

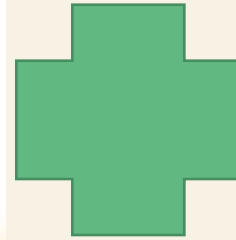
# **ORGANIC AND SUSTAINABLE PEST MANAGEMENT OPTIONS**

**KOON-HUI WANG, J. SUGANO, J. UYEDA, S. CHING, J. KAM  
T. RADOVICH, S. FUKUDA**

# SUSTAINABLE PEST MANAGEMENT

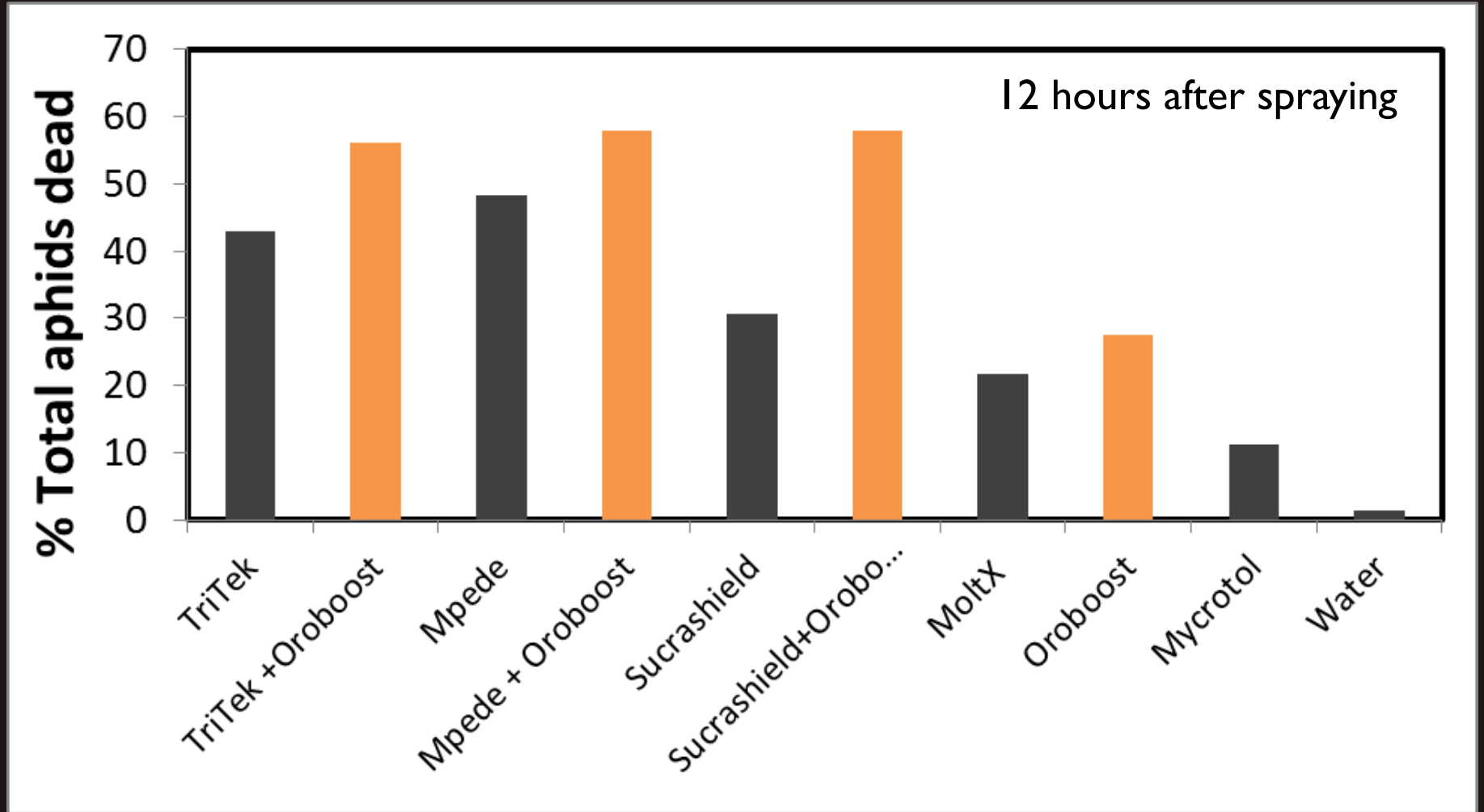


CRATE



USE INSECTICIDES AS  
THE LAST RESORT  
AVOID RESISTANCE

# Laboratory test of OMRI certified insecticides activities against viability of aphids on lettuce



Adding surfactants can decrease drift and increase efficiency of insecticides.

ENHANCE NATURAL  
ENEMIES OF TARGET  
PESTS

# INSECTARY PLANTS

Plants that attract insects, either produce flowers with pollen and nectar for beneficial insects, or lure insect pests away from the cash crop.



Hoverflies on buckwheat and cilantro



Sunn hemp flowers attracts Lycaenidae butterflies that drawn *Trichogramma* wasps to lay eggs on the Lepidopteran eggs.



Uhaloa attracts wasps and bees



Lady beetles on Aweoweo

# EXTRAFLOREAL NECTARIES

- **Extrafloral Nectaries** = nectar glands not associated with flowers.
- Good for attracting beneficial insects when most flowers are not in bloom.



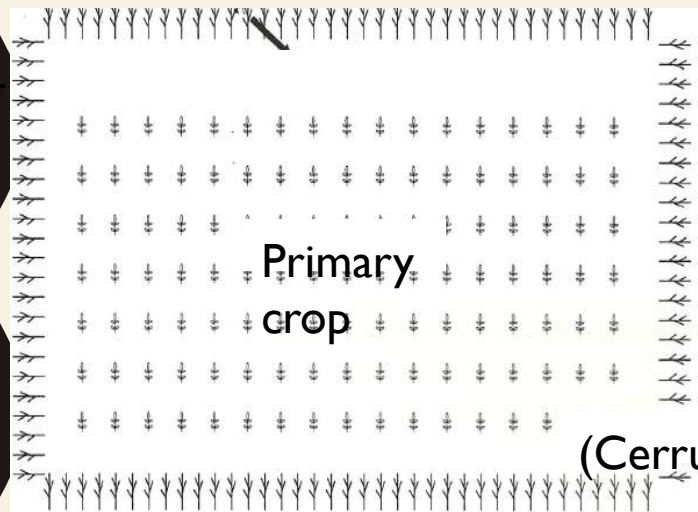
Partridge pea



# HOW TO INTEGRATE INSECTARY PLANTS INTO FARMS

## 2. As intercrop

### 1. As border crop



Buckwheat and zucchini

(Cerruti Hooks)



(Roshan Manandhar)

Sunn hemp and corn



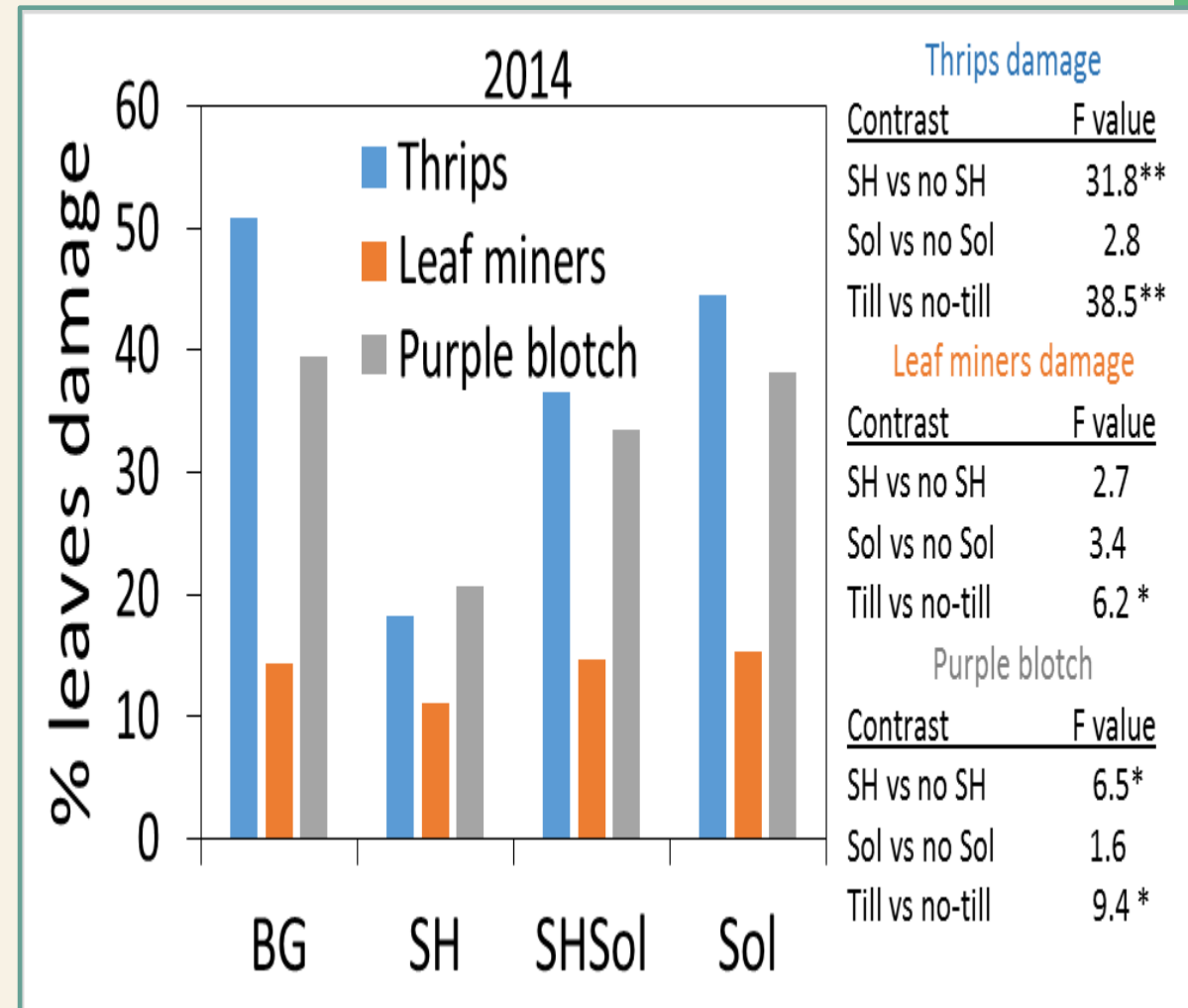
Insectary plant corridors  
(Nicholls, Parrella, and Altieri, 2000)

# Sunn hemp no-till with insectary borders



Cowpea and buckwheat as insectary borders, and sunn hemp organic mulch harbor natural enemies or parasites against insect pests (thrips, leaf miners) and fungal disease (purple blotch).

BG = bare ground, SH = Sunn hemp & insectary borders; Sol = bare ground & solarization





# INSECTARY PLANTS FOR HYDROPONIC PRODUCTION



Sunn hemp attracts Trichogramma wasps

Buckwheat attracts hoverflies

Wasp nesting block attracts keyhole wasps





# WASP NESTING BLOCK

## Pollinators



Leaf cutter bee



Hylaeus bee



Untreated wood

## Predators



Key-hole Wasp

<http://bugguide.net/node/view/241212>



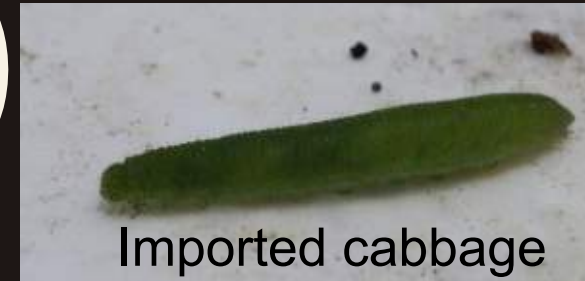
Aphid-collecting  
Wasp

# COMPARING INSECTARY SETTINGS AND METALLIC REPELLANT FOR HYDROPONIC BRASSICA



Whiteflies

Aphids





# Beneficial insects found in insectary treatment



*Trichogramma wasp*



Parasitized aphids



Hoverfly eggs among aphids

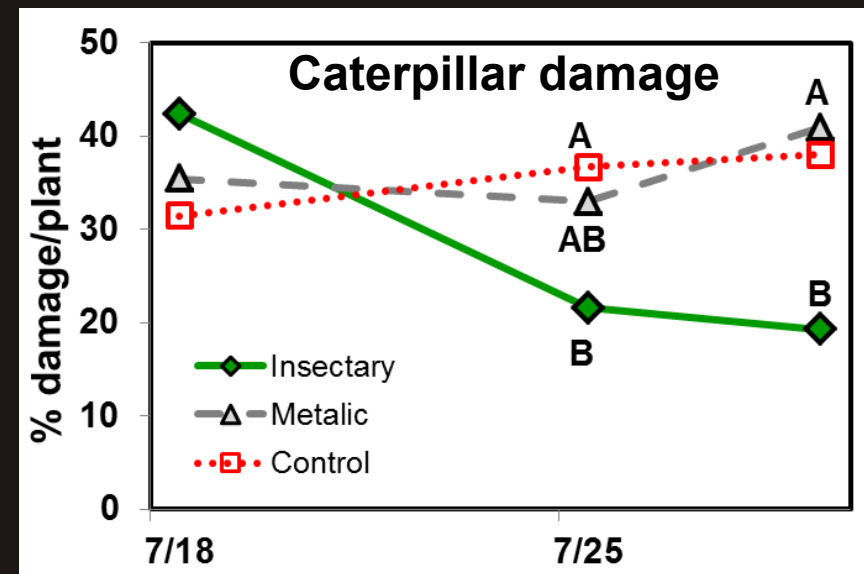
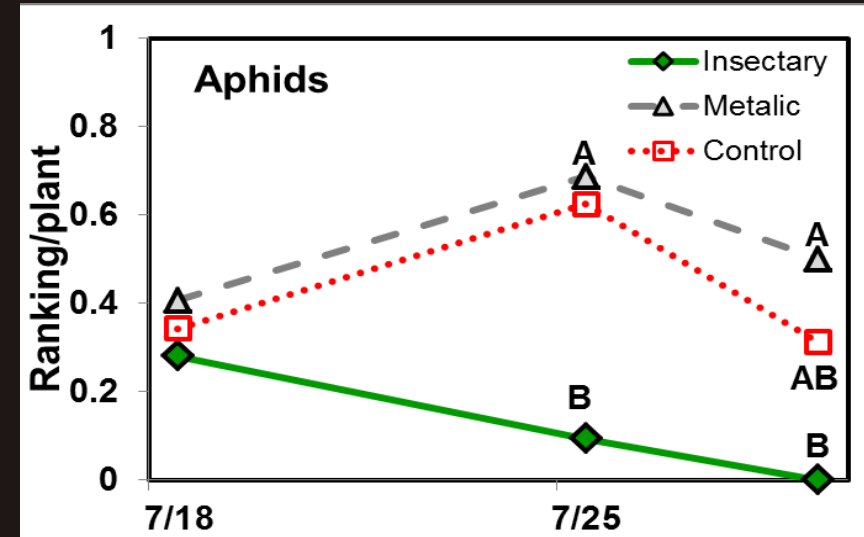


DBM pupae parasitized by parasitoid wasp

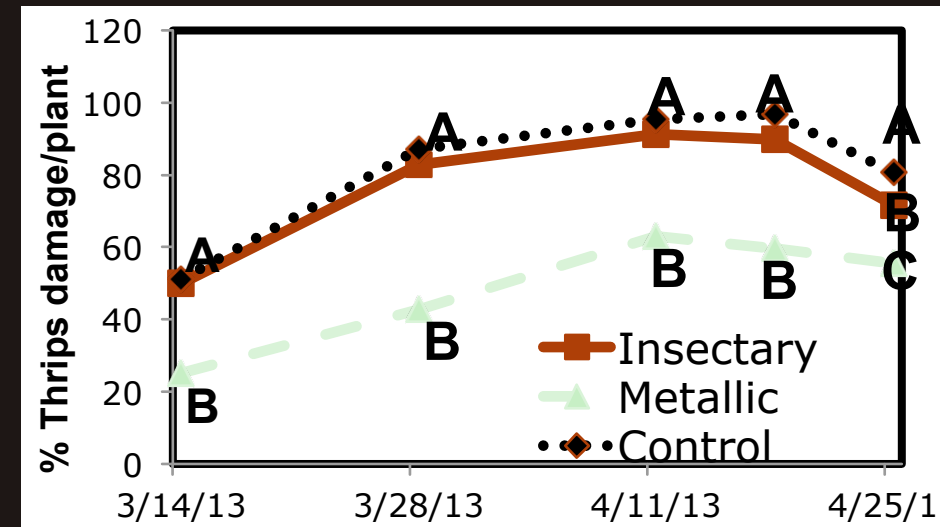
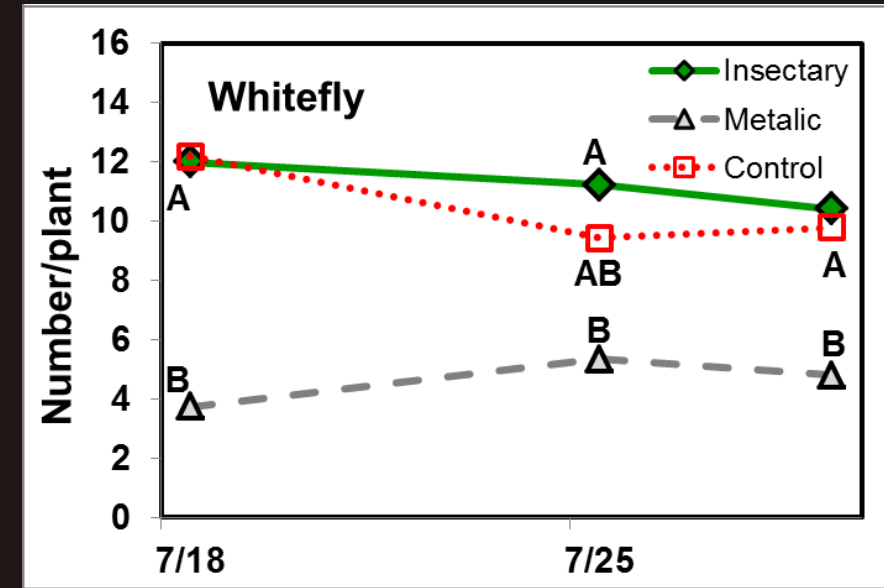
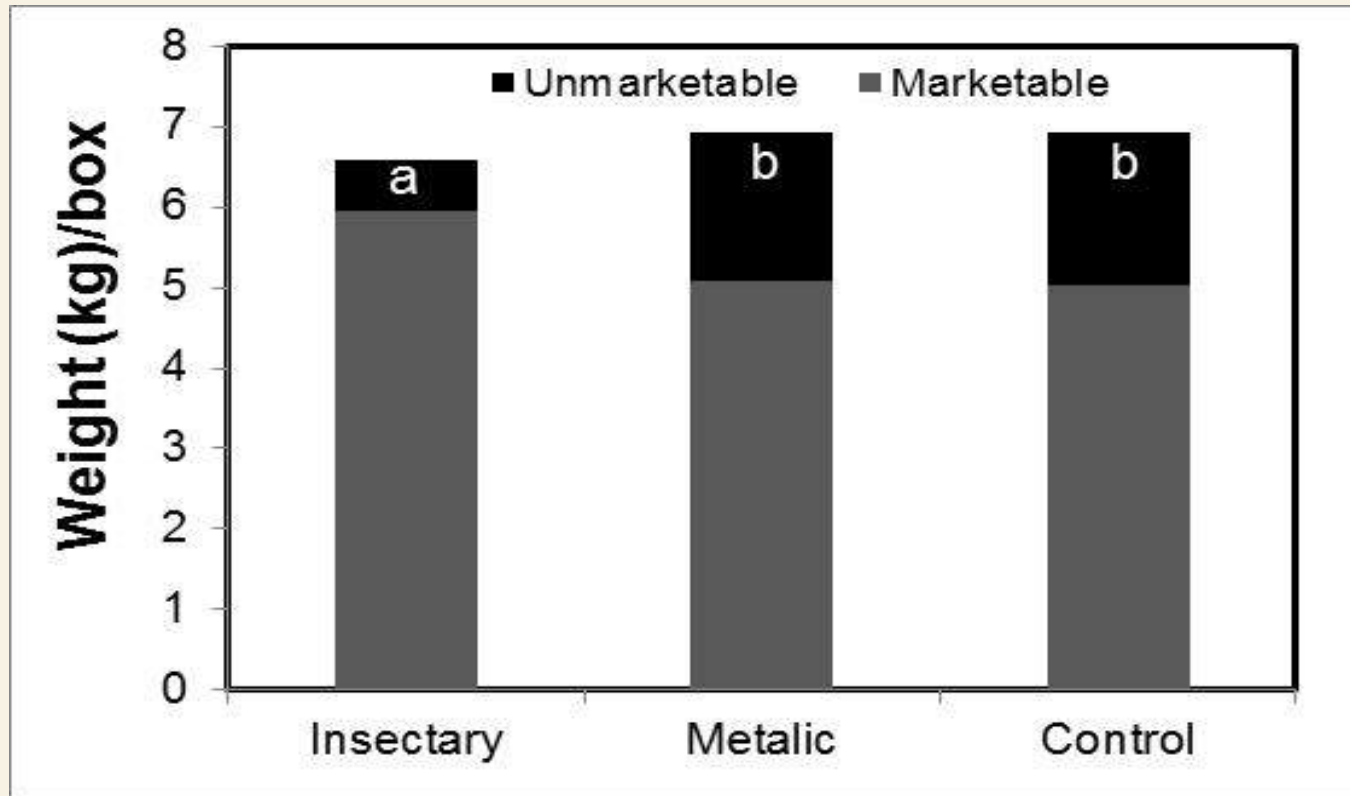


Hoverfly larvae eating an aphid

Insectary setting suppressed aphids and caterpillar damage



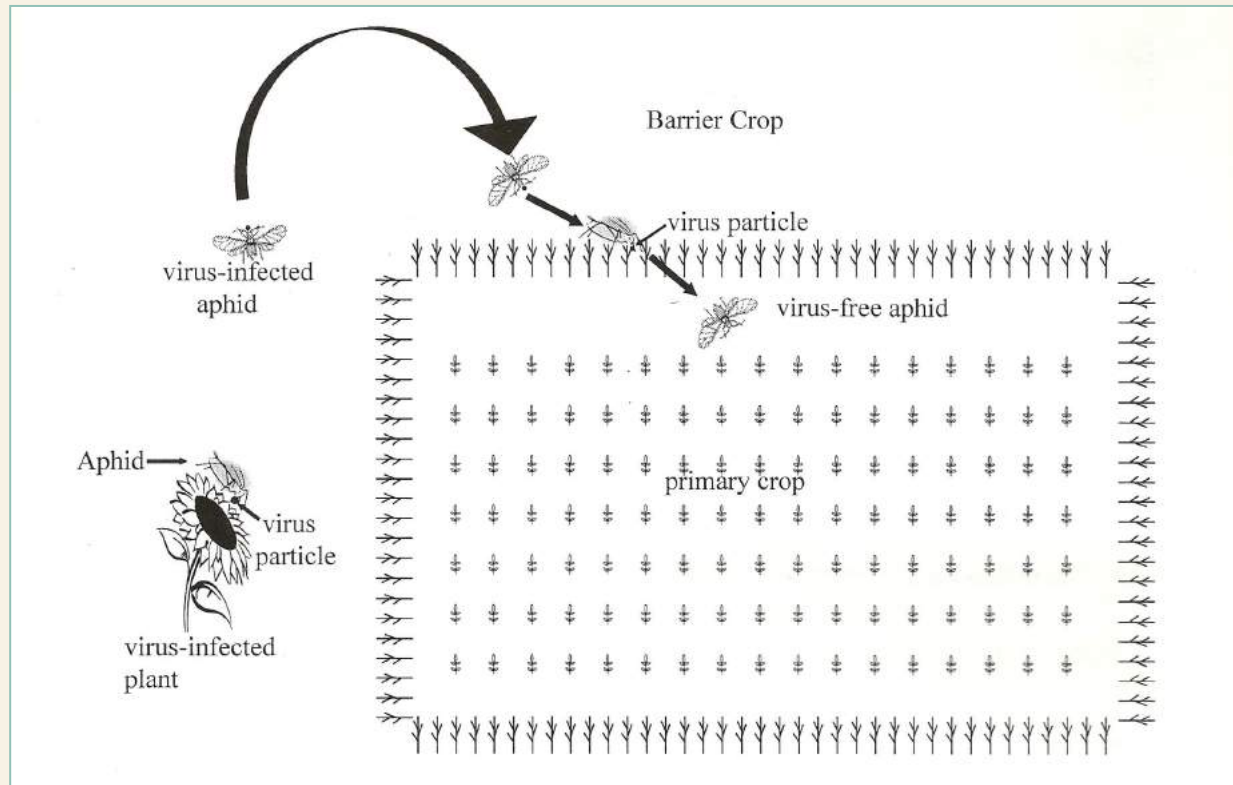
**Insectary settings reduced unmarketable pak choi yield, but did not protect it against thrips and whiteflies**





# SUNN HEMP AS A TRAP CROP FOR WHITEFLIES, REDUCING SILVERLEAF SYMPTOMS

Trap crop / virus sink theory



Zucchini in bare ground showing silver leaf symptom



Zucchini intercropped with sunn hemp

**INTEGRATE WITH  
PHYSICAL BARRIER**

**INSECT  
EXCLUSIVE NET  
SCREENHOUSE  
PRODUCTION**

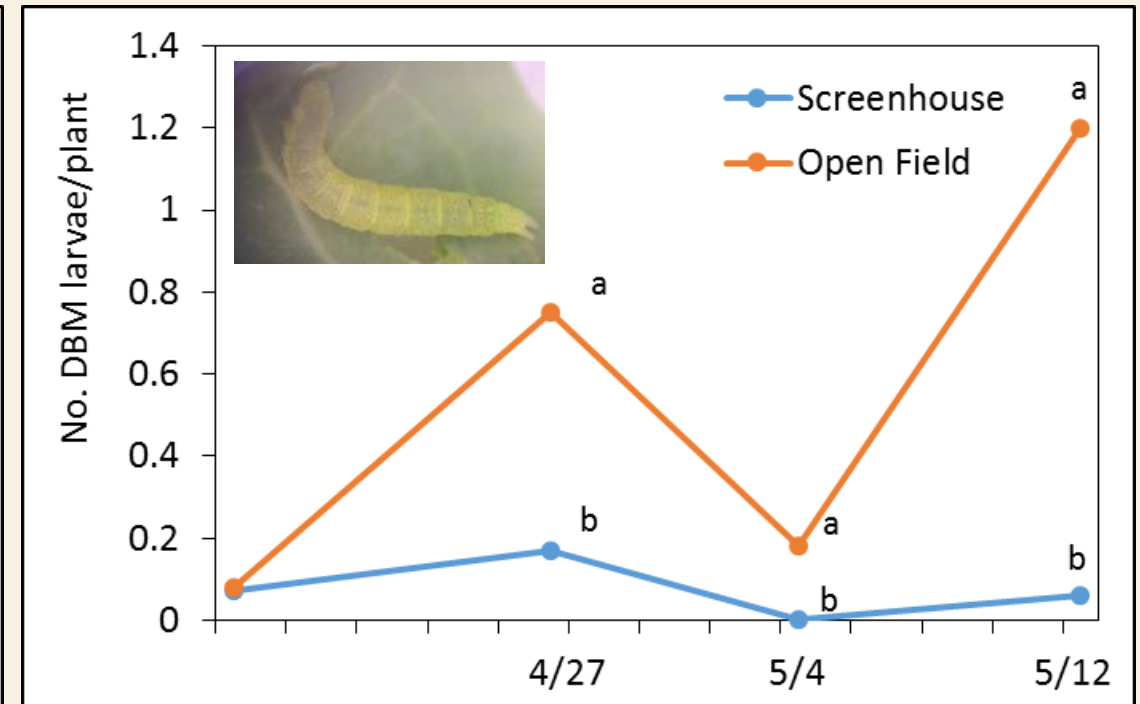
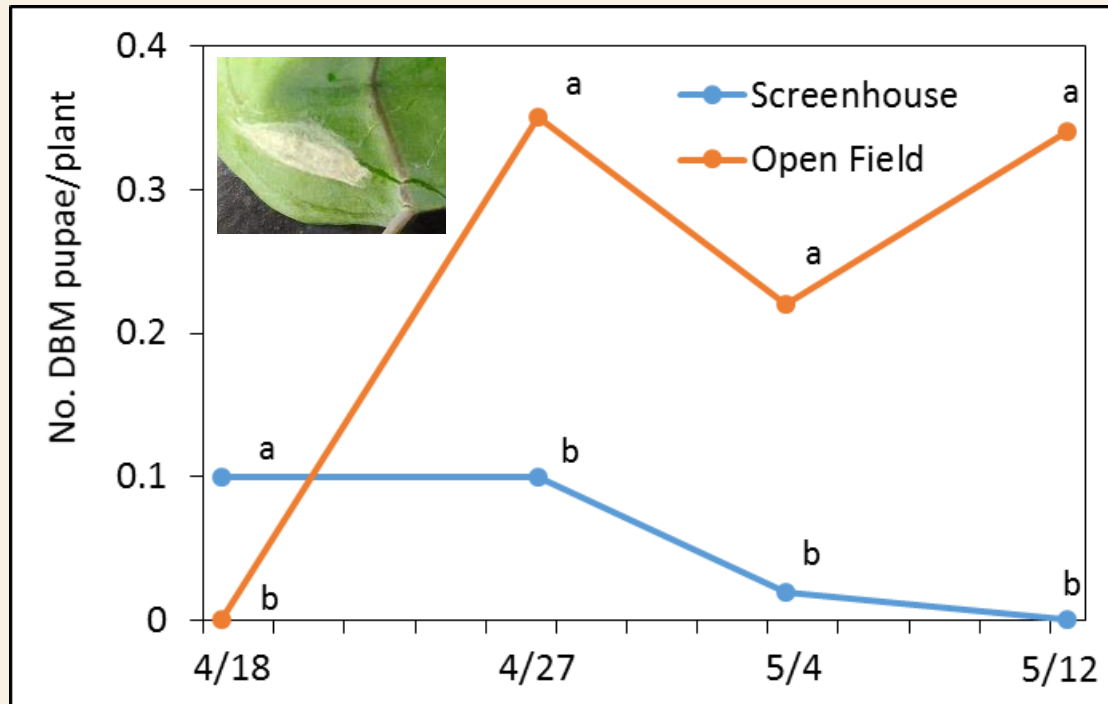




# SCREENHOUSE PRODUCTION FOR KALE

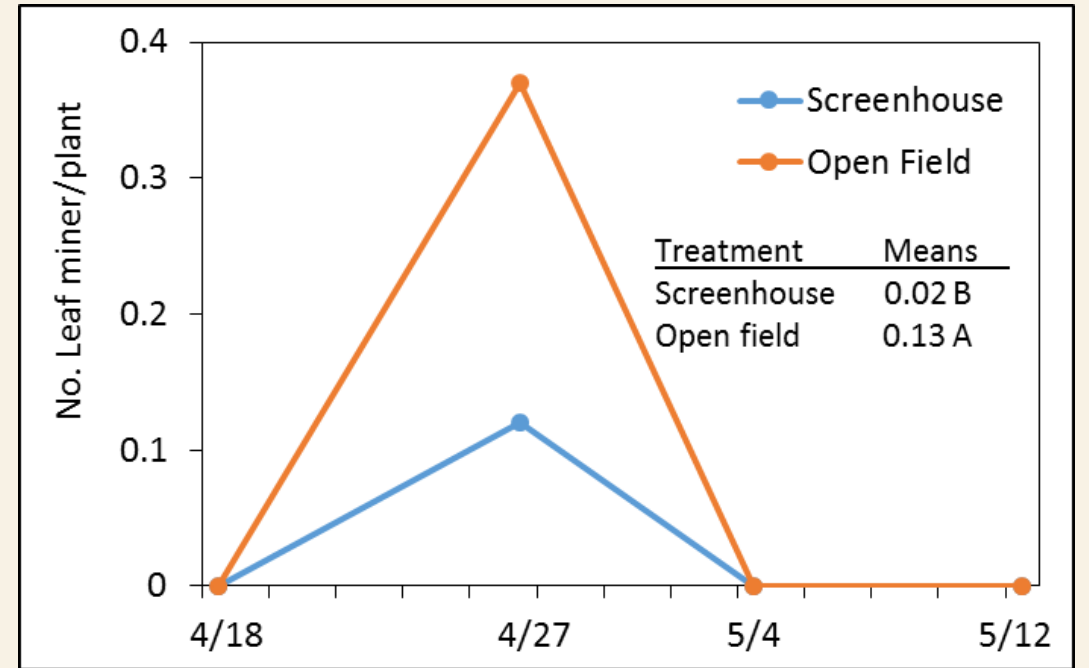
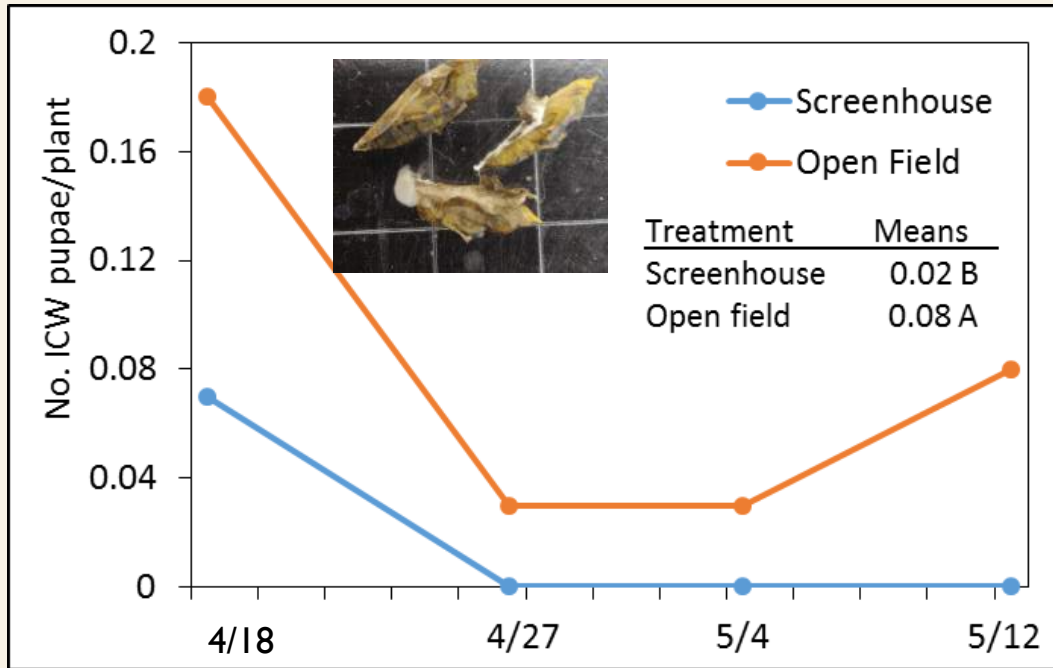
- ❑ 15 Varieties of kale were planted inside and outside of a screenhouse.
- ❑ 5 plants from 12 varieties were monitored for insect pests weekly from 4/18-5/12/16.

# SCREENHOUSE REDUCED DIAMOND BACK MOTH (DBM)





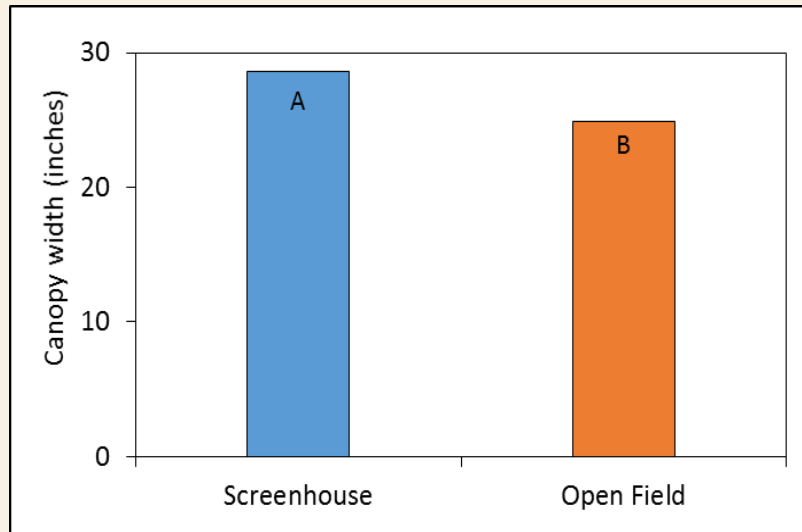
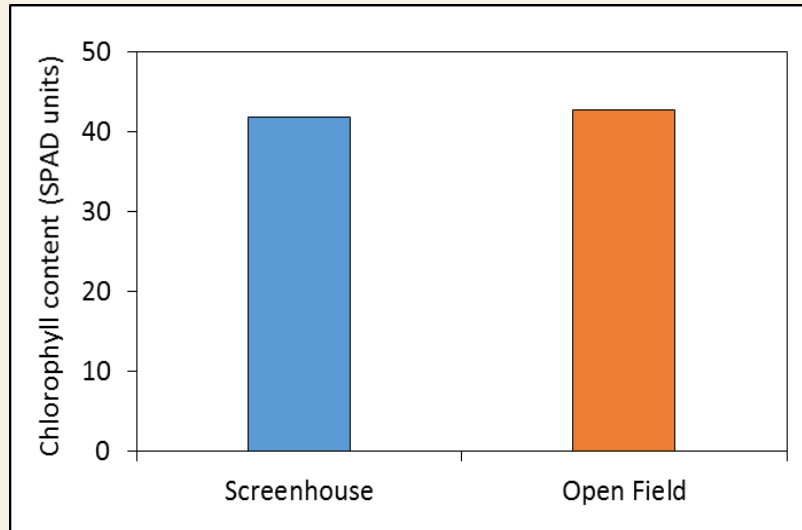
# SCREENHOUSE REDUCED IMPORTED CABBAGE WEBWORMS (ICW) & LEAF MINERS





# KALE GROWTH PARAMETERS

1 month after transplanting



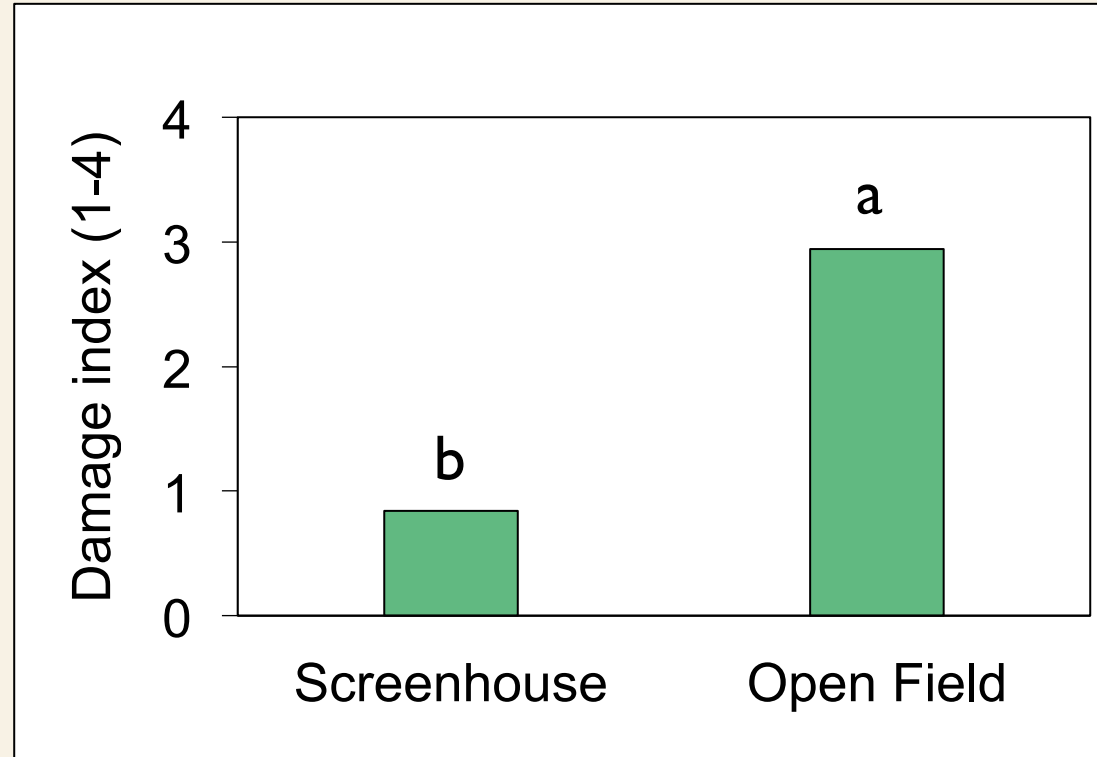
- Based on the 12 varieties monitored, screenhouse did not affect kale photosynthesis rate and resulted in wider kale canopy ( $P < 0.05$ ).



## Screenhouse



# CATERPILLAR DAMAGE



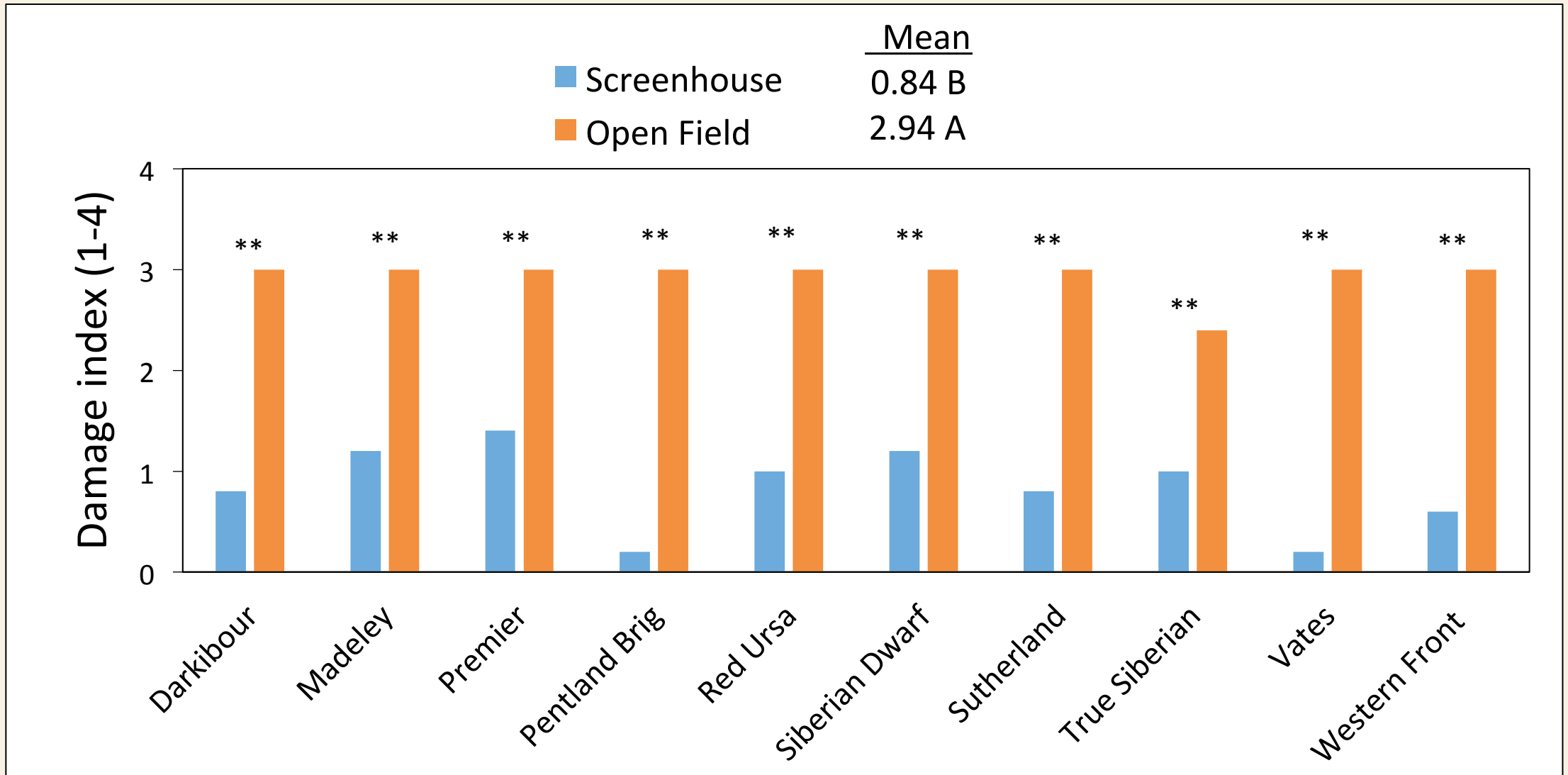
## Open Field



Some varieties are less preferred by the caterpillars present.



# DIFFERENCE IN KALE VARIETIES TO CATERPILLAR DAMAGE



0 = 0 damage, 1 ≤ 25% leaves w/ damage, 2 (26-50% leaves w/ damage), 3 (51-75% leaves w/ damage), 4 (75-100% damage)



# PARTICIPATING FARMER: ANTHONY DELUZE



Most unmarketable is from fruit cracking due to blossom end rot (fluctuating weather and insufficient Ca) and bird damage.

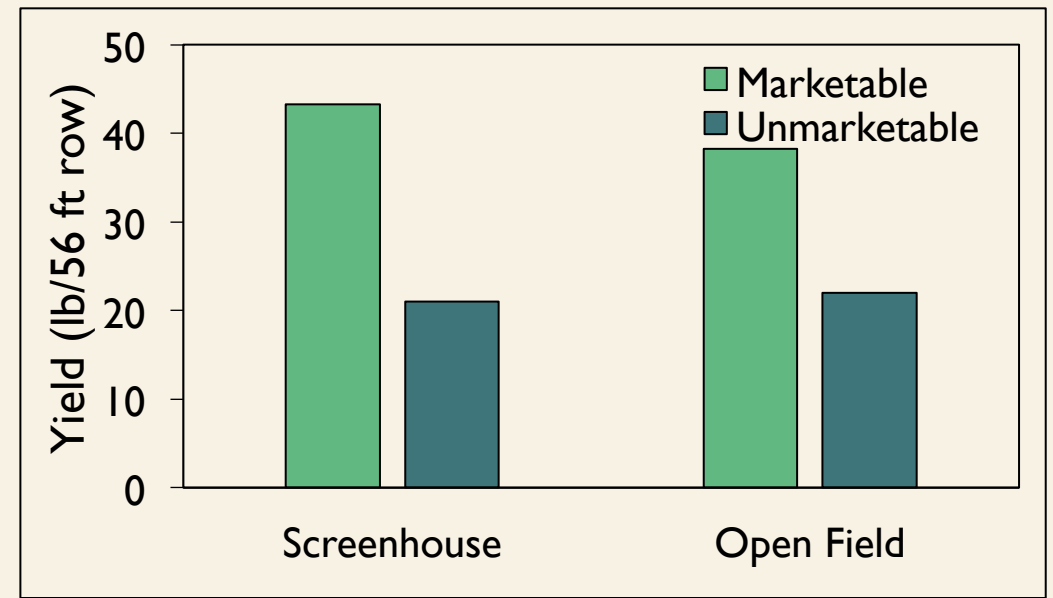


'Nyagous' tomato



Screenhouse did not protect peach tomatoes from *Tomato yellow leaf curl virus* transmitted by whiteflies.

'Nyagous' is resistant to TYLC virus, yield inside the screenhouse was higher than that in the open field.



# FARMER'S TESTIMONY

- “I think the screenhouse has been an awesome tool and love the design. The soil outside of the screenhouse was much richer in nutrients to begin with, under different circumstances, tomatoes inside the screenhouse would yield much higher. ”



**Anthony Deluze**

- “I'm trying to figure out as soon as possible how to fund another screenhouse in my farm. I think the screen is the most expensive part. That's the one we got to find a way to get more cost efficient.”



# SCREENHOUSE FOR CUCURBIT CROPS



Hand pollinated pumpkin



Minimal damage from pickle worm or fruit flies



But plants die prematurely from severe infection of root-knot nematodes that cause the plant to wilt.

16-mesh screen can block bigger insects such as



Pickle worm moth is nocturnal



Melon fly / fruit fly females only oviposit on cucurbit fruits in the evening.



# FUTURE WORK: SCREENHOUSE THAT CAN ADOPT POLLINATORS AND BENEFICIALS



Roll up the wall in the day for pollinators and predators to come in. Roll down the wall in the afternoon to block pickle worms and fruit flies adults from getting in.

Parthenocarpic zucchini and cucumber seeds are available, but are expensive.



# Luring and Trapping



## ROSE BEETLE LIGHT TRAP

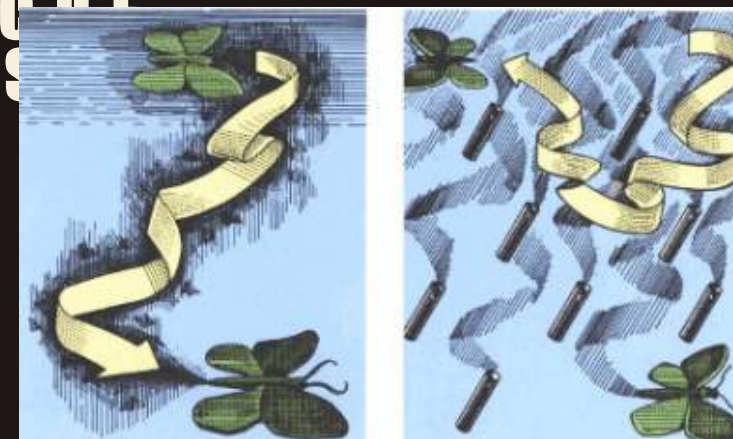
<https://vimeo.com/166306170>



## FRUIT FLIES METHYL EUGENOL/ LURE TRAPS



## PIN WORM NOMATE





# Heat Treatment



Propane tankless water heater (EccoTemp®)

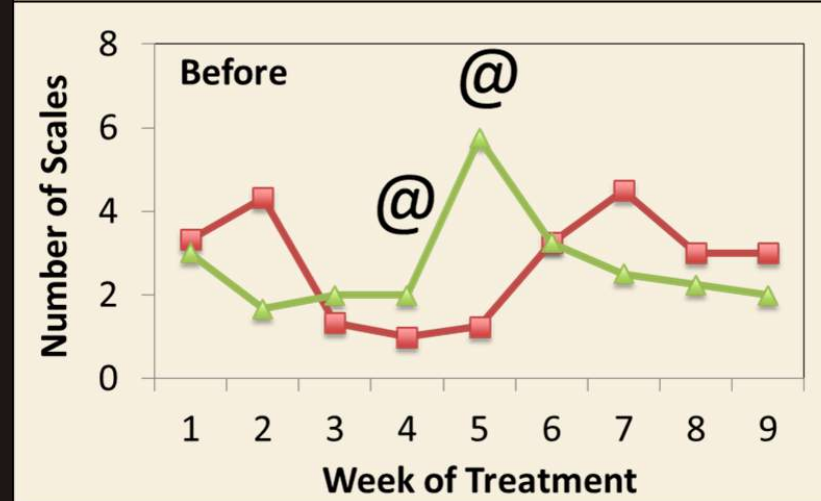
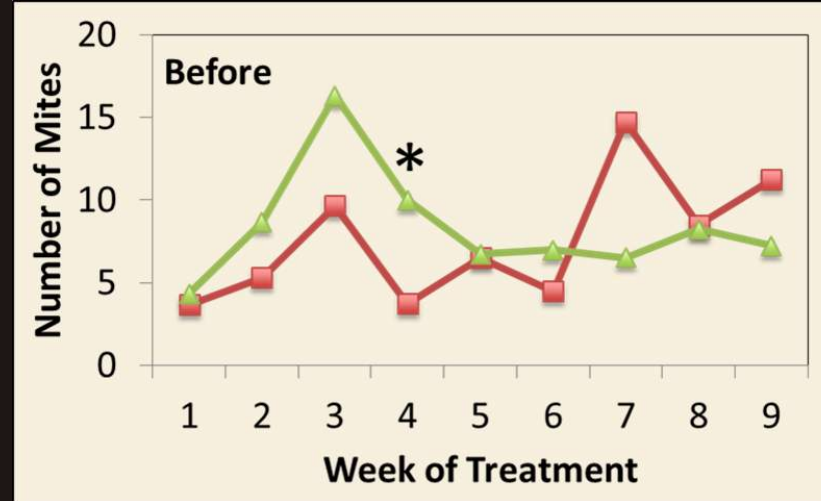


Treat spider mites on tea (*Camellia senensis*)



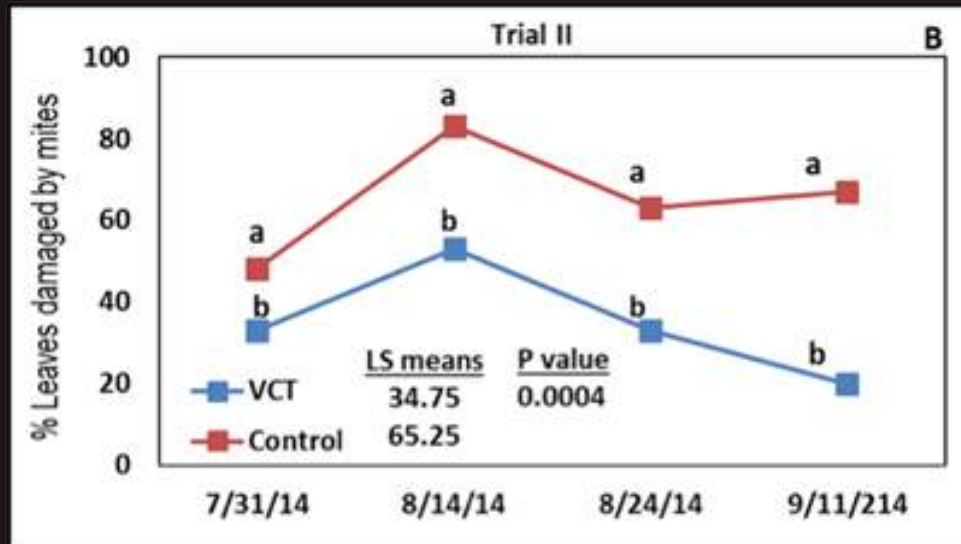
**LETHAL TEMPERATURE = 45-50°C (113-122°F)**

— Cold water  
— Hot water





# Induce Host Plant Resistance



Drenching VCT prepared from uncured vermicompost on tea root systems weekly reduced spider mite damage on tea leaves.



# ACKNOWLEDGEMENT



- Philip Waisen, Jon Kam, Shelby Ching, Shova Mishra, Josiah Marquez, Donna Meyer, Gareth Nagai, Sarah Moore, Brayn Janura, Kaori Suda, Caio Sousa.
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OW15-019



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## Uyeda's Video collection related to SPM

- <https://youtu.be/cBP52egYG9s>
- <https://vimeo.com/166306088>
- <https://vimeo.com/166306170>

## Websites

<http://www.ctahr.hawaii.edu/WangKH/CRATE.html>

<http://www.ctahr.hawaii.edu/WangKH/insectary.html>

<http://www.ctahr.hawaii.edu/WangKH/sustainable-pest.html>





# Questions?



College of Tropical Agriculture and Human Resources  
University of Hawaii at Manoa

