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

WESTERN SARE Sustainable Agriculture Research & Education

CRATE

MANAGING INSECTS AND WEEDS IN DIY SCREENHOUSES

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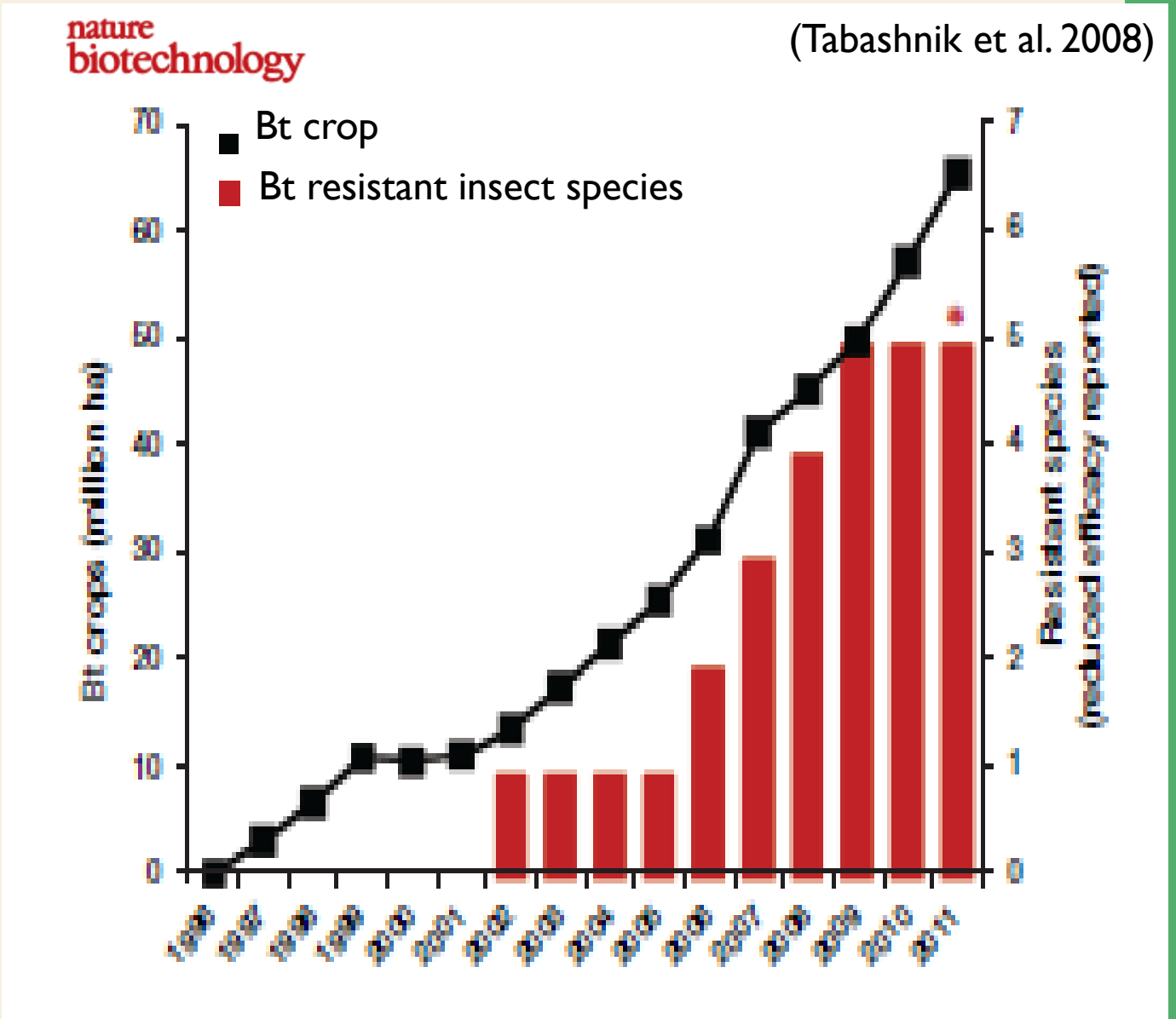
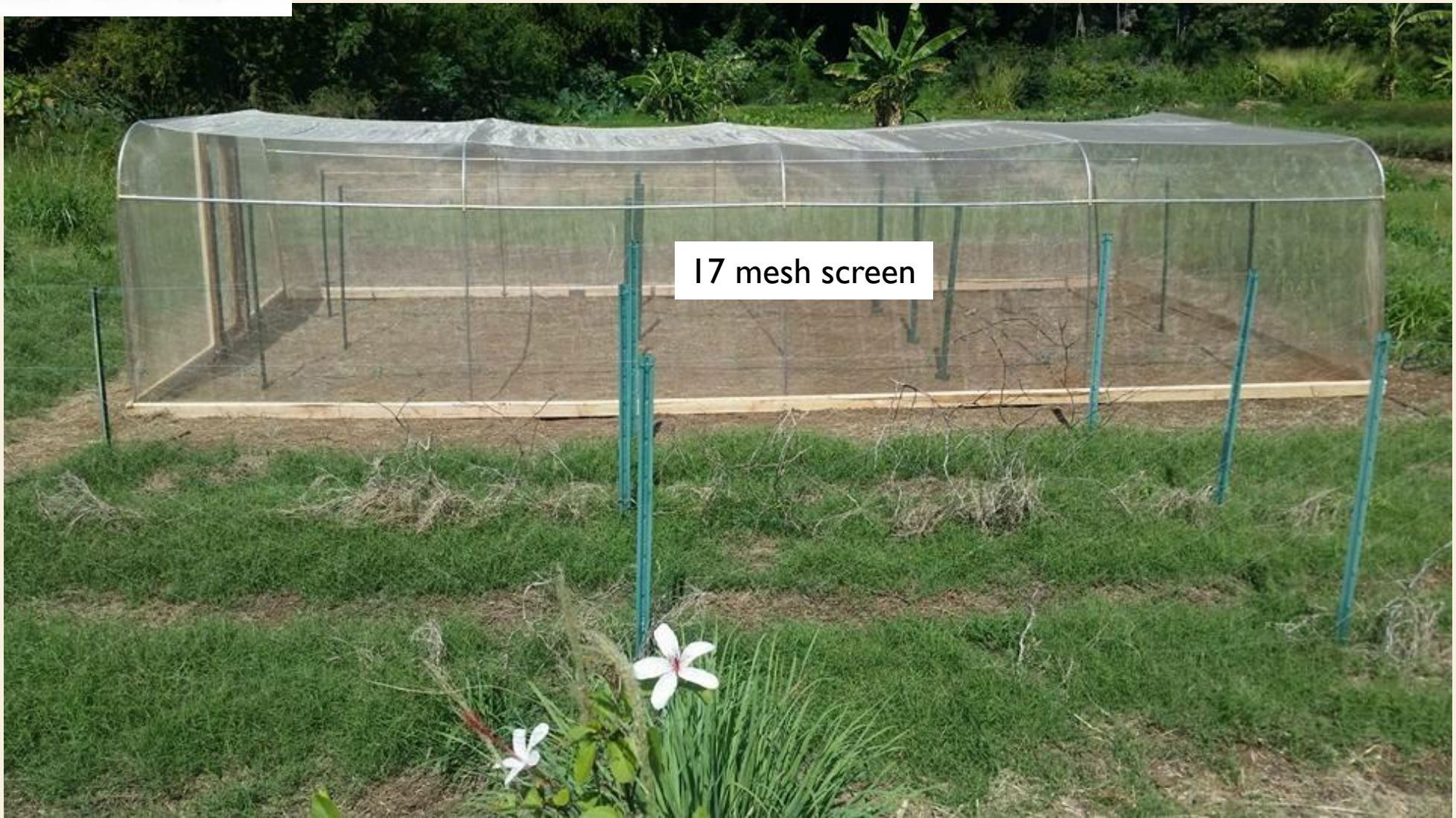
WHY SCREENHOUSE?

- Population of insecticide/Bt resistant insect pests are increasing.
- Bt only kill 25-33% of Bt-resistant diamondback moth compare to 100% kill of the susceptible population (Tabasnik 1990).
- Some insect pests like pickleworm is cryptic in nature, hard to reach by insecticides.
- Effective fruit flies management require area-wide collaboration (Vargas et al., 2008).
- For organic farmers, lack of effective OMRI certified insecticide for an effective pesticide rotation program.

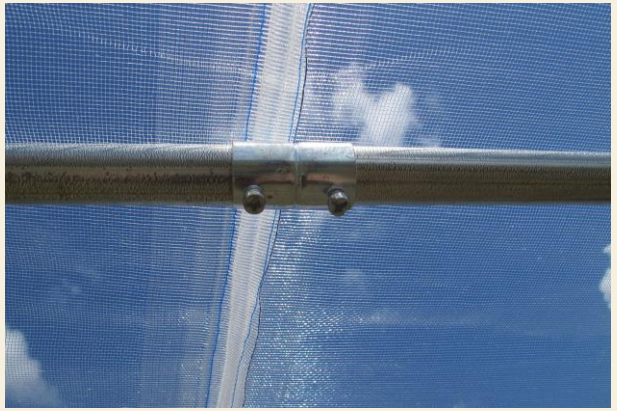


INSECT EXCLUSION SCREENHOUSE



CHALLENGES OF SCREENHOUSE

- Additional cost than open field production
- Construct stable structure that can withstand gusty wind
- Smaller insect pests can get in
- Exclude pollinators
- Rupture of screen from close contact with pipe connectors
- Difficult to till the soil for next crop (weeds and nematodes problems)



SCREENHOUSE DESIGNS #1

With wood-base frame

Dimension: 15’ × 50’ × 6’

	Price ($)
Insect netting (17 mesh)	137
Wooden door	86
Total	713
per sq ft	0.95

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

- ‘Nyagous’ is resistant to TYLC virus, yield inside the screen house was higher than that in the open field.
- Attribute to reduction in bird damage and fruit flies infestation.

SCREENHOUSE W/ WOOD-BASE FRAME & RETRACTABLE WALL

- Important for pollinator-dependent crops

“Adopt insectary plants” concept

Cucumber

Parthenocarpic var.

Pumpkin

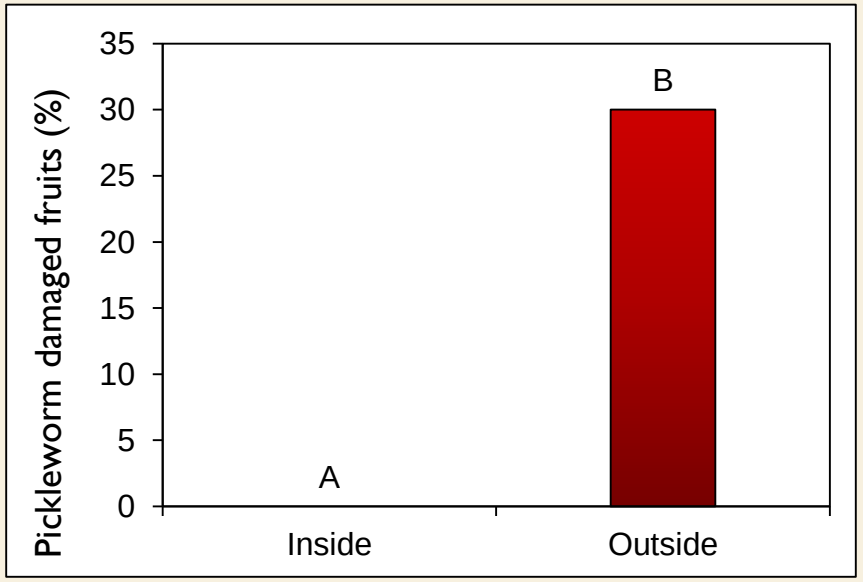
Hand pollination

SCREENHOUSE DESIGNS #2

Wood-base frame with retractable wall

Dimension: 15’ × 50’ × 6’

	Price ($)
Insect netting	137
Wooden door	86
Total	820
per sq ft	1.09



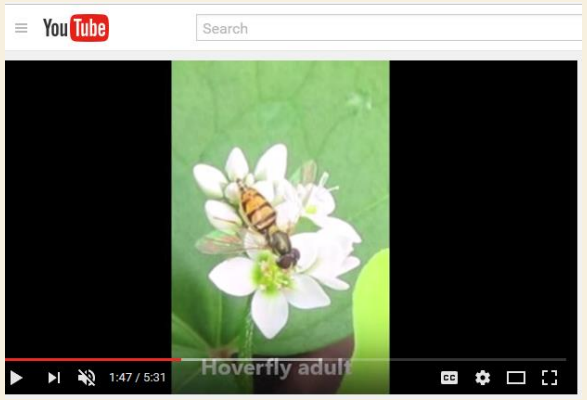
- No zucchini ‘Felix’ was harvestable when grown outside.
- Pickleworms were the main culprit.
- ‘Felix’ doesn’t seems to require pollination.

ADOPT INSECTARY PLANTS

INSECTARY PLANTS SELECTION

Video

- https://www.youtube.com/watch?v=BsN_3lC35wg&feature=youtu.be
- https://www.youtube.com/watch?v=1stOru5l-a0&feature=youtu.be



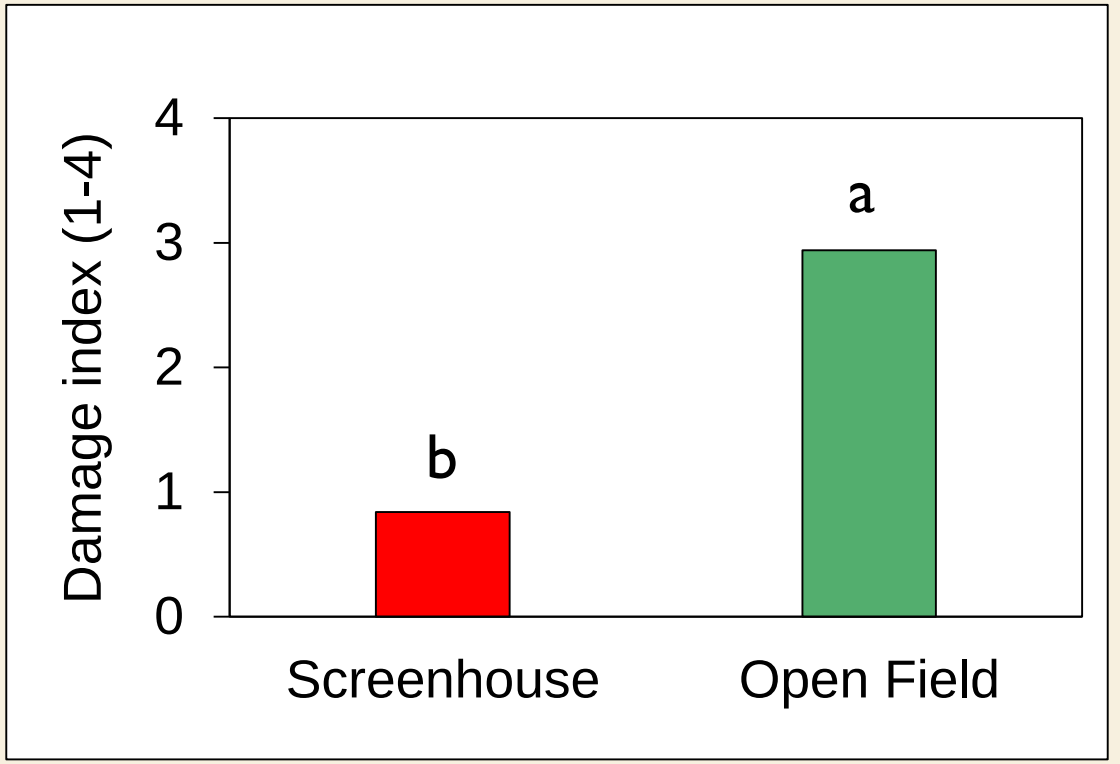
TARGET PESTS

Although the 17-mesh screen cannot block out all insect pests, the goal is to manage insect pests that are difficult to be managed with insecticides.

	Target Pests
Kale	Diamondback moth, Imported cabbage worm, leaf miner,
Zucchini	Pickle worm, Fruit fly
Pumpkin	Pickle worm, Fruit fly
Tomato	Fruit fly, pin worm, stink bugs

CATERPILLAR DAMAGE ON KALE

Screenhouse

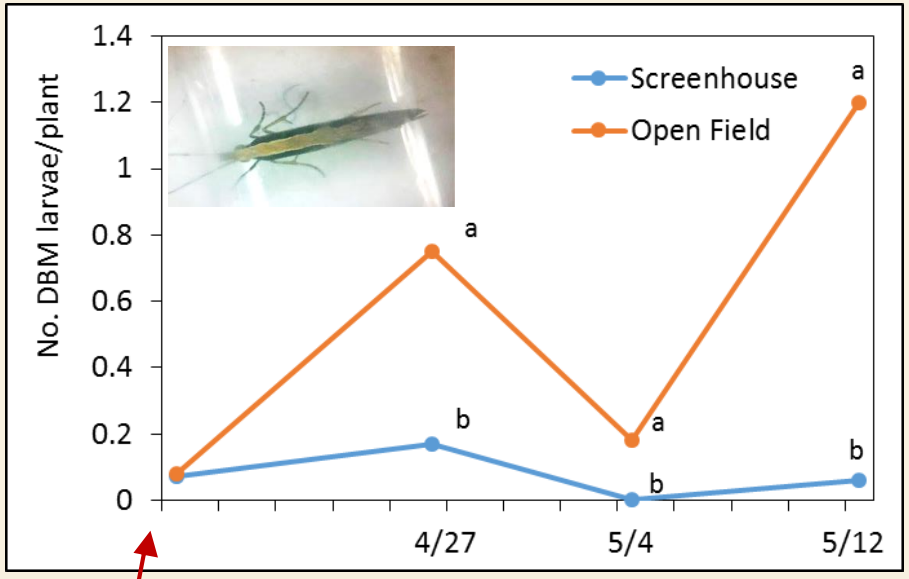


Some varieties are less preferred by the caterpillars present.

Open Field

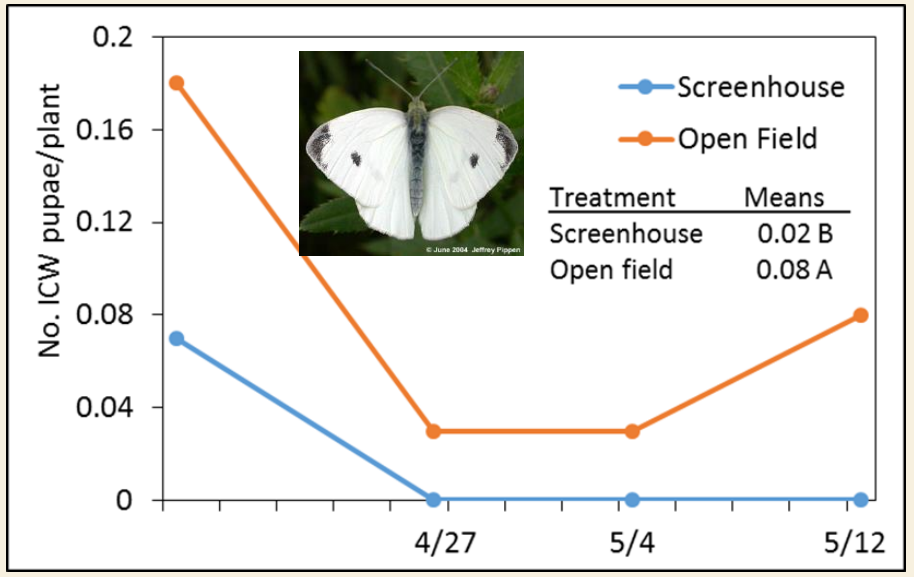
SCREENHOUSE FOR KALE PESTS MANAGEMENT

Diamondback moth

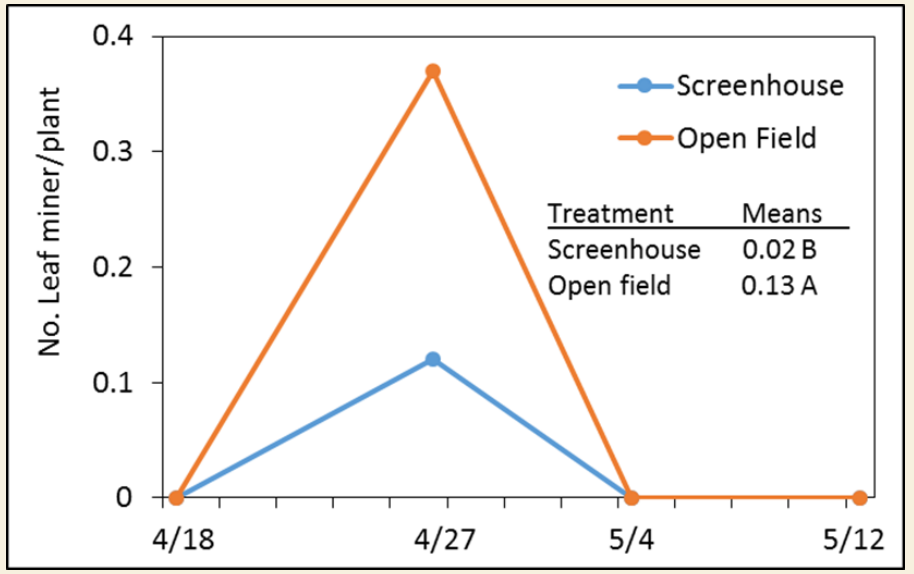


Planted end of March, 2016

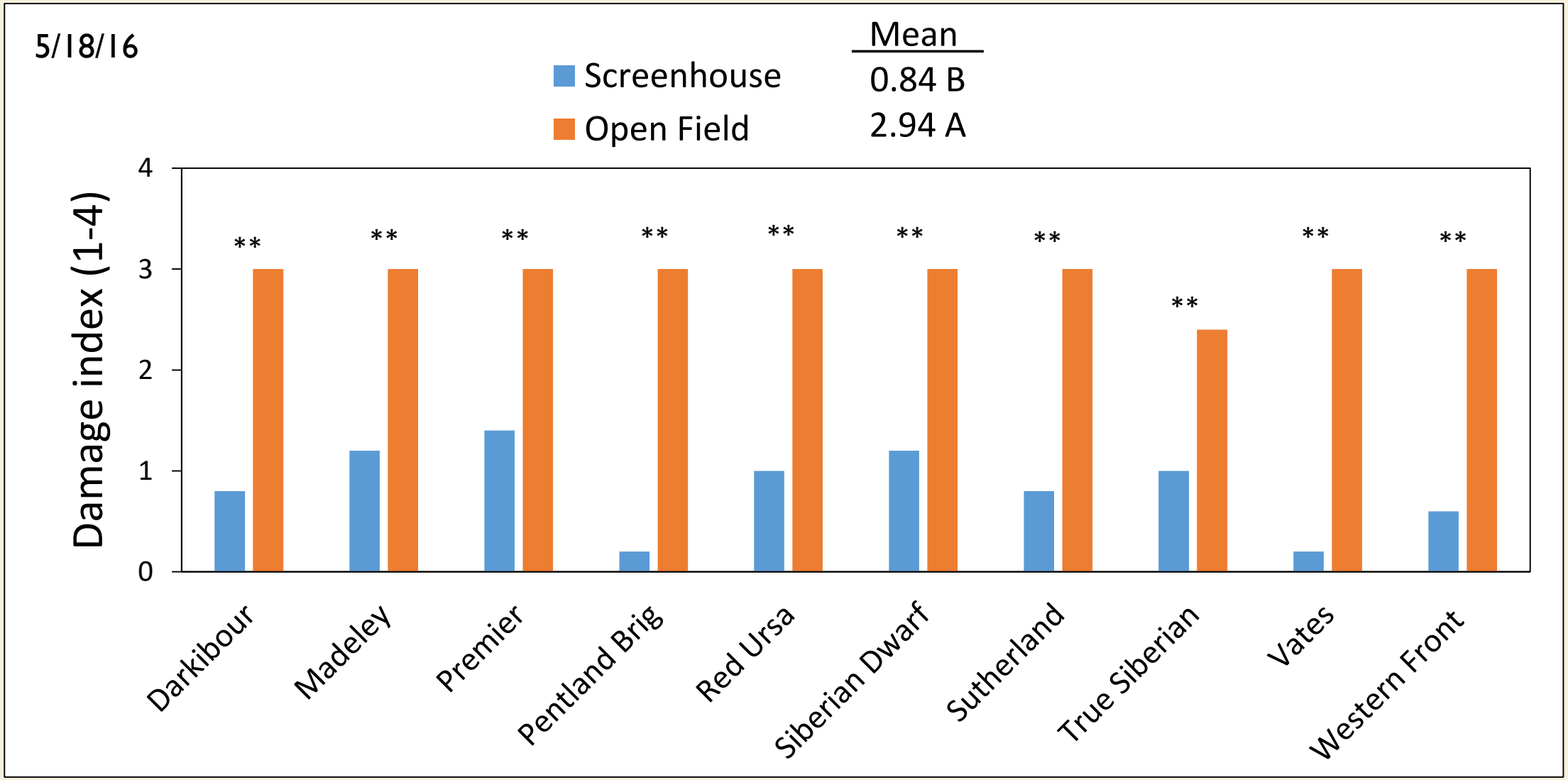
Imported Cabbage Worm



Leaf miner



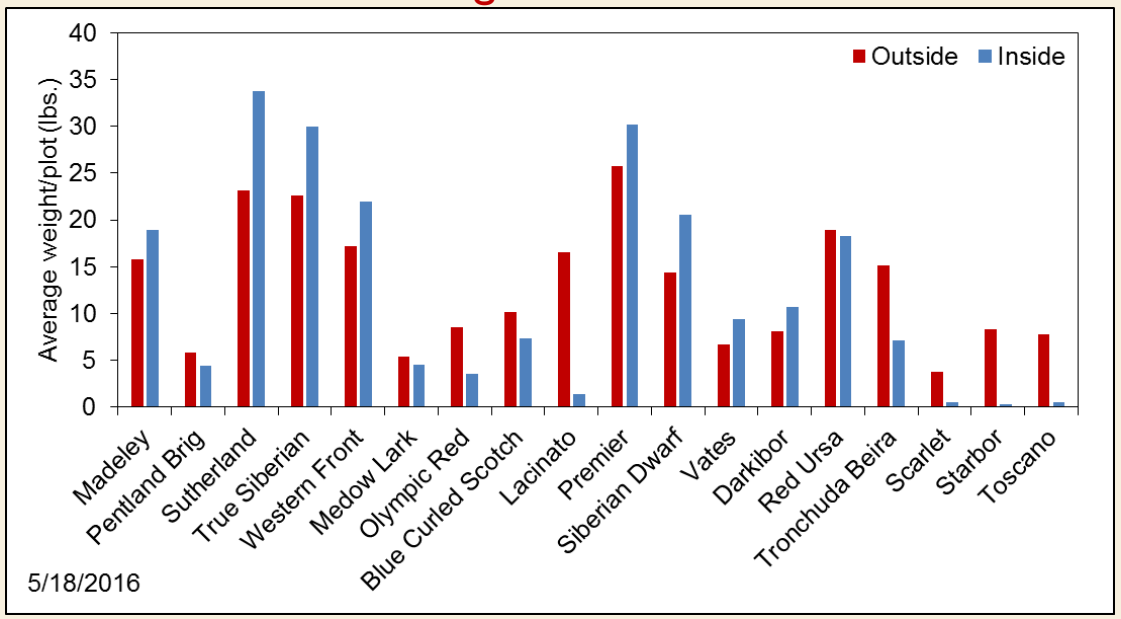
DIFFERENCE IN KALE VARIETIES TO CATERPILLAR DAMAGE



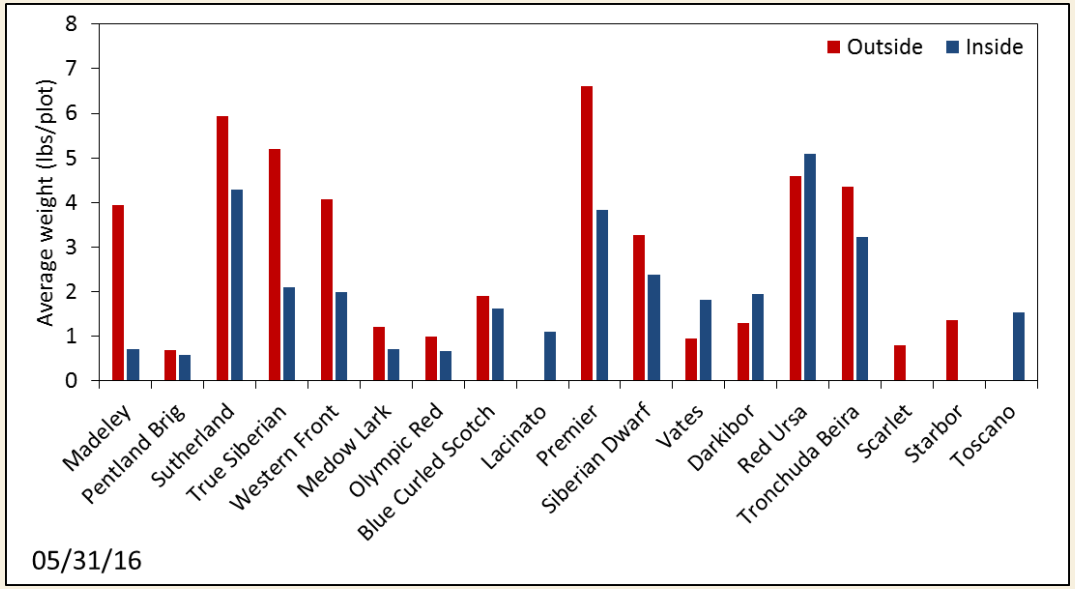
0 = 0 damage, 1 ≤ 25% leaves w/ damage, 2 (26-50% leaves w/ damage), 3 (51-75% leaves w/ damage), 4 (75-100% damage)

KALE YIELD BY DATE

Initia`l harvest was good inside the screenhouse.

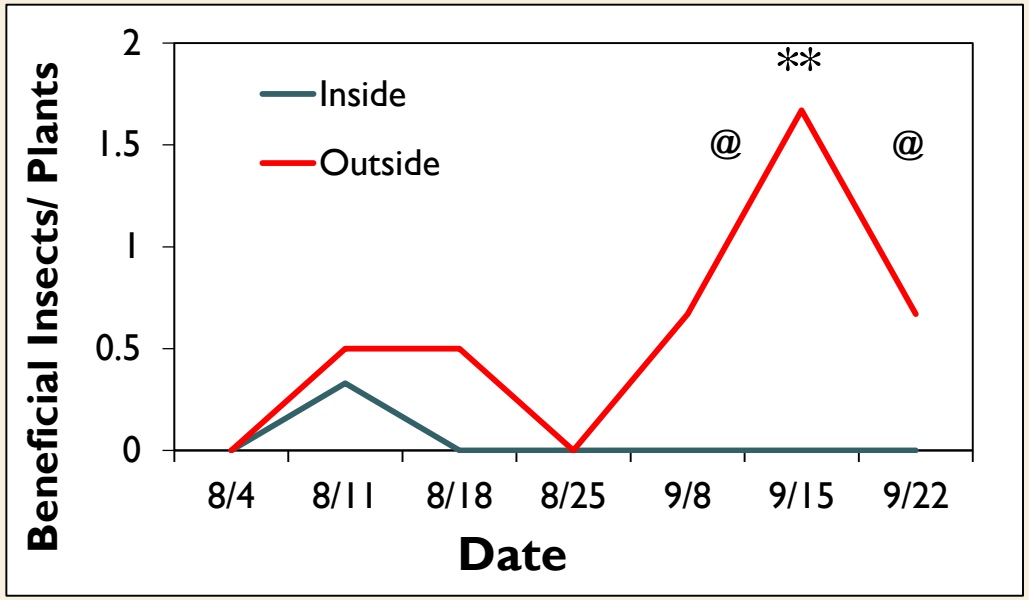


Major outbreak of whiteflies and thrips two weeks after initial kale harvest, resulted in poorer yield inside the screenhouse.



Integrate with insecticide spray program for soft body insects.

DILEMMA OF 17-MESH SCREENHOUSE



Out break of aphids also can be more severe inside the screenhouse than outside

Beneficial insects were more abundant in open field than inside the screenhouse.

Adopt insectary plants into screenhouse

Insecticide rotation against soft body insects

What if we use finer mesh?

What if we don't use weed frame (to cut cost)?

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EFFECTS OF SCREENHOUSES WITH DIFFERENT MESH SIZES

15'× 50'× 6'	Price ($)
Insect netting (17 mesh)	137
Structure (with door)	330
Total	467
Price per sq ft	0.62

Open field

EMT conduits to support PVC pipes.

Hoop house

17 mesh ($0.09-0.125/sq ft)

Reflective shade ($0.35/sq ft)

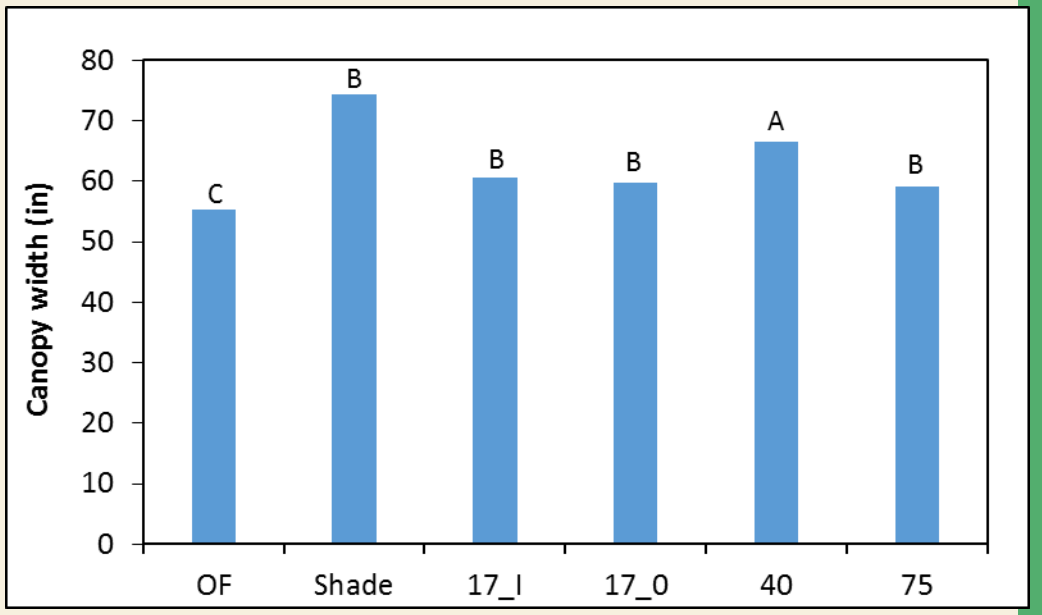
Anti-insect netting
40 Mesh ($0.22/sq ft)

No thrips insect screen
75 Mesh (0.85/sq ft)

EFFECTS OF SCREEN MATERIALS ON ZUCCHINI GROWTH

Screen materials	Light (μmol $m^{-2}s^{-1}$)	Temp (°C)
Open field	979.6	28.6
Reflective shade	446.4	26.7
17-I mesh	802.5	28.4
17-0 mesh	662.5	27.3
40-mesh	766.9	29.1
75-mesh	563.5	28.8

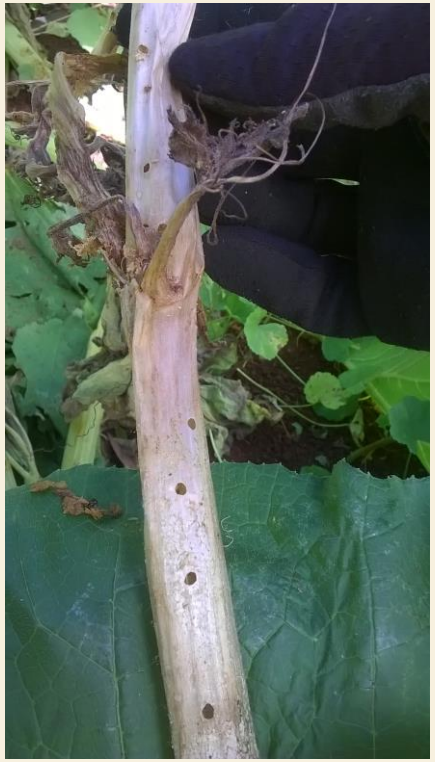
- Screen materials reduced light intensity to some extent compared to the open field.
- But zucchini growth was improved in all screenhouses especially 40-mesh house than the open field (OF).



PUMPKIN

Pumpkin grown under the protection of a screen can increase marketability, but hand pollination or parthenocarpic seeds is necessary.

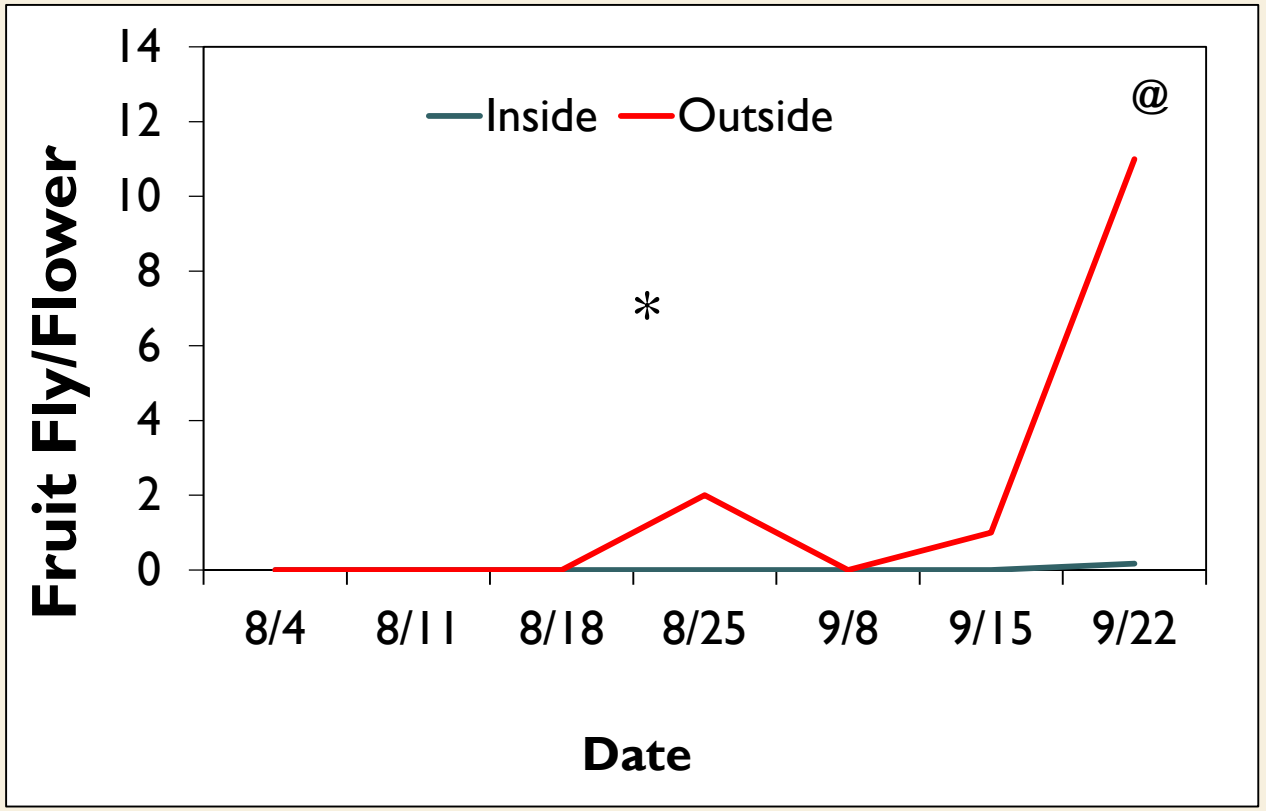
INSECT DAMAGE ON PUMPKIN OUTSIDE OF THE SCREEN HOUSE



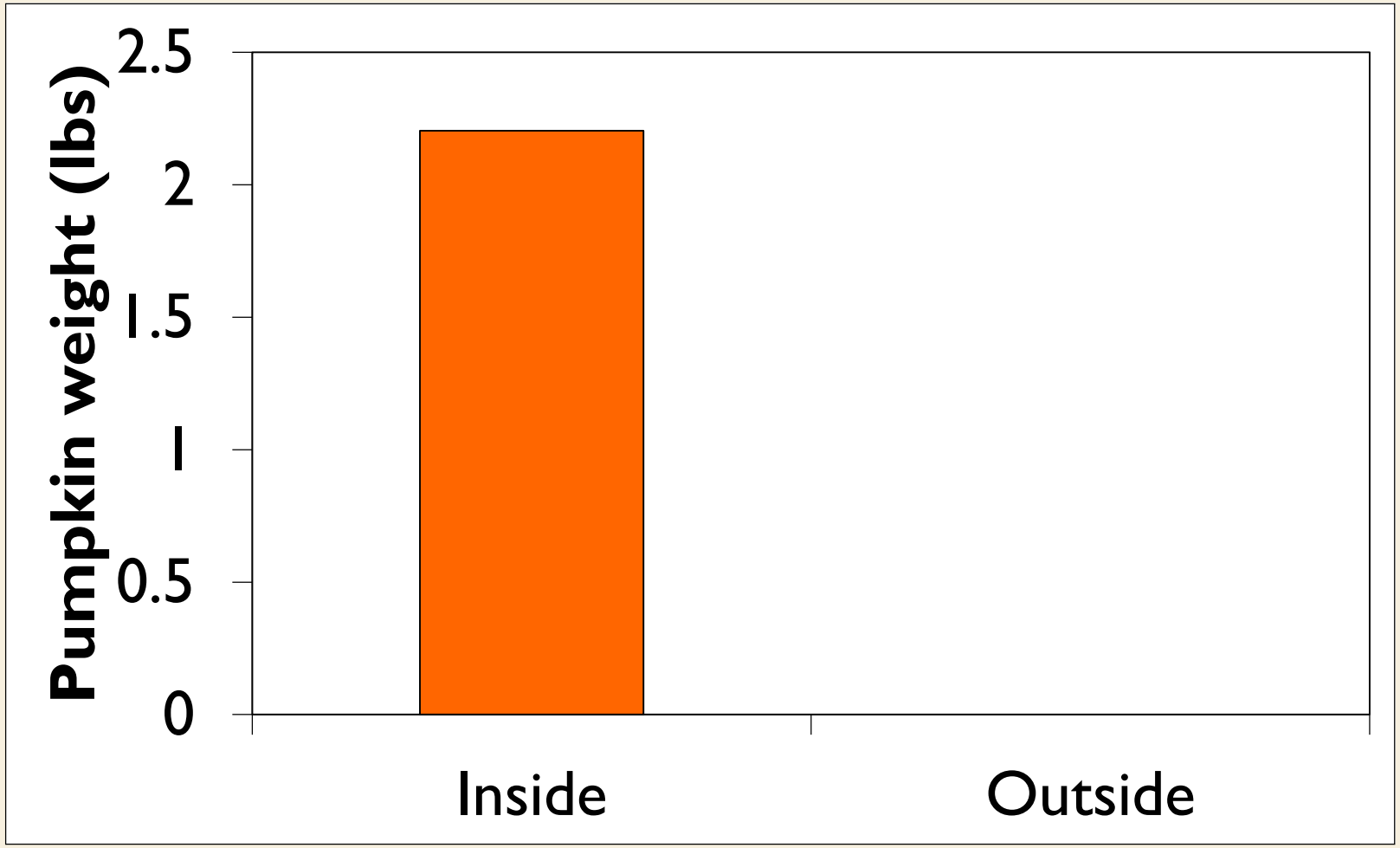
Pickle worms (PW) and melon flies (MF) caused total crop failure for pumpkin production outside of the screenhouse:

- Early infestation of fruits by PW or MF resulted in no fruit development.
- Pickle worms bored into stem tissues can cause entire stem die back.
- Late infestation of fruits by PW or MF caused unmarketable fruits.

INSECT PESTS ON FLOWERS



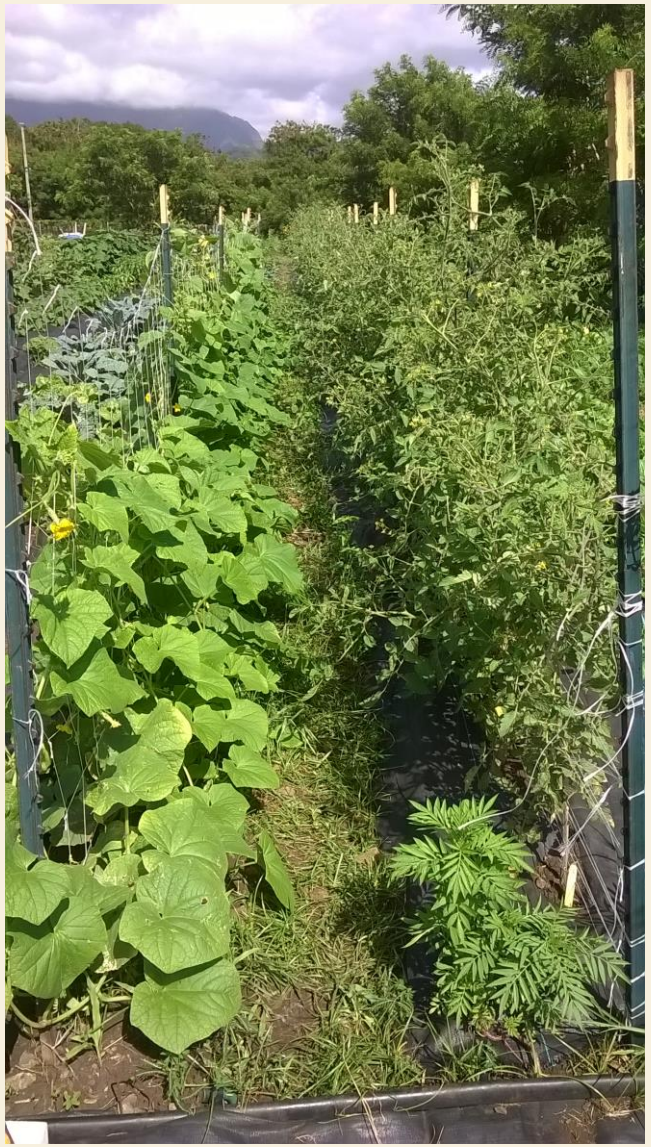
PUMPKIN YIELD



Screenhouse for Tomato at Waimanalo

Inside

Outside



PARTICIPATING FARM COACH: JAY BOST

Tomato cultivars:

- ‘Rojita’
- ‘Taiwan’
- ‘Felicity’ (TYLCV resistant)

Target Pests of Tomato at Waimanalo

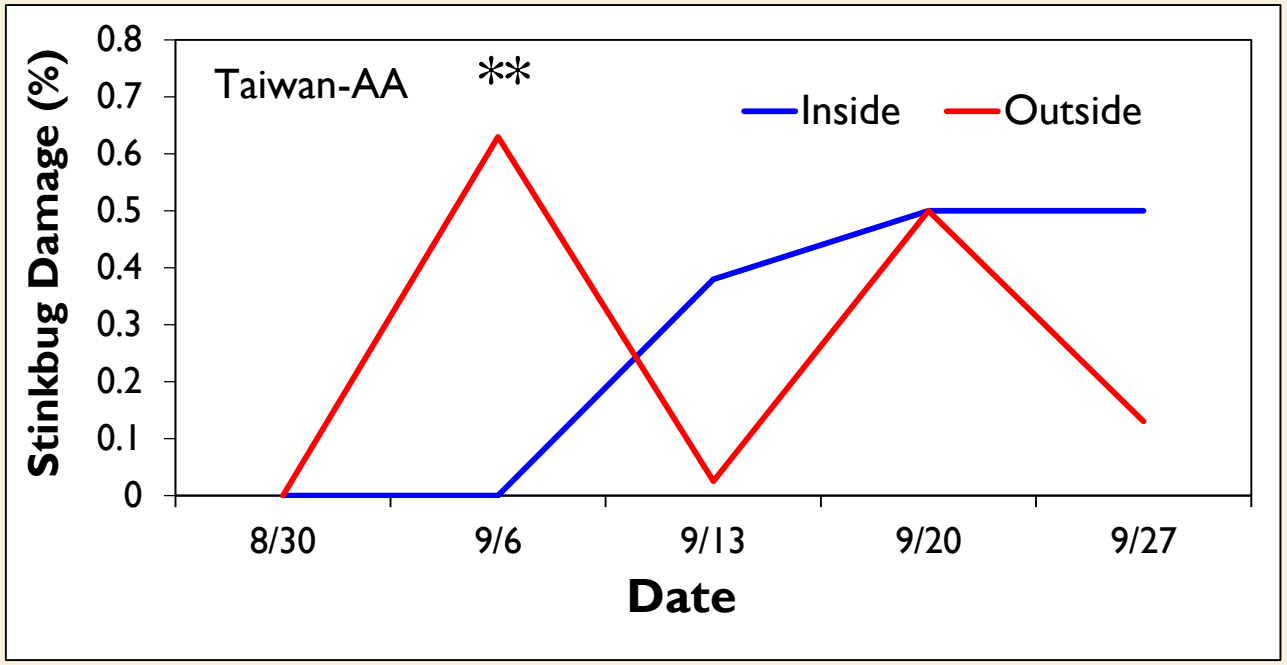
Stinkbug on Taiwan AA

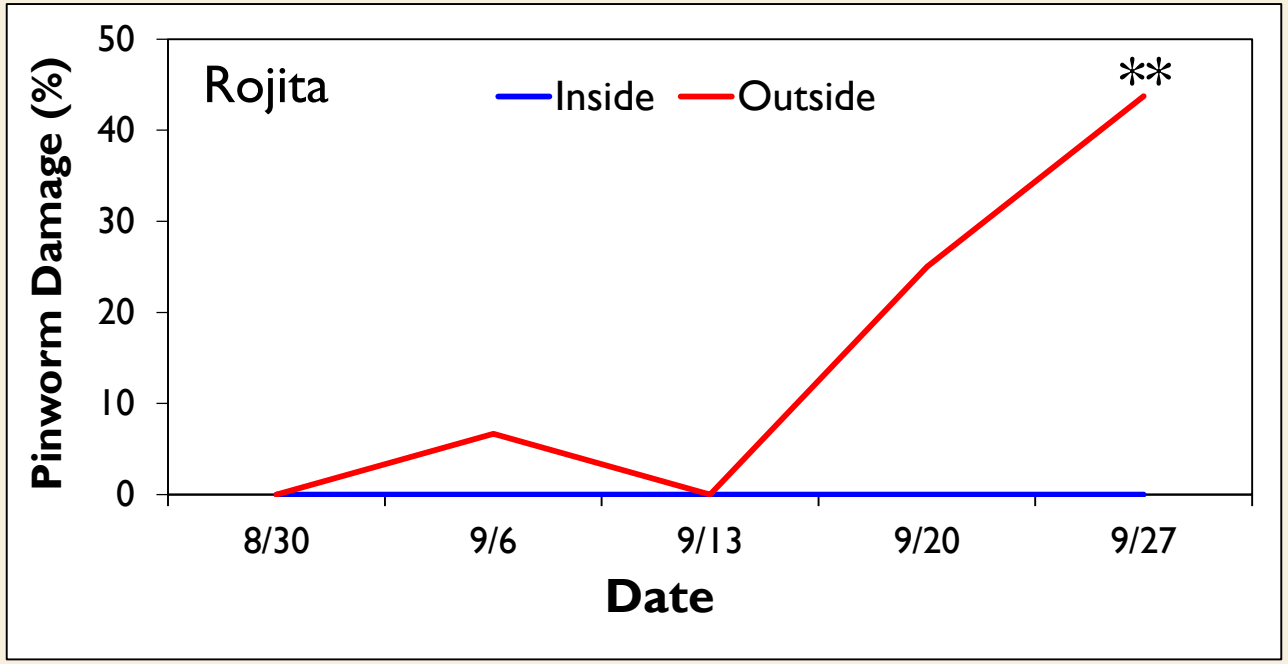
Bird damage

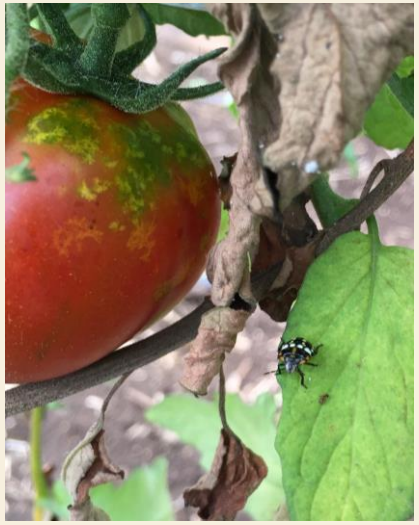
Tomato pinworm

Mite damage

Insect Damage on Plants







FARMER TESTIMONY JAY:

- “LOVED the screenhouse, zucchini and tomato fruit were pest free, but there was heavy aphid pressure.”
- “Cucumbers did not work out probably due to lack of pollinators, but should try parthenocarpic varieties.”
- “Larger slice tomatoes had decent yield from inside the screenhouse something we have never been able to do in field due to fruit fly.”
- “The pepper in the screen has no fruit fly or pepper weevil, both of which infect nearly 100% in the field.”

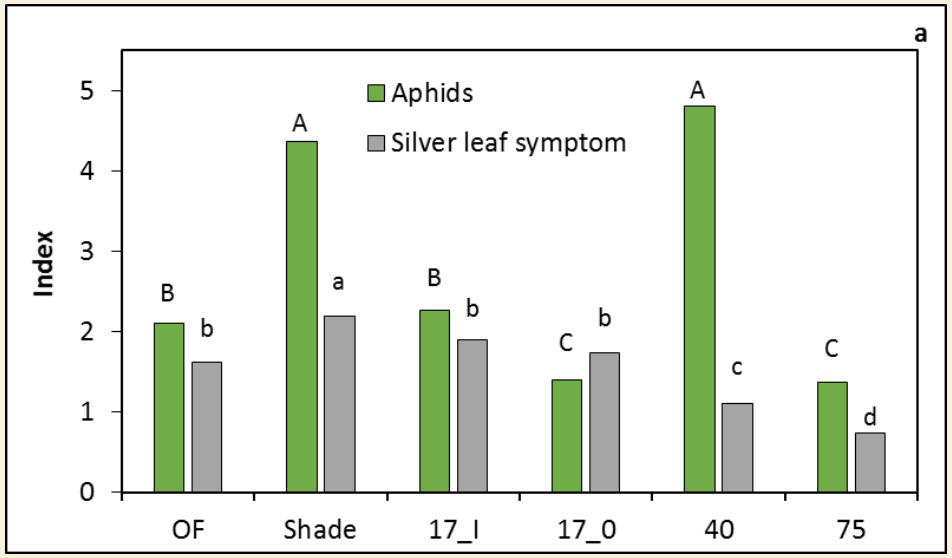
PESTS ON ZUCCHINI

Melon aphids

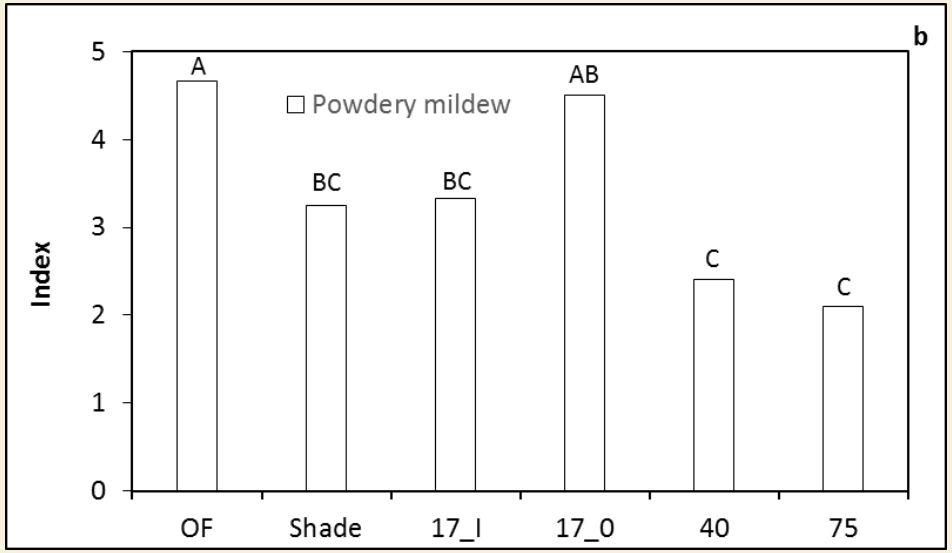
Zucchini mosaic virus

Silverleaf symptom caused by whiteflies

Powdery mildew



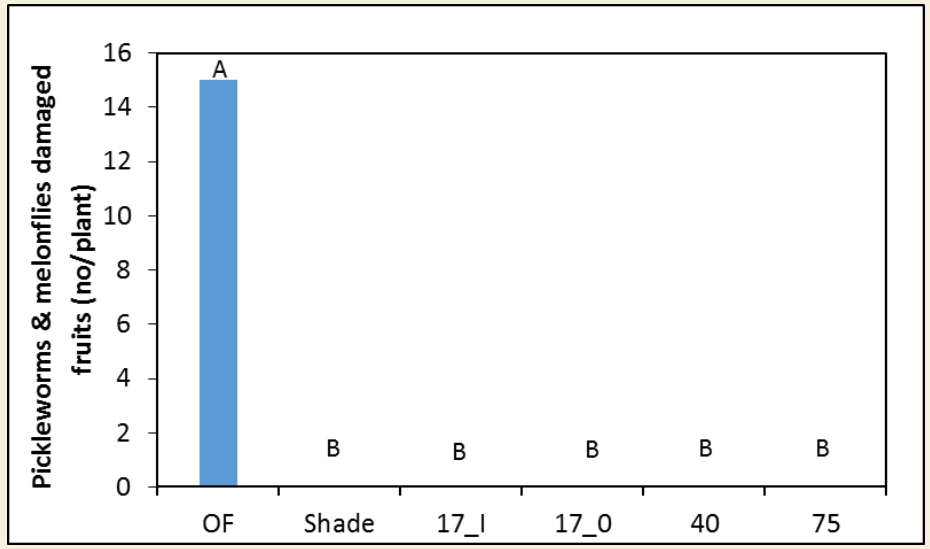
- 40 and 75 mesh reduce silverleaf symptomatic plants but did not reduce aphids numbers.

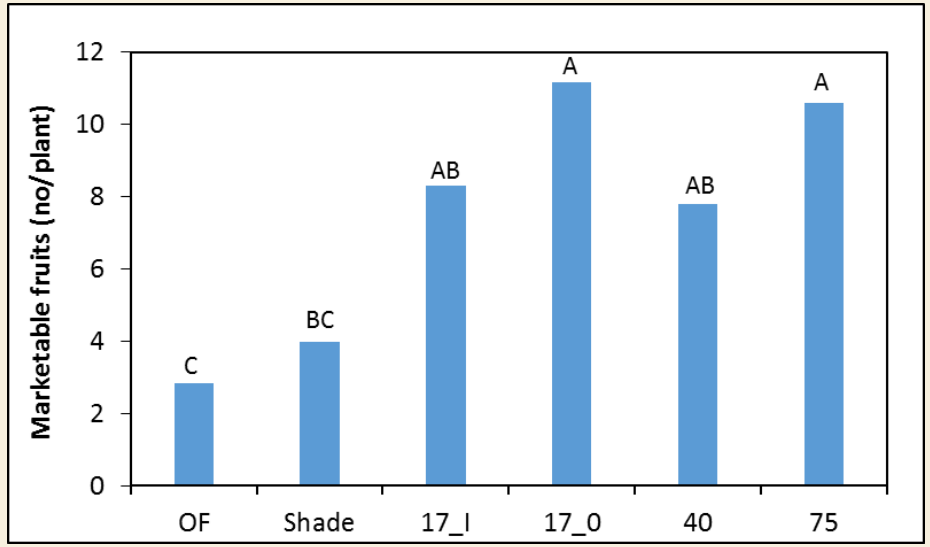


- Most screens can reduce powdery mildew, but effect of 17-mesh is not consistent.

PICKLEWORMS & FRUITFLIES DAMAGE

- All fruits in open field suffered from pickleworms or fruitflies damages, but no damage from these pests was detected in all the screenhouses.
- Yield was higer in screenhouses 17, 40 and 75, but not in the reflective shade.





MARKETABLE VS UNMARKETABLE FRUITS

ACKNOWLEDGEMENT

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- Farm Crews from Poamoho and Waimanalo.
- Anthony Deluze, Jay Bost, Mele Judd-Cox.

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Videos

Websites

http://www.ctahr.hawaii.edu/WangKH/

- Western Sustainable and Agriculture Professional and Producer (WSARE P&P) program and the CTAHR Supplemental Fund funded a 2-year project for our team to develop and promote the use of screenhouses for small-scale vegetable crop producers. This report summarizes our screen house development in collaboration with three groups of participating farmers.

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