USDA Agricultural Research Service

UC RIVERSIDE

Update on the Navel Orangeworm Sterile Insect Technique Program

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Overview

- Previous Sterile Insect Technique (SIT) programs for moths
- Navel orangeworm (NOW) SIT program to date
  - Phase 0
  - Phase 1
  - Next step—phase 2

Previous SIT Programs for Moths

Pink bollworm
1970s to 2018
Suppression, eradication

Codling moth
1990s to present
Suppression

False codling moth
2008 to present
Suppression

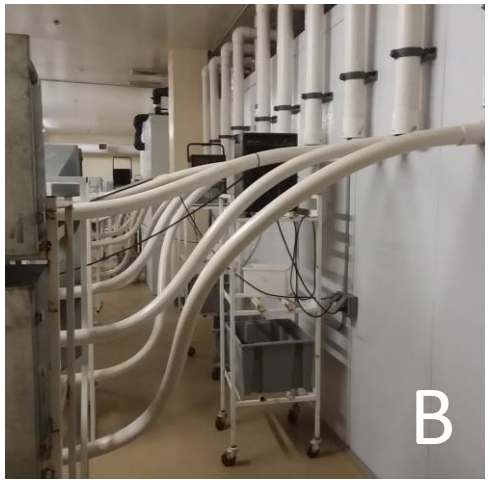
In Lepidopteran SIT both sexes are released

Phoenix, AZ

“Magazine” for transport

Shafter, CA


A


B


E


G

Commercial overnight transport to California


C


D

F

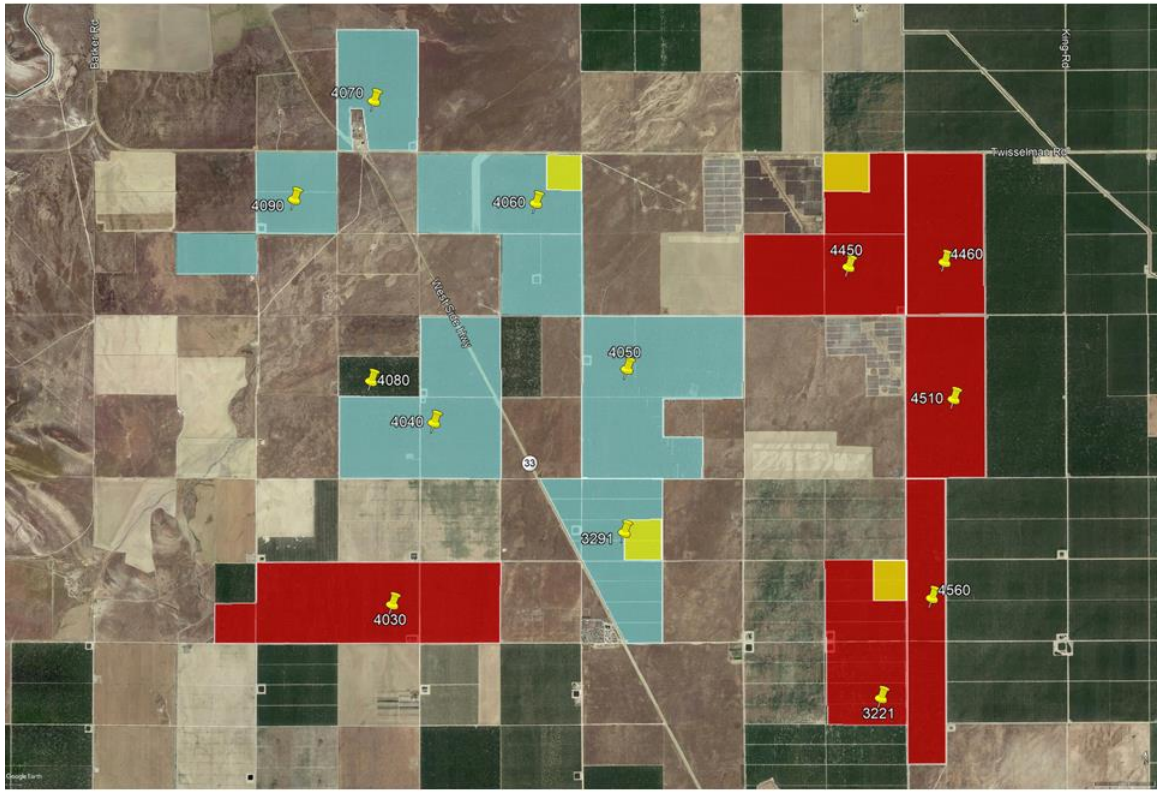
CA Central Valley


H

Phases of the NOW SIT Demonstration Program

Phase	Location, time	Monitoring	Mating Disruption?	Objective
0	Kern County, 2018 & 2019	Egg traps, pheromone	Yes	Delivery
1	West Fresno County, 2020-2022	Bait traps, PPO + pheromone	No	Improve recovery, characterize movement
2	West Fresno County, 2023…	PPO + pheromone	Depends	Improve plot pairing

NOW SIT Phase 0: Kern County, 2018 & 2019

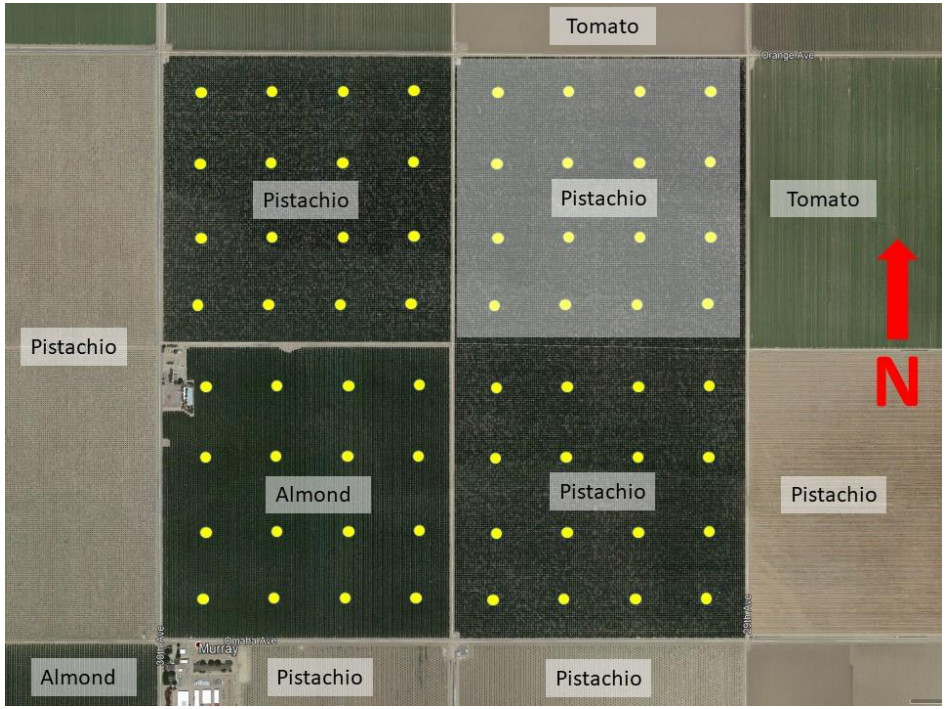


Poor recovery—real, or artifact of mating disruption and monitoring tools?

2018 Research Site, Kings County

Males captured in pheromone in absence of mating disruption?

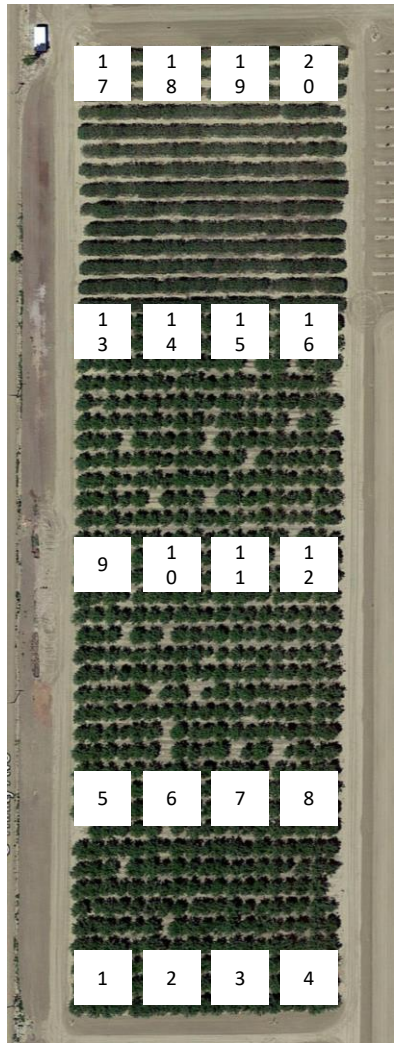
Jul-Oct 2018

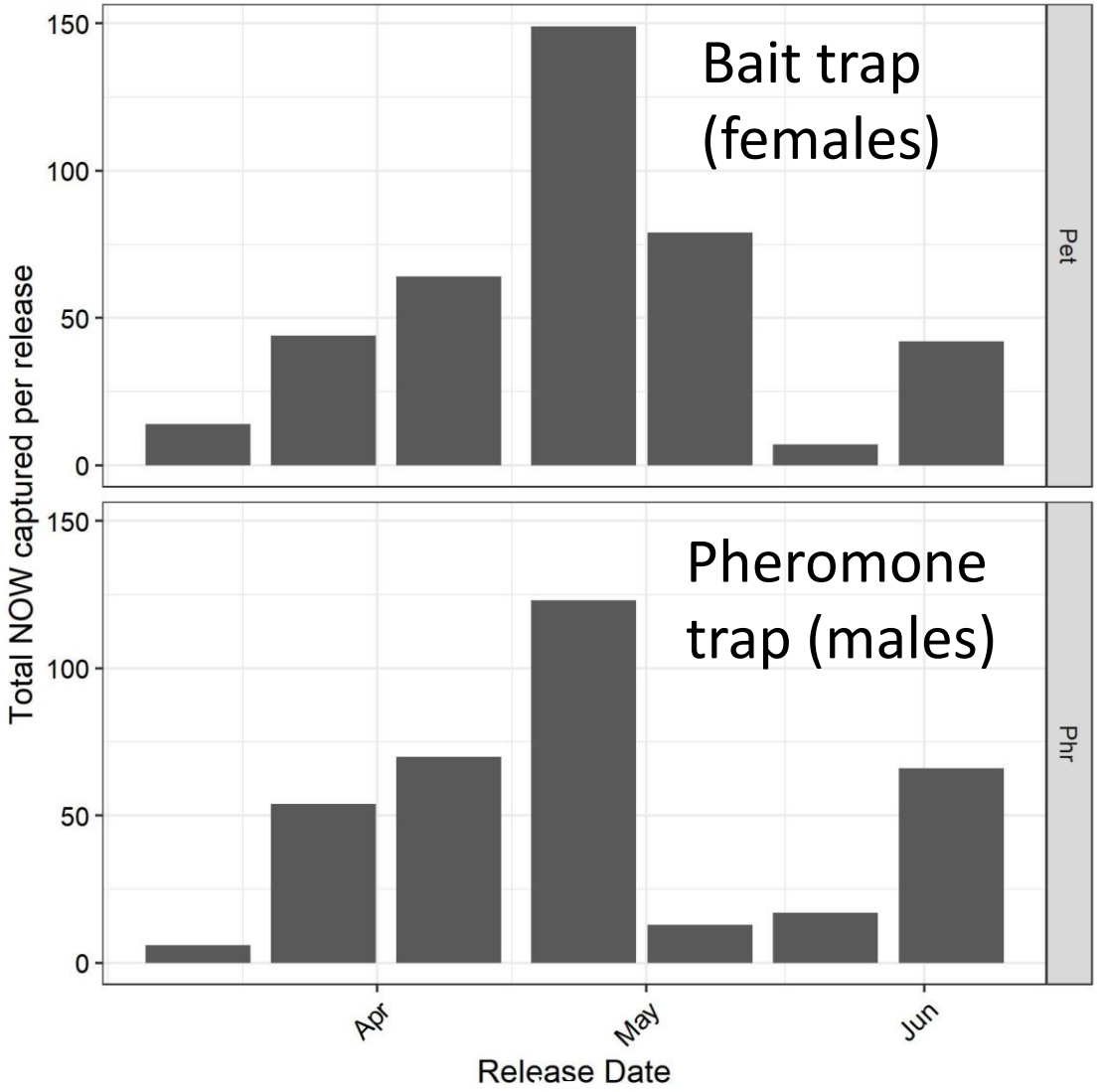


- No mating disruption
- Monitored with pheromone traps

Sterile males released:	**4.5 million**
Males captured:	**15,493**
Sterile males captured:	**55**
Sterile as percent captured:	**0.35%**
Percent steriles recaptured:	**0.0012%**

2019 Research Site, Fresno County





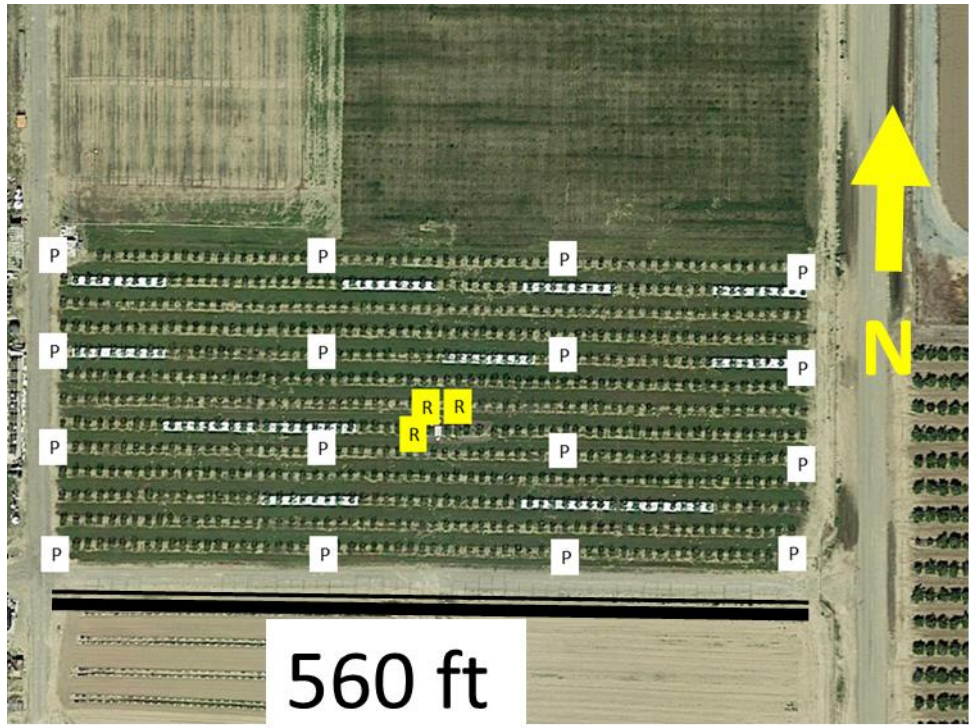
Q. Recovery improved with release of non-irradiated NOW shipped from Phoenix?

A. No

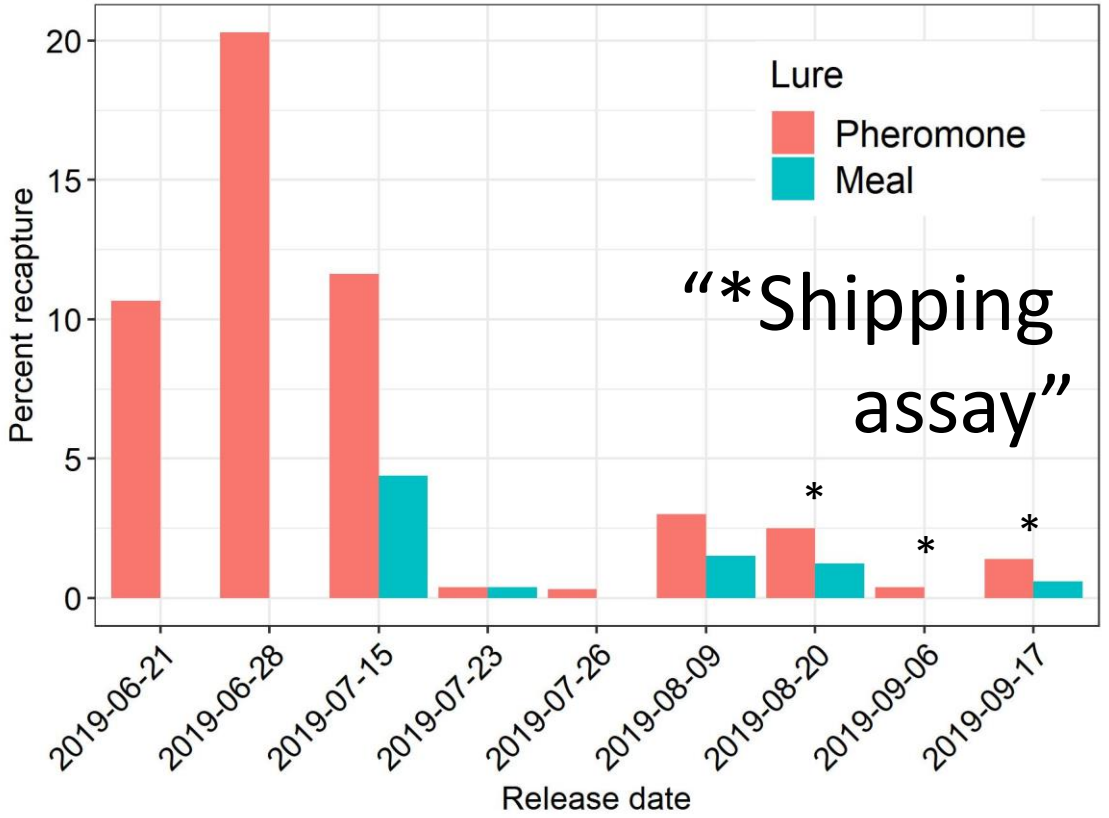
- Released 42,000 mixed-sex moths into UC Westside field station.
- Recaptured 39

2019 Research Site, Fresno County

USDA-ARS Parlier—Recapture of Locally Produced NOW

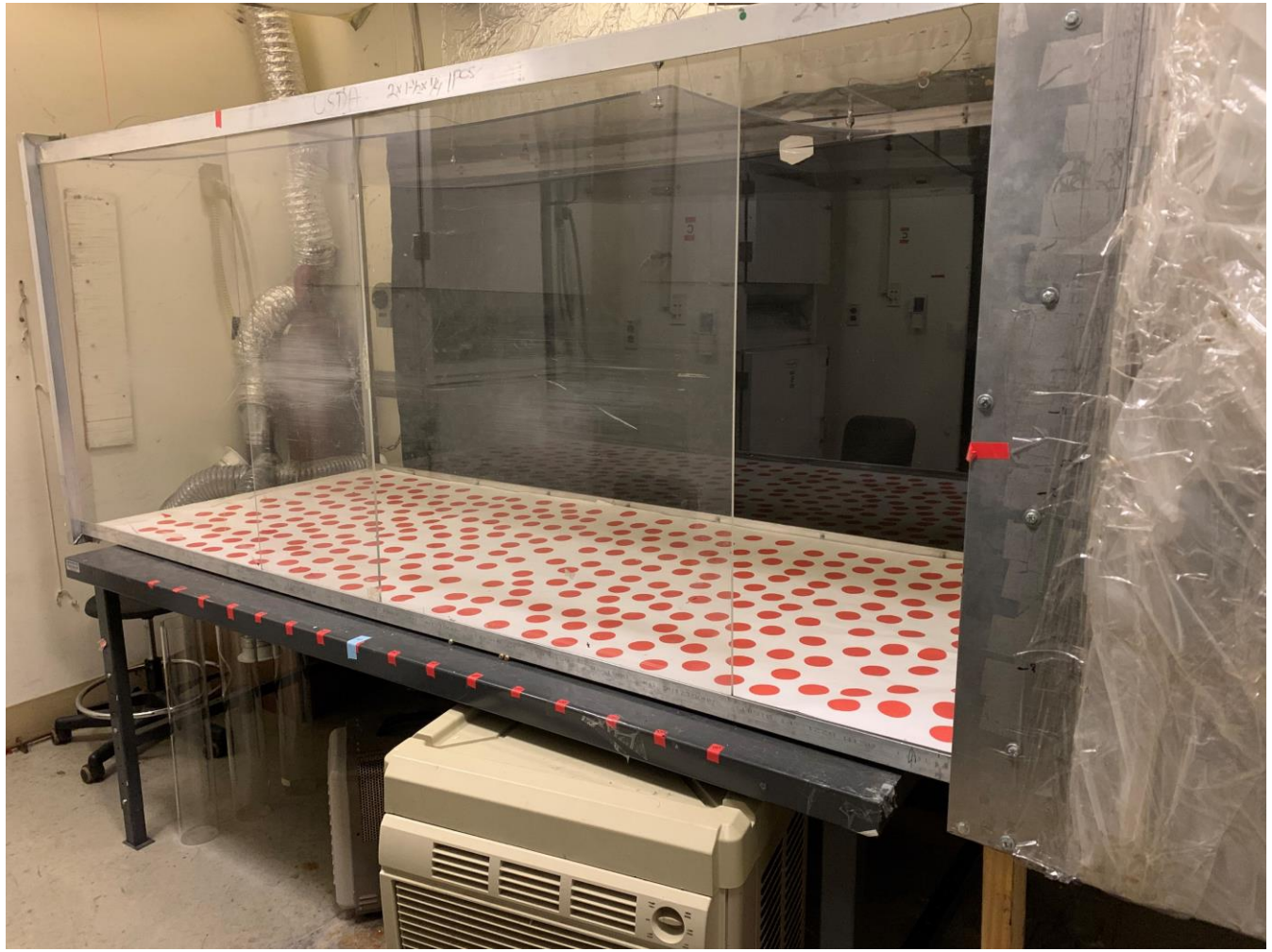


USDA-ARS Parlier Pomegranate Block



What is a reasonable recapture rate?

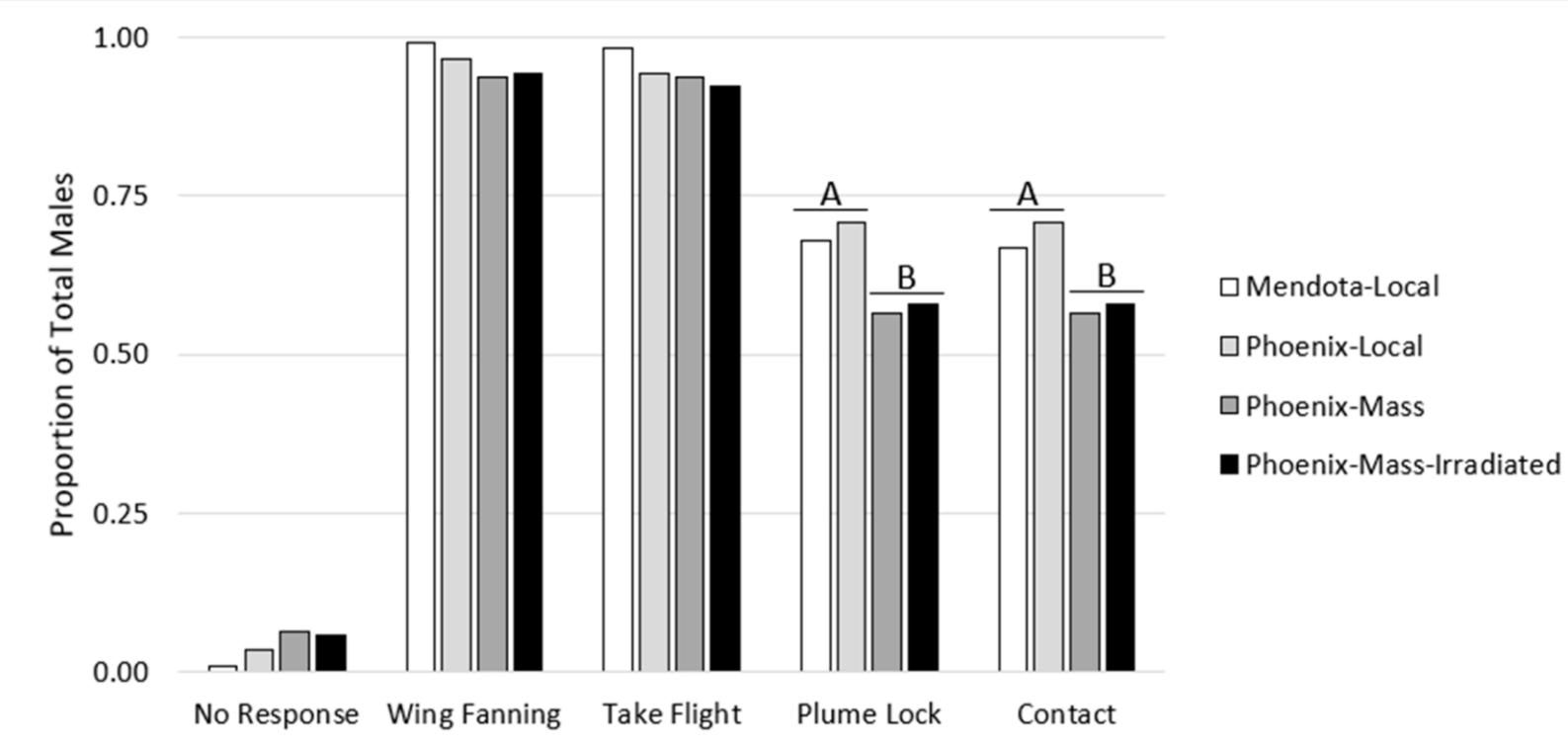
2019 Research—Wind Tunnel Response



- Impact of irradiation and shipping on male response to sex pheromone
- Are irradiated mass-release males unable to follow a pheromone plume?
- Compare locally-reared moths, shipped moths, and shipped irradiated moths

Joshua Reger (MS Thesis, Fresno State); Matt Hicks, USDA-ARS Parlier

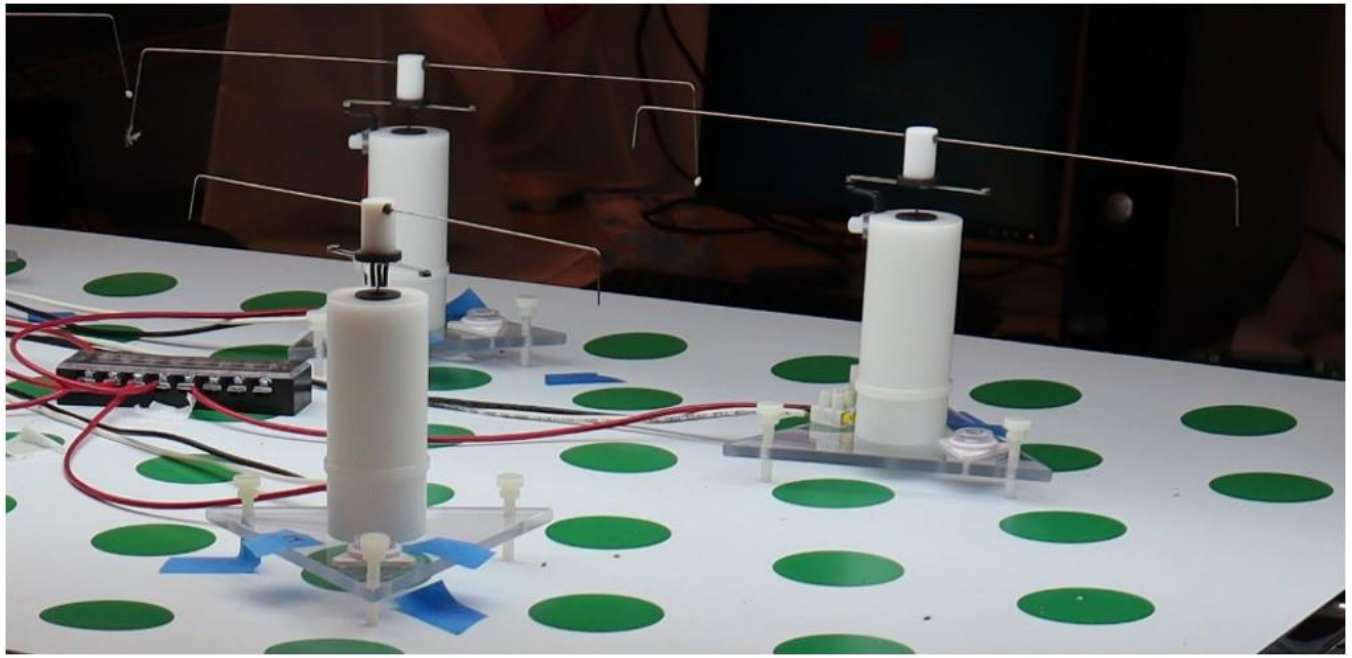
2019 Research—Wind Tunnel Response



Reger et al., Insects 2020 Vol. 11 Issue 10 Pages 703

- Irradiated mass-produced NOW can follow pheromone
- Pheromone tracking reduced by shipping, but not by irradiation

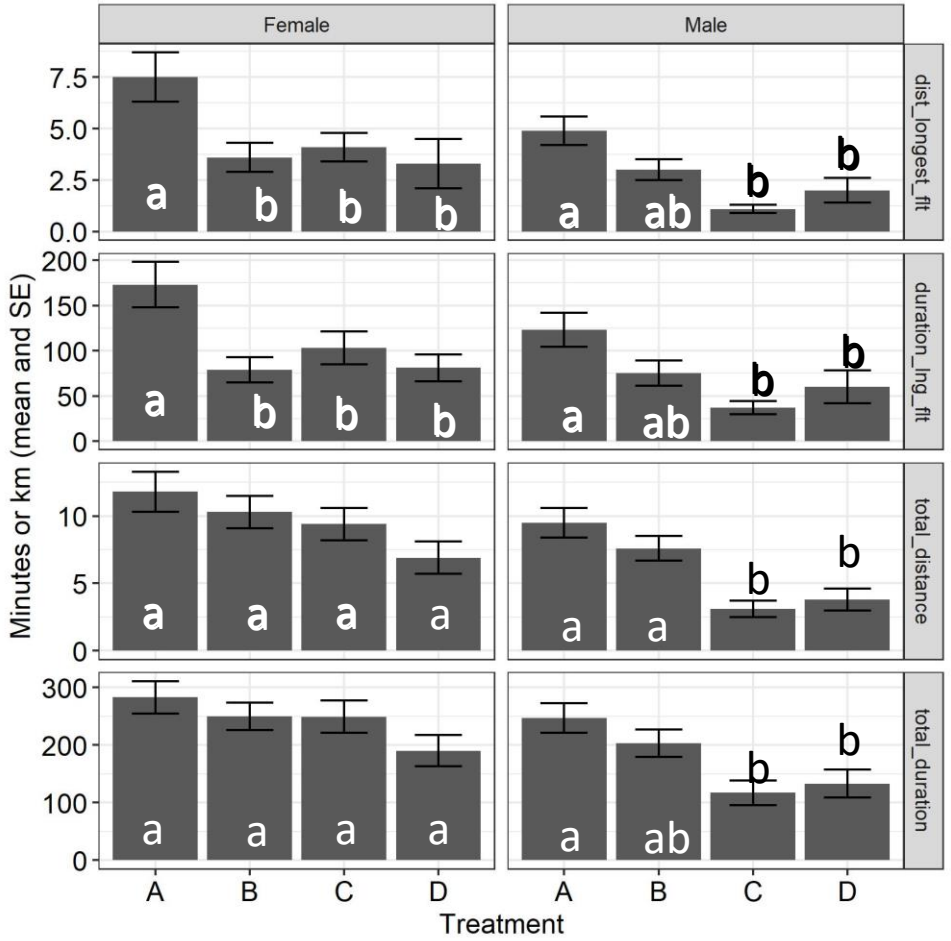
2019 Research—Flight Mills



Joshua Reger (MS Thesis, Fresno State)

- Does shipping or irradiation affect flight ability?
- Is the impact different between males and females?

2019 Research—Flight Mills

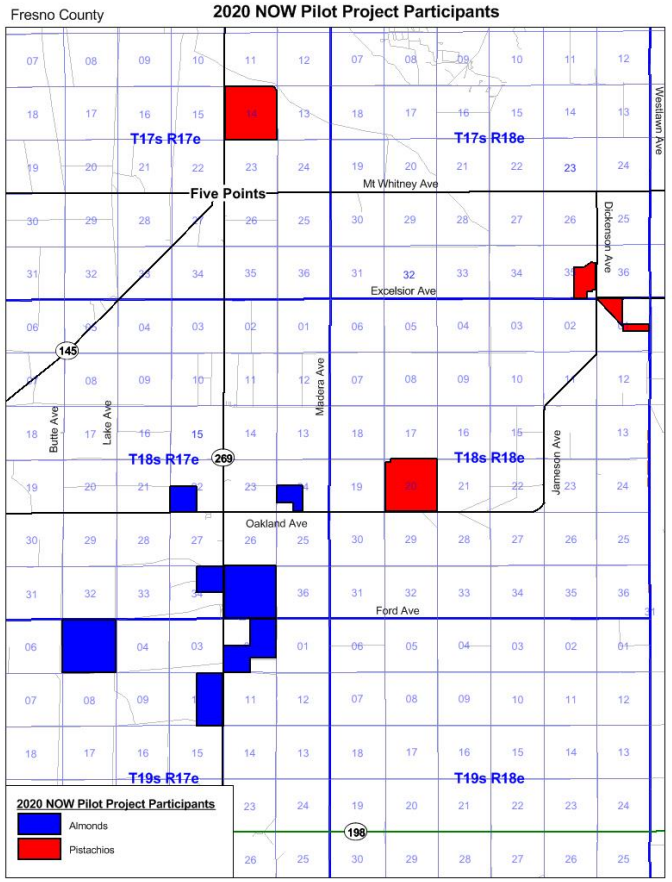


A – Mendota Local
B – Phoenix Local
C – Shipped Non-irradiated
D – Shipped Irradiated

- Male flight ability affected by shipping, not irradiation
- Impact on females different and more subtle

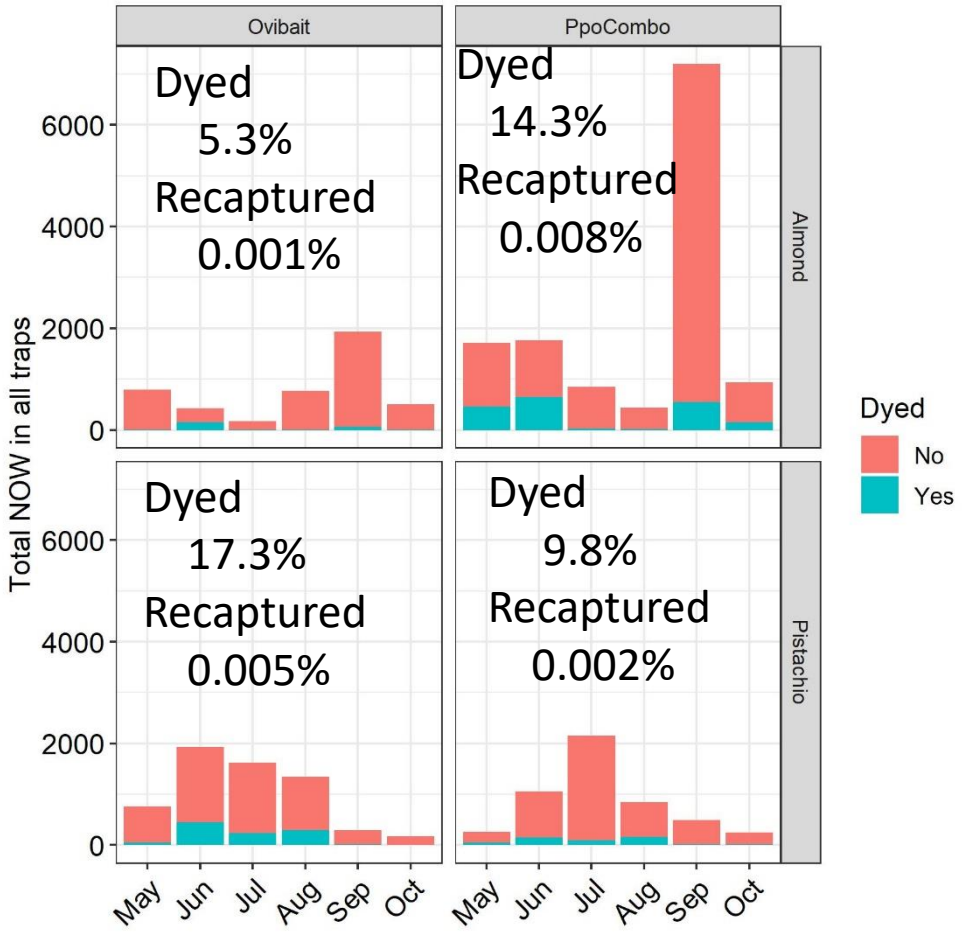
Reger et al., J. Econ. Entomol. 2021, 114: 1542-1548

NOW SIT Phase 1: Fresno County, 2020-2022



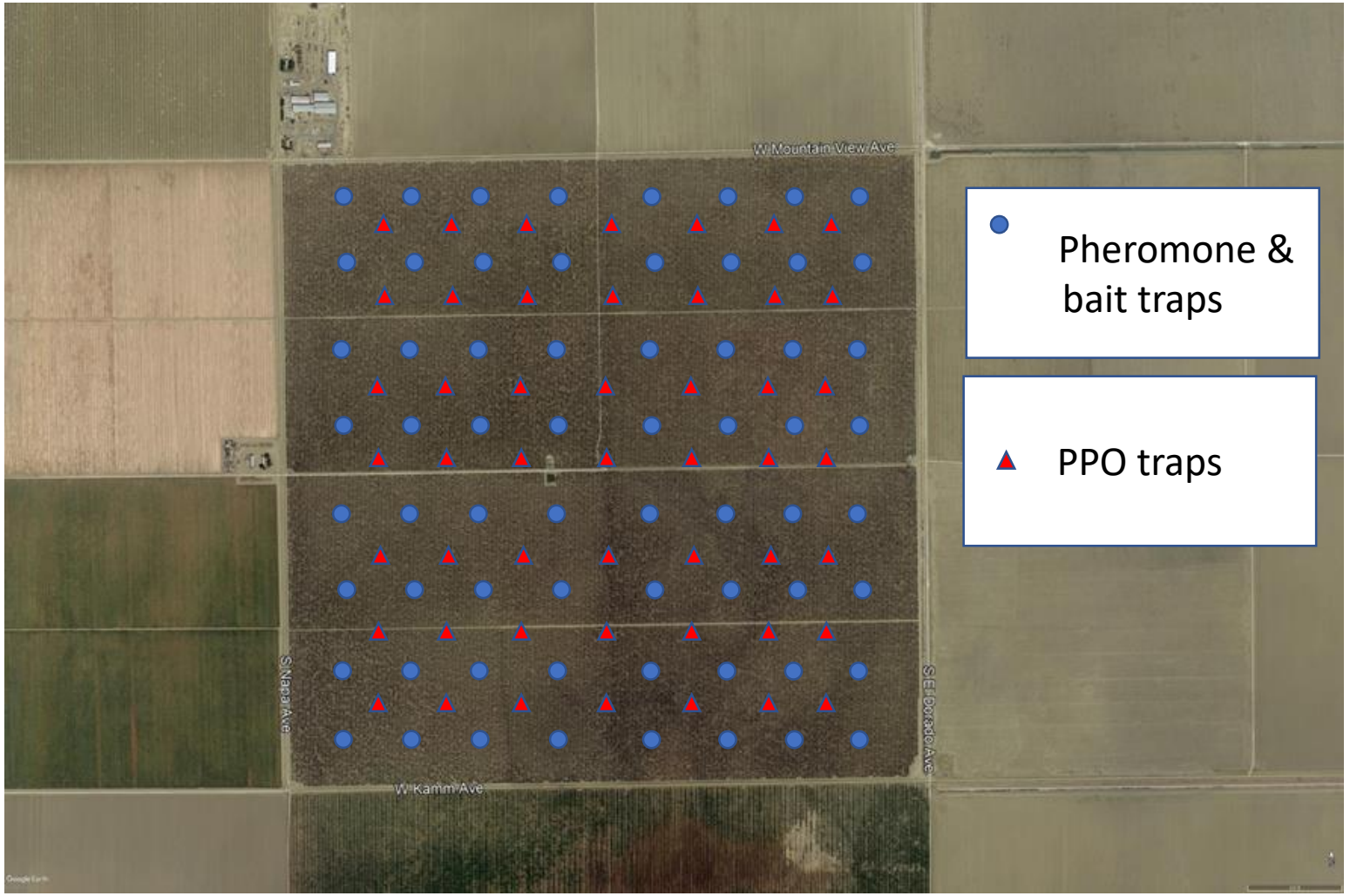
- Various cooperators
- Bait traps (females) and PPO synergized with pheromone (both sexes)
- No mating disruption*

Phase 1: 2020 NOW SIR Pilot Program—Improved Recapture



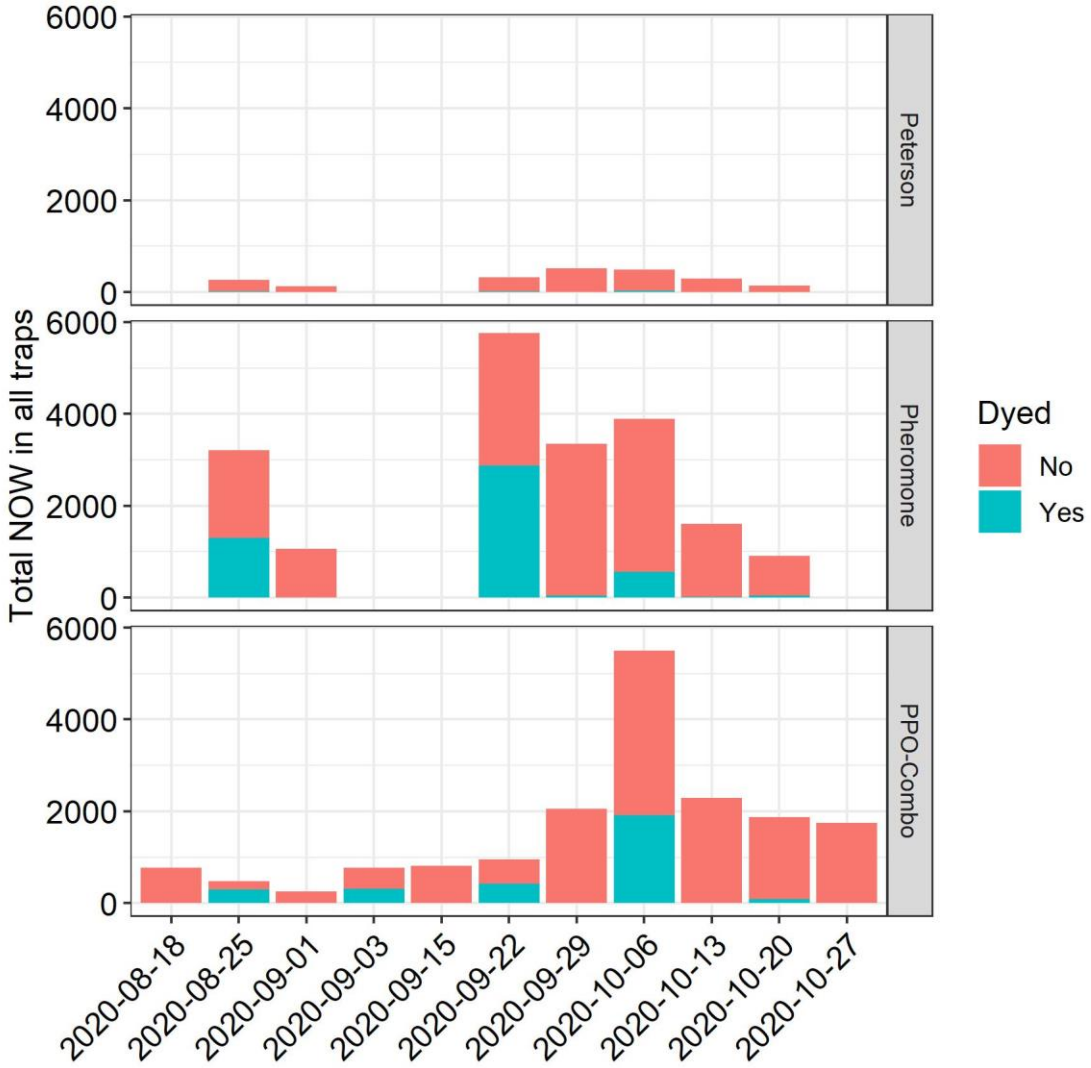
- Date only for the two drop zones
- May 5 to October 12
- Recapture rate presumes 22.5 million of each sex dropped at each site
- Markedly improved recovery
- Recapture rate still low

2020 Research—Aerial releases over a non-MD site



- 8 x 8 grid of pheromone and ovibait traps (blue)
- 7 x 7 grid of PPO combo traps (red)
- Received NOW SIR releases on two single days, 2 weeks apart
- **No mating disruption**

Phase 1: 2020 NOW SIR Pilot Program—Improved Recapture



- PPO-combo used for comparison with data from mating disruption sites
- Substantial and replicated recapture of males; less of females
- Up to half of moths in trap dyed
- Recovery ~ 0.5%, higher than pilot zones with daily drop

Crop Years 2021/2022

Dispersal in Large Block Setting - Pistachios

Weekly Release with Grid of Traps

Crop Years 2021/2022

Dispersal in Large Block Setting - Pistachios

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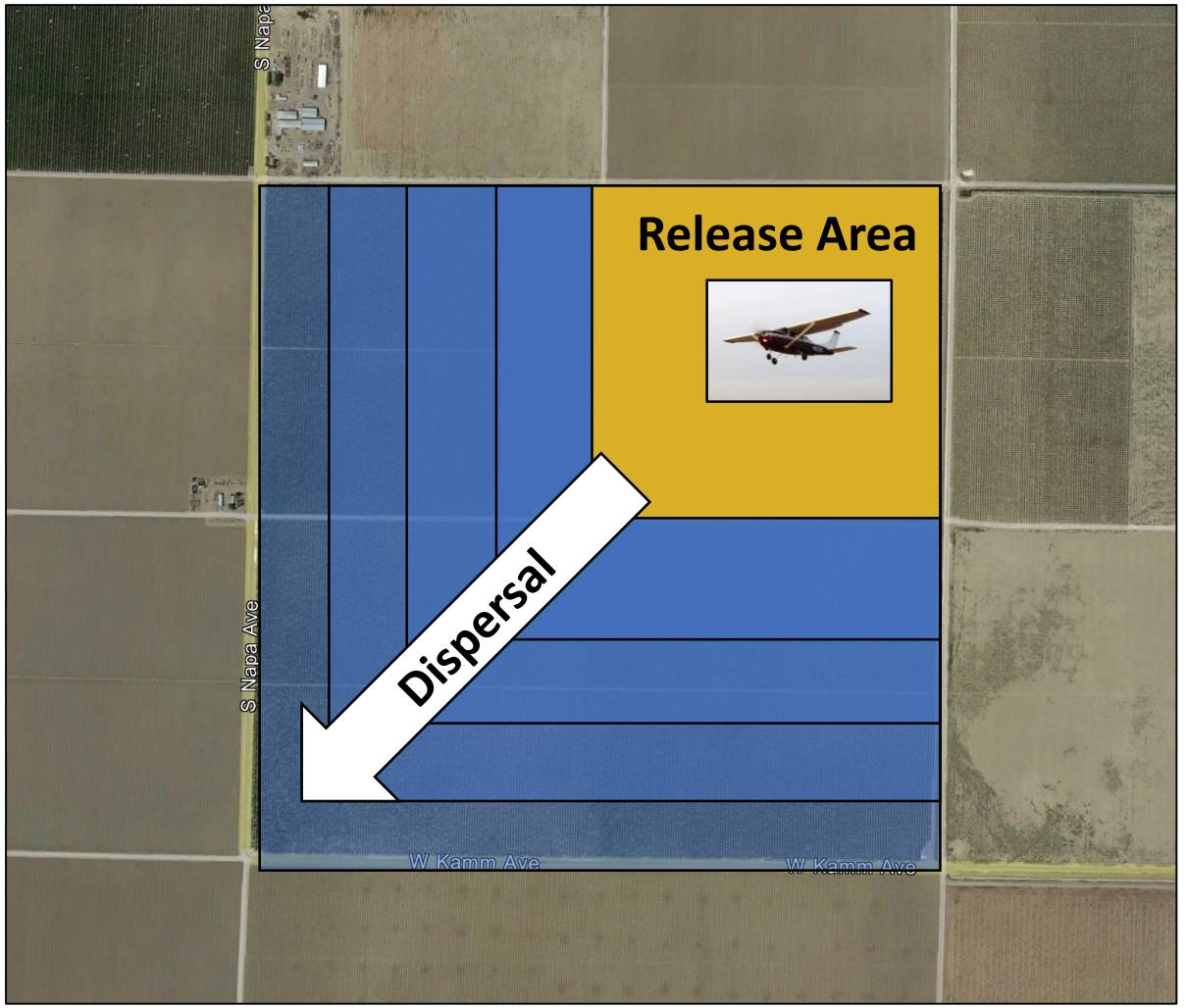
Dispersal in Large Block Setting - Pistachios

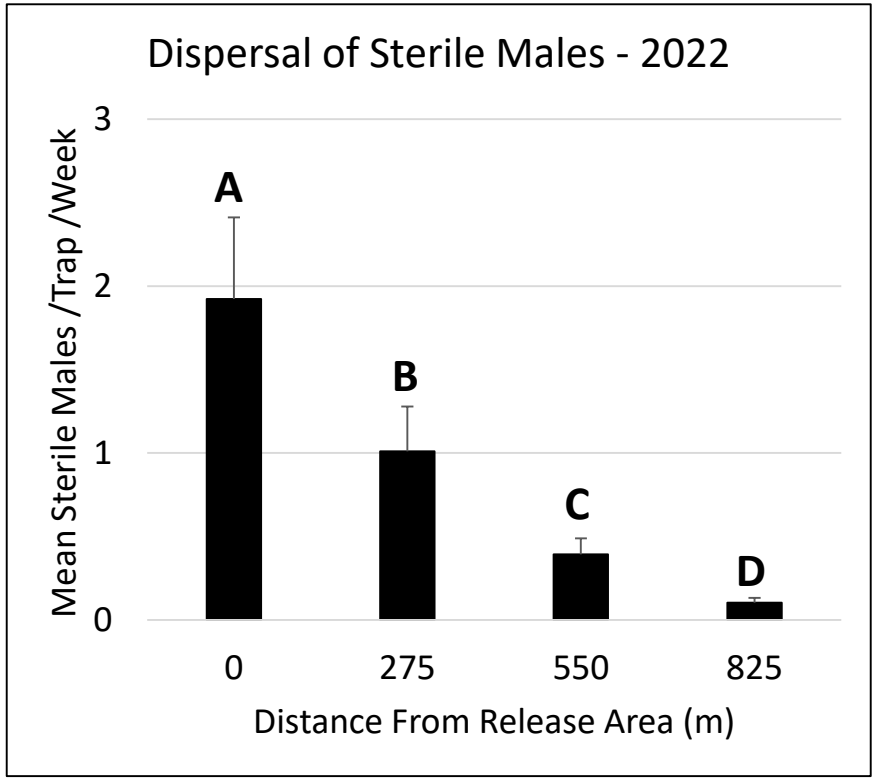
Weekly Release with Grid of Traps

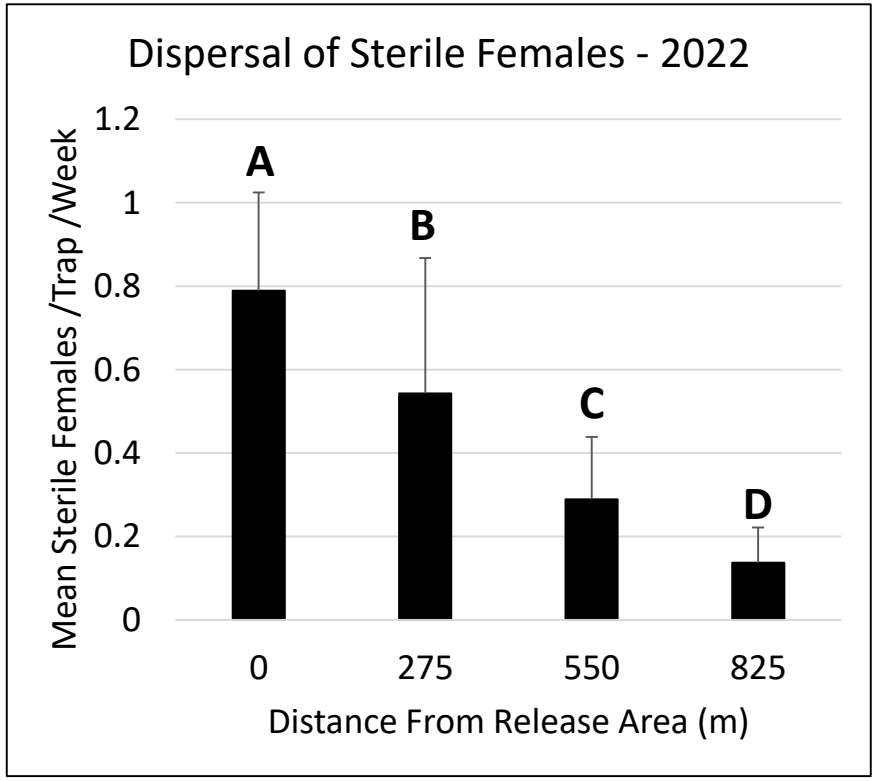


Crop Years 2021/2022

Dispersal in Large Block Setting - Pistachios

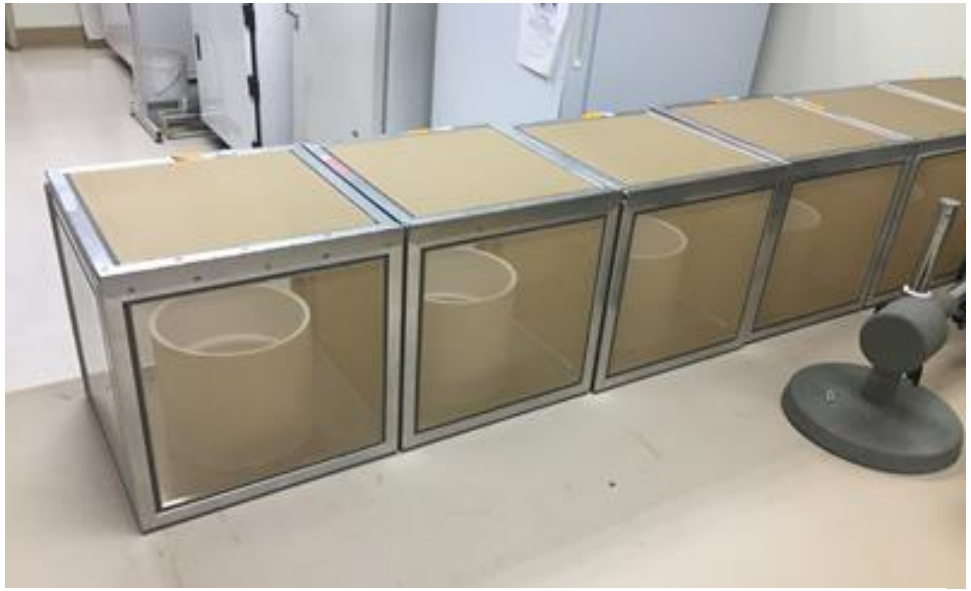
Most remain in the release area, 10-20% disperse outward



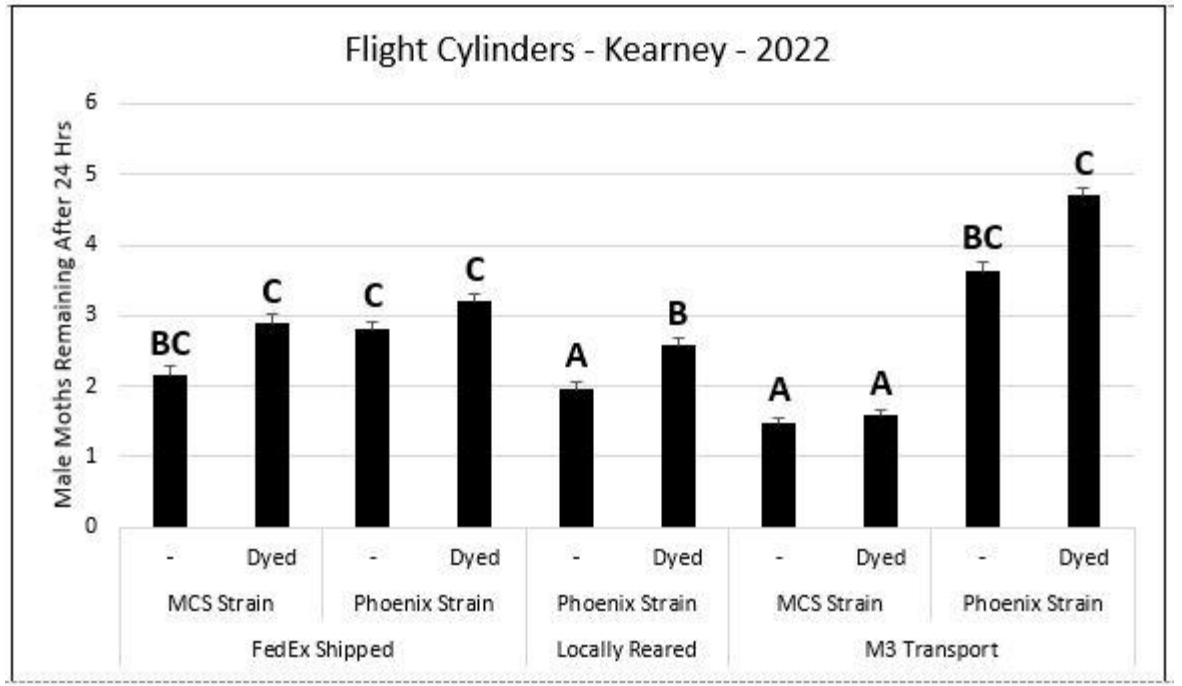


2022 Research—Flight Tunnel Examination of New ‘MCS’ Strain

Data courtesy of Houston Wilson



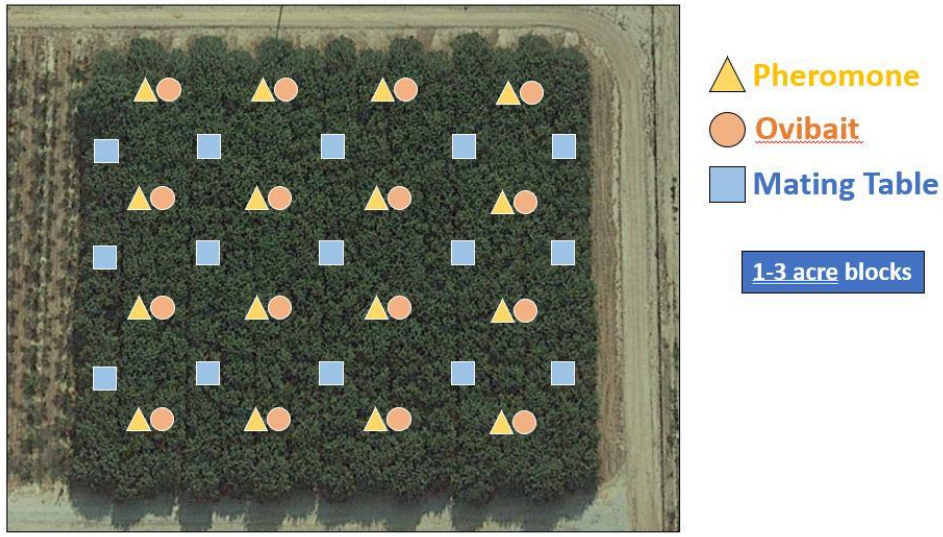
Examples of flight tunnels

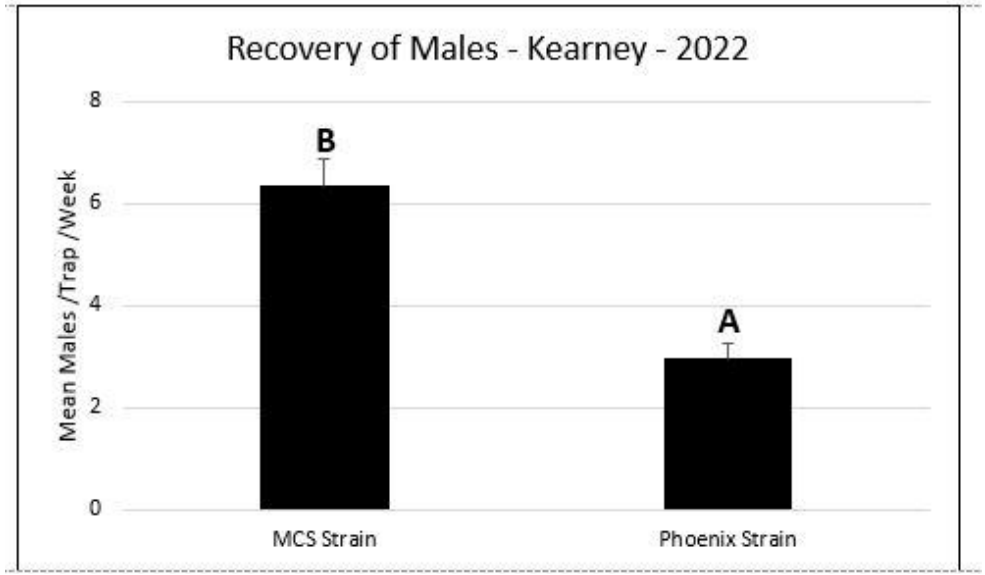


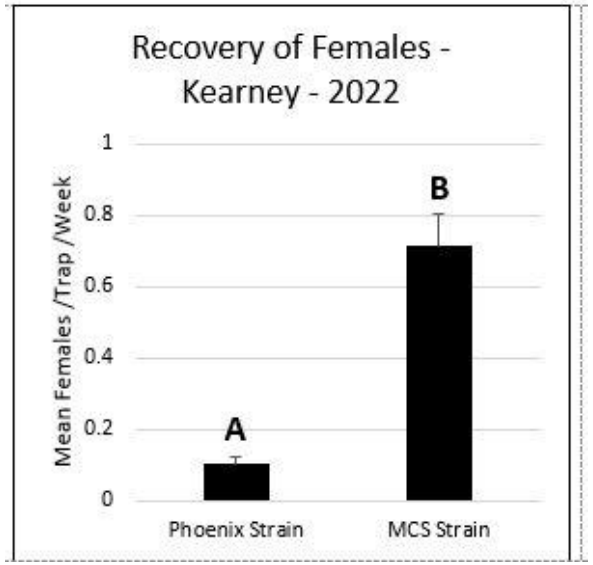
- Number **not** flown—smaller is better
- MCS performed better
- Fluorescent powder had performance cost

2022 Research—Small Plot Examination of New ‘MCS’ Strain

Data courtesy of Houston Wilson

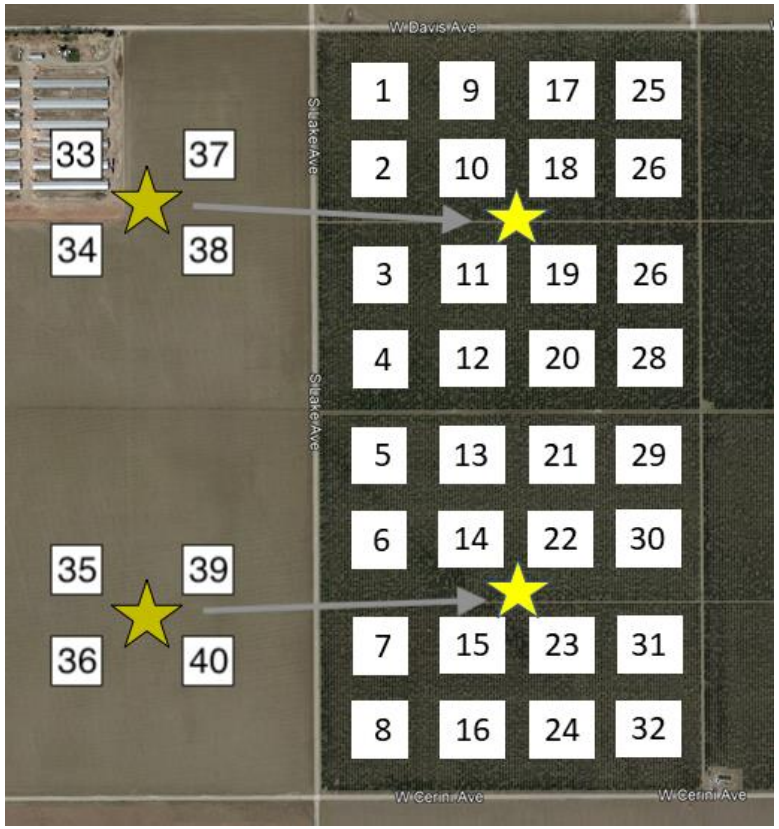






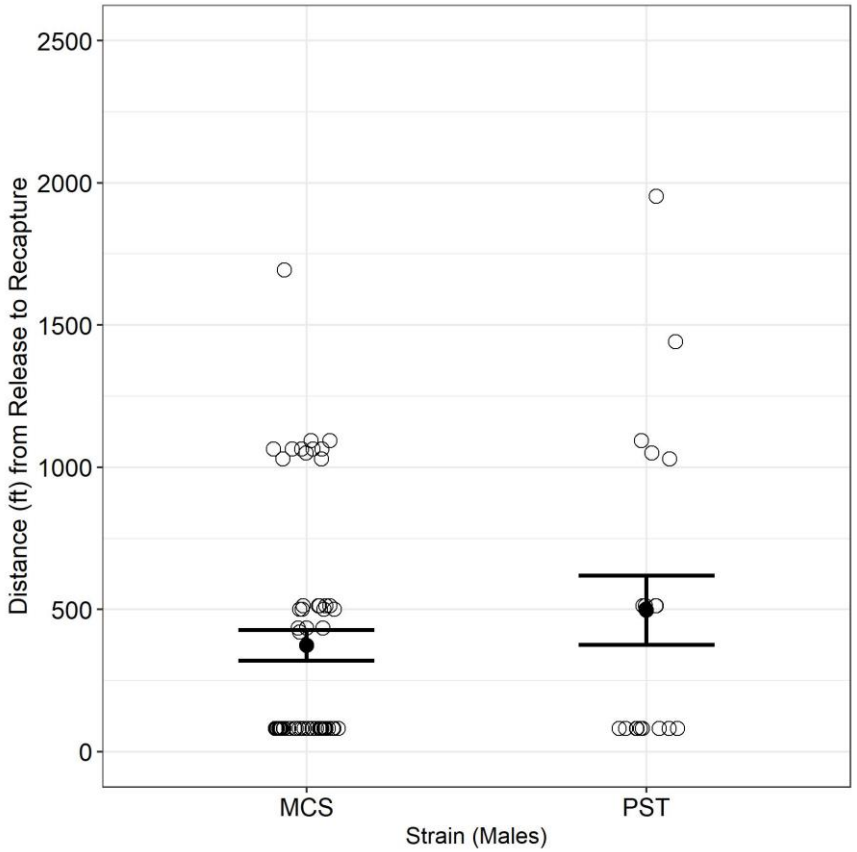
MCS recapture significantly better for both sexes

2022 Research—Commercial Scale Examination of New ‘MCS’ Strain



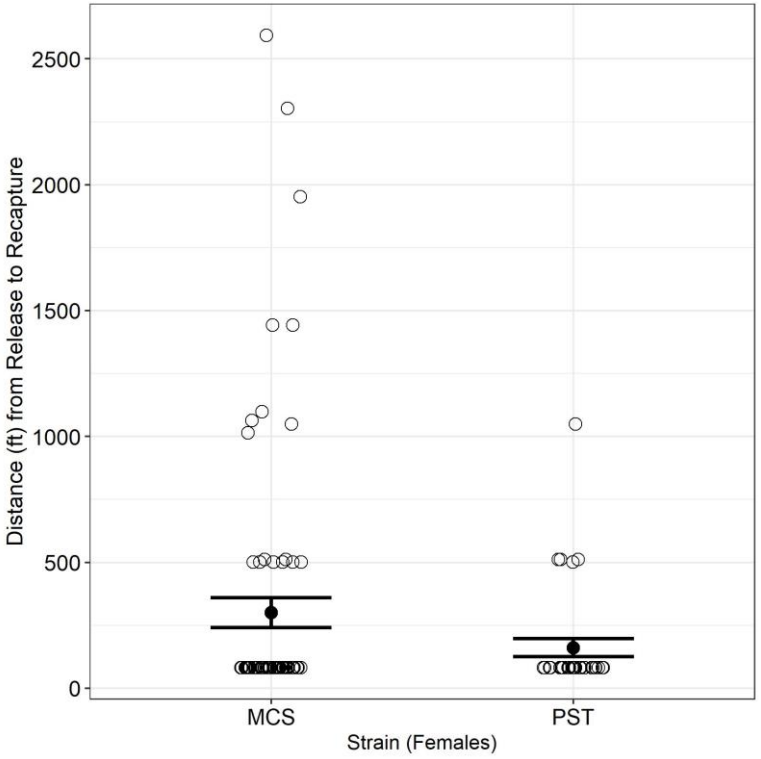
320 acres, divided into two square plots

Males



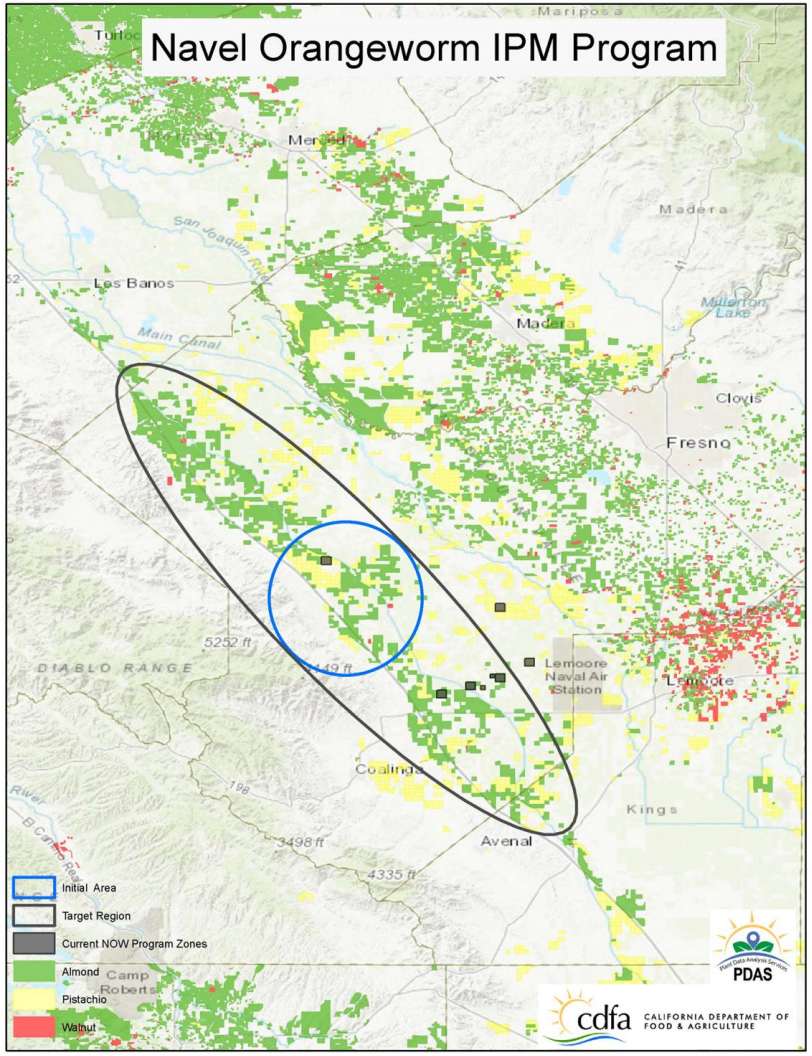
- MCS had significantly greater recapture
- No significant difference in dispersal distance

Females



- No significant difference in recapture
- MCS had significantly greater dispersal distance

NOW SIT Phase 2: Fresno County, 2023



- PPO-Pheromone lures only (improve processing efficiency)
- 640-acre orchards paired by sanitation status and pest management practices (including mating disruption)
- Cooperator pre-agreements and windrow/harvest sampling

Summary

- Initial limitations to performance were identified
- Improved recovery and movement have been documented
- The new MCS strain from Phoenix shows better field performance
- A new phase in 2023 will facilitate measurement of impact in similar IPM environments

Thank you!

Questions?