2018 | THE ALMOND CONFERENCE

IPM DEMONSTRATION PROJECT

ROOM 312-313 | DECEMBER 6, 2018

california almonds
Almond Board of California

growing ADVANTAGE
The Almond Conference

Demonstration and Implementation of IPM in Almonds 2016-2019

David Haviland, Jhalendra Rijal, and Emily Symmes

UCCE and UC IPM

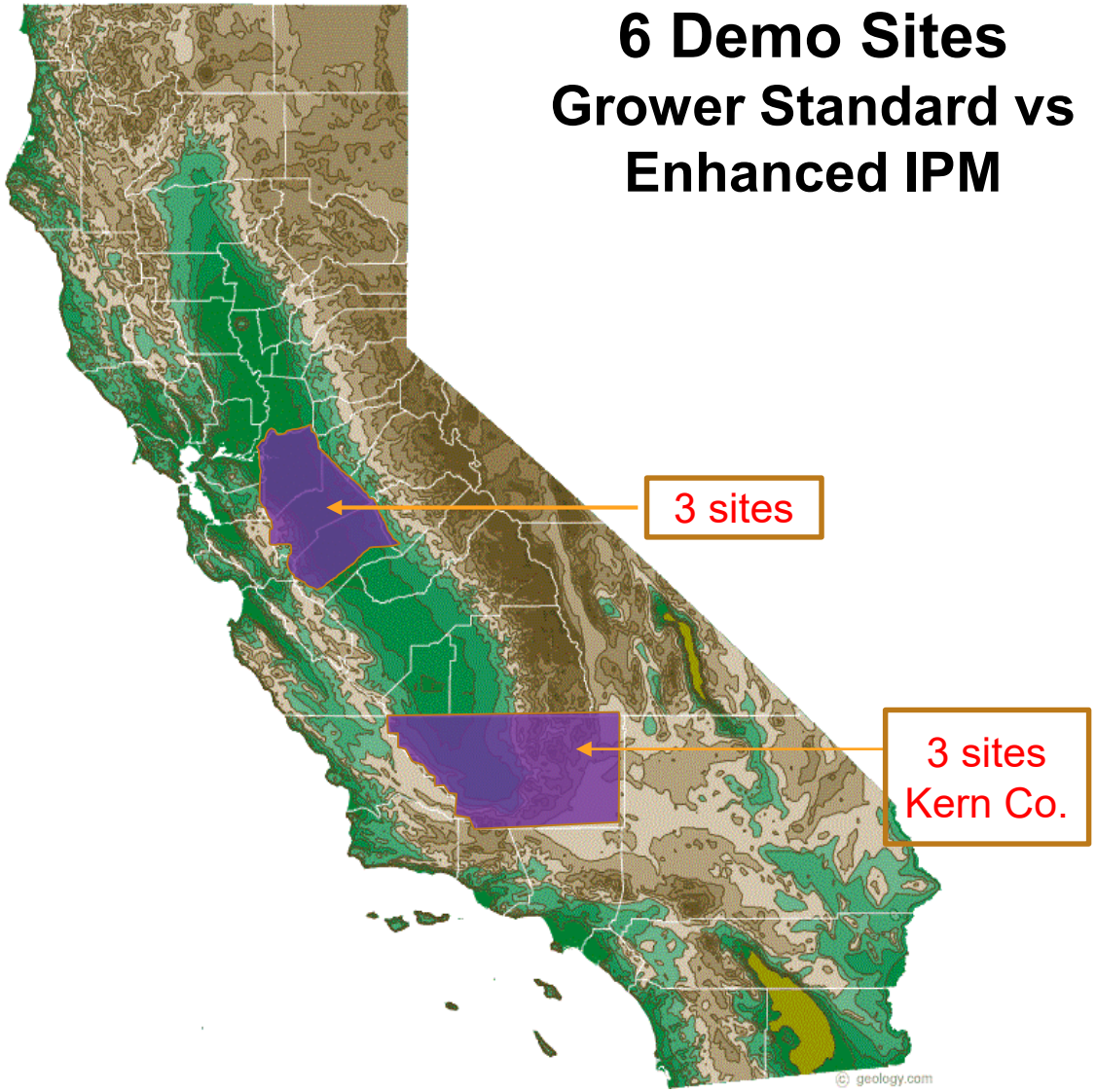
Why IPM Demonstrations in Almonds?

- California's #1 and fastest growing commodity
- Many new almond growers and PCAs
- Rich history of IPM research funded by the almond industry
- Underutilization of some IPM tools
- Opportunities for synergism with the California Almond Sustainability Program
- Collateral benefits to IPM programs in pistachios and walnuts

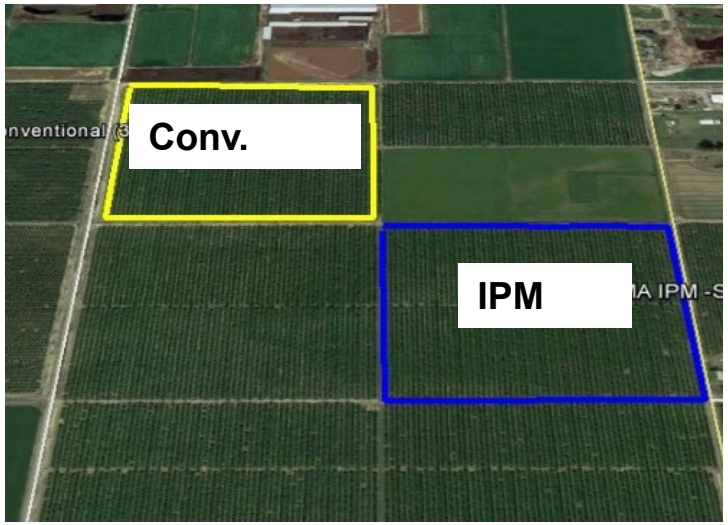
The Team

- UC Statewide IPM Program (4)
  - Statewide representation
- DPR
  - Funding, general assistance
- UCCE Farm Advisors (4)
  - Consultations, extension, guidance
- Almond Board of California
  - Funds for complimentary research
- Almond Growers and PCAs
  - Host research, guidance
- Mating Disruption Manufacturers
  - In-kind donations, guidance

PMA project sites



6 Demo Sites
Grower Standard vs Enhanced IPM



Southern San Joaquin Valley
Wasco
Maricopa
Lost Hills
Northern San Joaquin Valley
Escalon
Turlock
Ballico

ABC 2025 Vision- Areas of Opportunity for increased integration

Navel orangeworm

- Winter sanitation
- Monitoring
- Mating disruption
- Early harvest
- Pesticide choice (avoid pyrethroids)
- Resistance management

Spider mites

- Monitoring
- Increased reliance on biocontrol
- Avoid prophylactic treatments
- Resistance management

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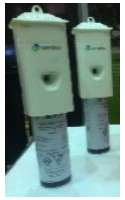
Mating Disruption Products



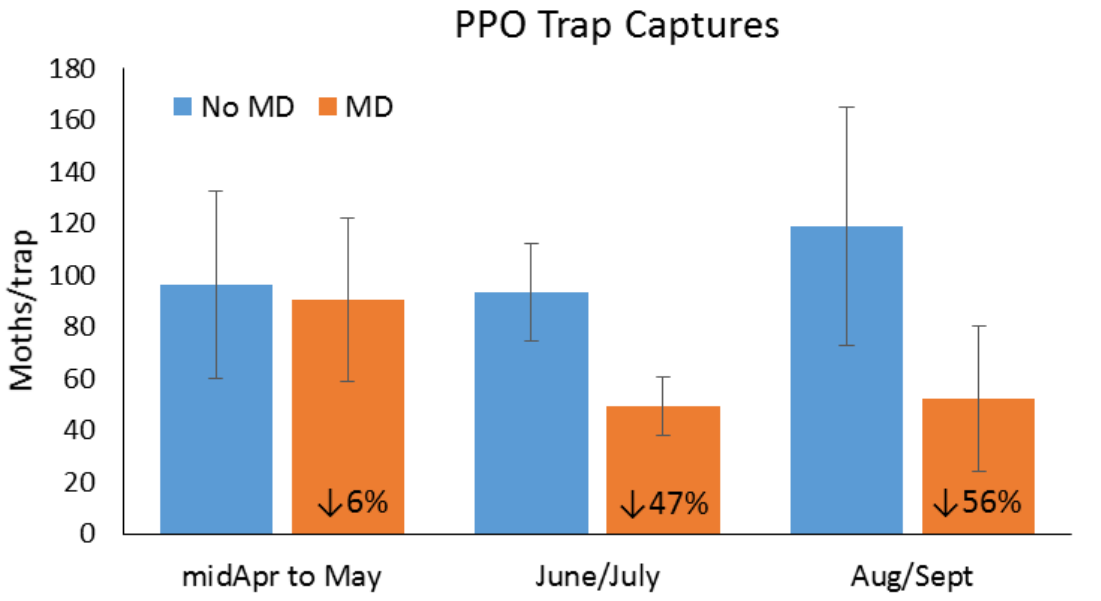
Trade Name	Manu-facturer	Dispen-sers per acre	Type	Release rate	Other perks/ costs	Organic
Puffer NOW	Suterra Wonderful	2	Aerosol	Static Nightly	No	No
Semios NOW	semios	1	Aerosol	Variable	Yes	No
Isomate NOW	Pacific Biocontrol	1	Aerosol	Static nightly	No	No
Cidetrak NOW Meso	TRÉCÉ INCORPORATED	20 (15-28)	Passive	Static 24/7	No	Yes

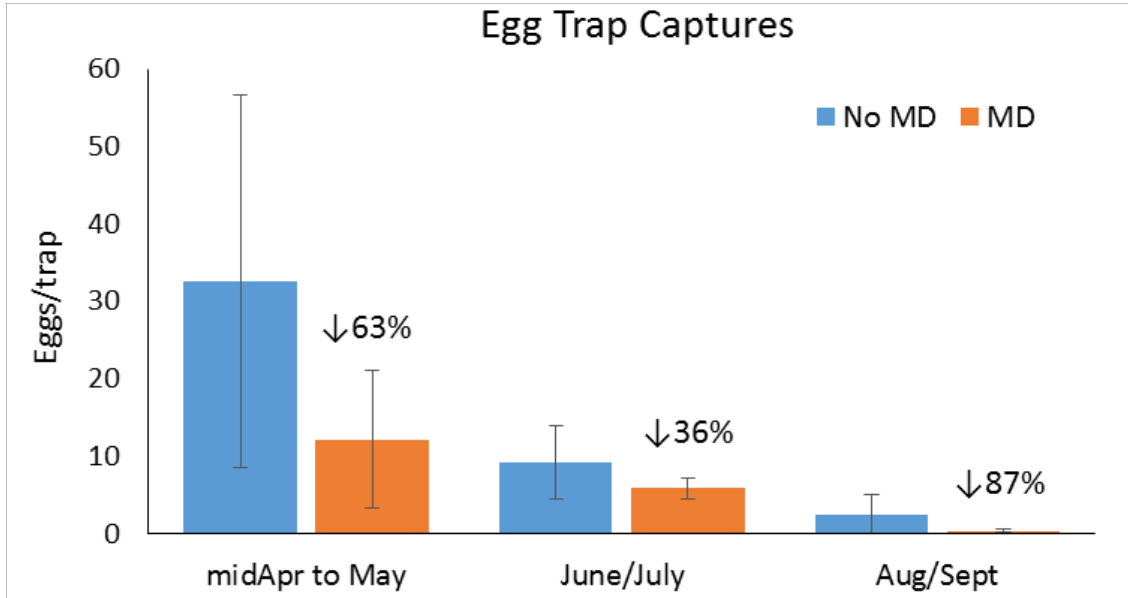
How Mating Disruption Works

Data from 2018 Kern Co. PMA sites

Male/female lure and Egg traps

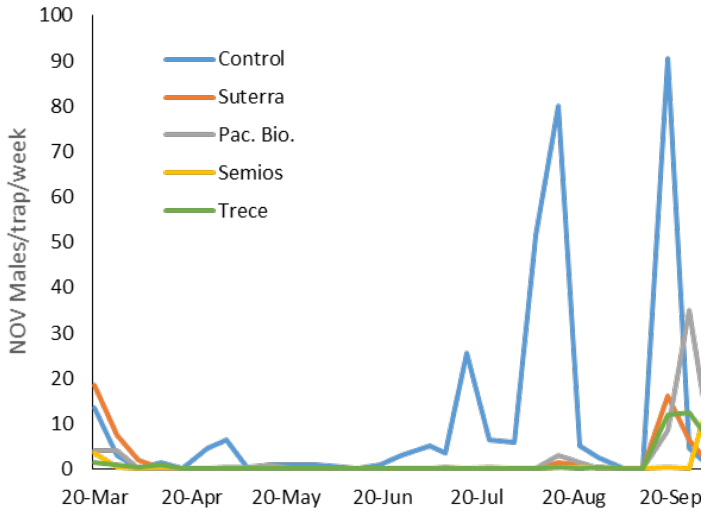
- 1st flight- same number of moths
  - 1st generation- 63% less eggs in MD
- 2nd flight- 47% less moths
  - 2nd generation- 35% less eggs
- 3rd flight- 56% less moths
  - 3rd generation- 87% less eggs

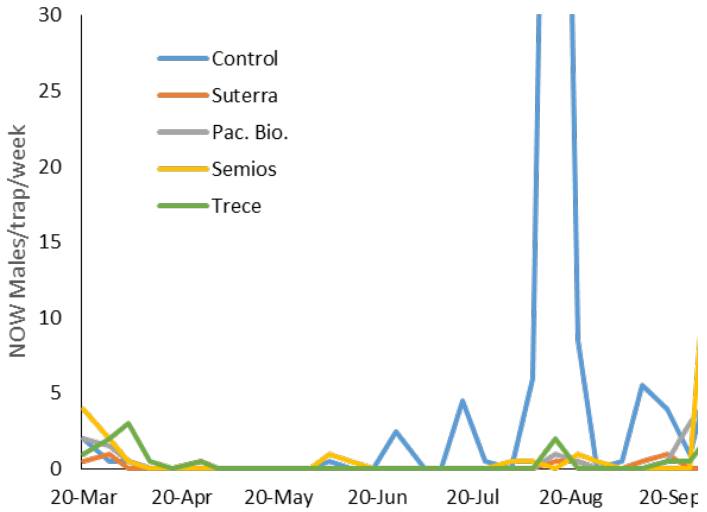


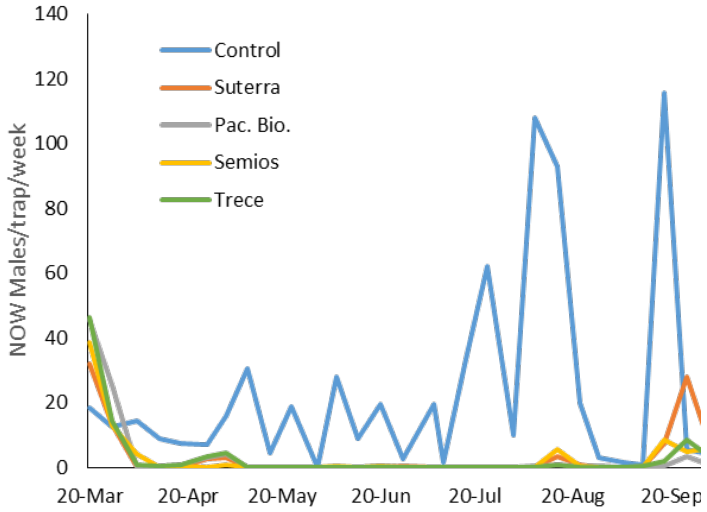


Pheromone trap captures- Southern SJV

Haviland Almond Board Project, 2017







Reductions in trap captures

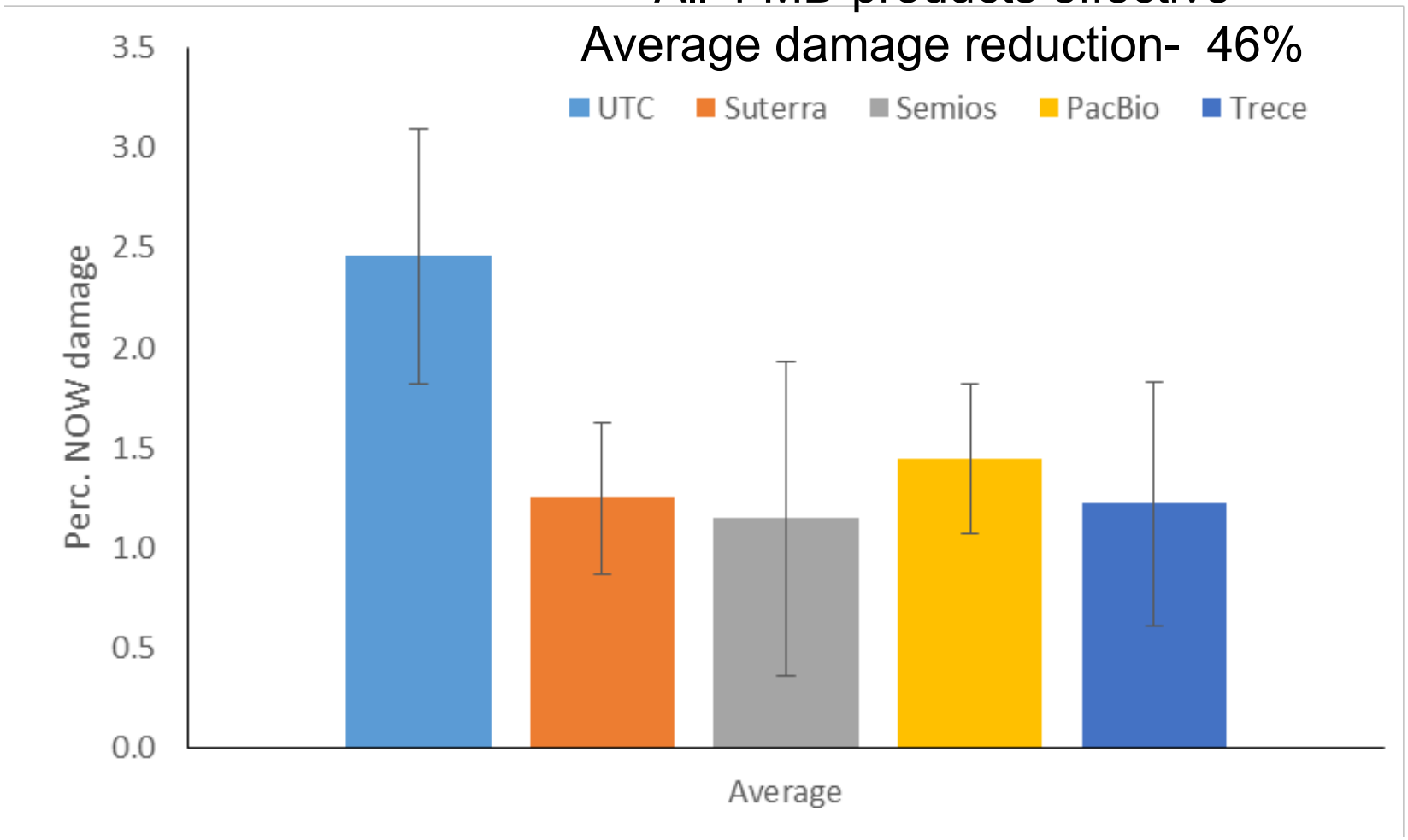
ABC 2017	PMA 2017	PMA 2018
89%	97%	100%
95%	93%	97%
91%	94%	99%

NOW damage at harvest- Southern SJV

Haviland Almond Board Project, 2017

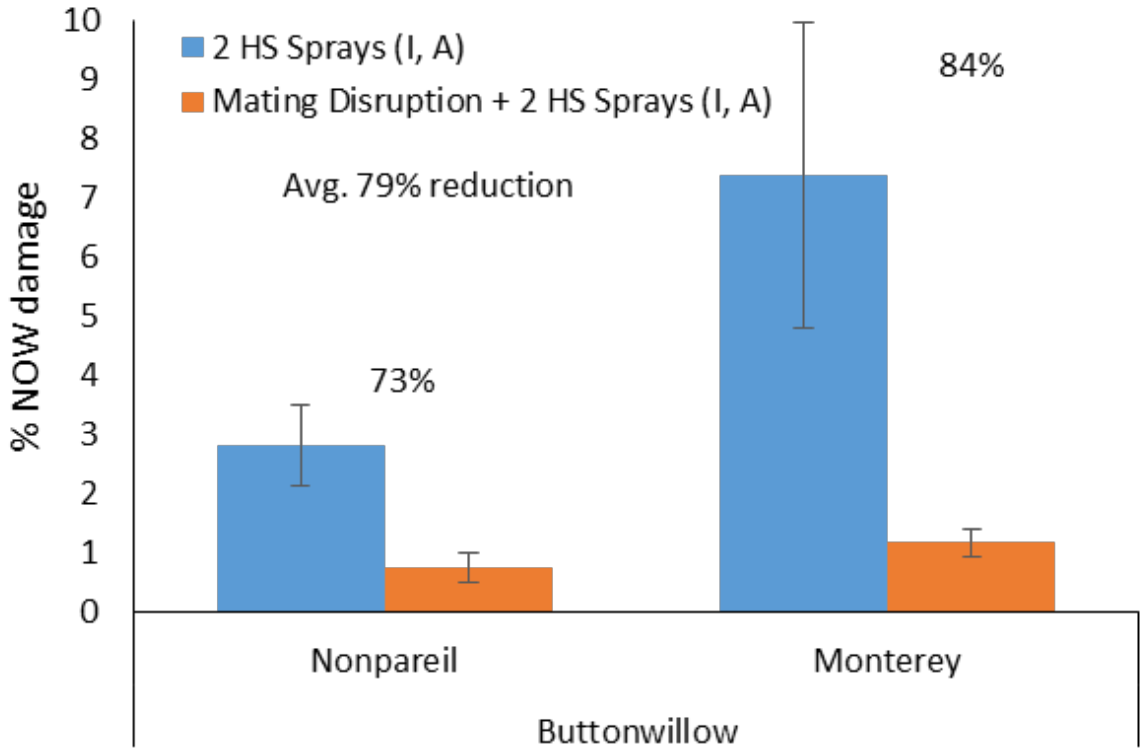
All 4 MD products effective

Average damage reduction- 46%

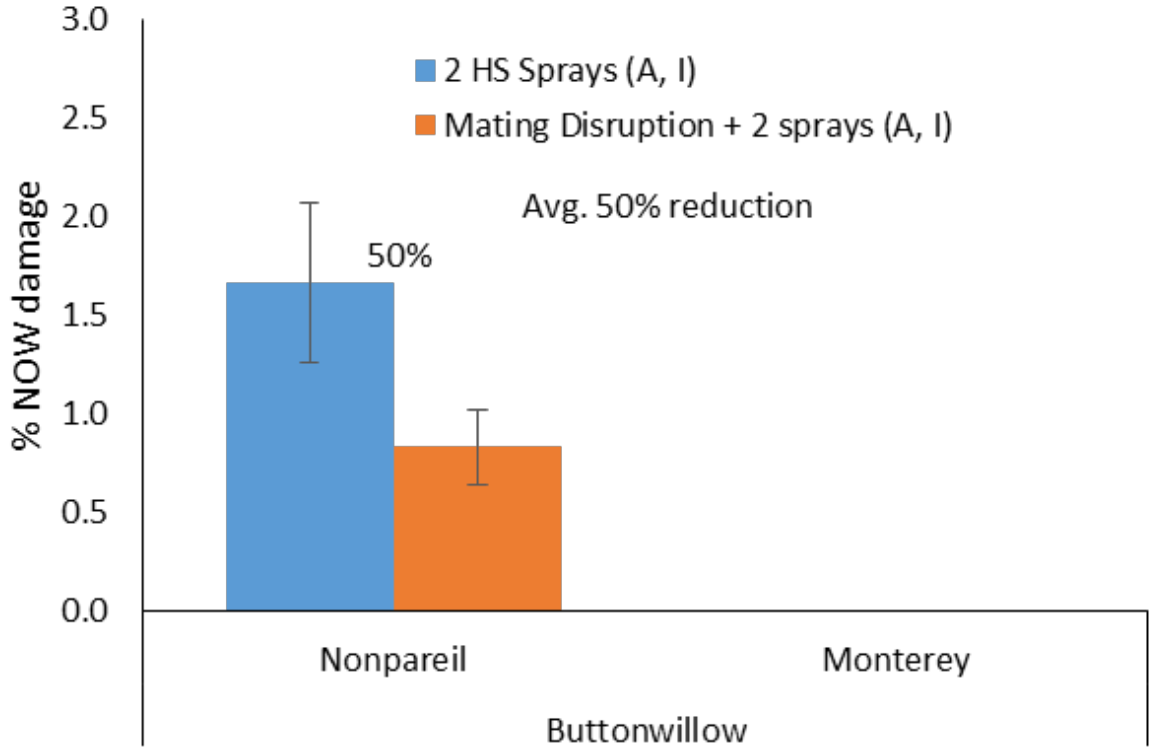


PMA Site- Lost Hills

2017



2018

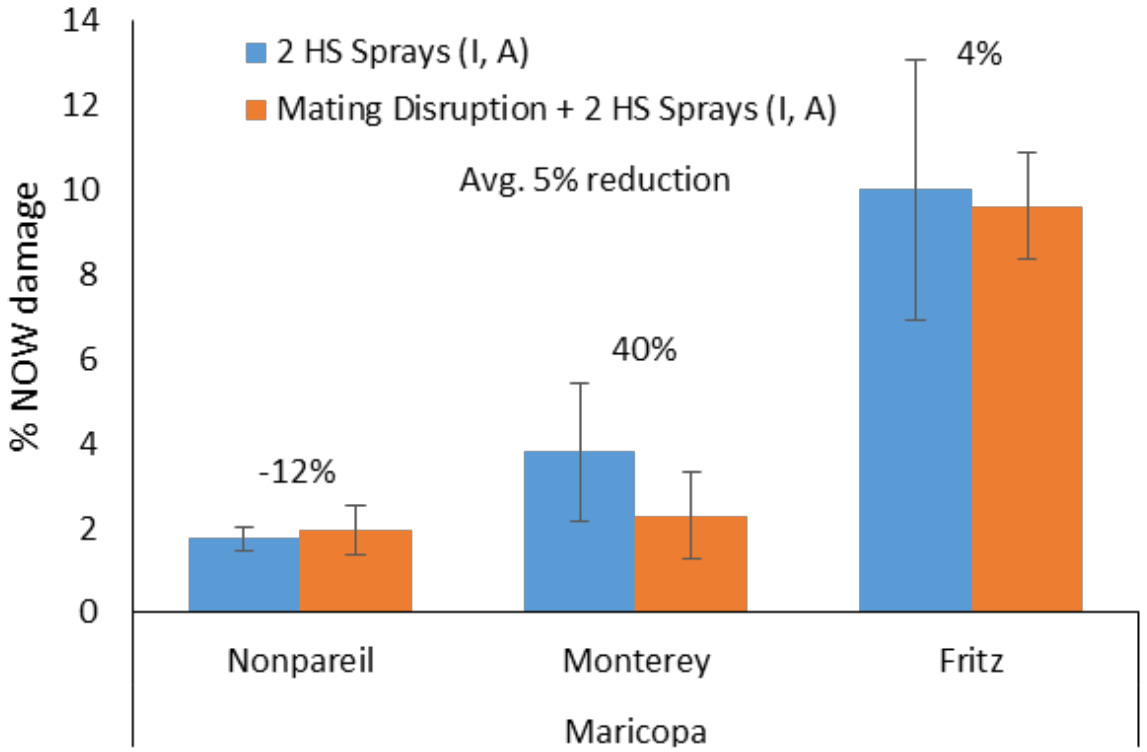


- One or Two sprays w/ or w/o MD

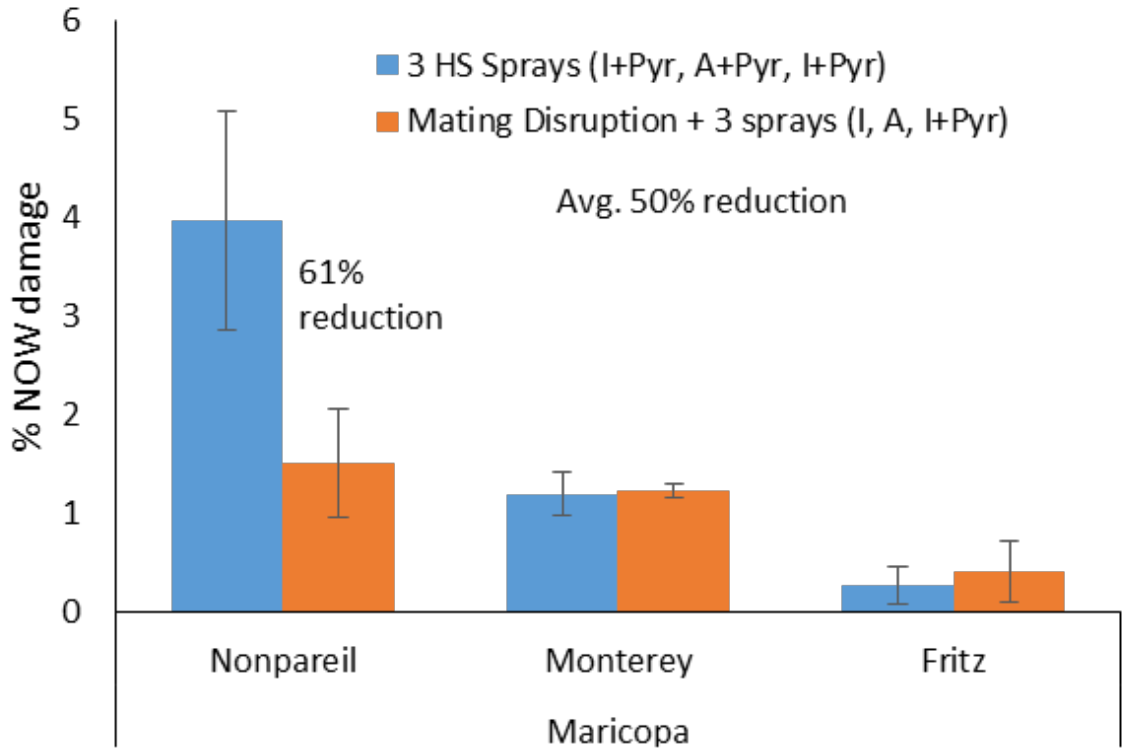
- Two-year damage ↓ 49%
- Net grower return ↑ $84/yr/acre

PMA Site- Maricopa

2017



2018

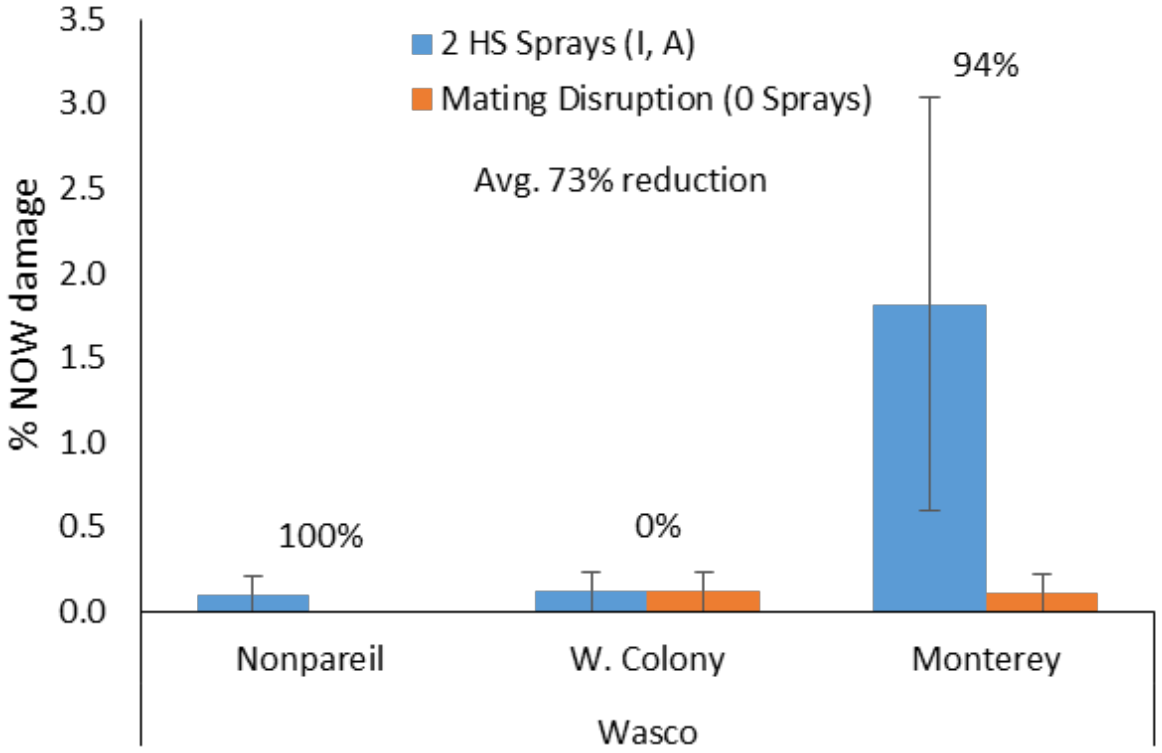


- 100ac triangle vs. 200ac square
- 2-3 sprays w/ or w/o MD

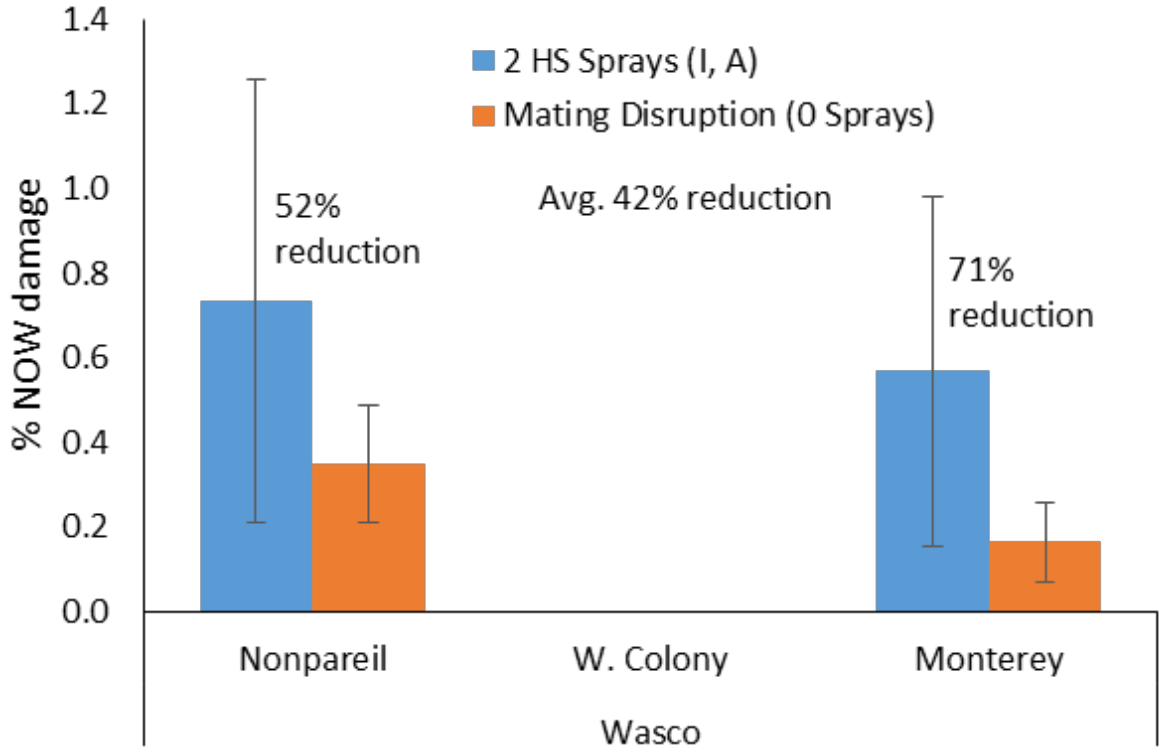
- Two-year damage ↓ 28%
- Net grower return ↑ $28/yr/acre

PMA Site- Wasco

2017



2018



- Low pressure
- MD replaced two sprays

- Two-year damage ↓ 58%
- Net grower return ↑ $36/yr/acre

Mating Disruption Summary

- Four commercial products, they all work
- 90+% reduction in male moth captures
- 50-70% reduction in damage
- Reduction of aflatoxins
- Two-year average benefit ($49/ac)
- Economic benefits depend on baseline damage
  - Break-even around 2.0-2.5%
  - Below 1.5%, costs can be offset by less sprays
- Larger scale = larger benefit
- Marketing benefits of being ‘sustainable’
- Improved resistance management
- Improved worker safety
- No treatment timings, PHIs, REIs or residues

Areas of Opportunity for increased integration (ABC BOD)

Navel orangeworm

- Winter sanitation
- Monitoring
- Mating disruption
- Early harvest
- Pesticide choice (avoid pyrethroids)
- Resistance management

Spider mites

- Monitoring
- Increased reliance on biocontrol
- Avoid prophylactic treatments
- Resistance management

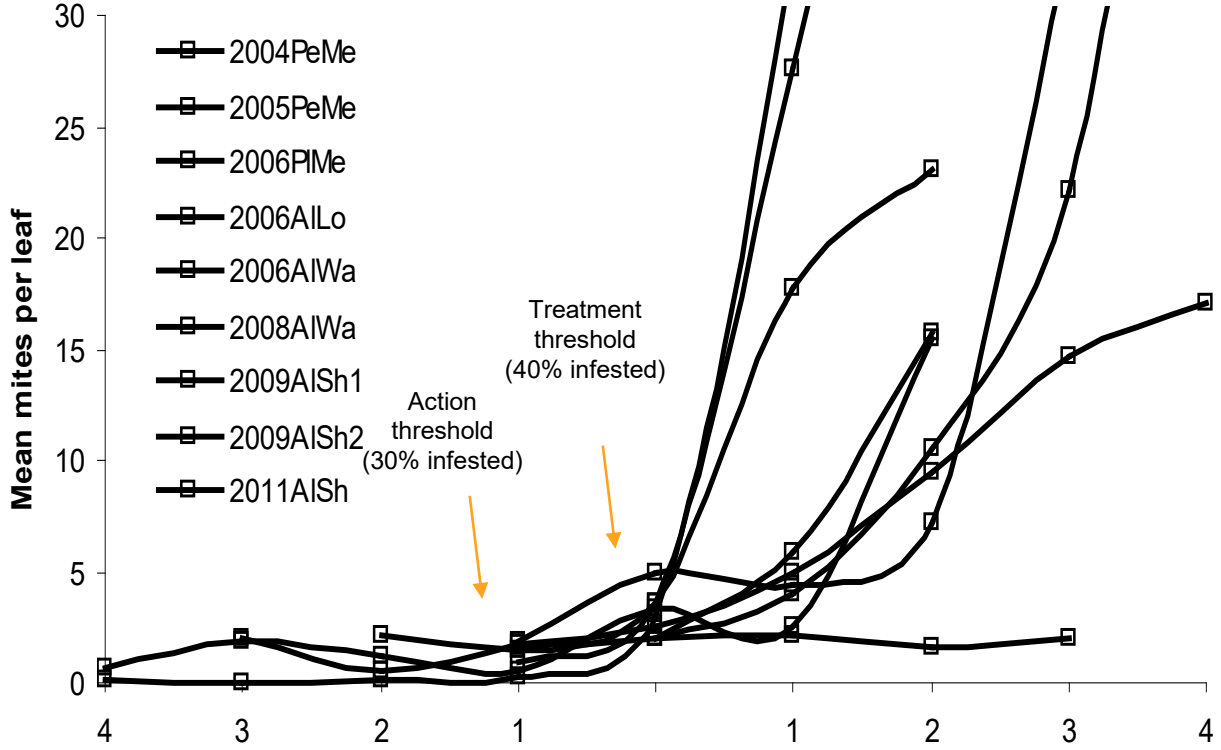
PMA Demonstration Battle Plan

- Monitor weekly for mites (presence/absence)
- Don’t treat unless you have
  - 33% leaves with mites (predators)
  - 25% leaves with mites (no predators)
- Monitor for sixspotted thrips
  - Use yellow panel traps
  - Watch for thrips mid-April to mid-May
  - Watch for thrips in response to mites
- Treat (if needed) with a miticide that doesn’t kill thrips

Spider mites- monitoring and thresholds

Treat too early

= Starve predators



Treat too late

= Risk of defoliation

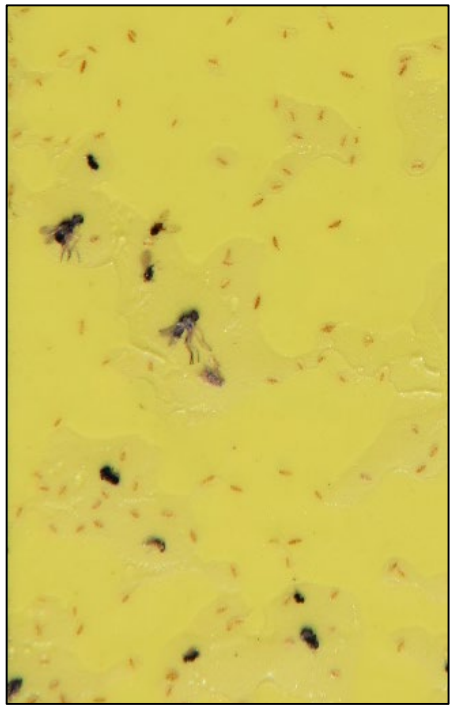
Sixspotted thrips

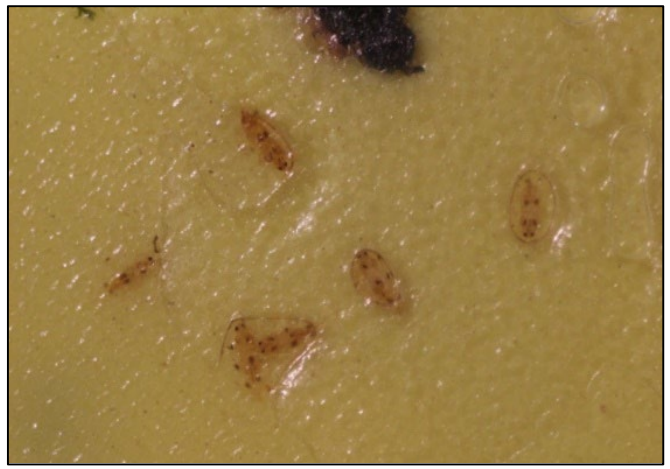
- Feed almost exclusively on spider mites
- Thrive in hot dry climates
- Have replaced predatory mites as the dominant natural enemy of spider mites
- Can eat 50 eggs per day at 86°F
- Population can quadruple in one week
- Thigmotaxic (not afraid of tight spaces, thrives in mite webbing)

Monitoring- sixspotted thrips

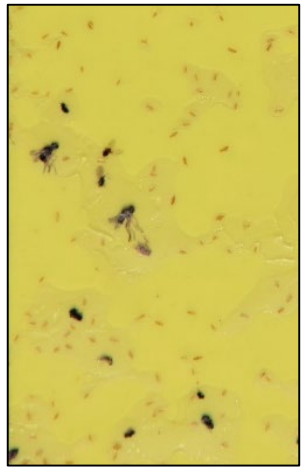
- Yellow strip trap
- 3” x 5”
- Great Lakes IPM
- Case of 1000 for $260

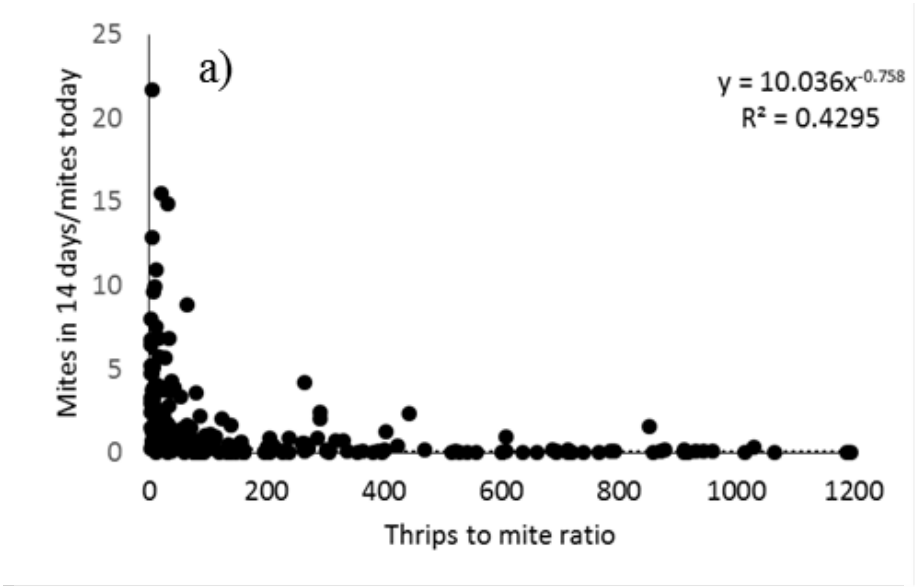
- Hang from tree using binder clip and large uncoiled paper clip
- Place near NOW or PTB traps traps





Thrips:mite ratios can predict change in mite density





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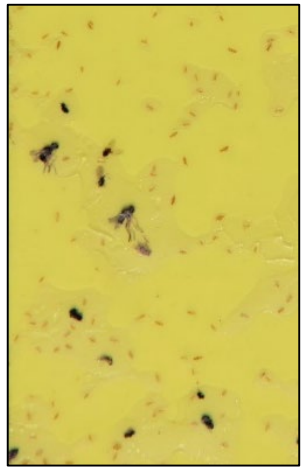

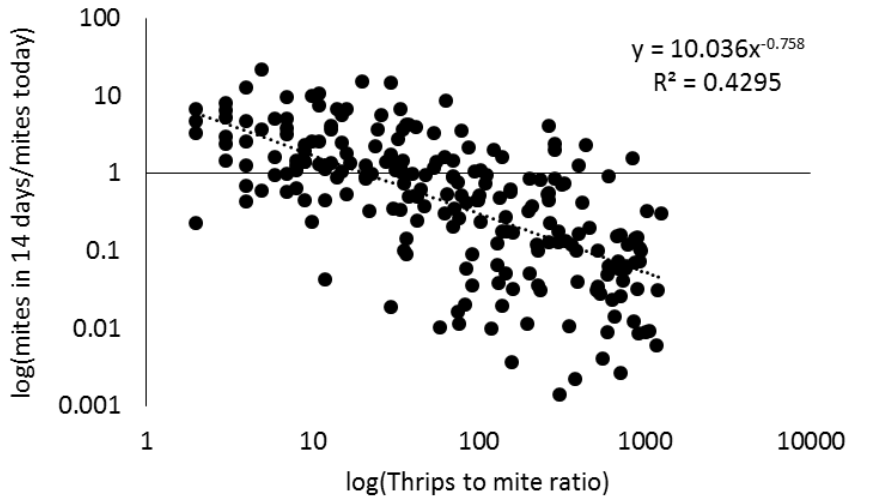

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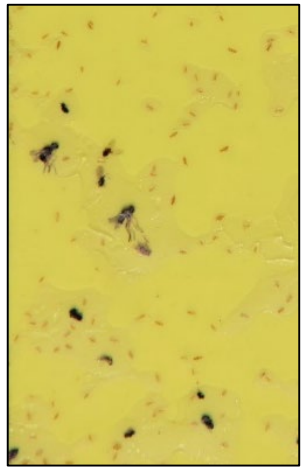

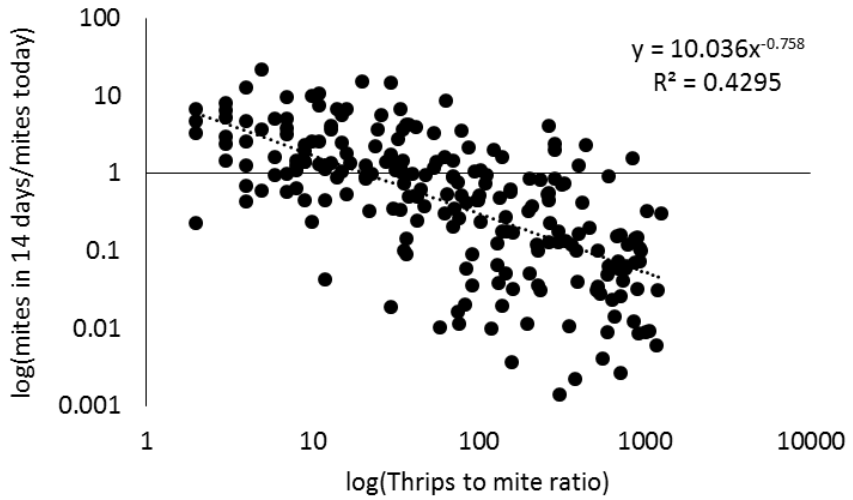

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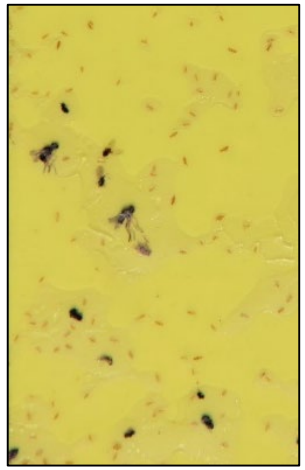
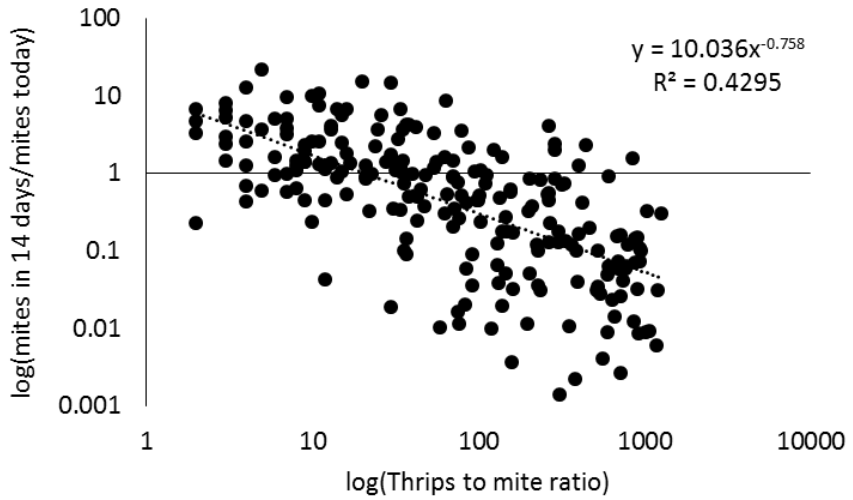
- 2.6 thrips/card/week for every 1 mite/leaf equals no change in mites 7 days later
  - Spring implication- If 1 mite per 3 leaves, 1 thrips on a card is all you need

Thrips:mite ratios can predict change in mite density





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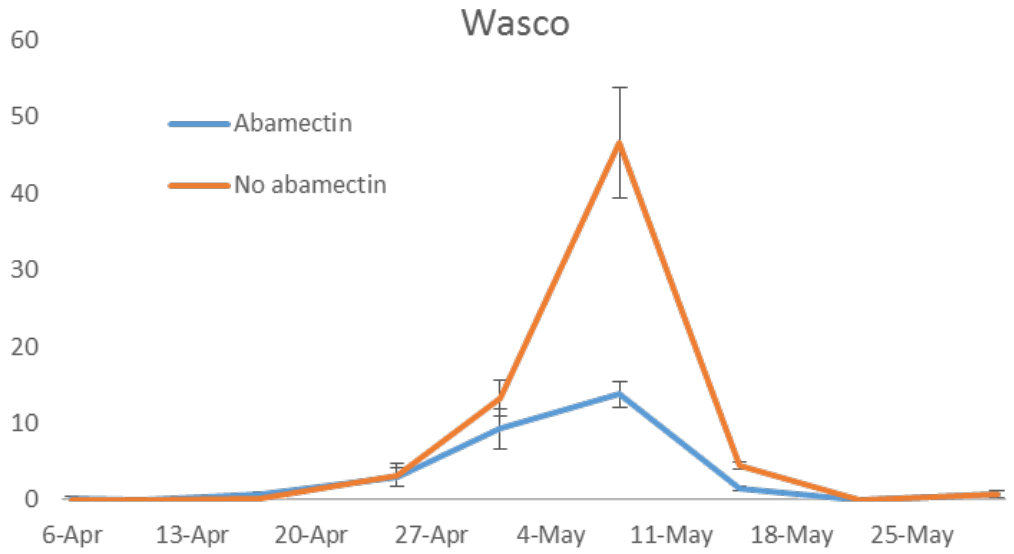
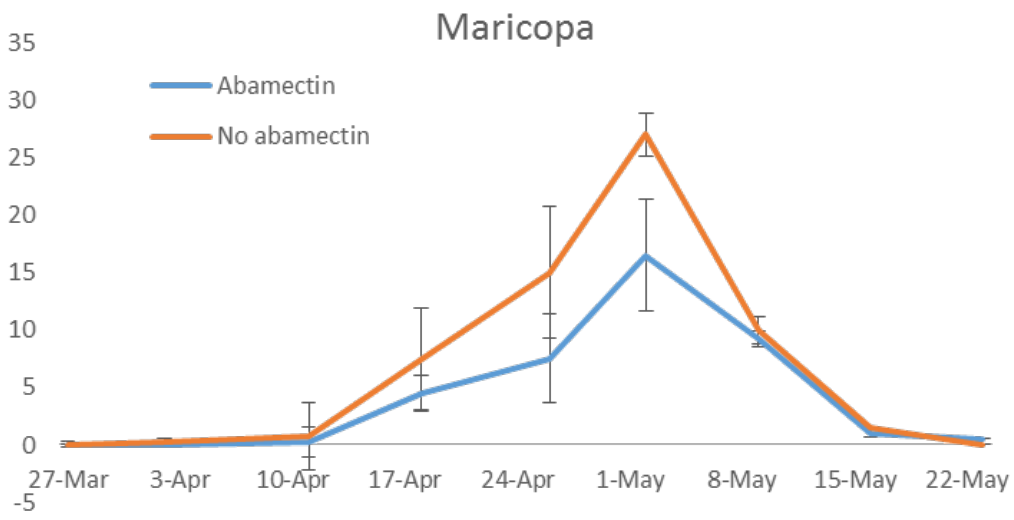
  - Spring implication- If 1 mite per 3 leaves, 1 thrips on a card is all you need
- Simplified version for mid-season to hull split
  - 3 thrips/trap/week = break even
    - 50% chance mites will be the same or lower in 14 days
  - 6 thrips/trap week = walk away
    - 72.7% chance mites will decrease in 7d, 96.6% chance mites will decrease in 14d

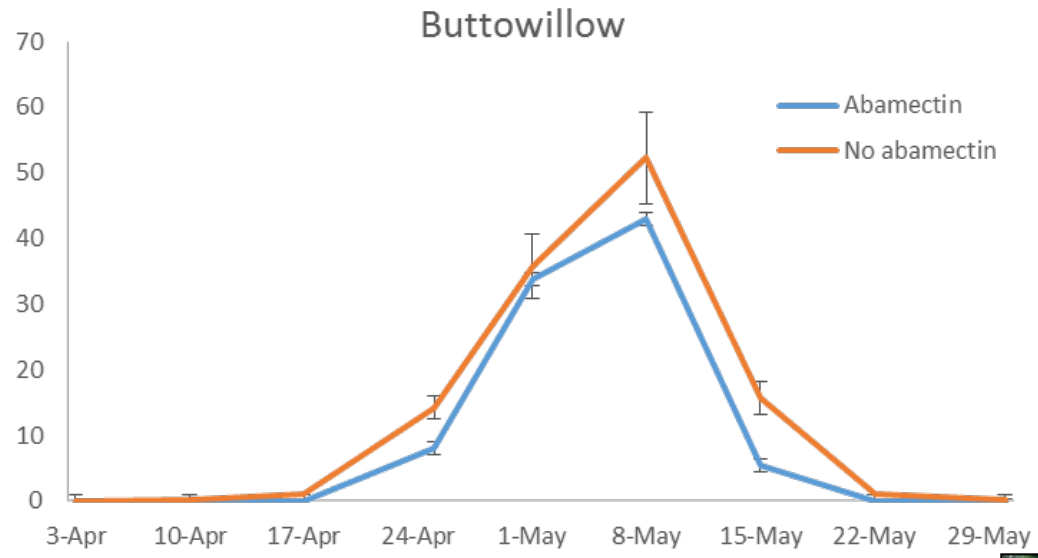
Avoid prophylactic treatments

- May sprays for mites becoming obsolete
- Nine orchards (9/9) miticides not justified
- Predatory thrips above thresholds in all cases
- Miticides should never be used in May without monitoring for spider mites and thrips
- If a treatment is justified, avoid products that kill thrips

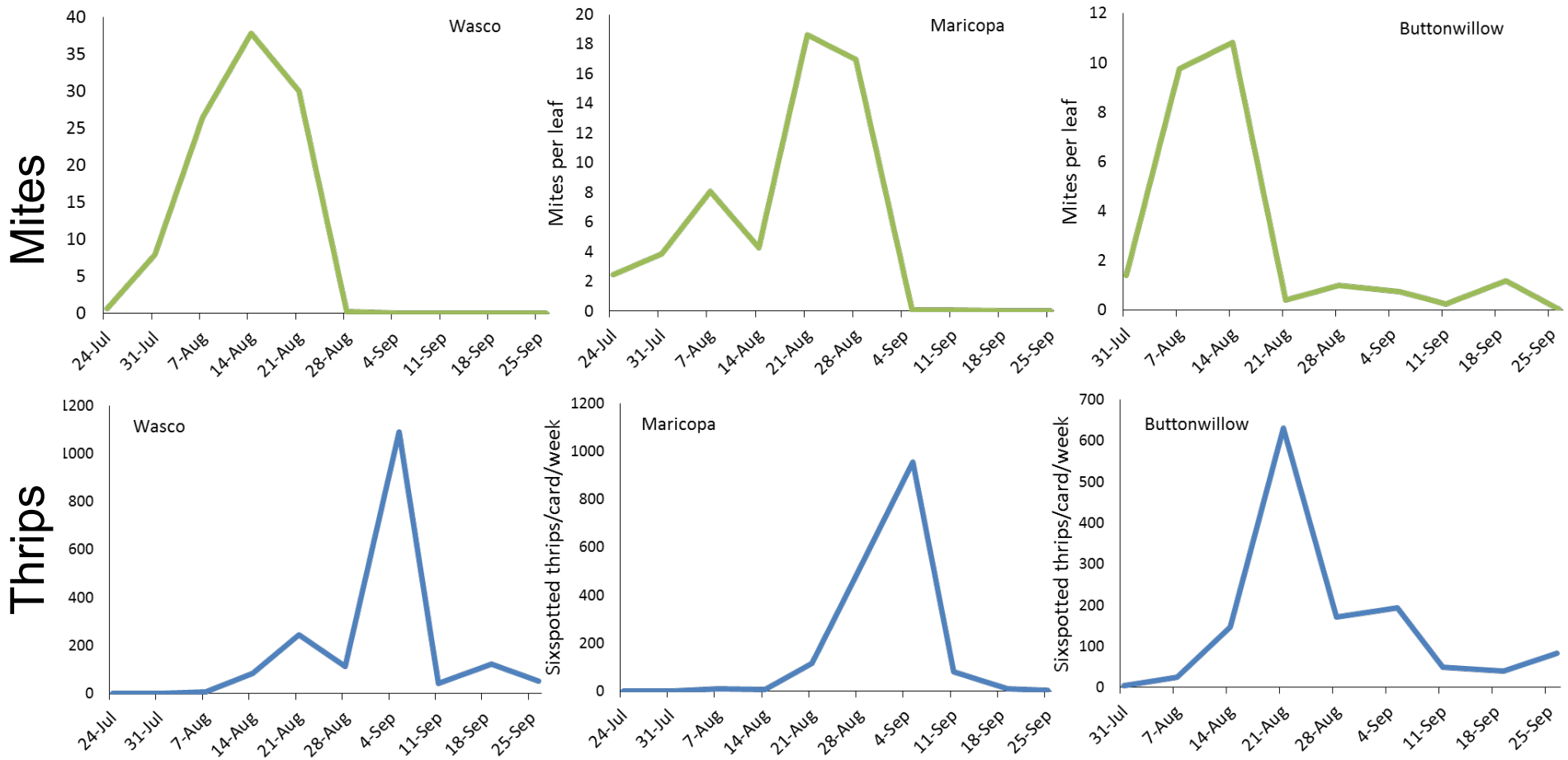
Sixspotted thrips/card/week







Maximizing biocontrol



- Mites flare up
- Appx. 2-week delay
- Thrips respond
- Thrips overtake mites
- Mites crash
- 9 case studies

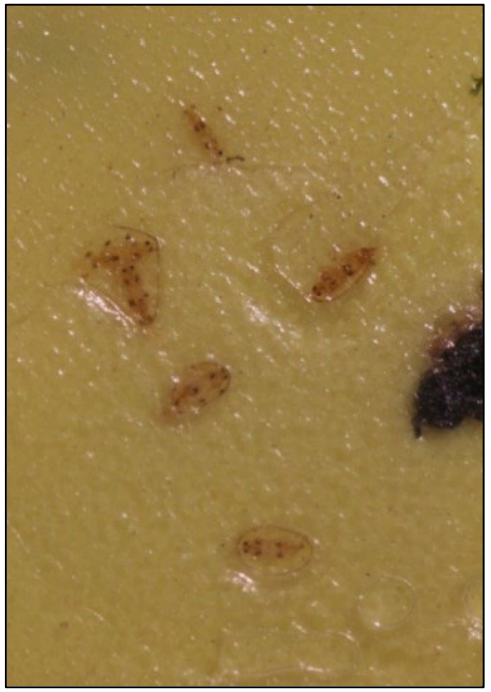
Population Doubling Time

Year	Location	Doubling time in days	
		Pacific Spider Mite	Sixspotted thrips
2016	Shafter	15.9	4.2
2016	McFarland	6.0	4.2
2017	Shafter	3.8	2.3
2017	Maricopa	9.3	2.7
2007	Buttonwillow	3.0	3.6
Average		7.6	3.4

Take-home messages

Spider mites

- Weekly monitoring
- Use thresholds
  - 25% to 33% presence/absence
- Avoid prophylactic sprays
- Maximize biocontrol
  - Sticky traps to thrips
  - Consider thrips populations in treatment decisions



PMA Project 2018 update: Navel Orangeworm and Mites (North San Joaquin Valley Perspective)

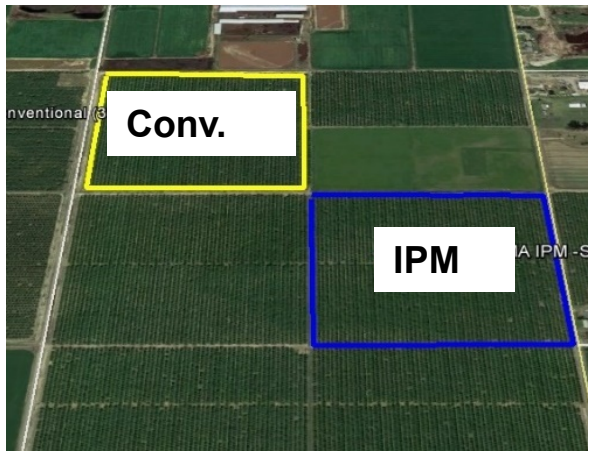
Jhalendra Rijal, Ph.D.

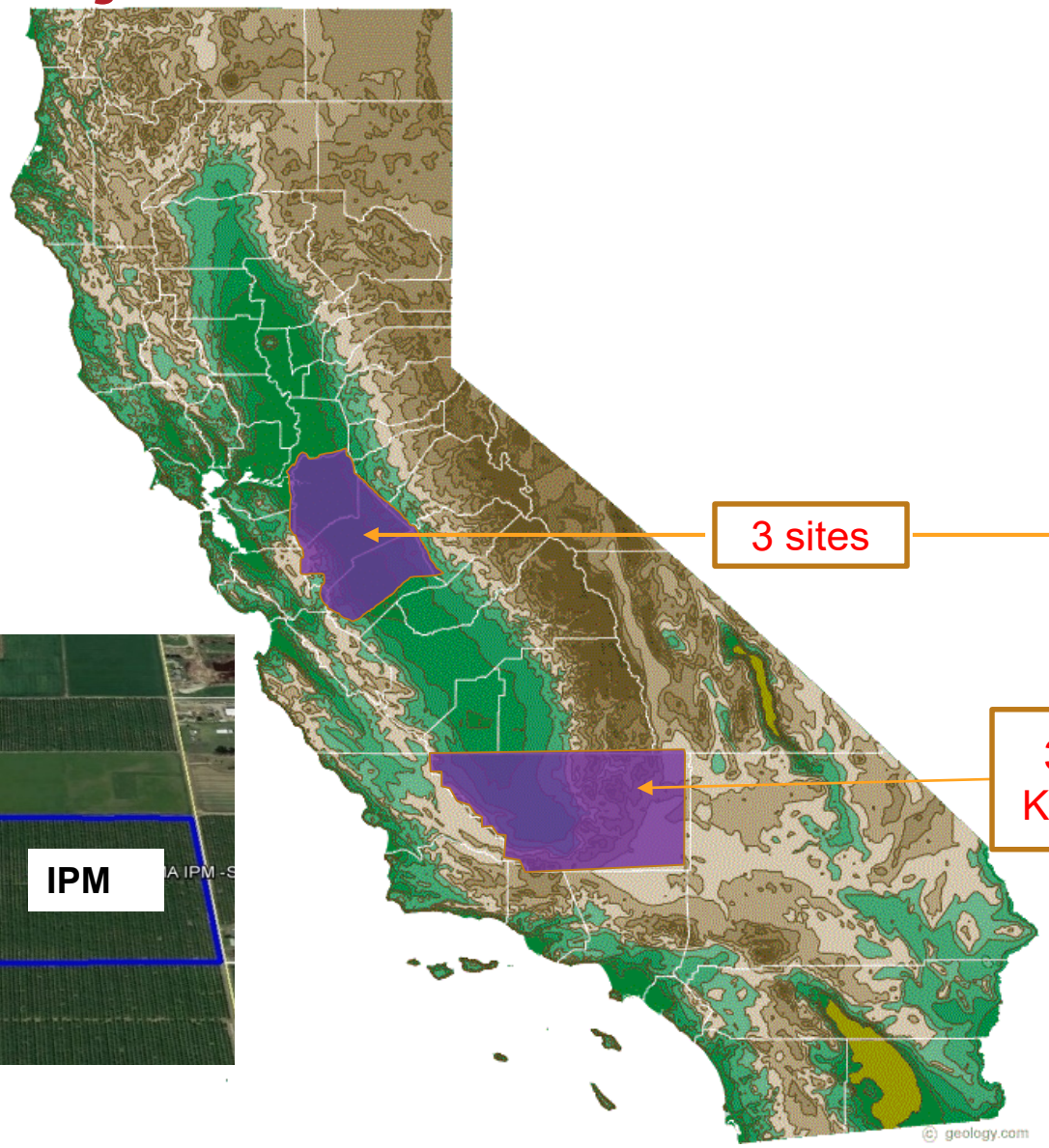
IPM Advisor, Northern San Joaquin Valley

UC Cooperative Extension & UC Statewide IPM Program

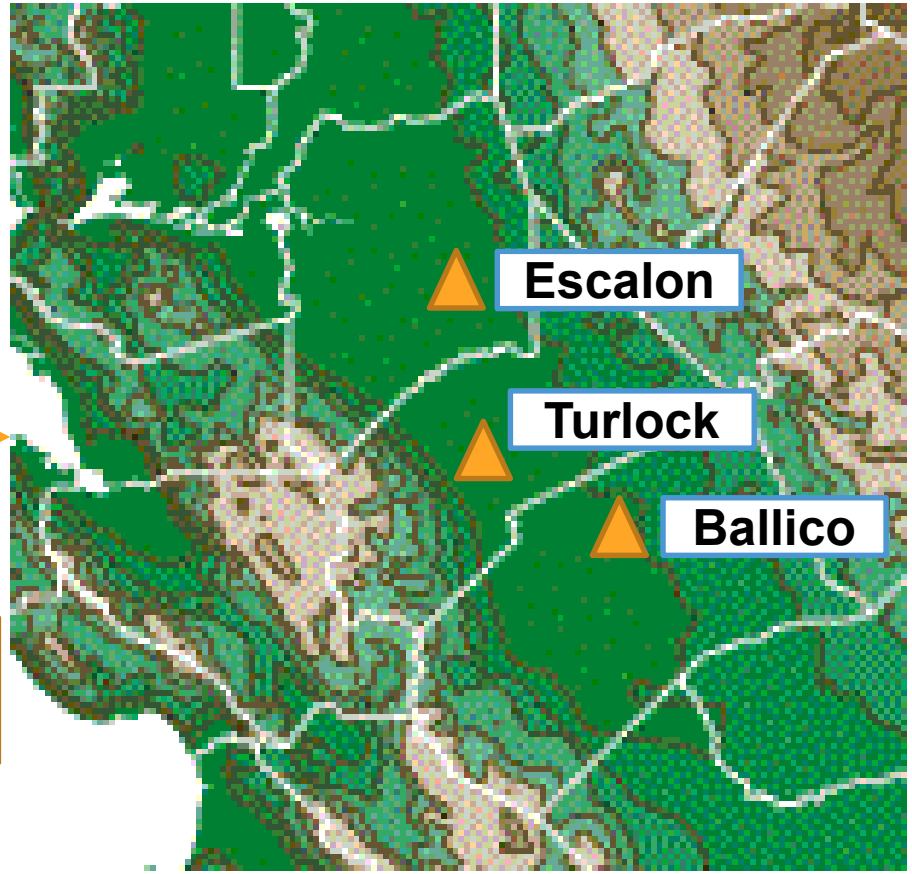
california almonds
Almond Board of California

PMA Project Sites

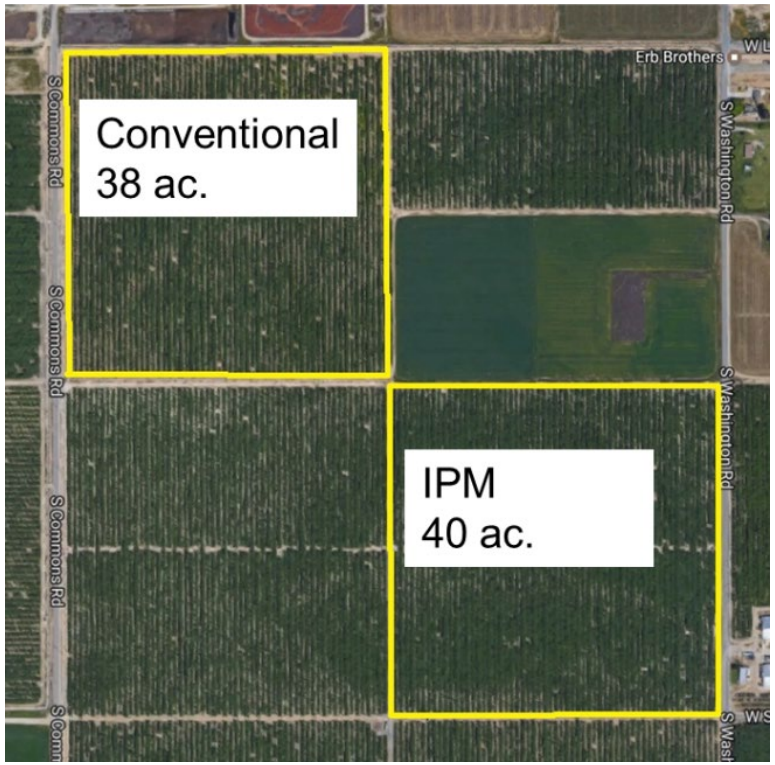




(Northern San Joaquin Valley)

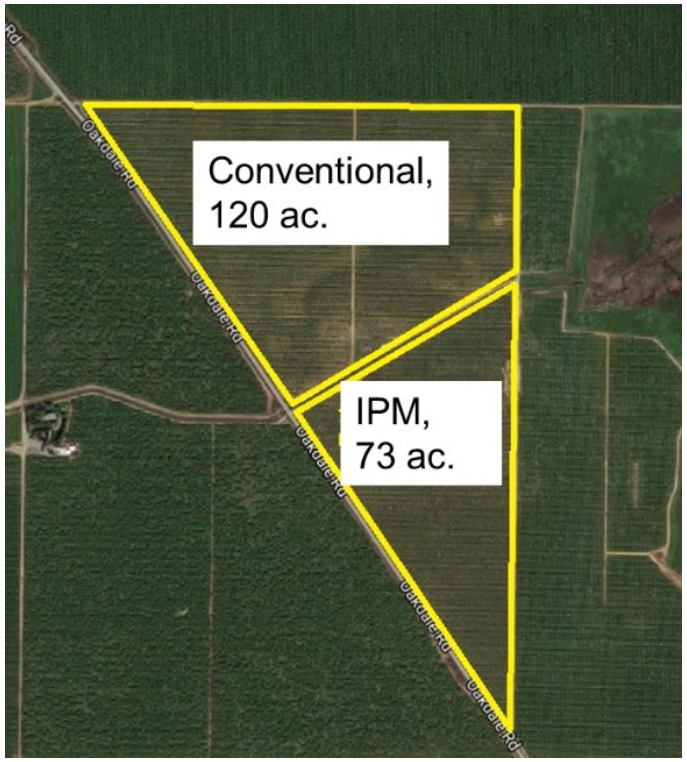


PMA Project Sites-North SJV



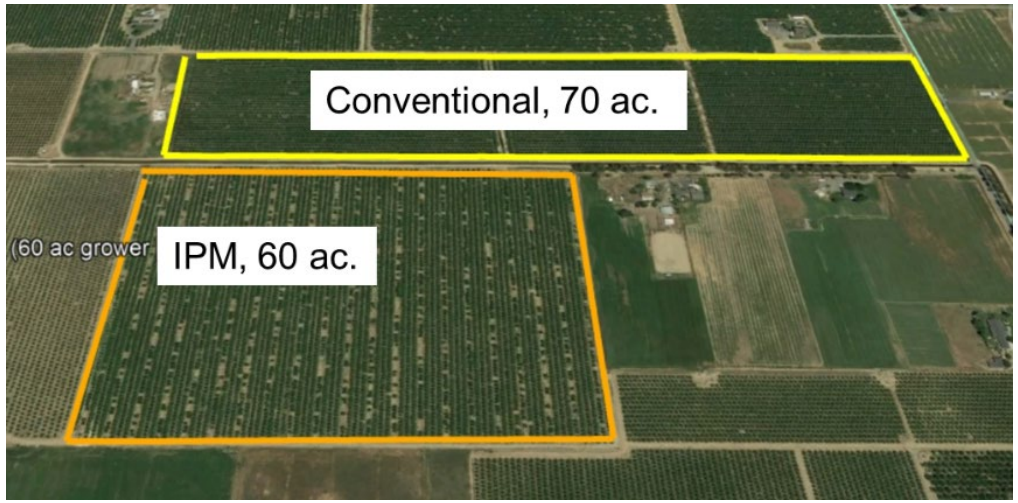
Turlock

Variety: NP/Carmel/Monterey
Age: 12 yrs.



Ballico

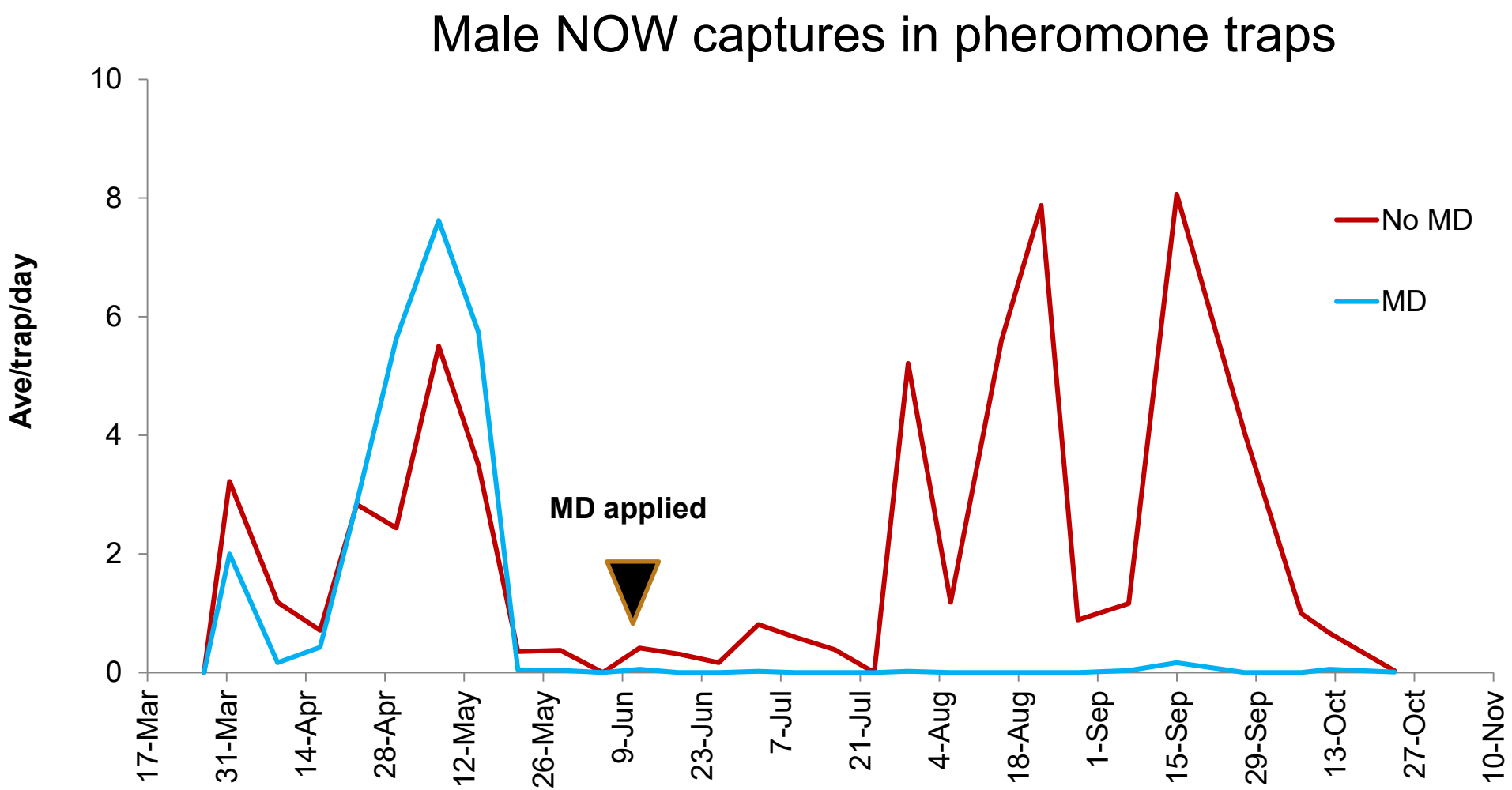
Variety: NP/Monterey/Fritz
Age: 6 yrs.



Escalon

Variety: NP/Aldrich/Wood Colony
Age: 6 yrs.

Turlock Site, Navel Orangeworm

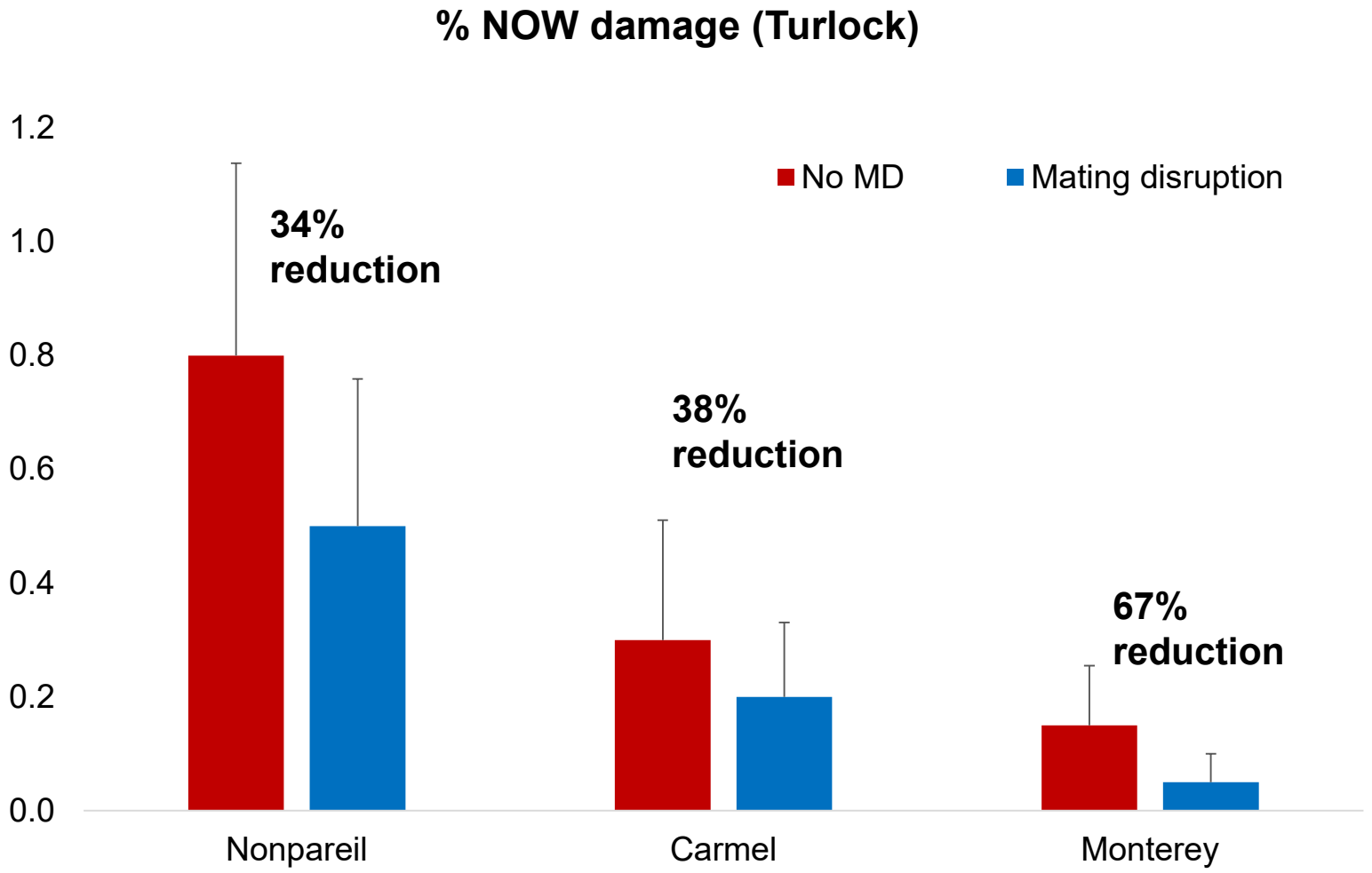


Reduction in trap capture

<u>2018</u>: 99.6%

<u>2017</u>: 94.7%

Turlock Site, Navel Orangeworm

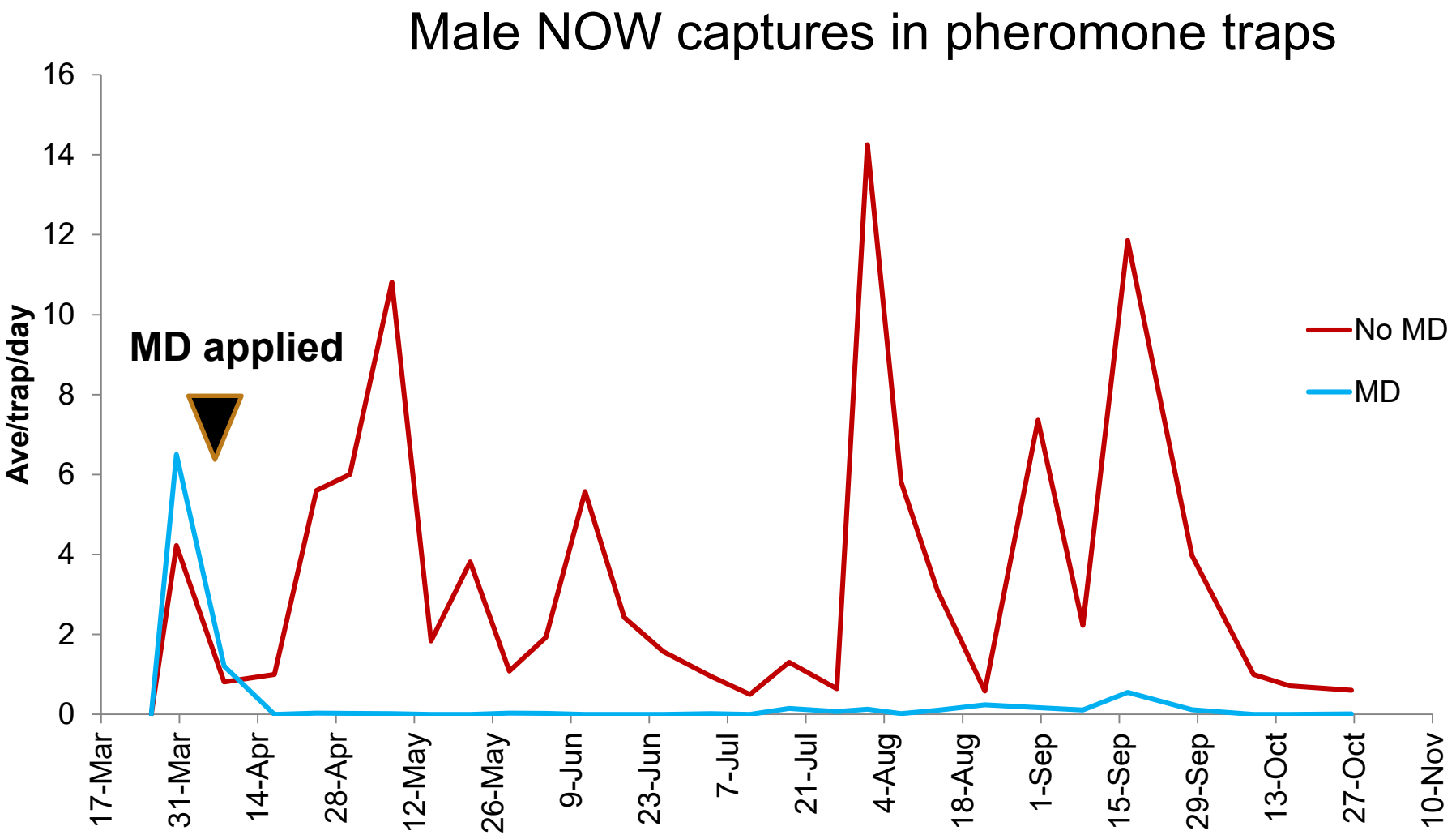


Overall damage reduction

<u>2018</u>: 46.3%

<u>2017</u>: 57.3%

Escalon Site, Navel Orangeworm

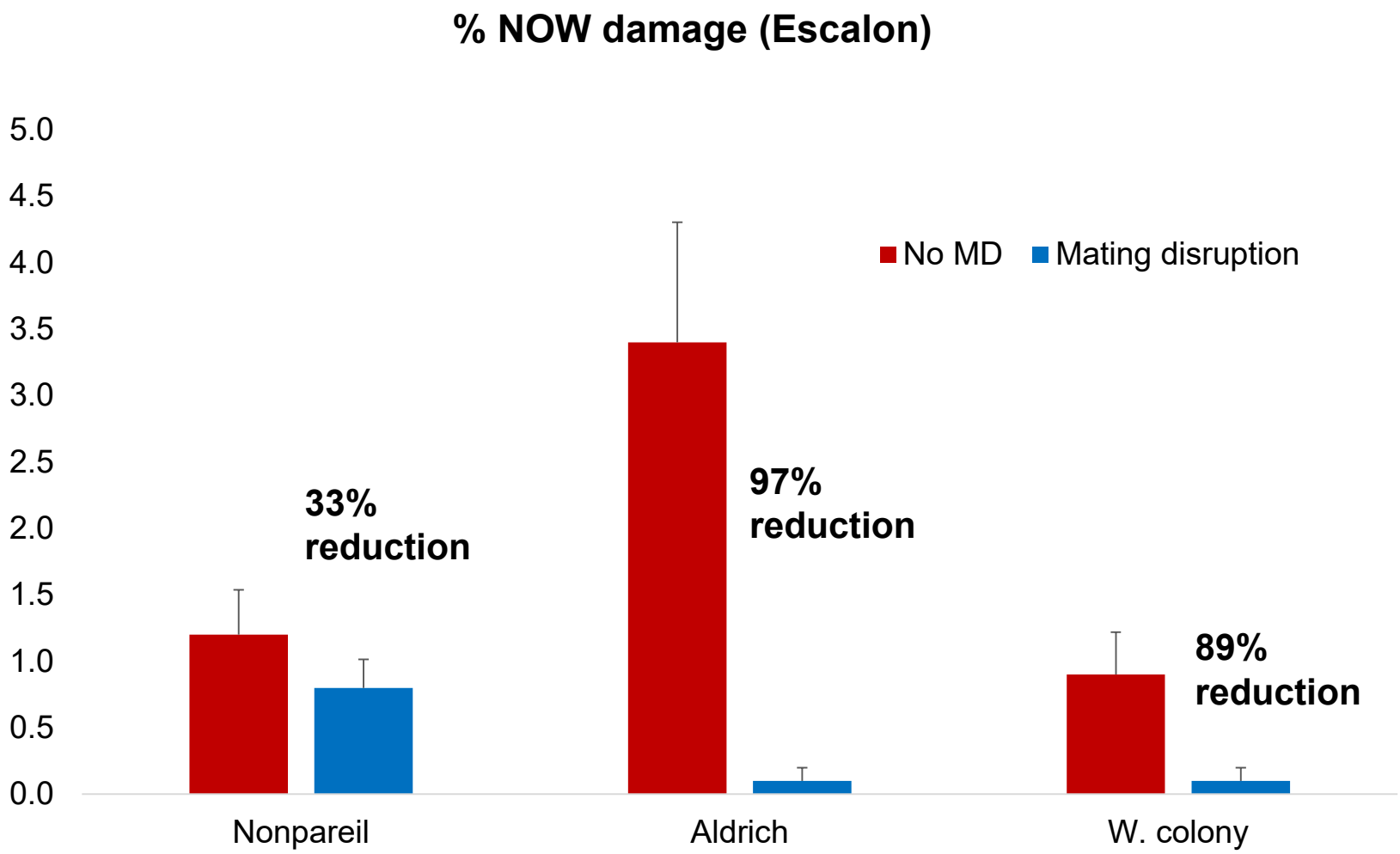


Reduction in trap capture

<u>2018</u>: 97.6%

<u>2017</u>: 97.1%

Escalon Site, Navel Orangeworm

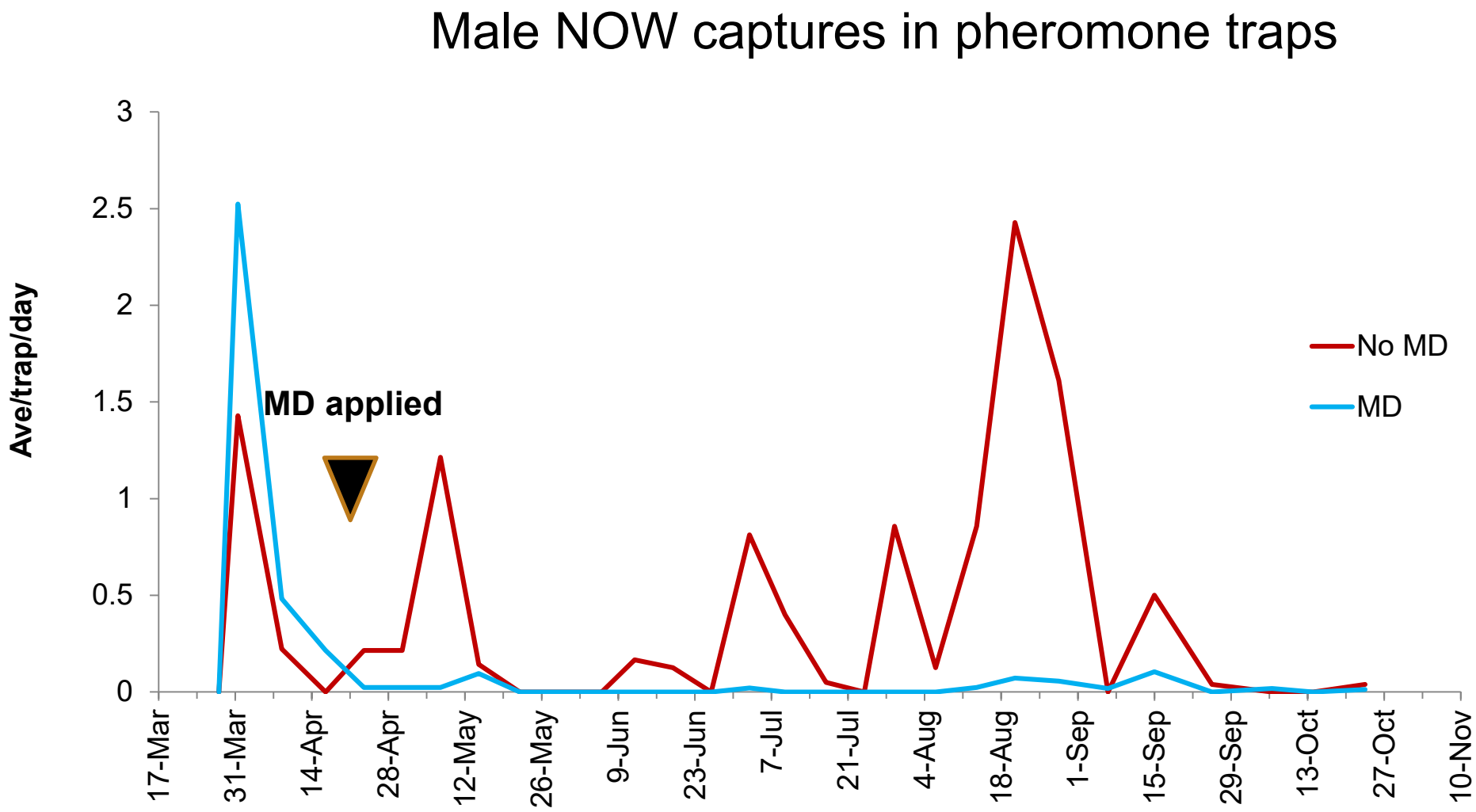


Overall damage reduction

<u>2018</u>: 73%

<u>2017</u>: 70%

Ballico Site, Navel Orangeworm

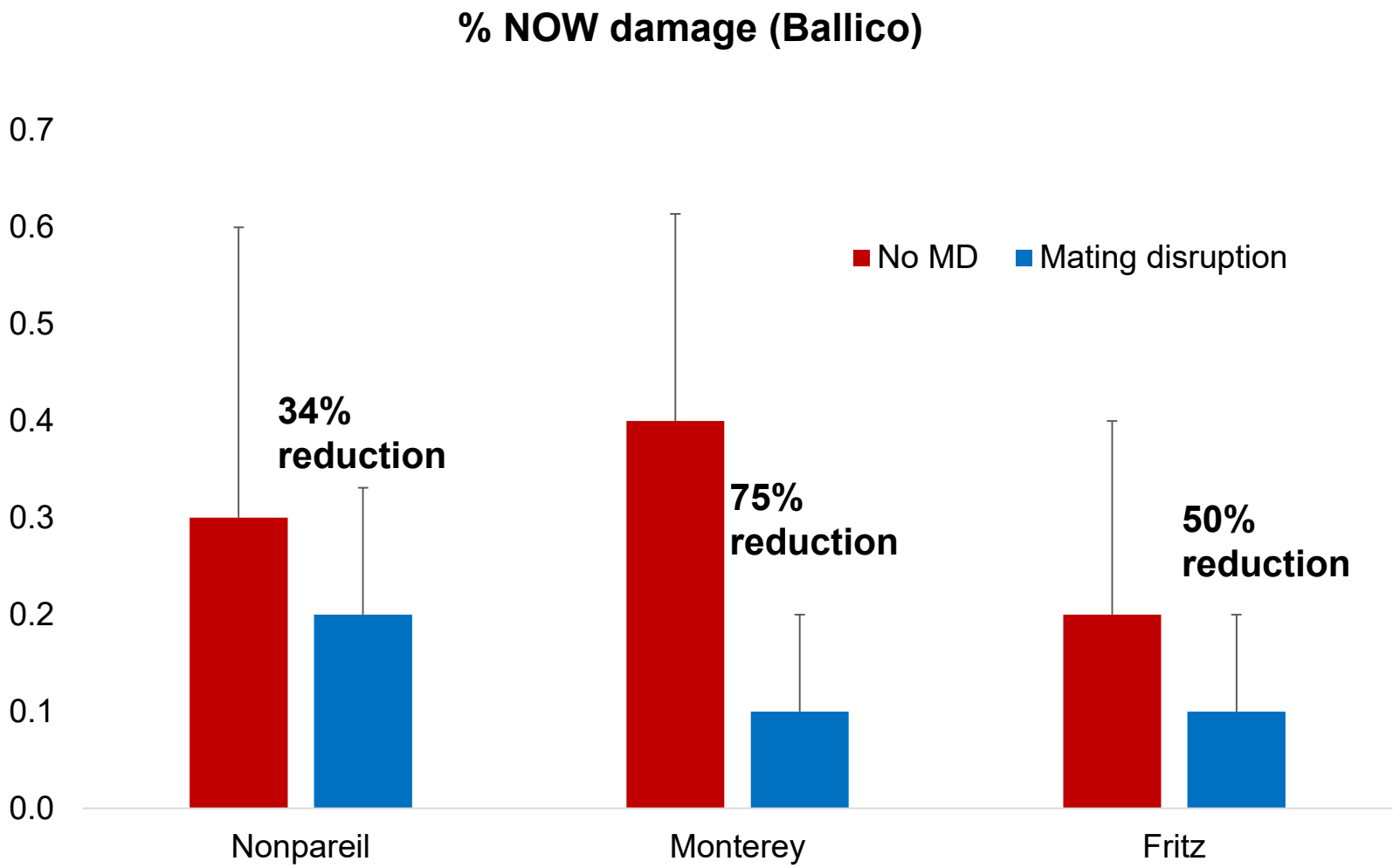


Reduction in trap capture

<u>2018</u>: 96.6%

<u>2017</u>: 83.2%

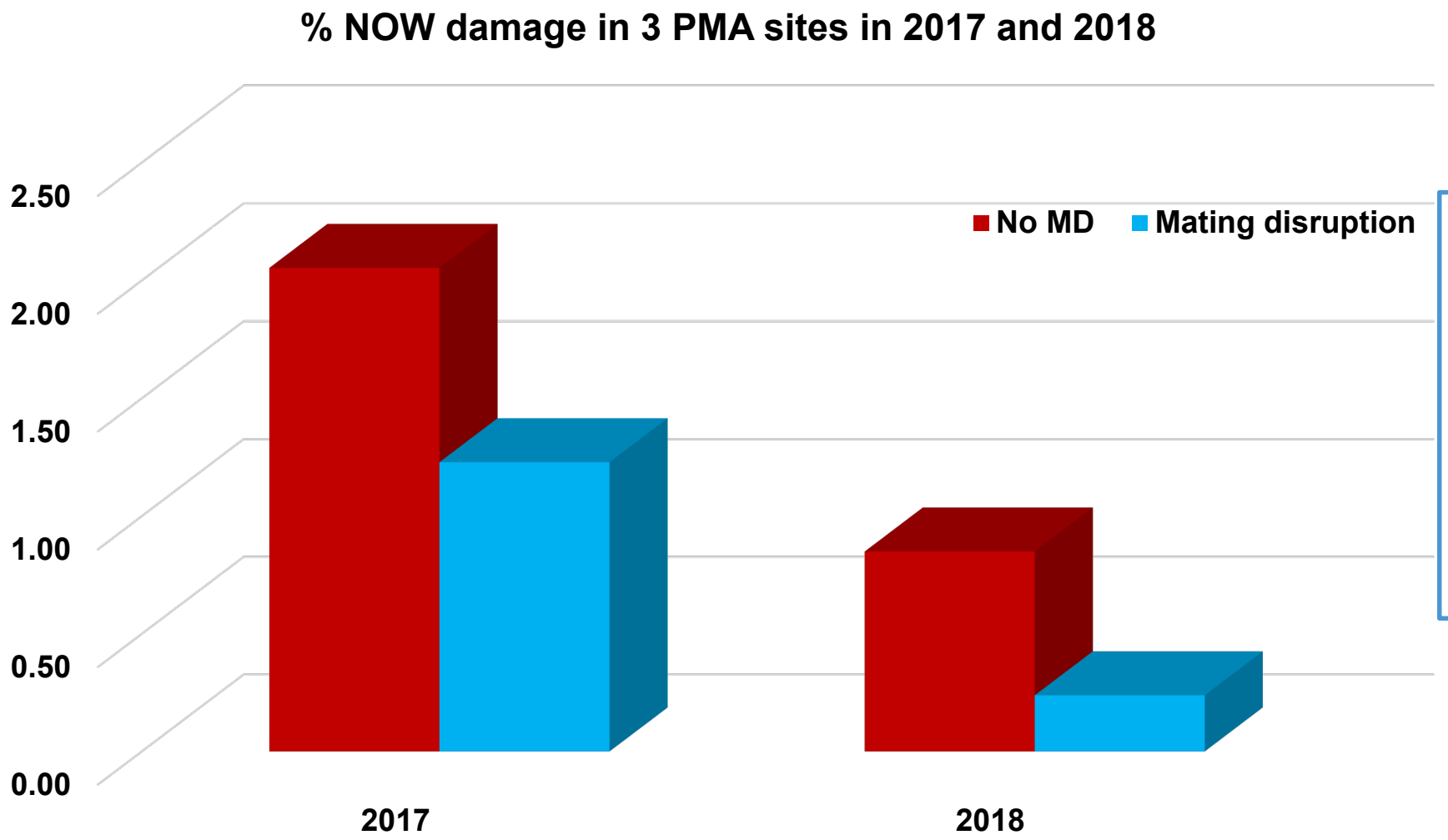
Ballico site, Navel Orangeworm



Overall damage reduction

2018: 53%

All Sites Combined, Navel Orangeworm



Reduction in damage

<u>2017:</u> 71. 9 %

<u>2018:</u> 63.3 %

Combined: ~68%

Prevalence of Spider Mites and Predators in NSJV

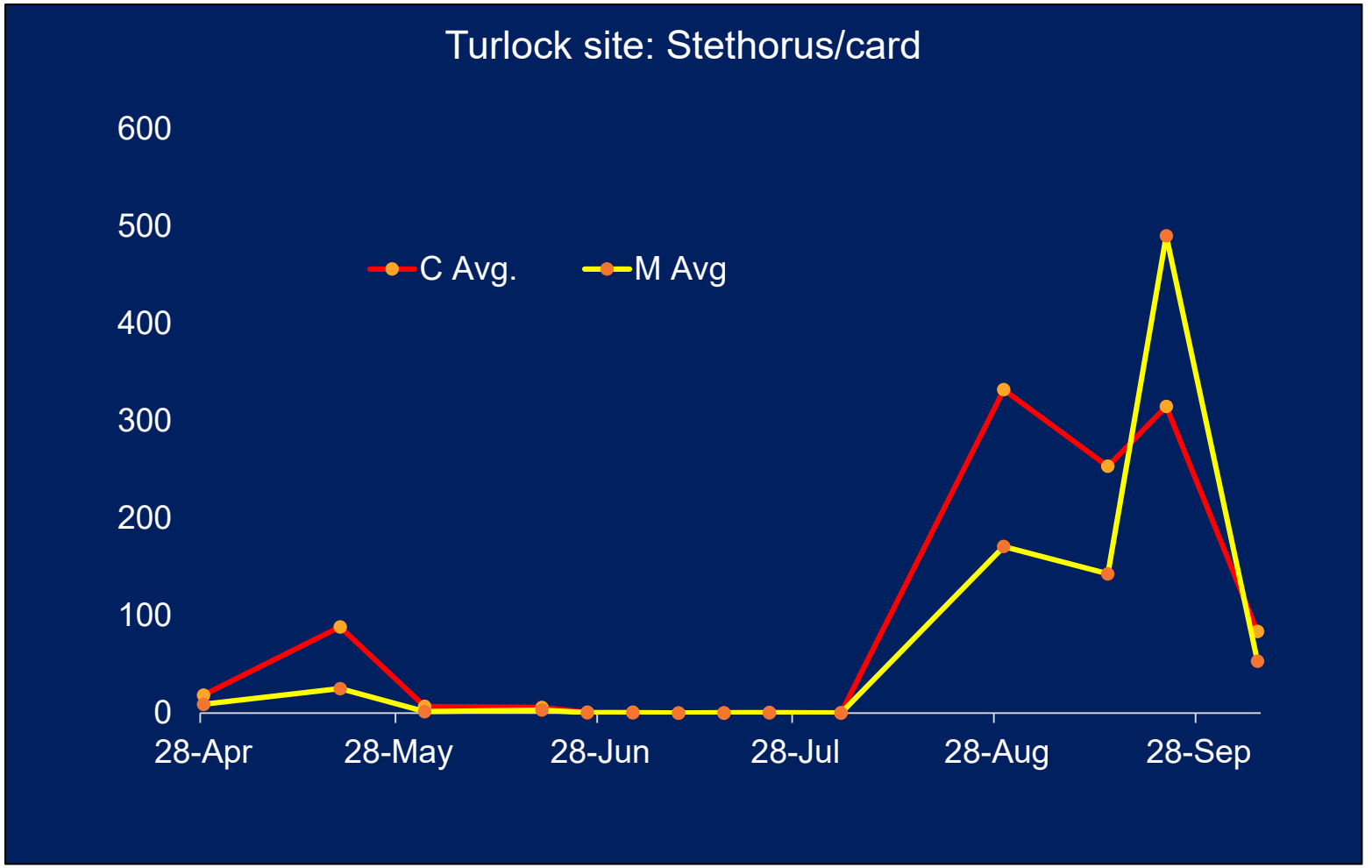
Spider Mite Infestation

Mite Predators

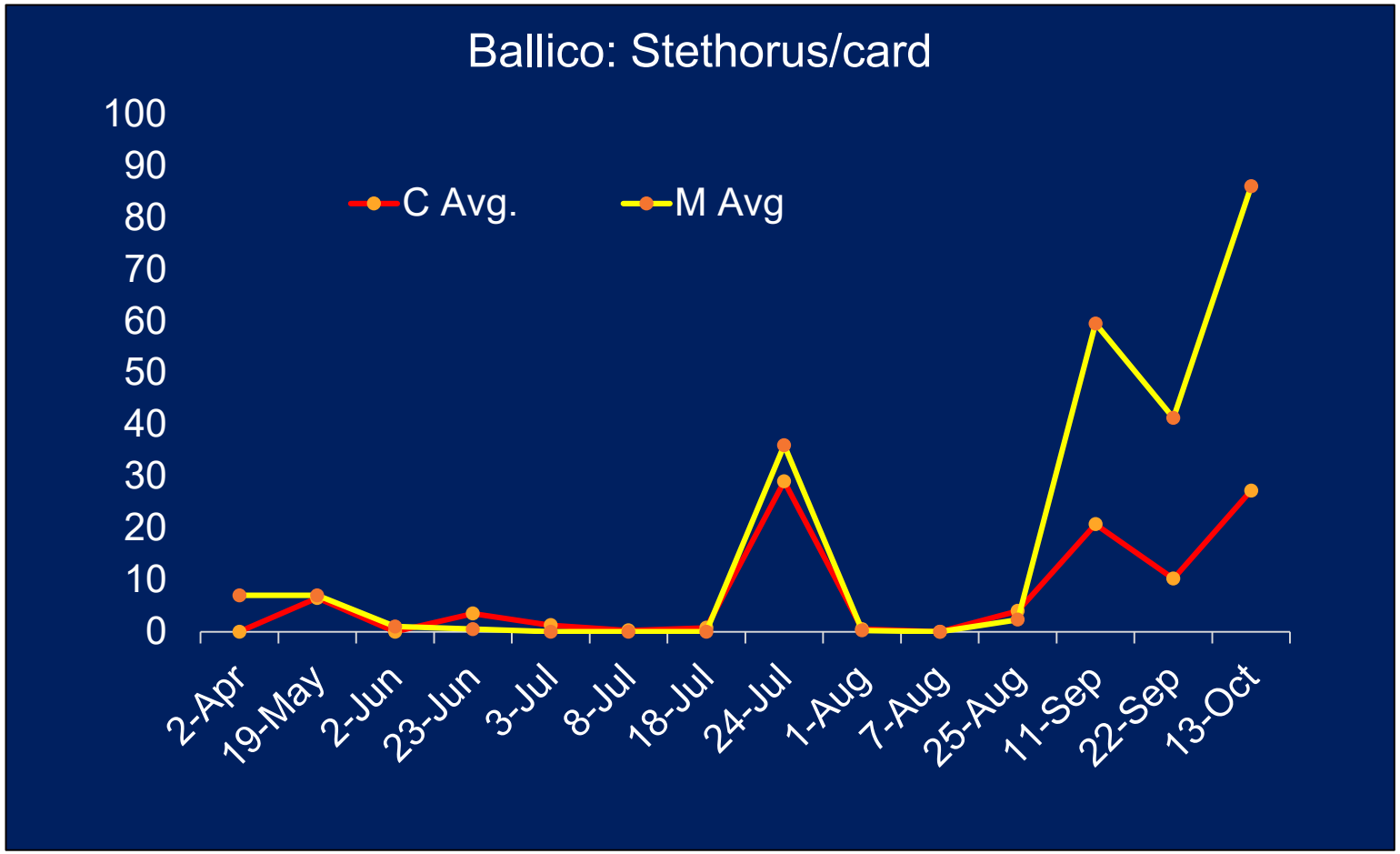
Stethorus Beetle

Sixspotted Thrips

Stethorus population
North San Joaquin Valley

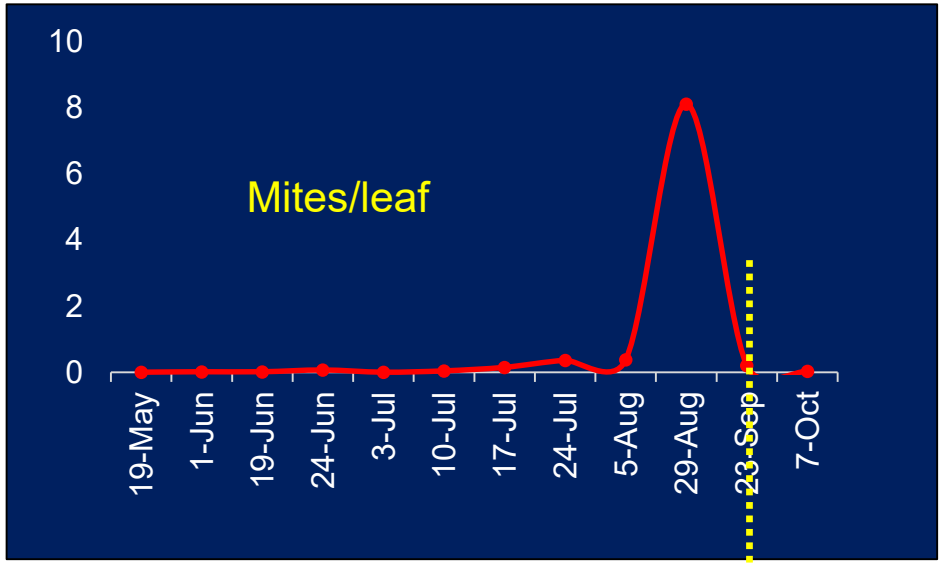


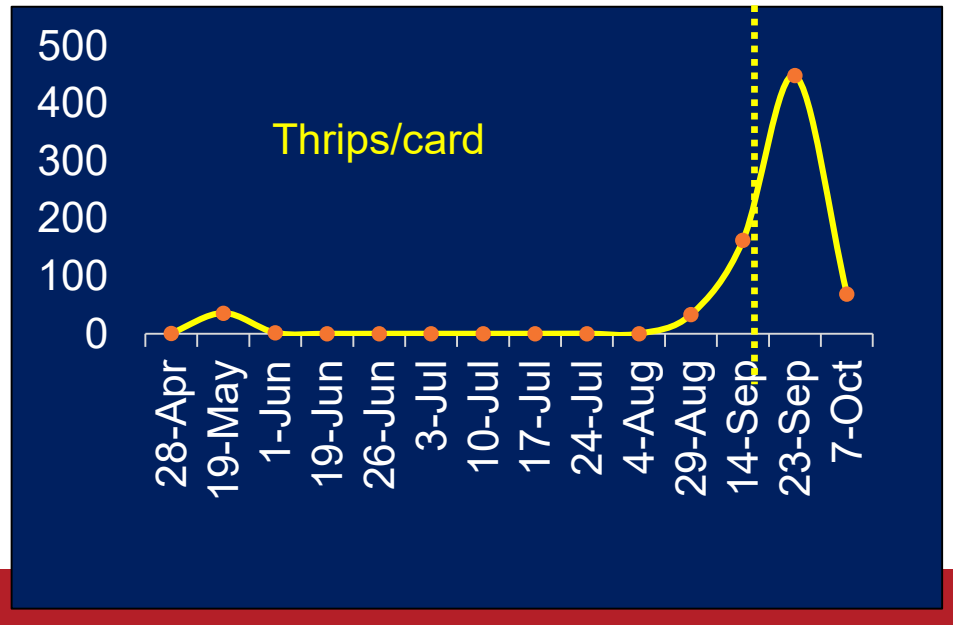
Stethorus population
North San Joaquin Valley



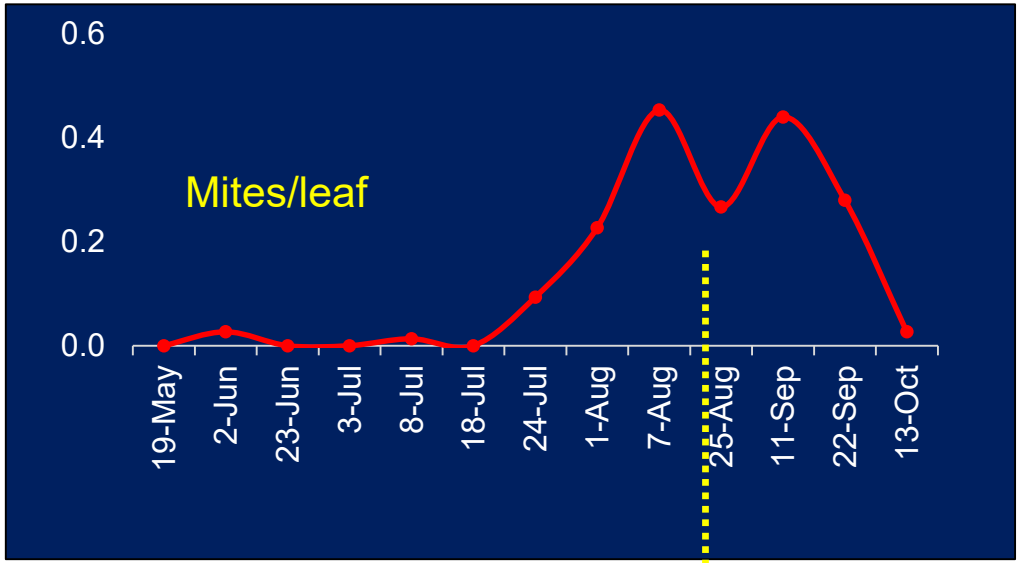
Sixspotted Thrips vs. Mite Population
North San Joaquin Valley

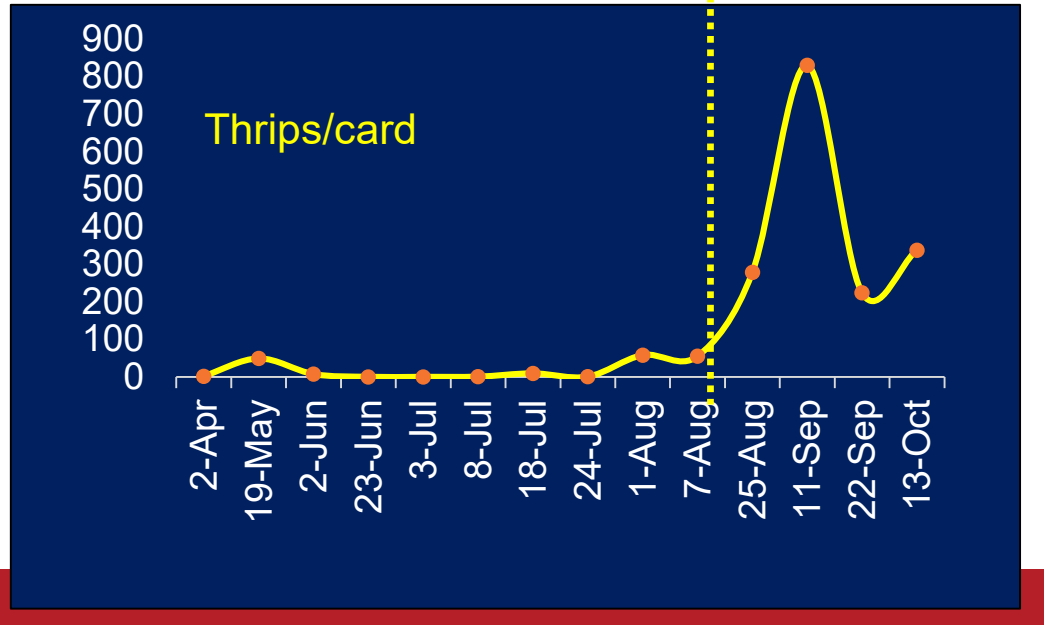
Turlock





Ballico





Conclusion: NOW and Mites

Navel Orangeworm

- Mating disruption (an excellent candidate for IPM)
- >65% damage reduction by using MD based on 2-yr demo trials in the northern San Joaquin Valley (along with regular insecticide program)
- Areawide MD approach should be the next step for comprehensive NOW management

Spider Mites:

- Strong evidence of mite predators (Stethorus, sixspotted thrips) presence in almond orchards in NSJV
- Monitor mites and predator population with leaf and yellow sticky card sampling
- Avoid broad-spectrum insecticides and prophylactic miticide application to conserve NEs

2018 Research Update: Brown Marmorated Stink Bug (BMSB)

Jhalendra Rijal, Ph.D.

IPM Advisor, Northern San Joaquin Valley

UC Cooperative Extension & UC Statewide IPM Program

california almonds
Almond Board of California

Brown Marmorated Stink Bug

- Invasive stink bug, *Halyomorpha halys* (Stal)
- First detection in PA around late-1990s
- In 2010, significant economic loss in Mid-Atlantic States ($ 37 million only in apple)
- >170 host crops

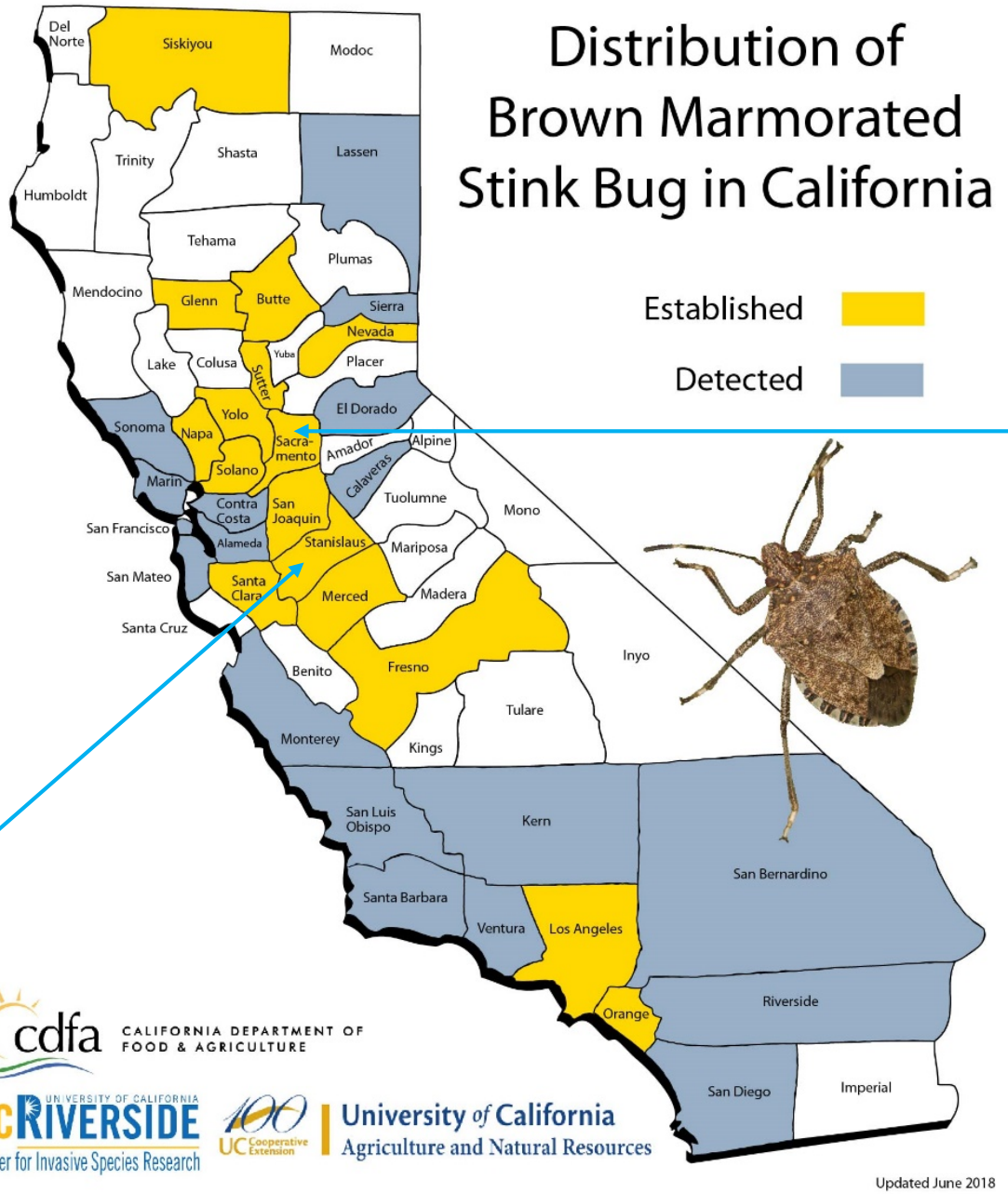
Photo: Doug Pfeiffer, Virginia Tech

~5/8 inch long, marble brown

www.pestworld.org

BMSB in CA

Established in 16 Counties



Severe nuisance problem since Fall 2013

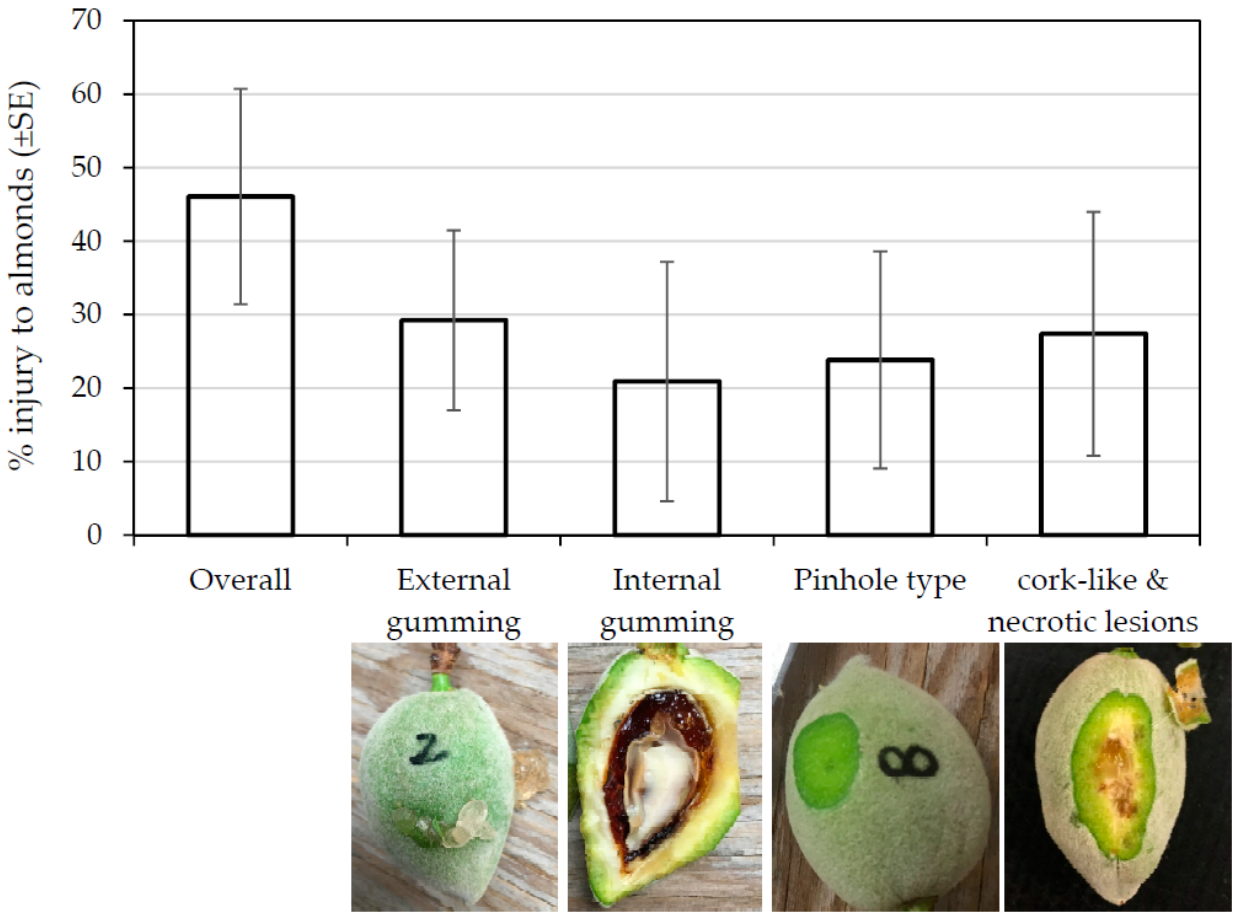
Modesto First detection 2015 July 2015

cdfa CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

UC RIVERSIDE UNIVERSITY OF CALIFORNIA Center for Invasive Species Research

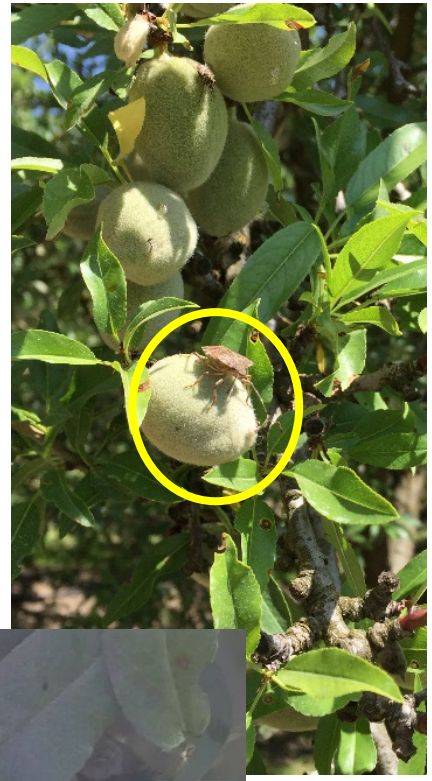
UC Cooperative Extension | University of California Agriculture and Natural Resources

2017-BMSB in almond orchard (First Report)



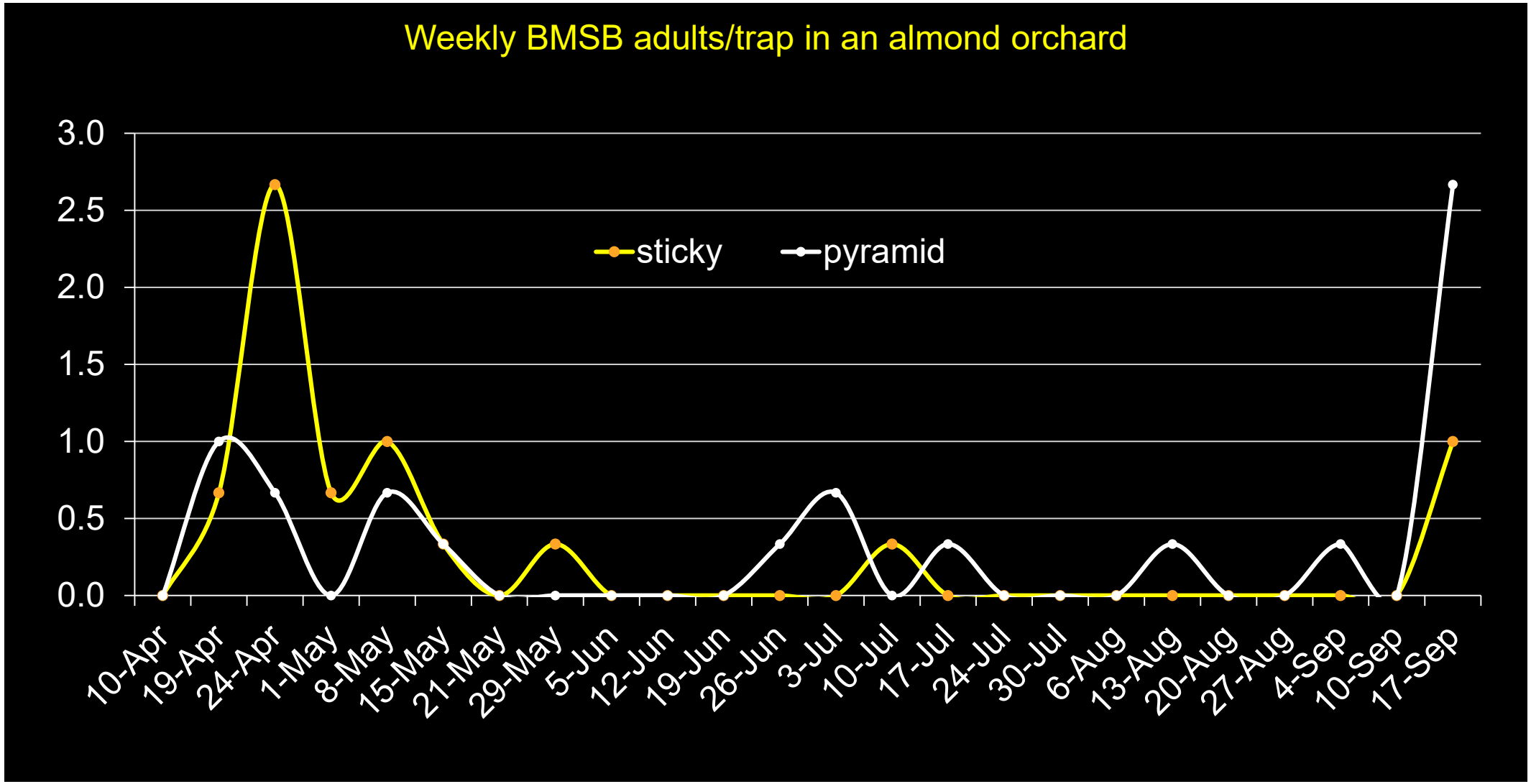
Rijal and Gyawaly 2018, Insects, 9(4):126

2018-BMSB infestation in 6 almond orchards in NSJV



Substantial nut drop

BMSB phenology



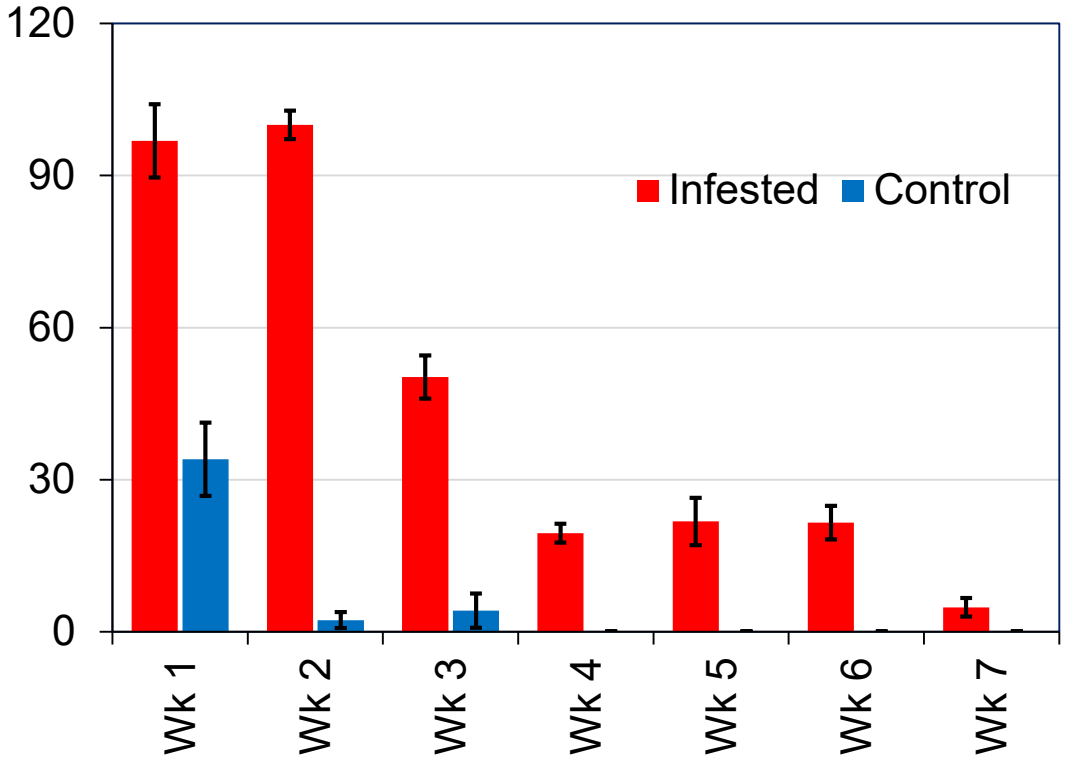
2018-Temporal Feeding Study in Almonds
(in collaboration with Dr. Zalom Lab, UCD)

- 2 varieties: Nonpareil and Monterey
- Fabric cages placed at early fruit set covering 7-15 nuts/cage
- 9 cages/variety infested with 3 BMSB adults/cage weekly
- Last wk. of March (Wk. 1) to the last wk. of July (Wk. 18)
- Nut size, nut development stage, drop nuts, shell hardness, injury categories: hull, shell, kernel.

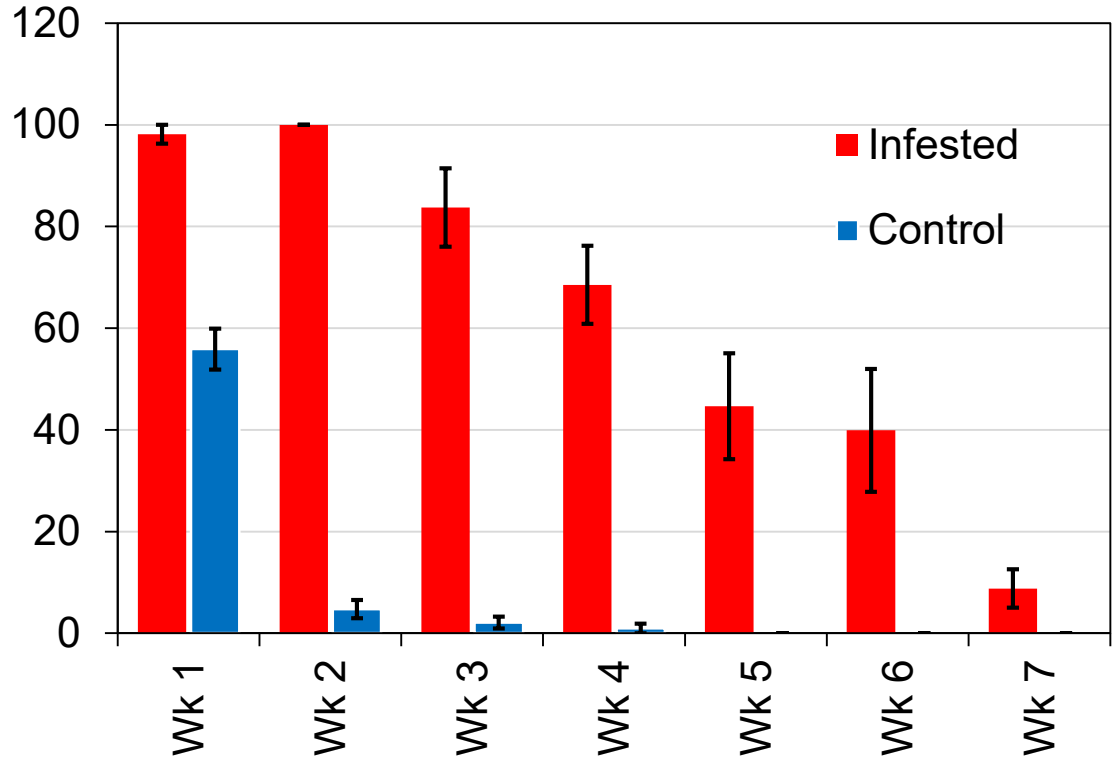
BMSB feeding study in almonds

% nut drop after 21 days of BMSB infestation

(var. Nonpareil)



(var. Monterey)



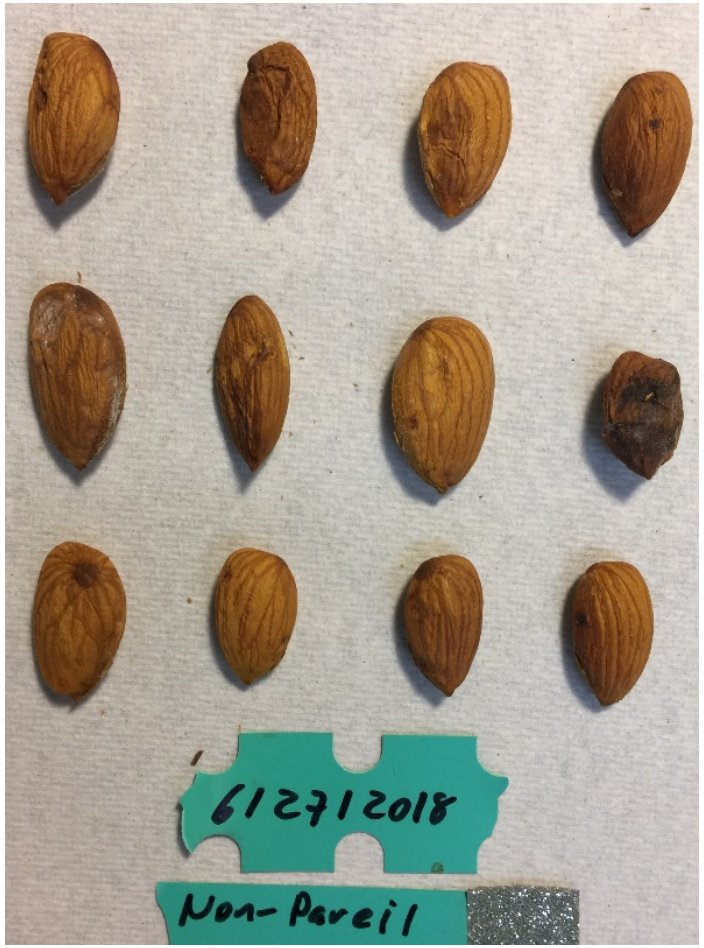
27 March (Wk 1) → 9 May (Wk 9)

BMSB feeding injury to almonds (April 11, Wk 3 infestation)

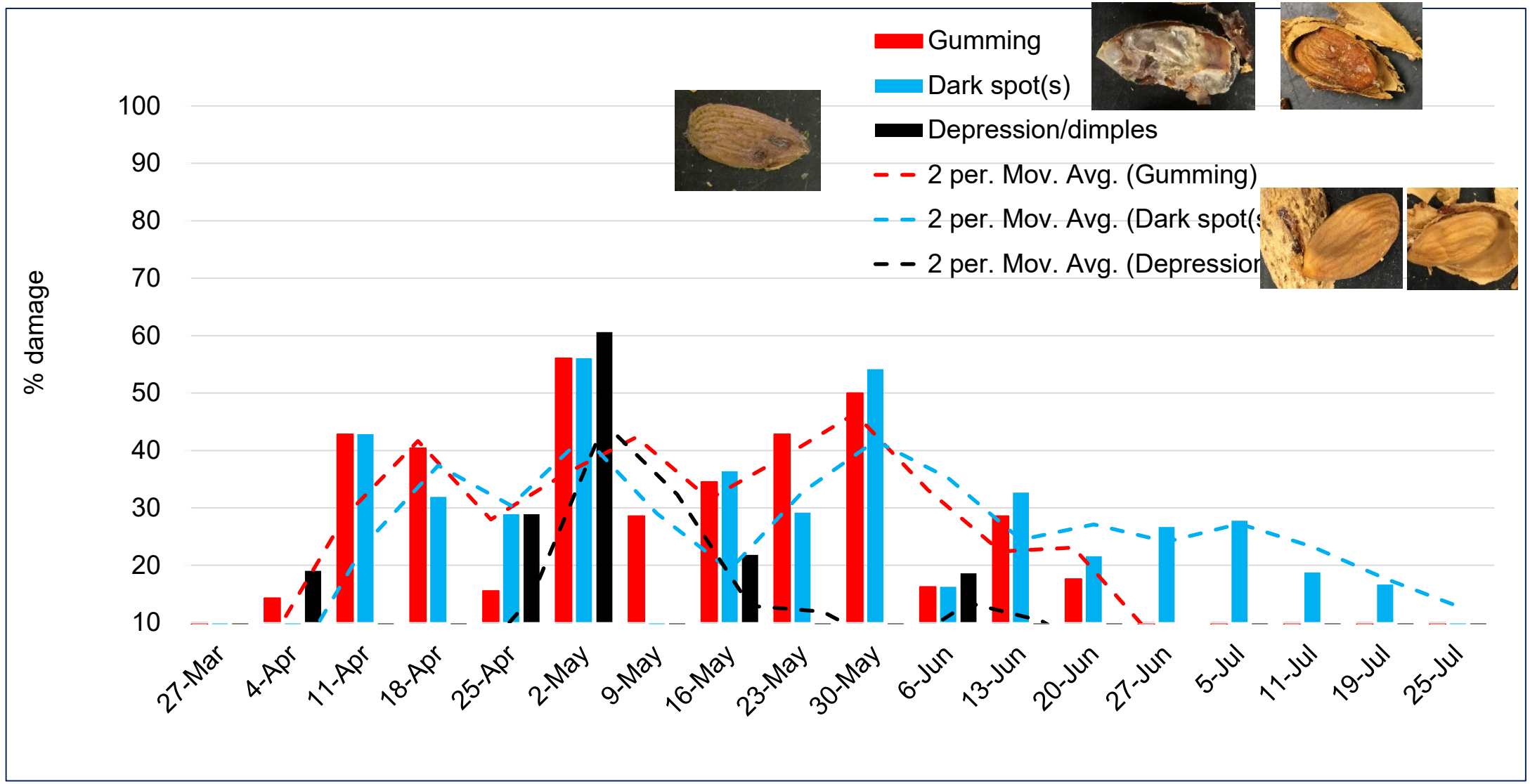
Control

Infested

BMSB damage at harvest



BMSB damage at harvest



Conclusion and recommendation for BMSB monitoring

- BMSB is spreading to agricultural areas and causing damage in commercial orchards
- BMSB seems to cause damage in almonds throughout the season
- Conduct visual inspections for the bug and damaged fruits (beginning March)
- Use sticky panel traps with BMSB lure early in the season to detect BMSB presence in the orchard

Acknowledgements

Pls. visit BMSB Poster # 18.ENTO23.Rijal

United States Department of Agriculture
National Institute of Food and Agriculture

USDA-NIFA SCRI 2016-51181-25409

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- **MD Product Support: Pacific Biocontrol, Semios, Suterra, Trece**
- **Cooperator Growers,**
- **Pest Control Advisers**
- **UC Farm Advisors and Faculties**

Help from: Daniel Green, Daniel Rivers, Raquel Gomez, Emily Buerer, Adriana Medina

Dr. Joanna Fisher, UCD

2018 Research Update: Sacramento Valley

Emily Symmes

IPM Advisor, Northern San Joaquin Valley

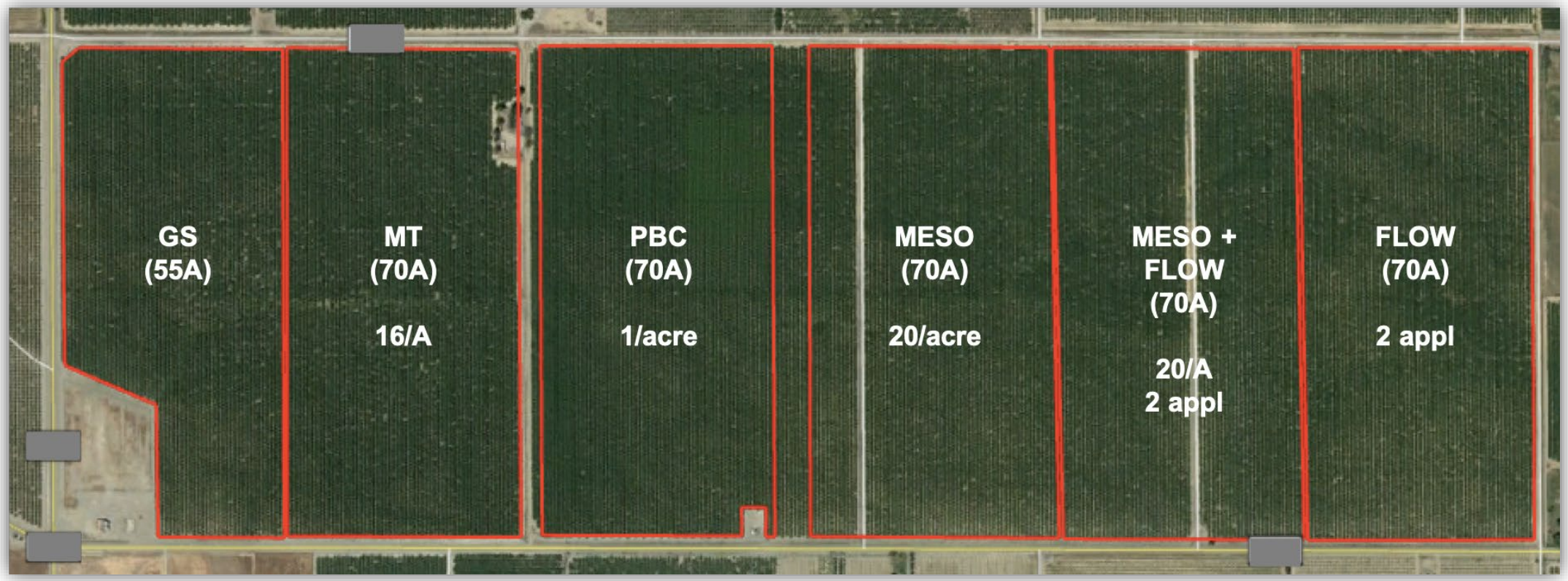
UC Cooperative Extension & UC Statewide IPM Program

california almonds
Almond Board of California

NOW IPM Demo 2018 – Sacramento Valley

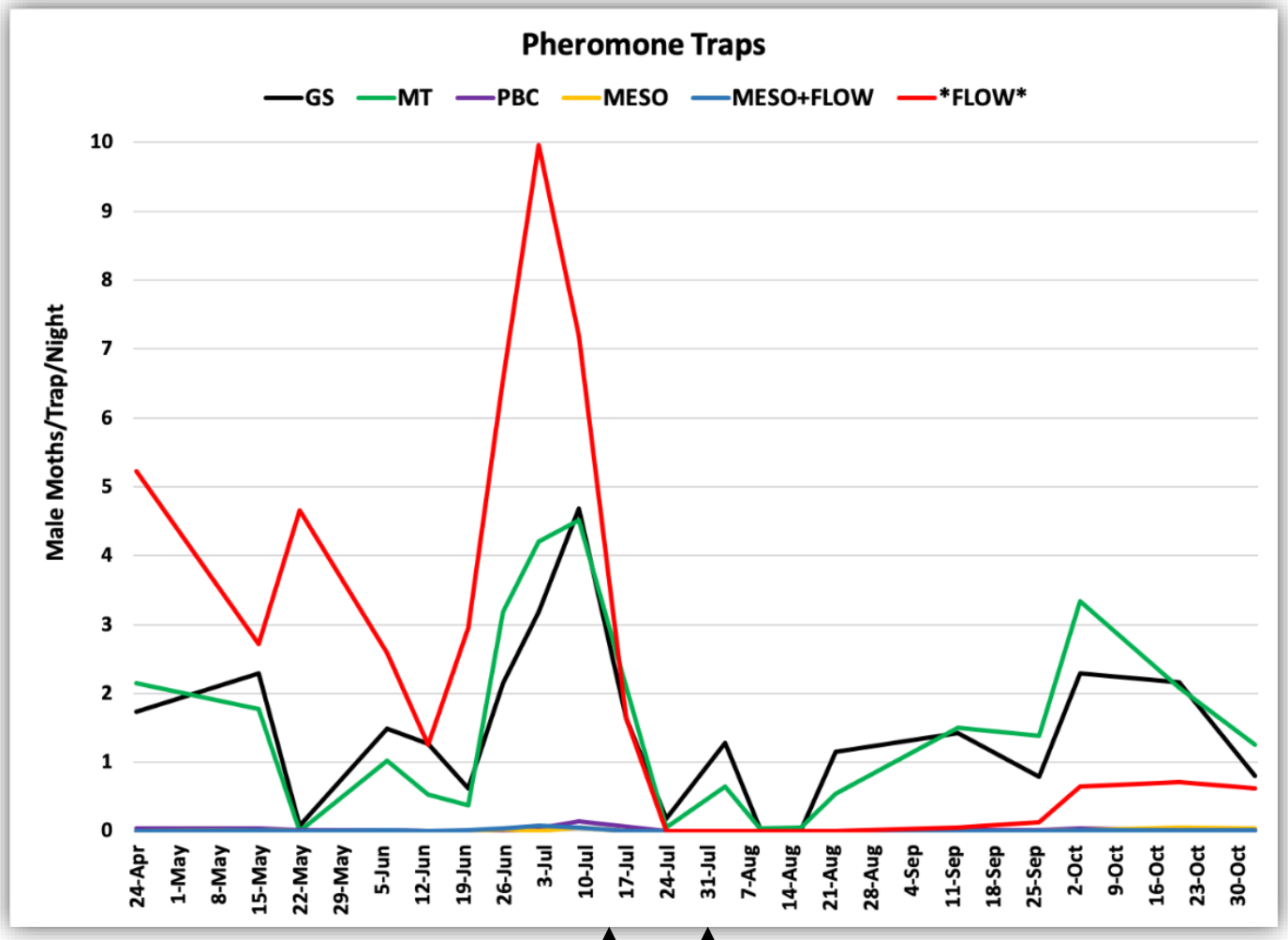
Treatment	Description	Plot Size	Application Timing
GS*	Grower Standard (3 insecticide applications)	55 acres	May 8, July 14, July 31
MT	Mass Trapping, Peterson Trap Co.	70 acres	April 19 – August 9
PBC	Pacific Biocontrol ISOMATE® NOW Mist (aerosol)	70 acres	April 9
MESO	Trécé Cidetrak® NOW MESO (passive)	70 acres	April 9
MESO+FLOW	Trécé Cidetrak® NOW MESO (passive) + sprayable NOW pheromone (experimental formulation)	70 acres	April 9 (MESO) July 14, July 31 (FLOW)
FLOW	Trécé sprayable NOW pheromone (experimental formulation)	70 acres	July 14, July 31 (FLOW)

NOW IPM Demo 2018 – Sacramento Valley



Glenn County, CA. Nonpareil, Winters, Monterey

NOW IPM Demo 2018 – Sacramento Valley



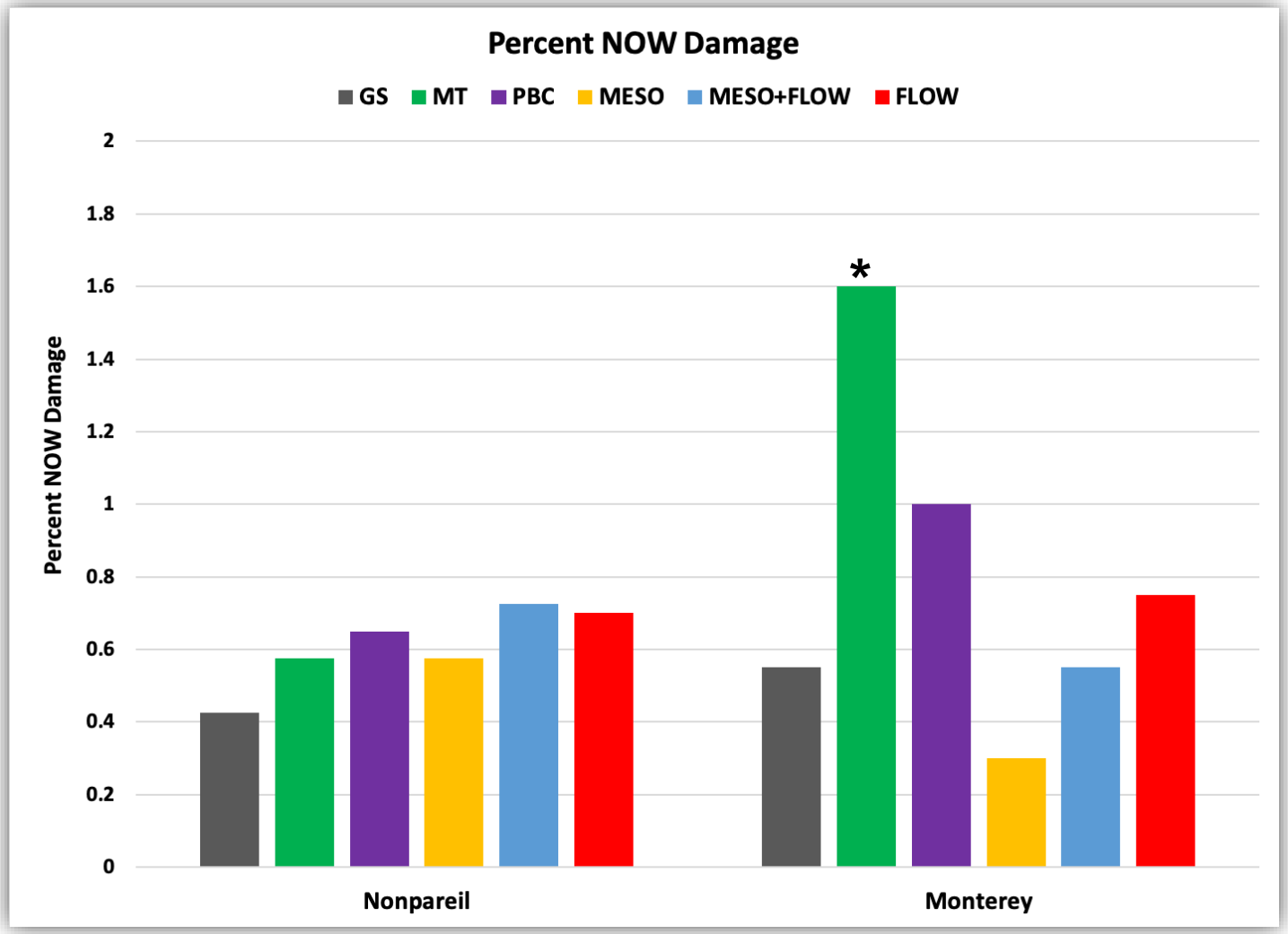
Flowable applications

% Reduction Relative to GS	
MT❖	NA (+1.4%)
PBC	98.7%
MESO	99.3%
MESO+FLOW	99.3%
FLOW*	98.0%

* Cum. 8 wks post appls. (7/17-9/12)

❖ 12,456 total moths reduced by MT

NOW IPM Demo 2018 – Sacramento Valley



Harvest Samples

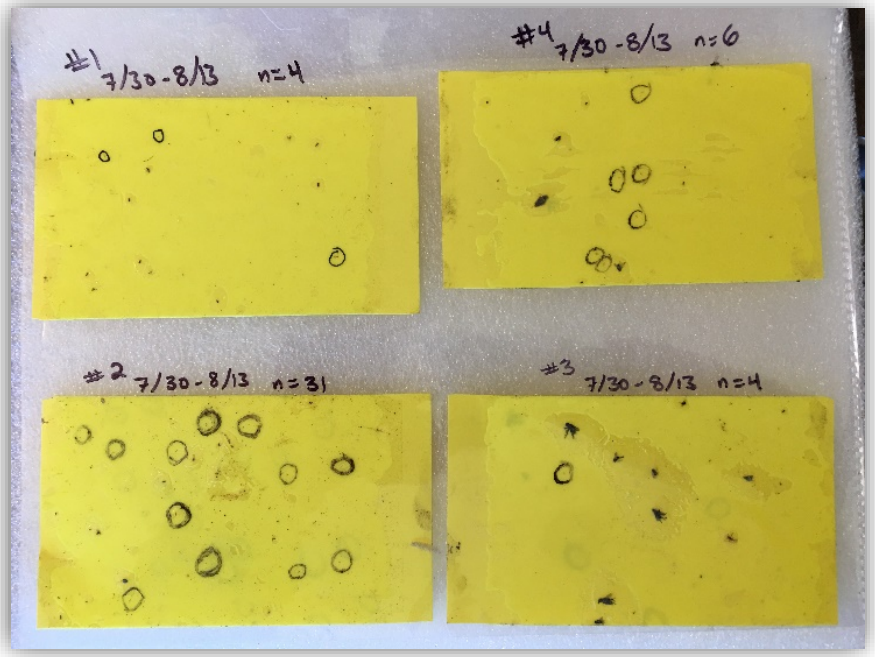
Variety	Date Collected	No. Evaluated/Plot
Nonpareil	9/5-9/8	4,000 (20 X 200)
Monterey	9/26	2,000 (10 X 200)

*Mass trapping removed prior to Nonpareil harvest

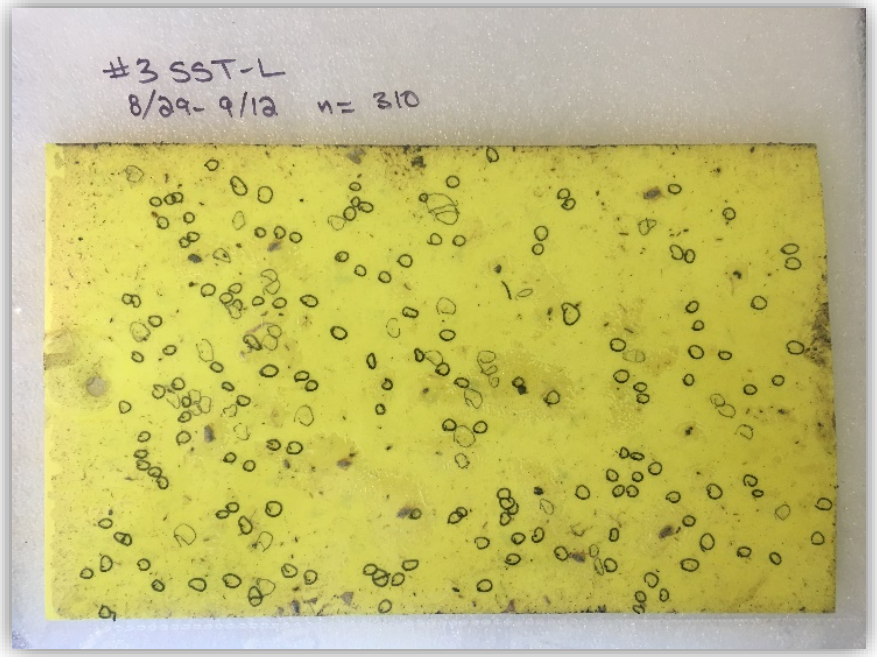
NOW IPM Demo 2018 – Sacramento Valley

Female mating status evaluation underway

Sixspotted Thrips – Sacramento Valley



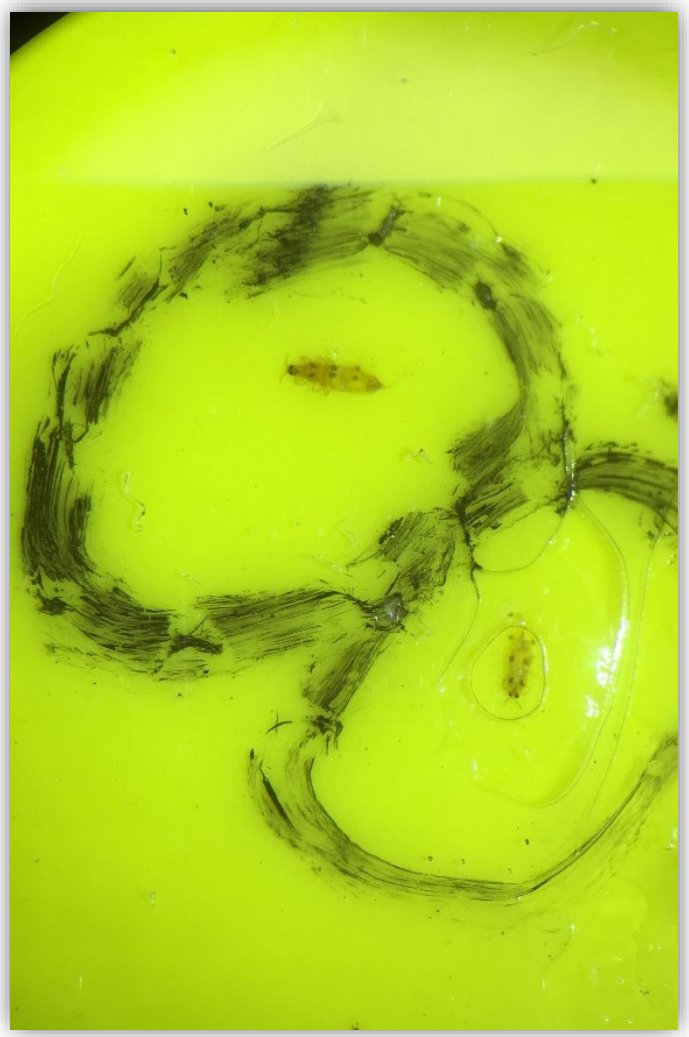
Small 5-in X 3-in

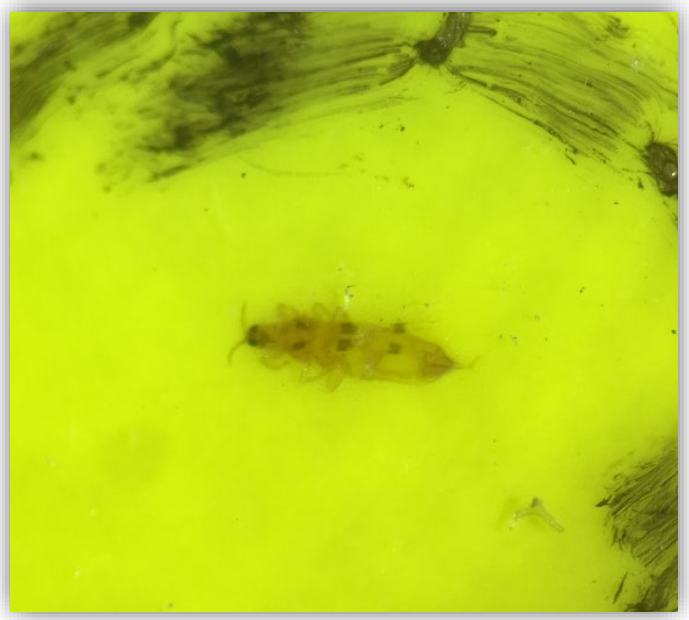


Large 10-in X 6-in

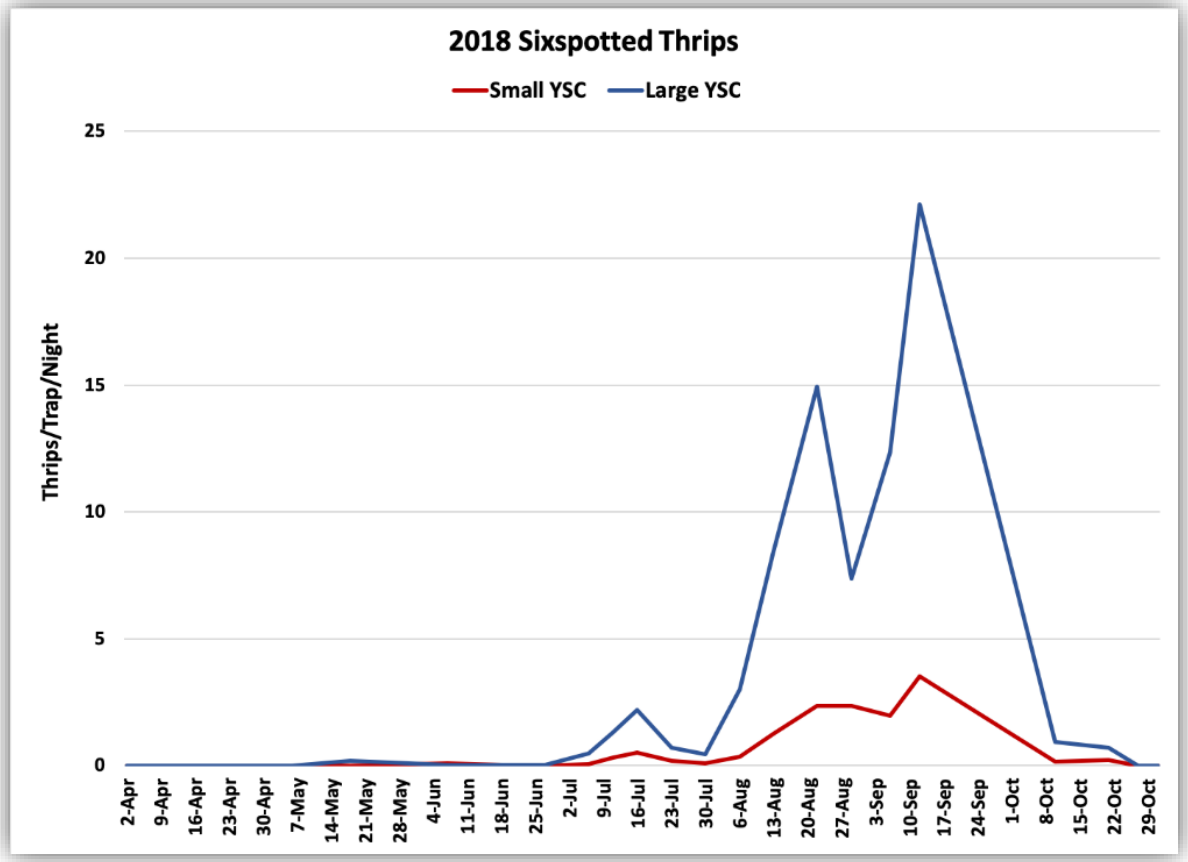
Great Lakes IPM Yellow Sticky Strips

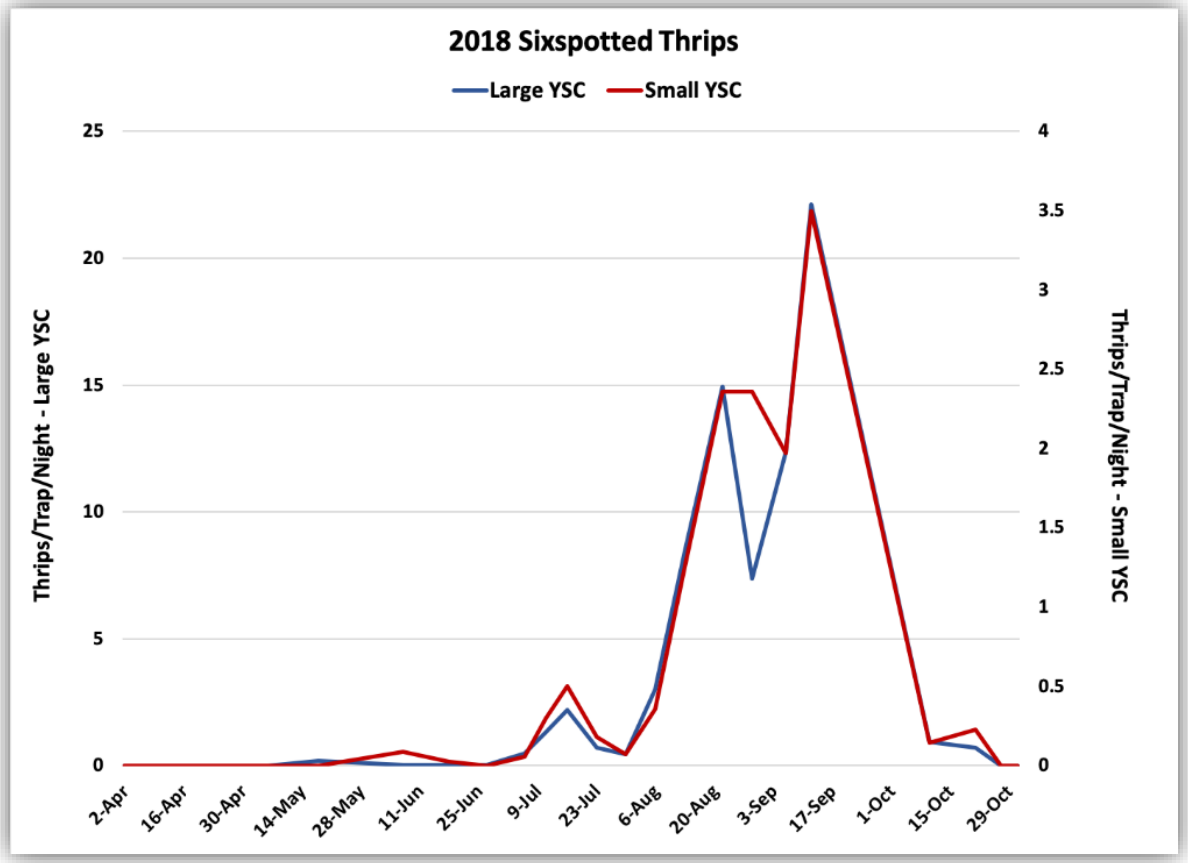
Sixspotted Thrips – Sacramento Valley





Sixspotted Thrips – Sacramento Valley





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Thank you!


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