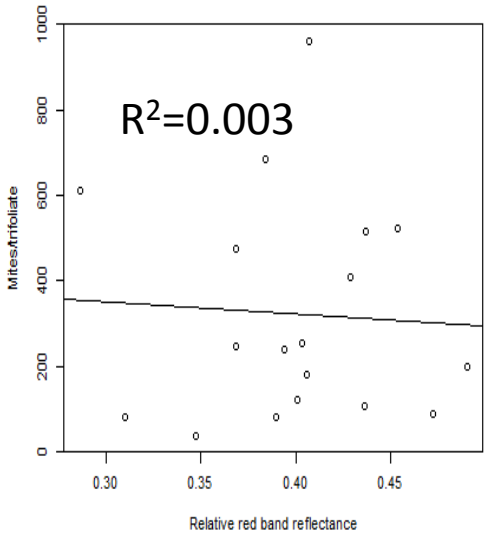
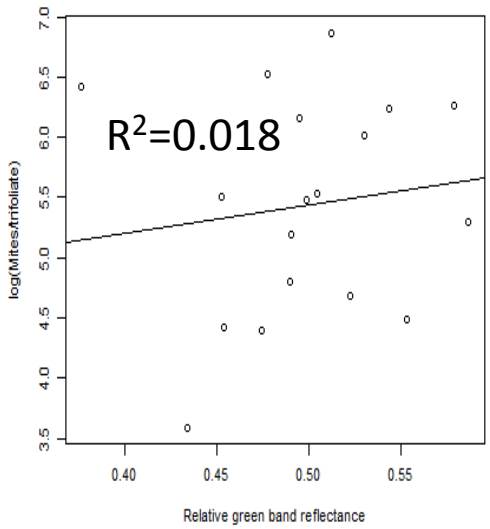
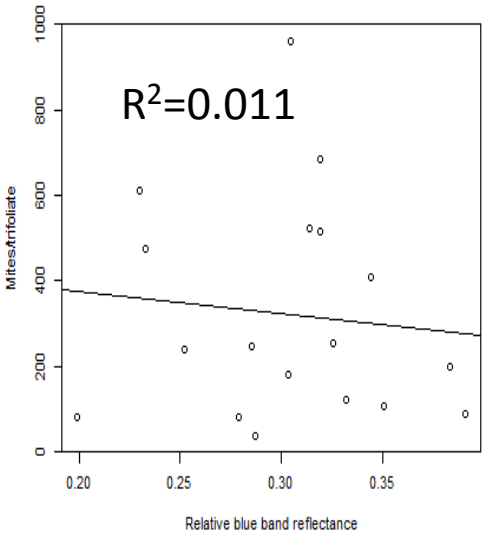
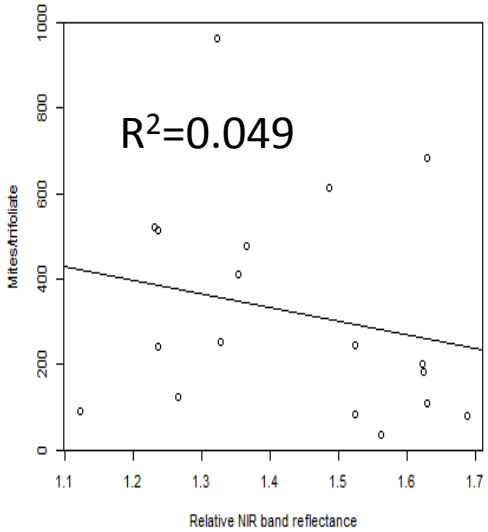
2015: Sensation









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Conclusions

- Various single reflectance bands and vegetation indices derived from strawberry plant images were correlated with TSSM infestation level, and may be useful in estimating the severity of TSSM infestations in the field.

- Varietal differences in leaf reflectance in response to TSSM damage exist, and necessitate further study.

QN- 4.

Can we integrate *N. californicus* into a strawberry production System where conventional miticides are a common practice

Acaricides

Acramite® (Bifenazate)
Agri-mek® (Abamectin)
Savey® (Hexythiazox)

Nealta® (Cyflumetofen)

Neoseiulus californicus
(McGregor)

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A) Compare the efficacy of three miticides on TSSM pop.

B) Assess the effect of these miticides on *N. californicus*

- Randomized complete block design with four replicates
- Released *Neoseiulus californicus* in all plots
- 4 Acaracide Treatments:
  - Acramite® (Bifenazate)
  - Agri-mek® (Abamectin)
  - Nealta® (Cyflumetofen)
  - Untreated Control

- Recorded the number of TSSM motiles and eggs, *N. californicus*, and other beneficials
  - 2, 7, and 14 days post-application of acaricide

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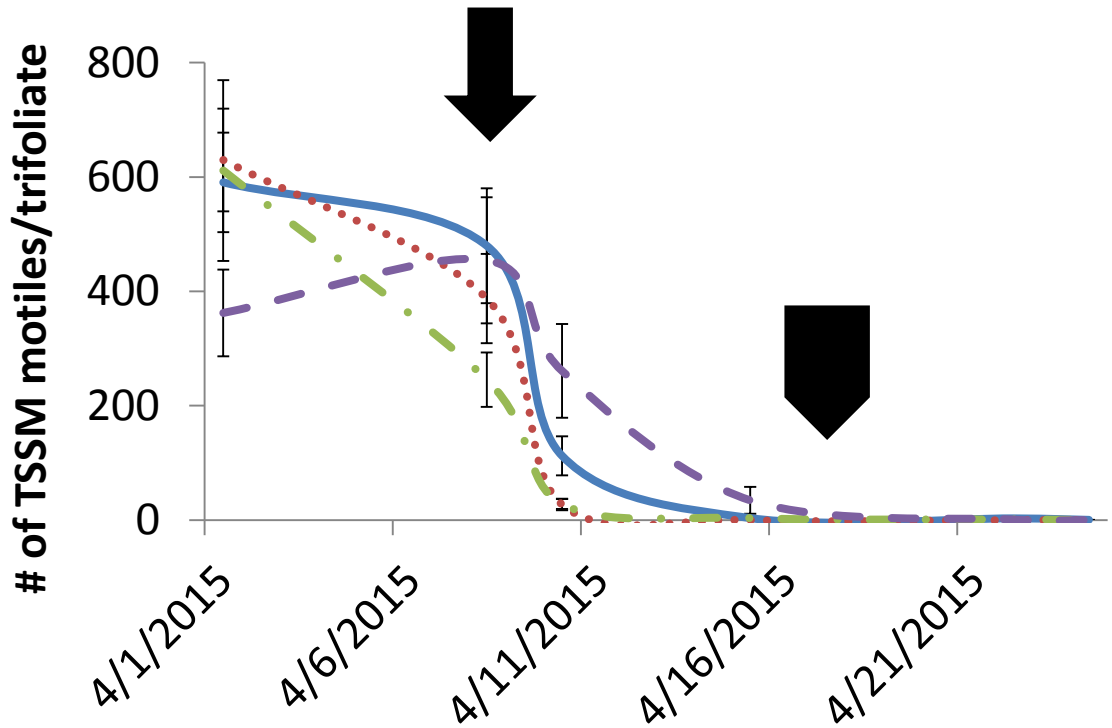
Abundance of TSSM motiles in acaricidal treated plots



Abamectin
Acramite
Nealta
Control

# of TSSM motiles reduced in Acramite and Nealta trts compared with Abamectin trt and untreated control (F = 7.43; df = 3, 300; $P \leq 0.0001$).

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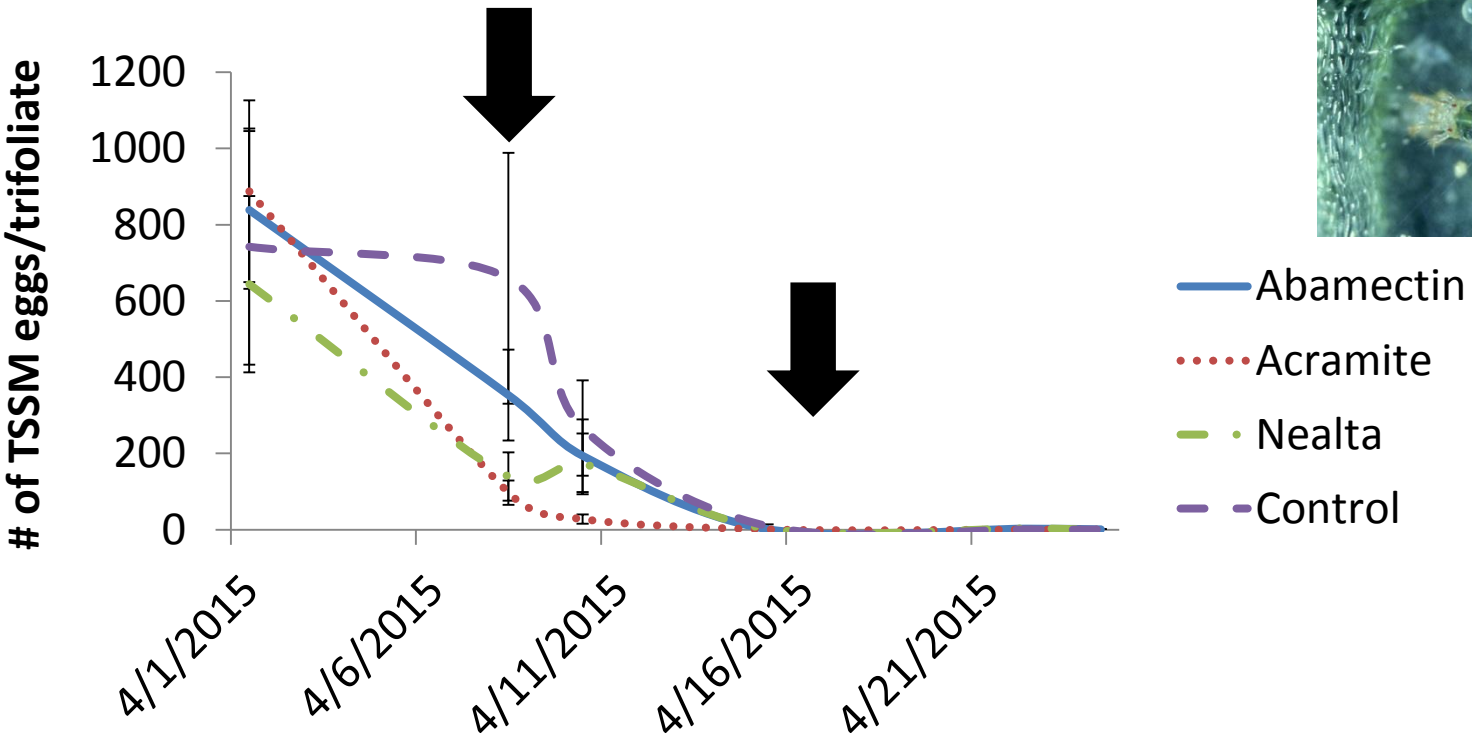
Abundance of TSSM eggs in acaricidal treated plots



# of TSSM eggs higher in untreated control compared with Acramite and Nealta; higher in Abamectin compared with Acramite (F = 4.24; df = 3, 300; P = 0.0059).

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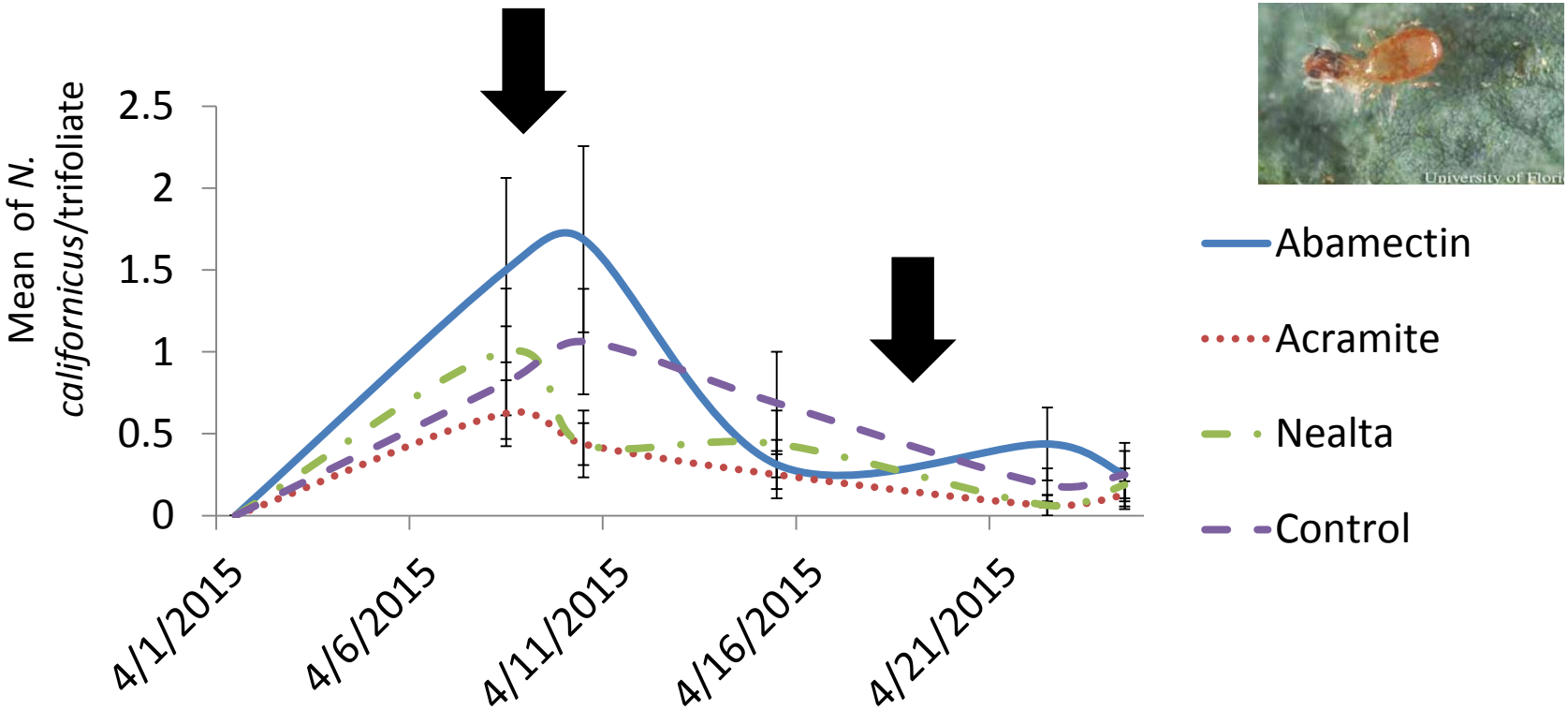
Number of *N. californicus* recorded in the various treatments



of *N. californicus* higher in Abamectin trt compared with Acramite and Nealta (F = 2.99; df = 3, 300; P = 0.0315).

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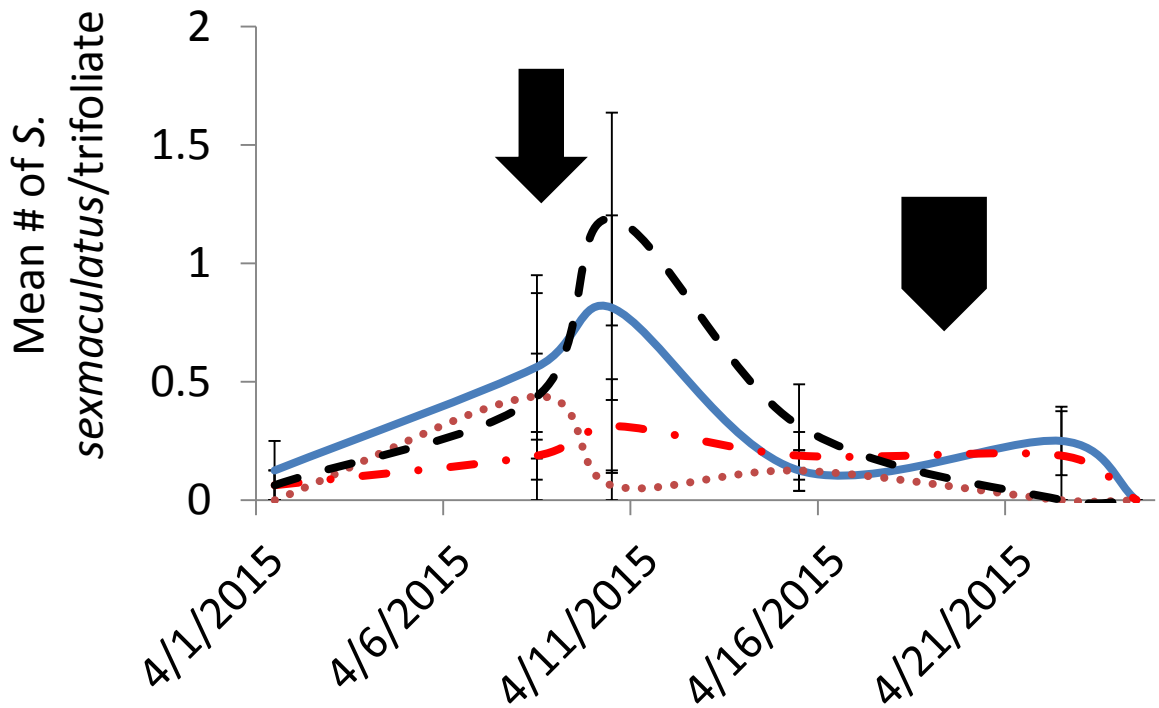
Number of *Scolothrips sexmaculatus* recorded in the various treatments



Abamectin
Acramite
Nealta
Control

of *S. sexmaculatus* higher in untreated control and Abamectin trt compared with Acramite (F = 2.51; df = 3, 300; P = 0.0591).

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Findings

- Nealta® and Acramite® applications resulted in lower TSSM populations.
- *N. californicus* densities were reduced with applications of Nealta® and Acramite®.
- *S. sexmaculatus* densities were not significantly reduced with applications of Nealta®, unlike Acramite®.

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Summary

- High populations of mites significantly reduced marketable yields
- SSM tactics effectively manage TSSM populations in strawberries due to the formation of hot spots
- *N. californicus* can be integrated into mite management programs where conventional pesticides are used
- Nealta® is an additional tool for managing TSSM populations in strawberry

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Acknowledgements

- The Plant Science Research and Education Unit at Citra

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  - Florida Strawberry Growers Association
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  - Lindsy Iglesias
  - Chris Crockett
  - Lorena Lopez
  - Michael Gonzalez
  - Mary Diaz

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