

# Proactive IPM Strategies for the South American Tomato Leafminer, *Tuta absoluta*



Photograph credit: Antonio Biondi

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# *Tuta absoluta*

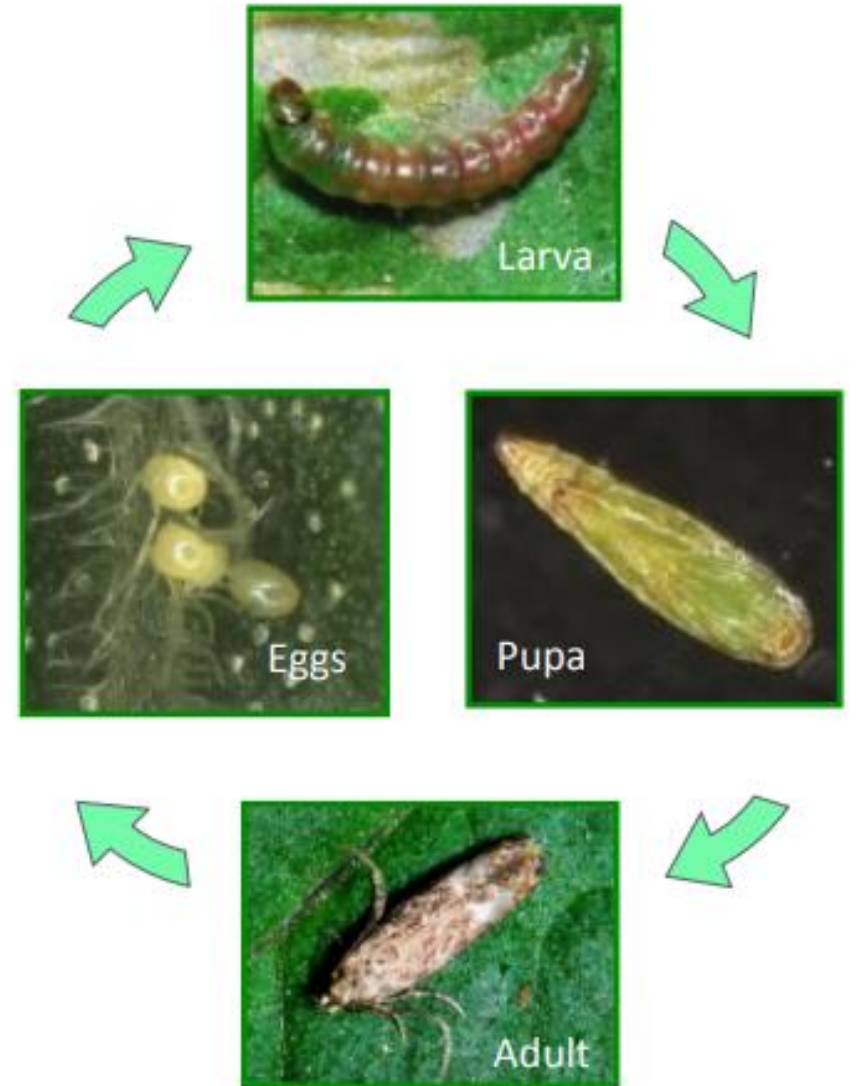
*T. absoluta* adults



2nd instar larvae in mine



## Life Cycle



- 5-6mm long adults, laying ~200 eggs each
- Larvae feed under leaf surface or in fruits and stems
- Hosts include Tomato, Potato, Pepper, Eggplant, Wild Nightshades, some non-Solanaceous

# *Tuta absoluta* Damage



- Hollow, translucent mines within leaves
- Entry holes on fruit with frass (poop)
- Brown, crispy, desiccated foliage



# *Tuta absoluta*

- Native to Peru, became pest of tomato & potato production across South American in the 1960s

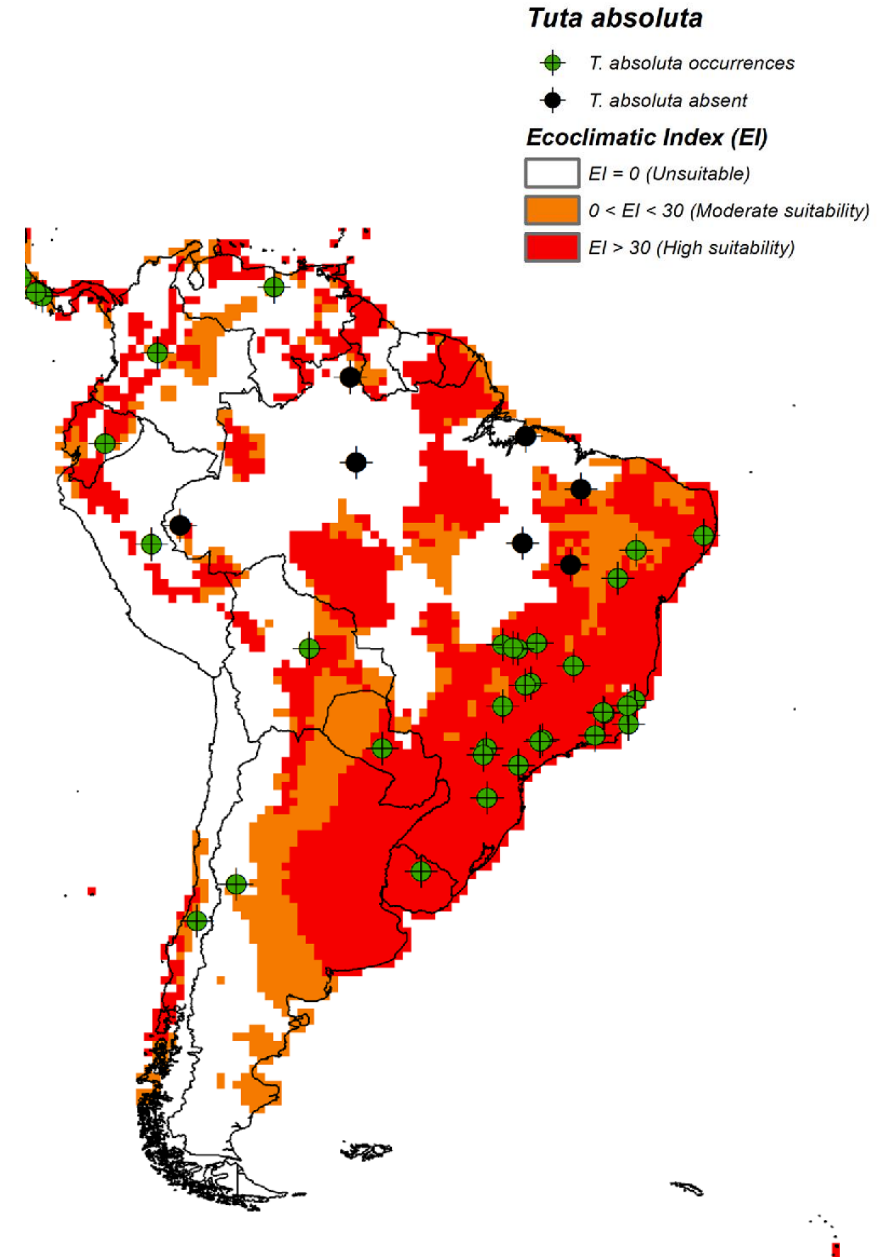


Figure from Santana et al. 2019

# Why *Tuta* threatens to US Production

- Since 2006, invaded > 80% of all tomato producing regions
- 80-100% yield loss in fields and greenhouses if uncontrolled

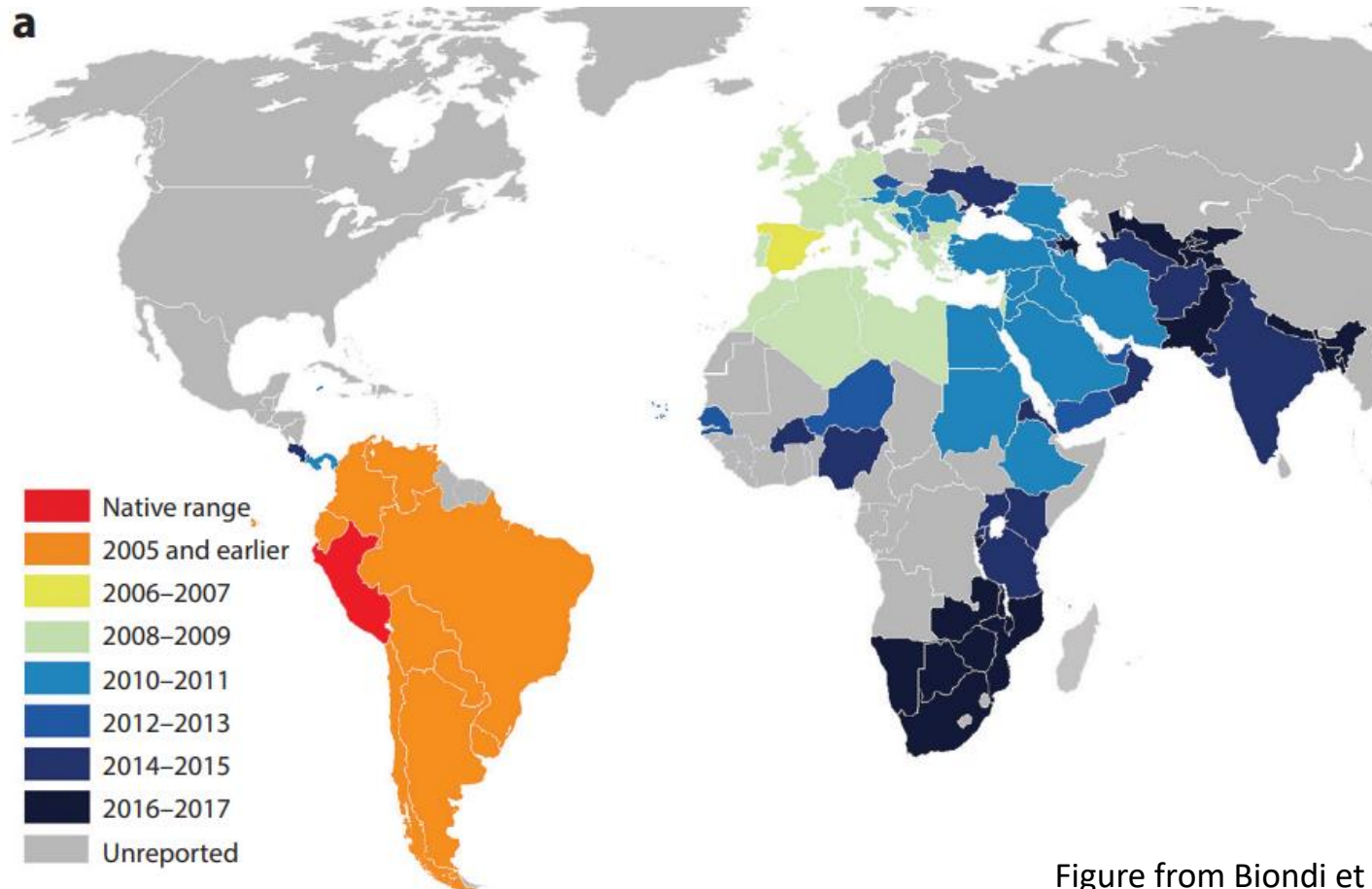
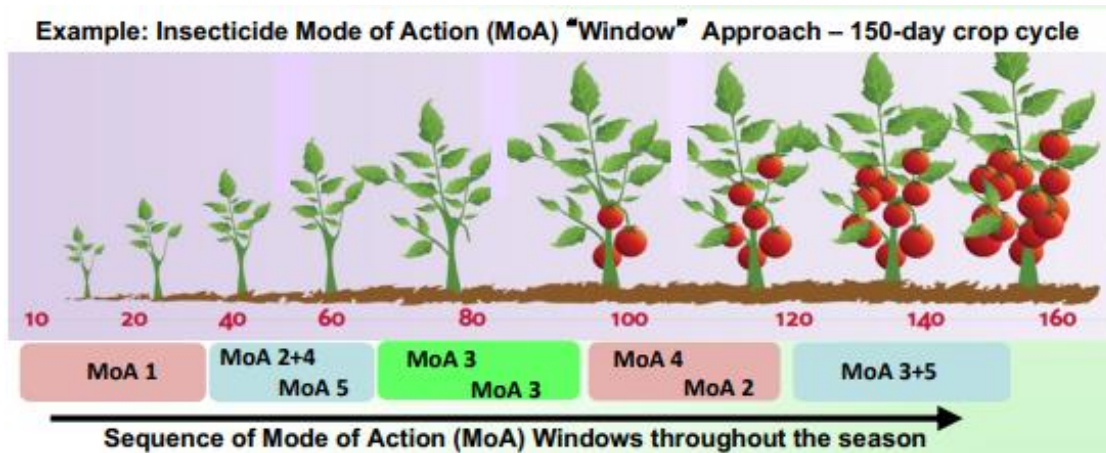


Figure from Biondi et al. 2018

# Control Strategies

- Large number of chemical options available, but resistance widespread
- Resistance management will be critical



- Leaf-mining behavior lowers efficacy of many insecticides

IRAC MoA group	Mode of action	Chemical class <sup>a</sup> or compound	Resistance described
1B	Acetylcholinesterase inhibitor	Organophosphates	Yes
3A	Voltage-gated sodium channel modulator	Pyrethroids	Yes
5	Nicotinic acetylcholine receptor modulator	Spinosyns	Yes
6	Chloride channel activator	Avermectins	Yes
11	Disruption of midgut membranes	B.t. toxins	?
13	Uncoupler of oxidative phosphorylation	Chlorfenapyr	?
14	Nicotinic acetylcholine receptor blocker	Cartap	Yes
15	Chitin biosynthesis inhibitor	Benzoylureas	Yes
18	Ecdysone receptor agonist	Diacylhydrazines	?
22A	Voltage-gated sodium channel blocker	Indoxacarb	Yes
22B	Voltage-gated sodium channel blocker	Metaflumizone	? <sup>d</sup>
28	Ryanodine receptor modulator	Diamides	Yes

# Control Strategies

- Careful quarantining and sanitation

Destroying infested tomato residues in field

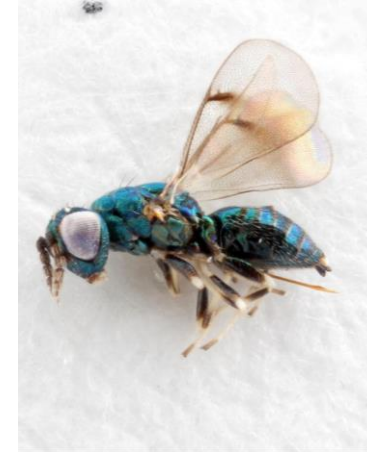


Removing and destroying infested material near greenhouses



- Local biological control agents useful abroad

Parasitoid Wasps



Predatory Mirid bugs



# High Likelihood of Invasion

- CDFA Class A Pest
  - Imported fruit require phytosanitary certificate, rigorous inspection
- Climate models predict California to have suitable environment
  - Temperature and precipitation ideal
  - Both crop and non-crop hosts available
- Tuta detected in Haiti in 2018
- Multiple pathways for introduction
  - Infested Fruit or Transplants
  - Pupae in soil
  - Dispersal once established



Black Nightshade (above) is a suitable host



Infested transplants and fruit are common pathways for introduction



# *Tuta absoluta* Damage



- Hollow, translucent mines within leaves
- Entry holes on fruit with frass (poop)
- Brown, crispy, desiccated foliage



# Identifying *Tuta absoluta* damage

*Tuta absoluta*



Tomato Pinworm  
(*Keiferia lycopersicella*)



- Tuta and Tomato Pinworm individuals and damage are almost identical, require molecular tests to diagnose
- If damage is found, **contact Cooperative Extension Agent or County Ag Commissioner ASAP**



# Identifying *Tuta absoluta* damage

*Tuta absoluta*



Leafminer Flies  
(*Liriomyza* sp.)



- Two species of leafminer flies common in CA
  - *L. sativae*
  - *L. trifolii*



- Leaf damage similar, but longer serpentine mines

# Proactive IPM Strategies for *T. absoluta* in California

- Develop our toolkit of control strategies **before *Tuta* arrives in the US**

1. Insecticides
2. Biological Control
3. Host Resistance



Ian Grettenberger

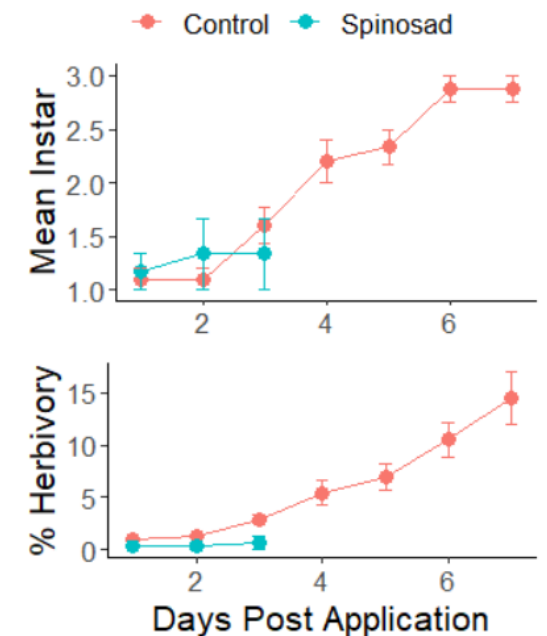
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# 1. Insecticide Testing

- *Tuta* colony established at CRF to test insecticide efficacy in lab
- Focus on new materials, options for home gardeners and organic producers



Contained Research Facility at UC Davis



Initial testing showed effectiveness of spinosad, validated protocol

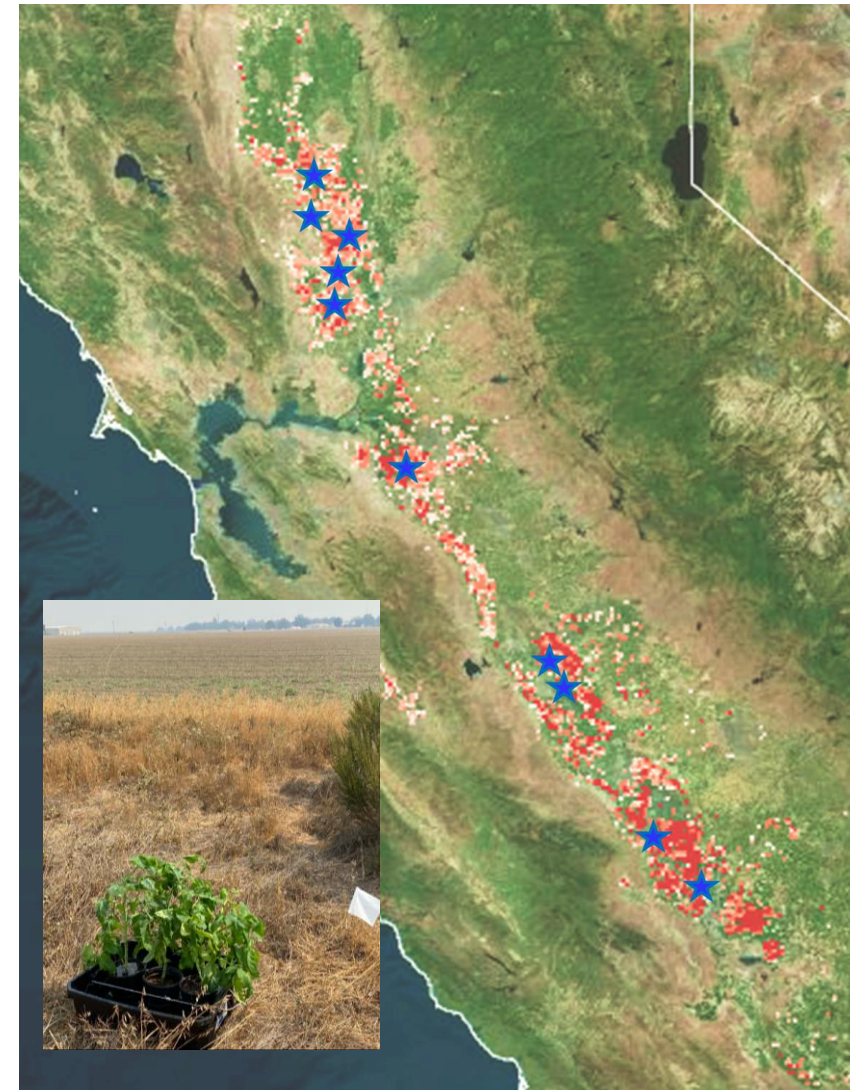
## 2. Surveying Natural Enemies

- Set out tomato plants infested with pinworm throughout Sacramento and San Joaquin Valleys to trap natural enemies
- 10 fields sampled monthly from July-October, infested tissue held for parasitoid emergence

Sample Collection



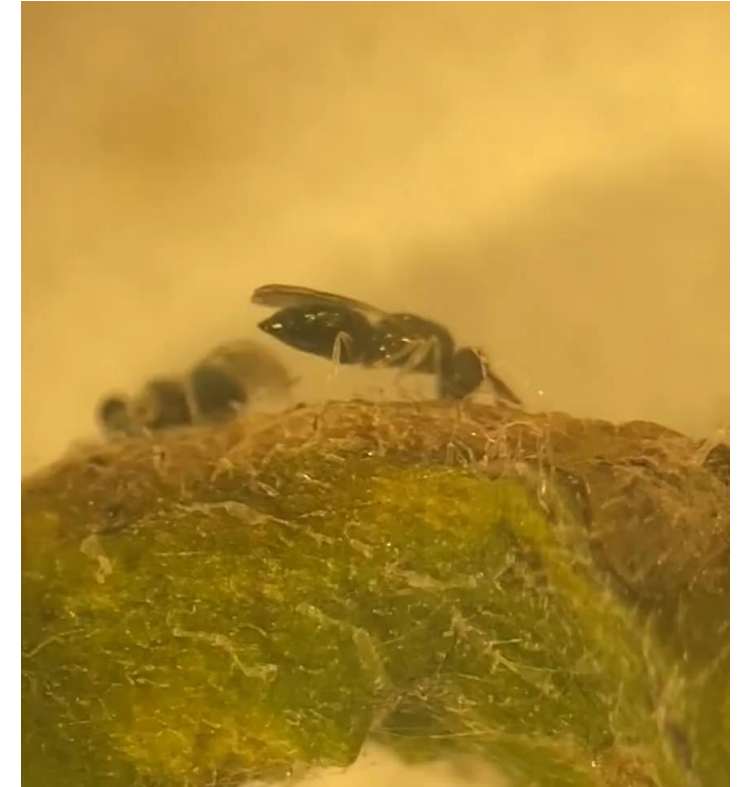
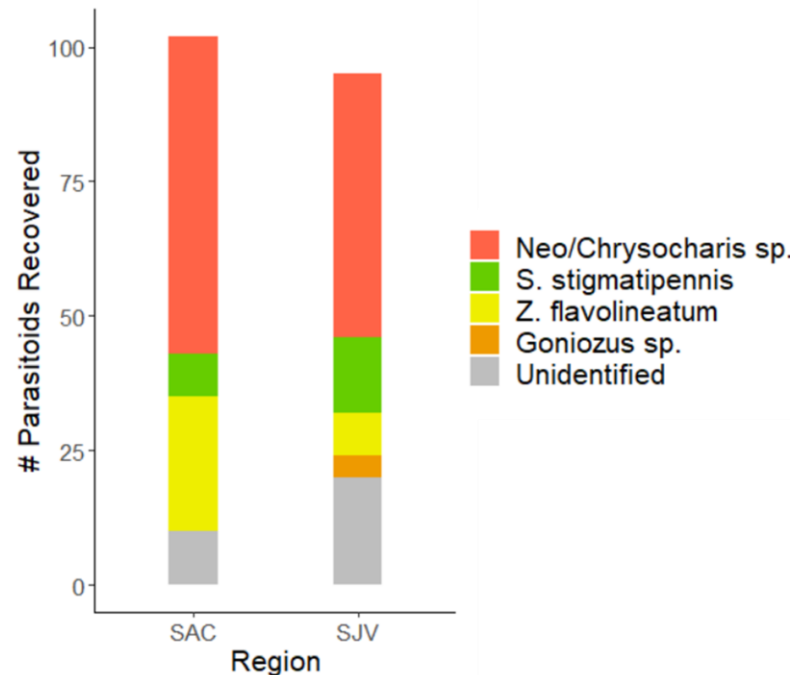
Parasitized Tomato Pinworm



Map of California processing tomato production (red) and locations sampled (blue stars)

## 2. Surveying Natural Enemies

- 3.9% parasitism rate overall on ~5000 pinworm larvae exposed
- Identified 4 parasitoid species as candidates for biological control



Liriomyza sp. or alfalfa pests may serve as alternate hosts

# 3. Identifying Wild Resistance

- Growing several lines of a wild tomato relative, *Solanum habrochaites*
- Previously demonstrated resistance to *T. absoluta* damage
  - Glandular trichomes
  - Defensive compounds (Acylsugars, Zingerberene)



Map of *S. habrochaites* accessions from  
Tomato Genetic Resource Center, UC Davis

# In Summary

- Be aware of introduction routes (i.e. transplants, imported fruit)
- If outbreak of what looks like pinworm damage occurs, **contact ag commissioner, extension agent, or CDFA ASAP**
- While invasion risk is high, several control options available



# Acknowledgements

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## Questions?

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**CDFFA Pest Prevention Hotline:**  
**1-800-491-1899**

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