



# Tweaking Your Tomato High Tunnel

**Tweak = to customize or modify something to suit a particular task**

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THE UNIVERSITY OF VERMONT  
**EXTENSION**

# What are your peers doing?

## 2024 high tunnel tomato benchmarking survey

- in-ground
- trellised
- double poly
- drip irrigation
- 3+ years in production
- slicer varieties





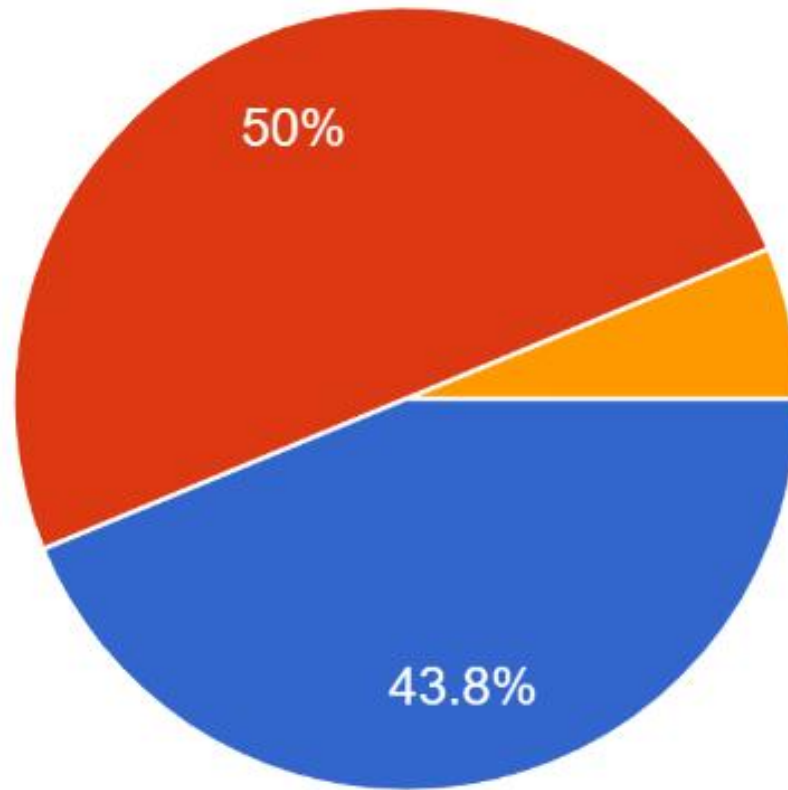
**“slicing”  
cultivars grown**



**Geronimo is grown  
on 42% of farms**

# Are the tomato plants grafted?

48 responses



- Yes
- No
- Some of them

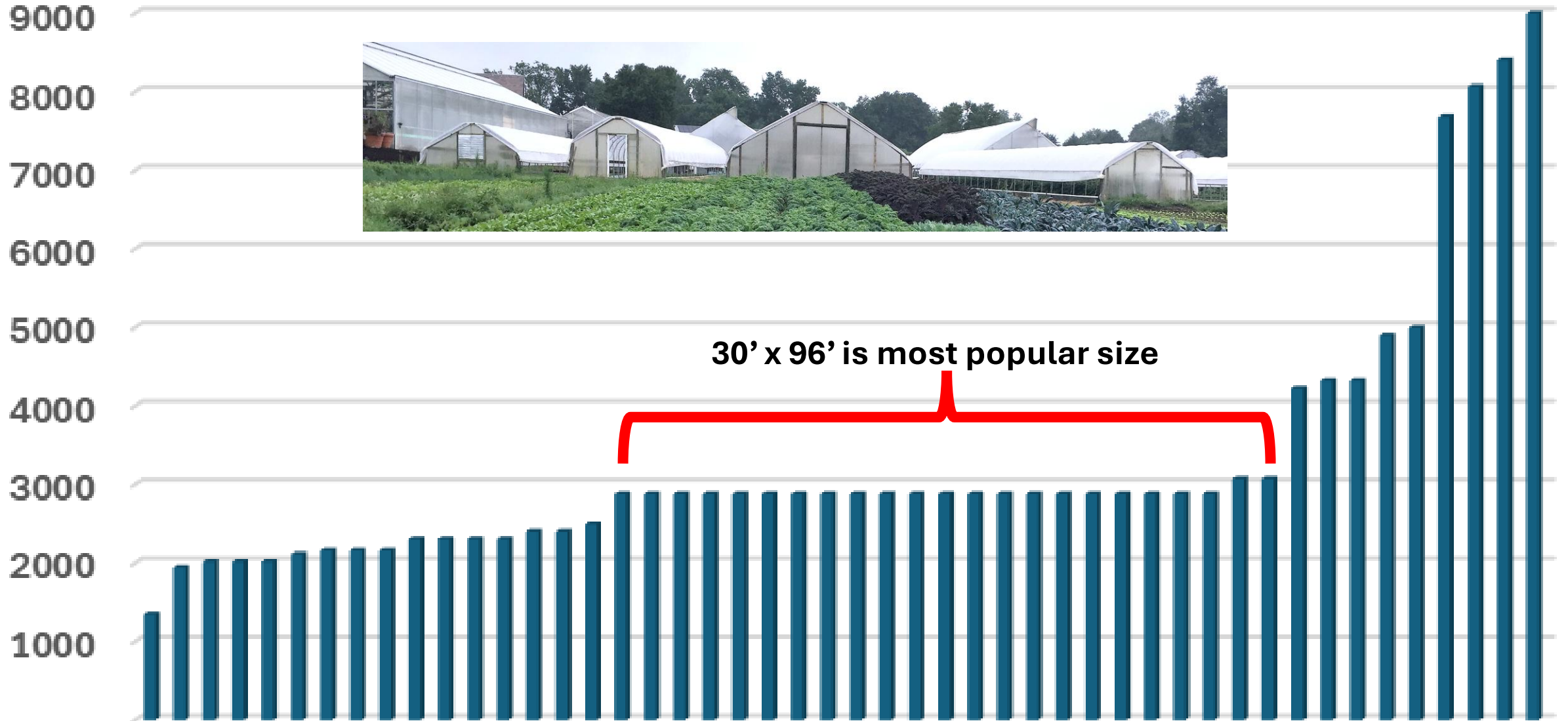
**half the growers use grafted plants**

**grafting  
rootstocks used**

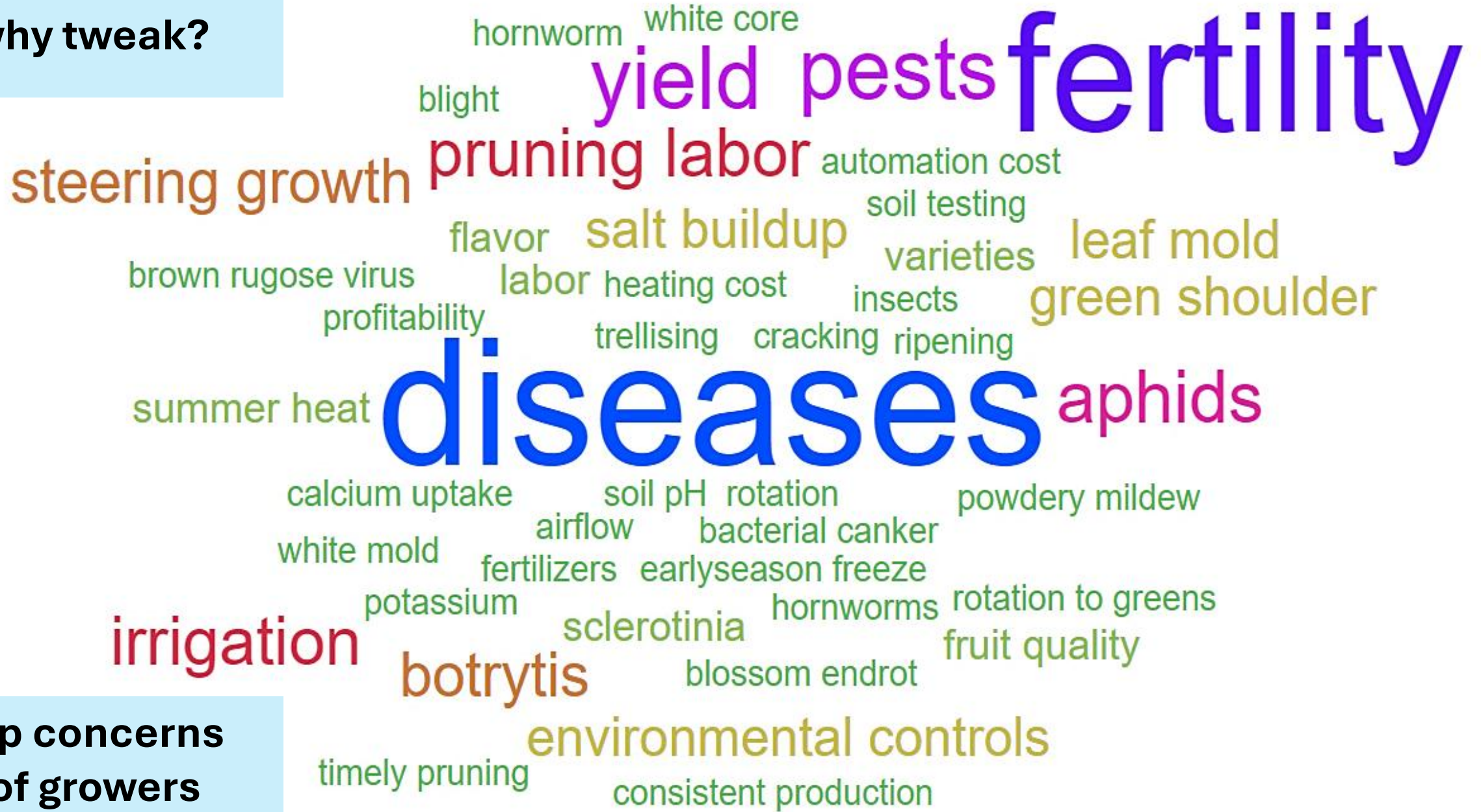
Estamino  
Fortamino  
**Maxifort**  
DRO141TX

**Maxifort is by far the most popular rootstock**

# high tunnel area (sq. ft.)

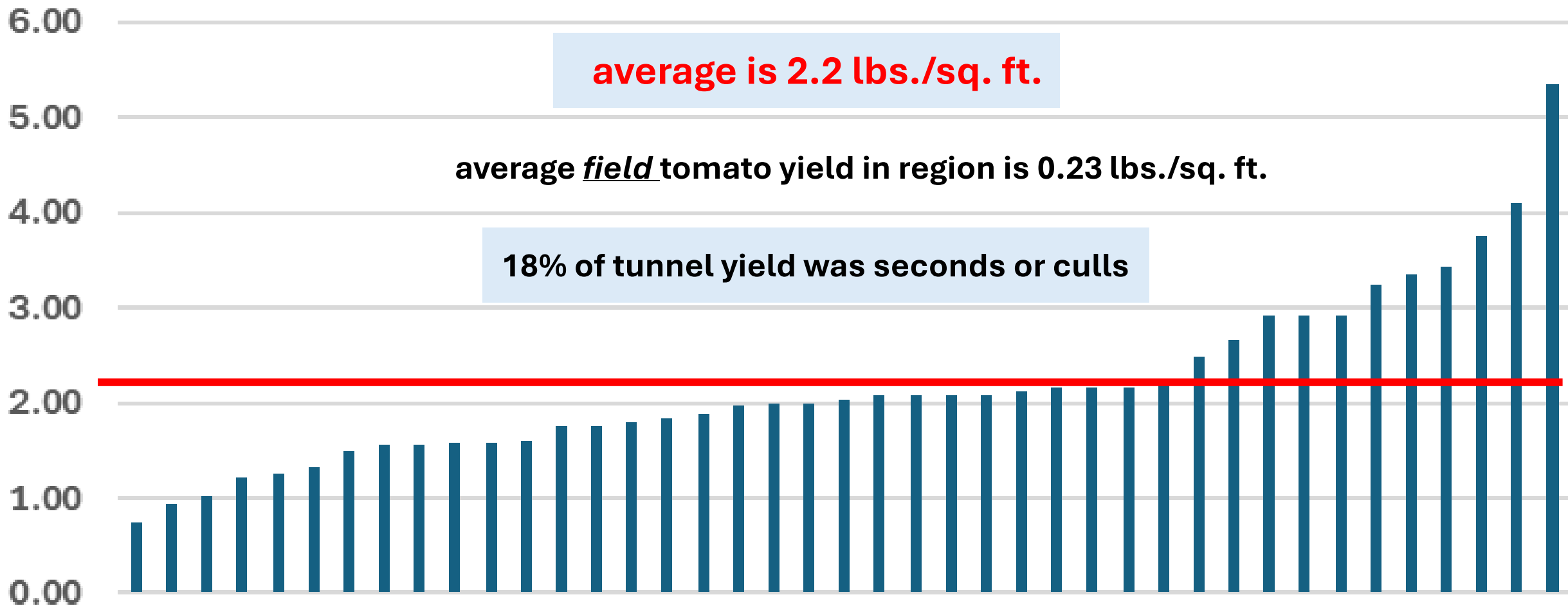


why tweak?

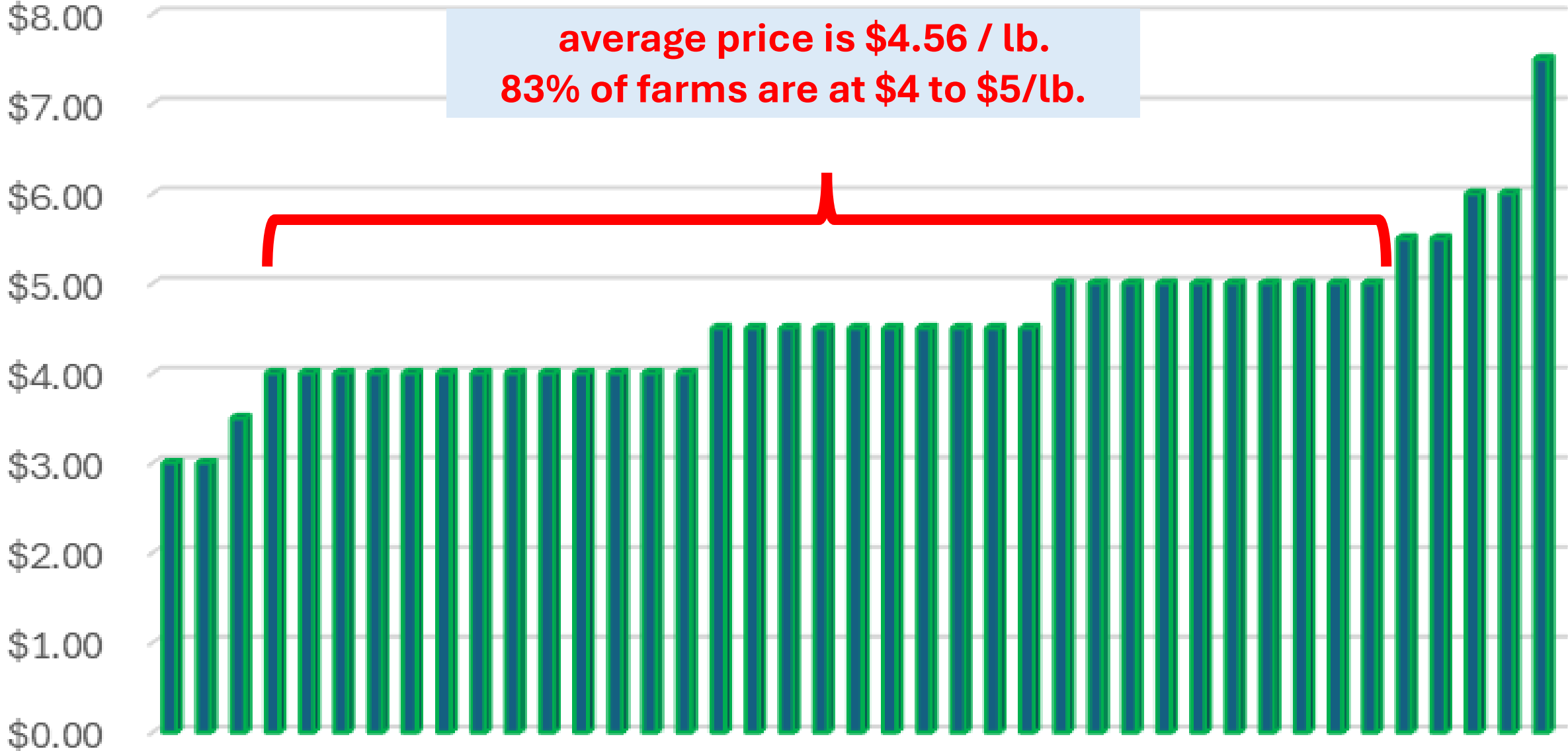


top concerns  
of growers

# total tunnel tomato yield lbs. per sq. ft. on 41 farms in 2024



# tunnel tomato retail price per pound



**2 lbs. marketable yield /sq. ft.**


**x 2,880 sq. ft. tunnel**

**x \$4.56 / lb. retail**

**= \$26,266 gross sales**

**a 10% yield increase = \$2,626**

**consider that in payback calculations**



**optimize yield with  
different types of tools**

# top 10 yielding tunnels vs. all others (n=31)

	top 10	all others	difference
total yield per sq. ft.	3.5 lbs.	1.8 lbs.	94%
tunnel width per drip line	1.6 ft.	2.3 ft.	44%
area per leader (density)	5.0 sq. ft.	5.6 sq. ft.	12%
ventilation area: tunnel area	0.37	0.34	9%
days of growth in tunnel	169	156	8%

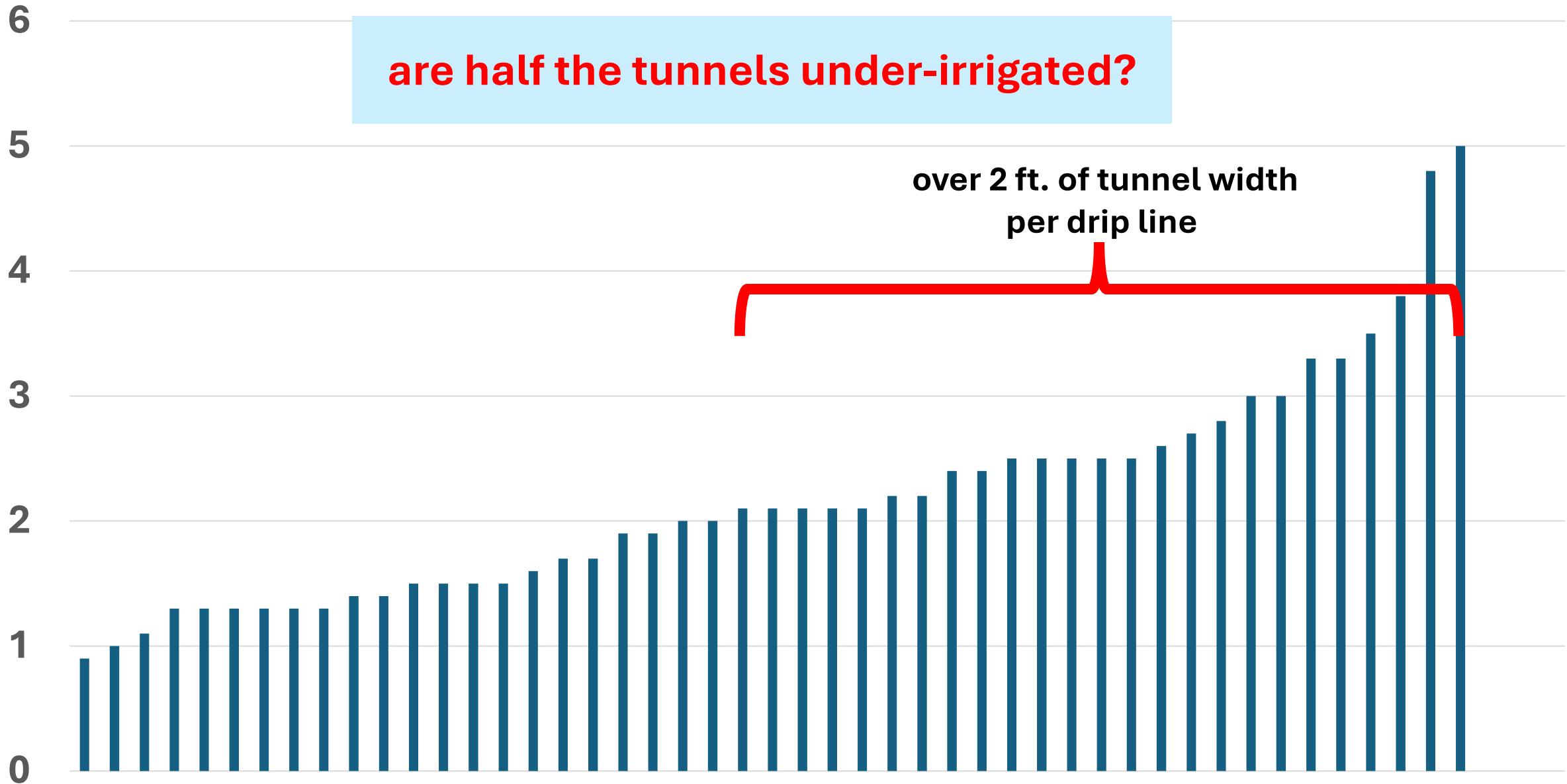
# top 10 yielding tunnels vs. all others

	<b>top 10</b>	<b>all others</b>	<b>difference</b>
<b>automated side ventilation</b>	<b>70%</b>	<b>10%</b>	<b>60%</b>
<b>grafted plants</b>	<b>80%</b>	<b>35%</b>	<b>45%</b>
<b>air heat</b>	<b>80%</b>	<b>42%</b>	<b>38%</b>
<b>long-term tunnel soil test</b>	<b>90%</b>	<b>55%</b>	<b>35%</b>
<b>surface mulch in row</b>	<b>100%</b>	<b>71%</b>	<b>29%</b>
<b>HAF fans</b>	<b>80%</b>	<b>55%</b>	<b>25%</b>

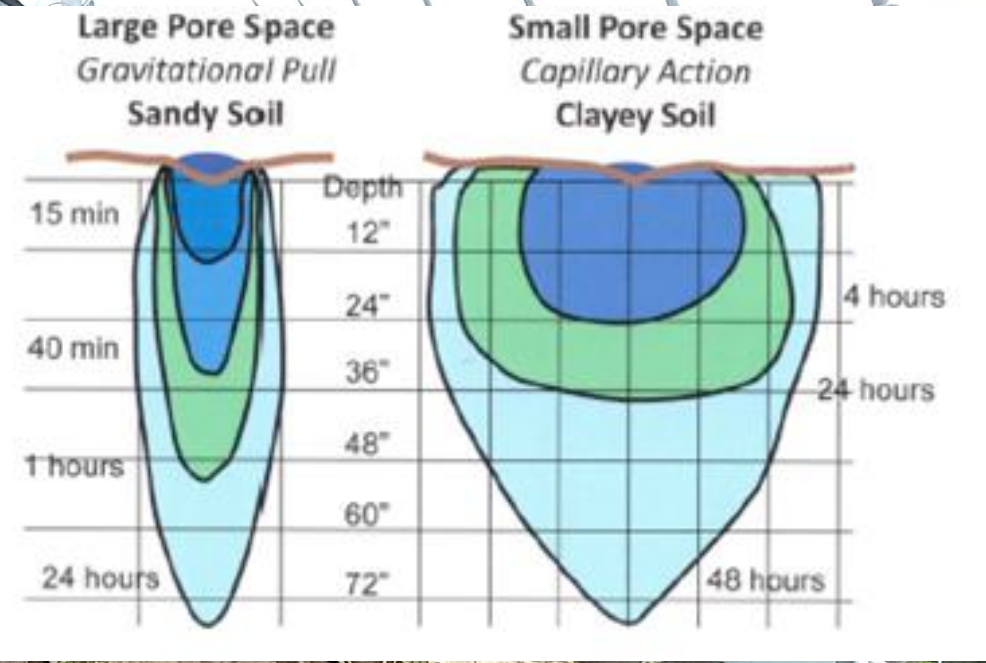
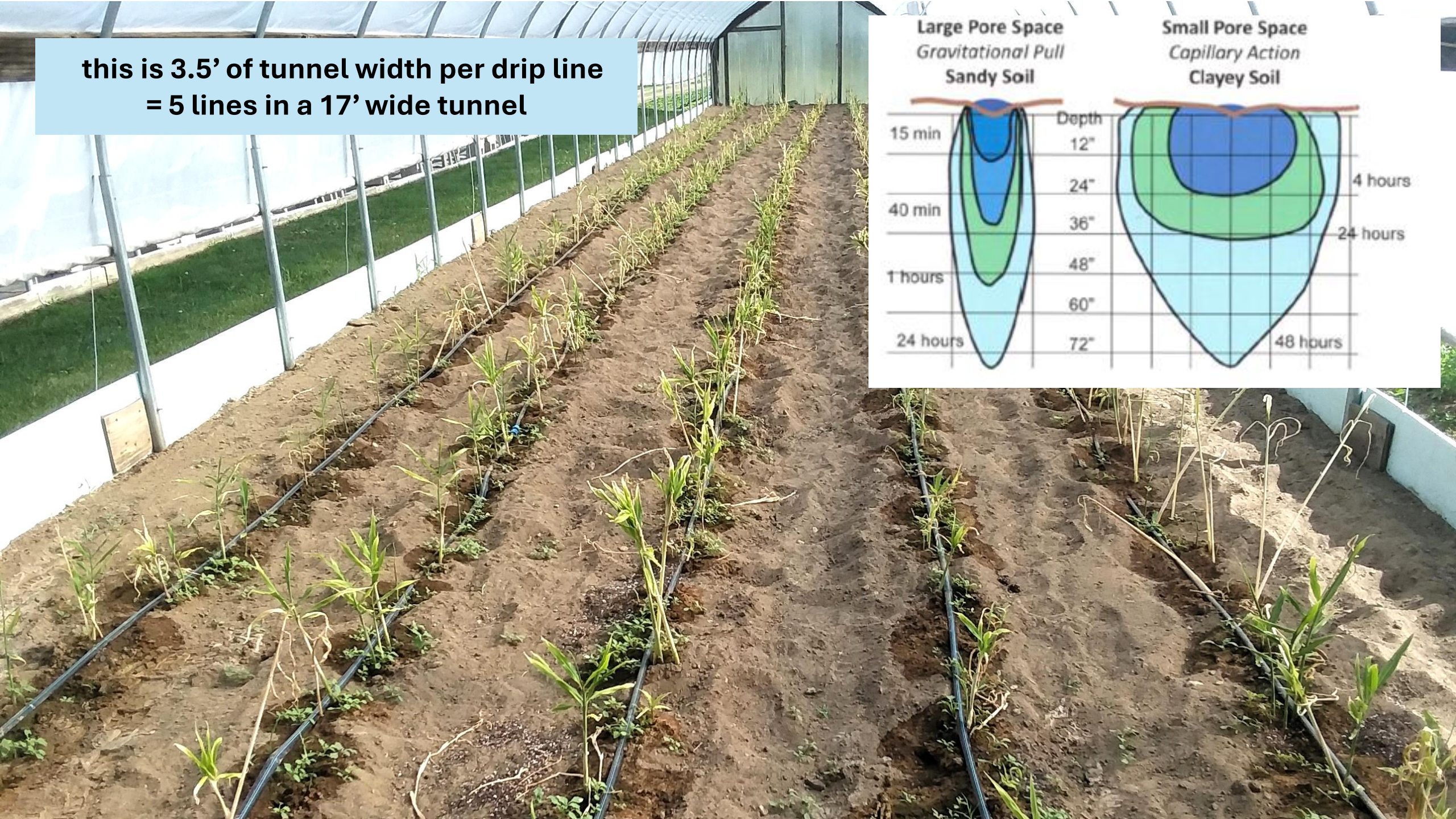
soil surface area width (ft.) per drip line

are half the tunnels under-irrigated?

over 2 ft. of tunnel width  
per drip line



this is 3.5' of tunnel width per drip line  
= 5 lines in a 17' wide tunnel



**make sure the entire rooting zone gets wetted**

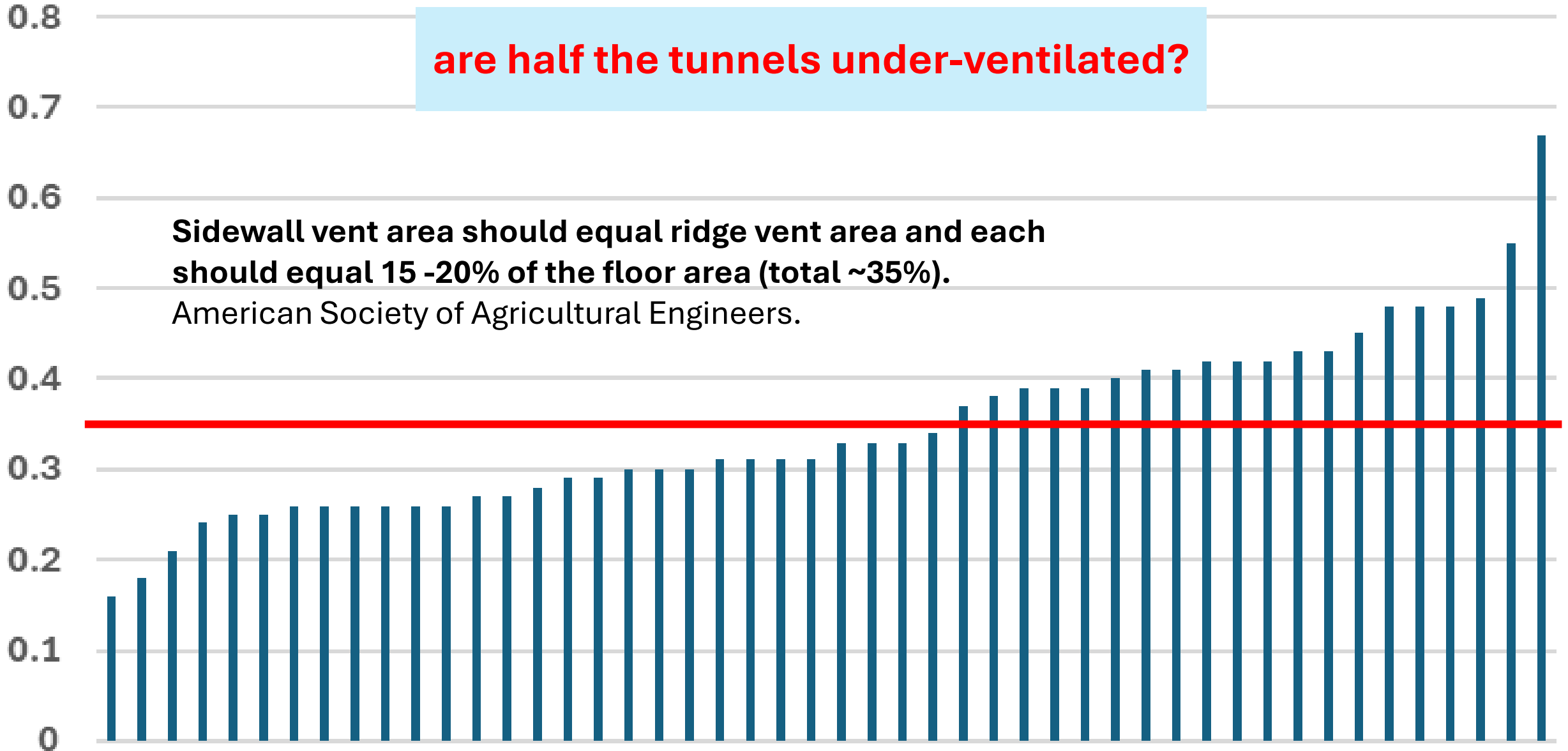
**this is 1.5' of tunnel width per drip line  
= 20 lines in a 30' wide tunnel**



# Ratio of total ventilation openings to tunnel floor area

are half the tunnels under-ventilated?

**Sidewall vent area should equal ridge vent area and each should equal 15 -20% of the floor area (total ~35%).**  
American Society of Agricultural Engineers.



## increasing passive ventilation



**extended ground posts**  
**\$1,000 +/-**

for older, lower tunnels  
may require additional bracing



**gable or butterfly vents**  
bigger the better  
**\$500 +/- for both endwalls**



**ridge vent \$4,000 +/-**

# roll-up (or down) side mechanisms affect timeliness of ventilation



hand over hand bar  
~\$800 for 96' tunnel



gear cranks, hand or drill  
add ~ \$200-500

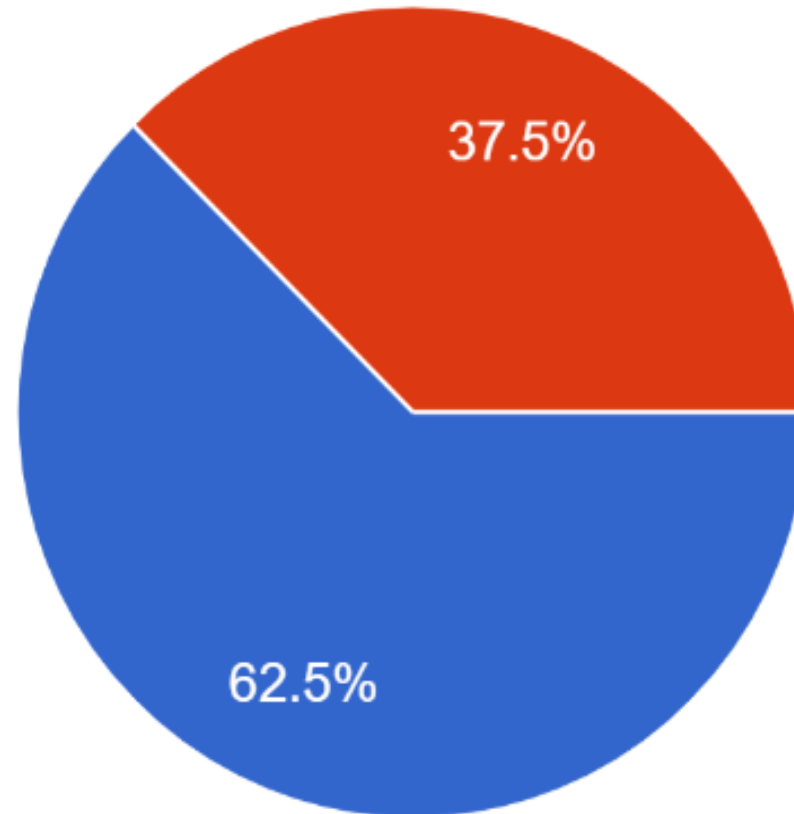


automatic side venting  
add ~\$ 3,000 for two drive  
motors, controller, thermostat

# Are HAF (horizontal air flow) fans used?

48 responses

**is air insufficiently mixed in ~1/3 of the tunnels?**



● Yes  
● No

**38% of tunnels lack HAF fans**

**Temperature, humidity and CO<sub>2</sub> gradients in a tomato greenhouse are greatest when it's sunny. HAF fans significantly improve uniformity of all three.**

The Influence of Fans on Environmental Conditions in Greenhouses. Fernandez and Bailey, 1994.

**optimize air circulation and mixing--in addition to ventilation**



**4 high quality fans \$1,200 +/-**



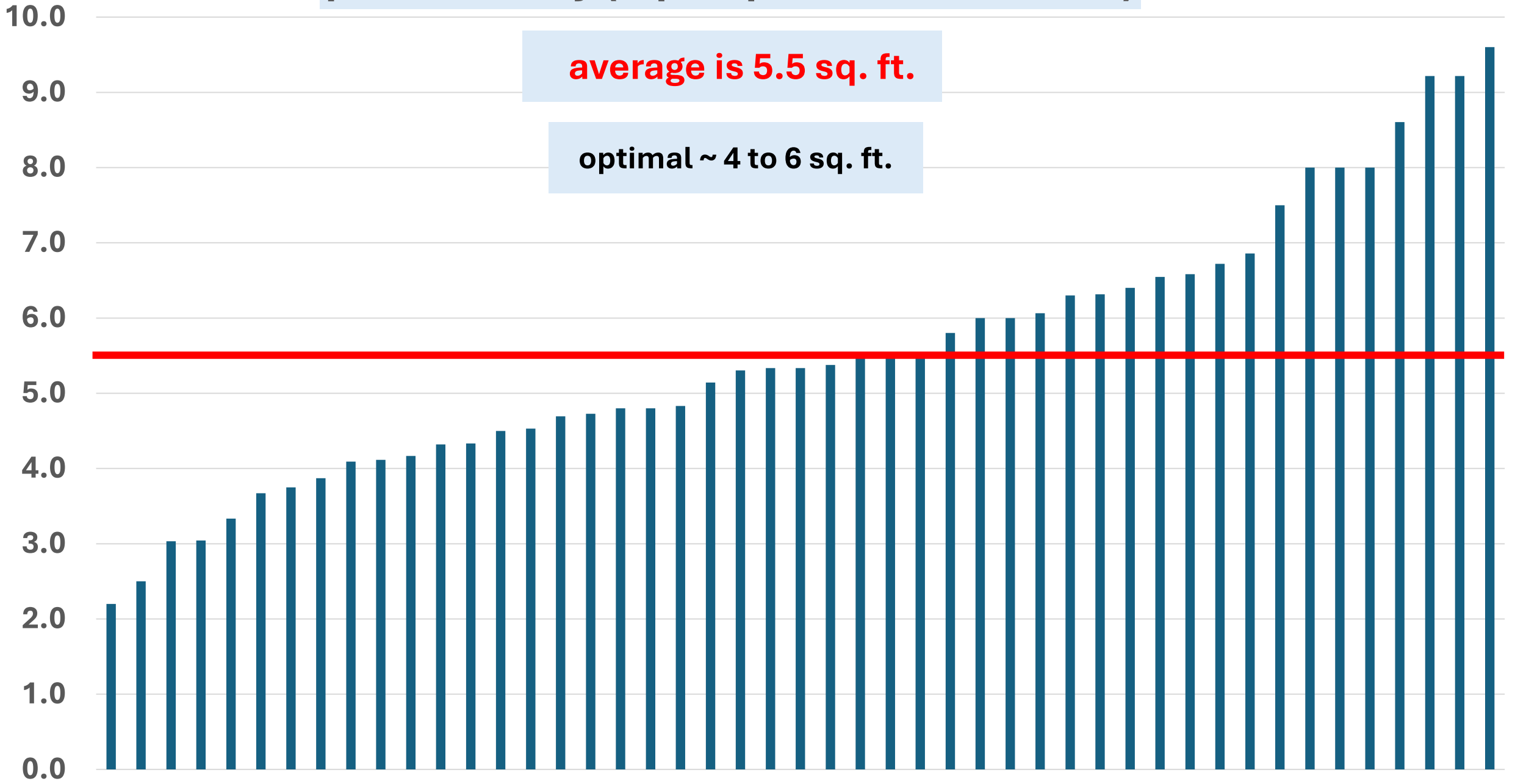
**In a 30' x 96' tunnel with a 15' peak the total HAF flow rate should be ~8,500 CFM**

<https://blog.uvm.edu/cwcallah/protected-culture/>



**plant density affects air circulation!  
need to balance yield potential with disease management**

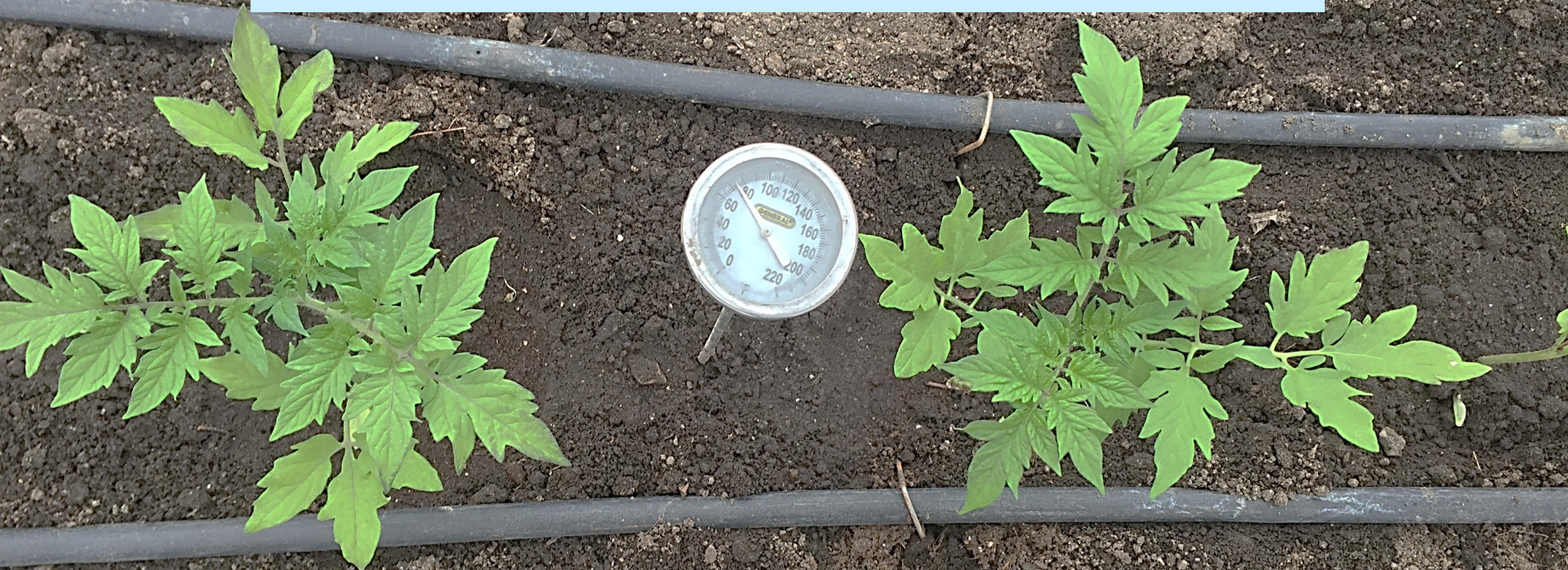
# plant density (sq. ft. per leader or stem)



average is 5.5 sq. ft.

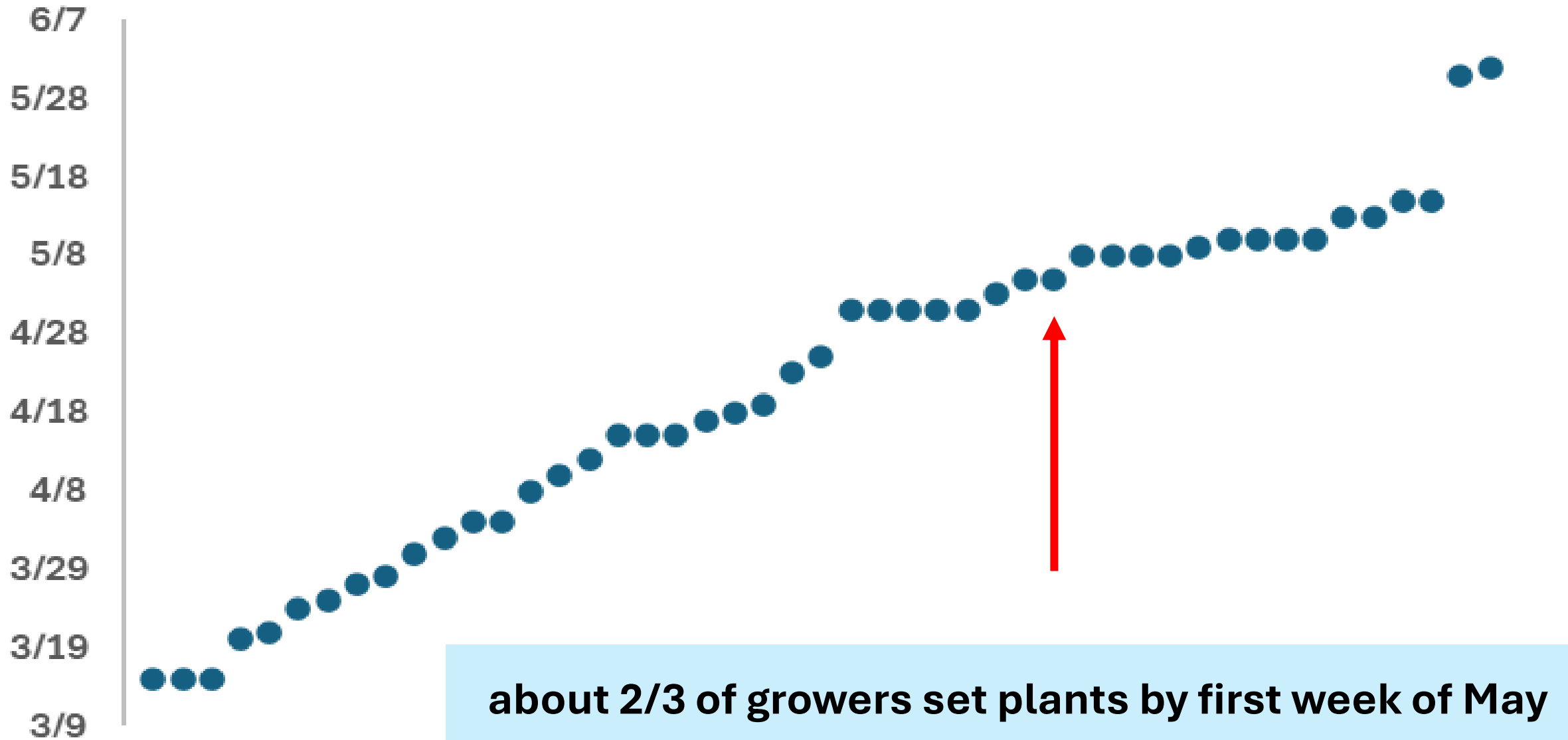
optimal ~ 4 to 6 sq. ft.

**is the root zone sufficiently warm early in the season?**



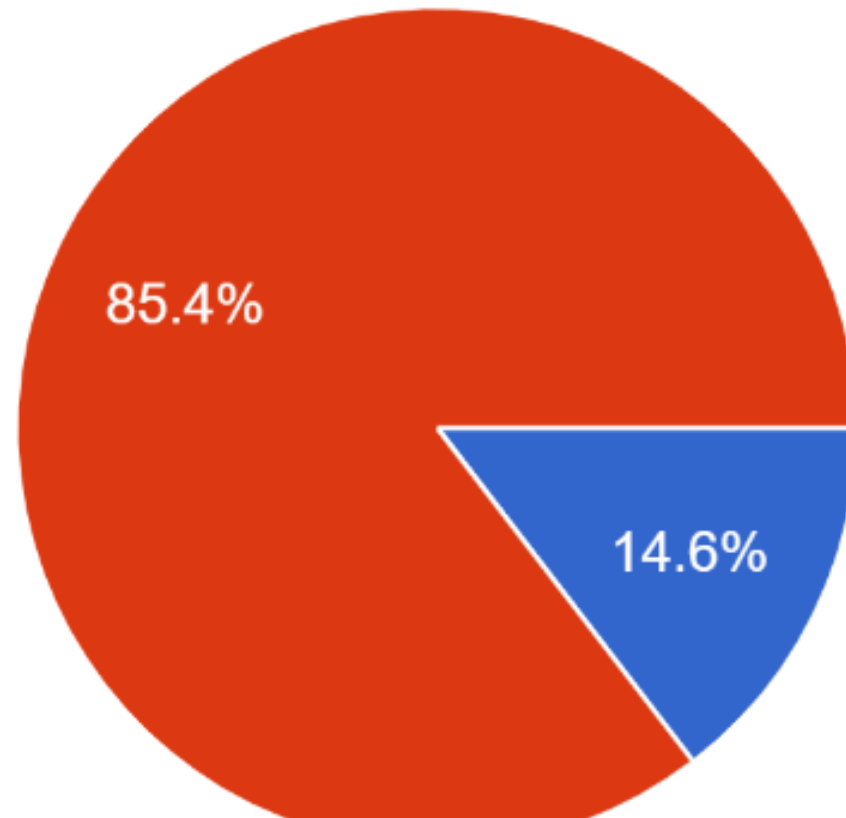
**optimum range is 70-75° F, minimum for growth is 60° F**

# date of setting transplants in tunnel



# Is ground (root zone) heat used?

48 responses



**Increasing soil temperature from 57 to 71°F increased tomato yield by 36 to 47% with transplants set 4/24 thru 5/6 in Quebec.**

Influence of Soil Temperature in Greenhouse Tomato Production. Trudel and Gosselin, 1982.

**Only 15% of tunnels have ground heat**

## root zone (ground) heat



~ \$1 -2 per square foot, plus fuel



**avoid cold soil and reduced plant growth  
near edges of tunnel with perimeter insulation**

# environmental controllers help optimize growing conditions



single zone  
heating and vents  
= \$1,000 +/-



single zone  
heating, fans,  
vents, pumps  
= \$2,000 +/-

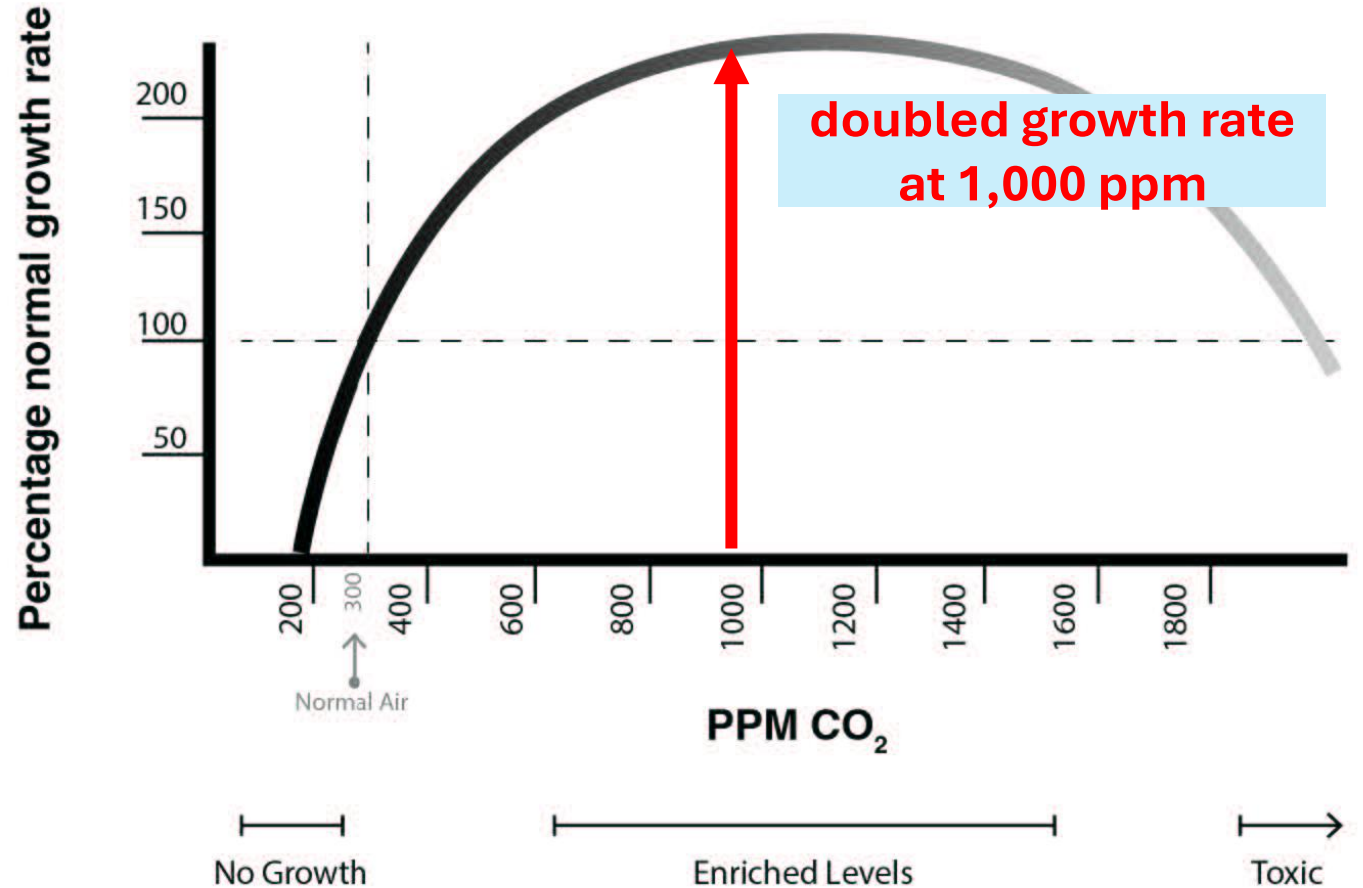


multi-zone  
irrigation  
= \$150 +/-

# what about carbon dioxide enrichment? in theory...



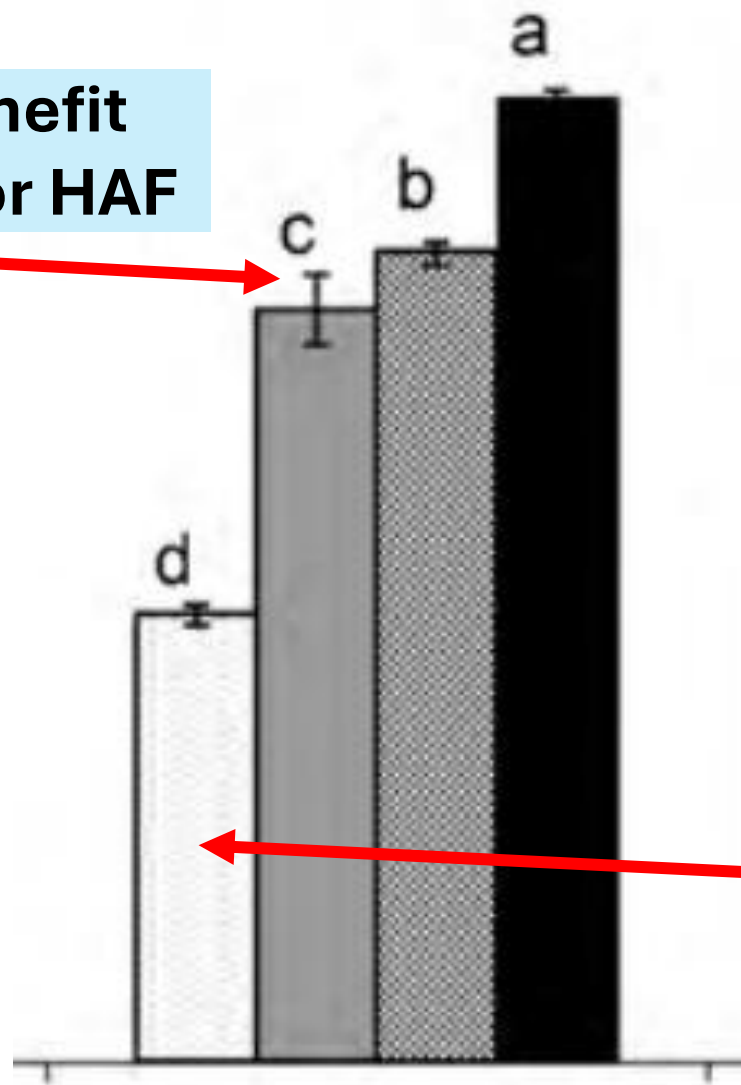
**CO<sub>2</sub> generator = \$1,700 +/-  
plus propane used.  
For up to 4,800 sq. ft.**



Ontario Ministry of Ag: maintain CO<sub>2</sub> levels ~1000 ppm on sunny days and 600 -700 ppm on cloudy days, when vents are closed; 400 ppm when vents are open > 10%

# CO<sub>2</sub> and air circulation effects on photosynthesis of tomato seedlings

similar yield benefit  
from added CO<sub>2</sub> or HAF



a = high CO<sub>2</sub>, high circulation

b = high CO<sub>2</sub>, low circulation

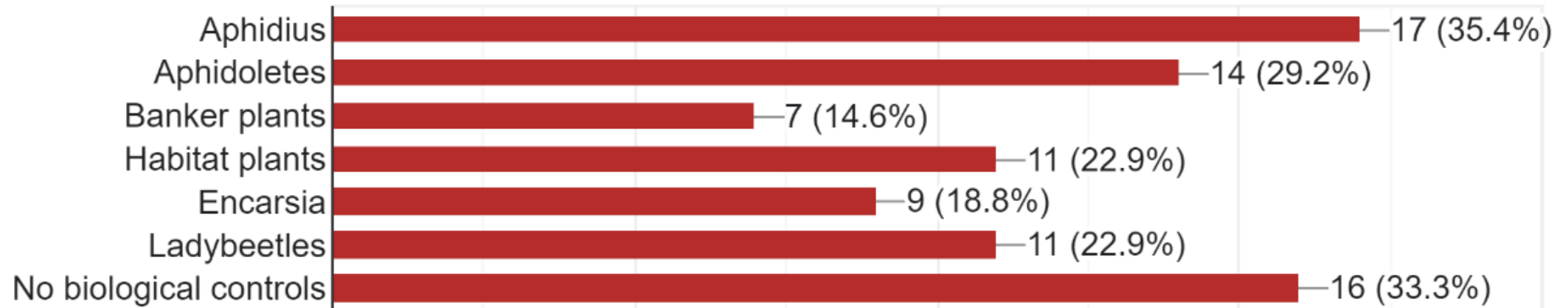
c = low CO<sub>2</sub>, high circulation

d = low CO<sub>2</sub>, low circulation

Thongbai, Kozai, and Ohyamaa. 2010. CO<sub>2</sub> and air circulation effects on photosynthesis and transpiration of tomato seedlings.

What biological insect controls are typically used? Check all that apply.

48 responses



**1/3 of growers do not any use bio-controls.**

**Only 23% of growers use habitat plants**

<https://site.uvm.edu/hightunnelhabitats/>

## gantry transport system to save labor



“I would never want to pick tomatoes or cucumbers again without the trolley carts.”

- Andy Jones  
Intervale Community Farm  
Burlington, Vermont

**Purchased components. ~\$2,500 parts and labor per 32'x132' house with 3 rails in each pathway between a pair of beds.**

# other practices to optimize production and quality

- long-term high tunnel soil test to guide fertilization

<https://umaine.edu/soiltestinglab/>

- fertigation to “spoon feed” N and K
- improved drainage if on a wet site
- a good battery-powered sprayer if applying sprays



# priority tunnel tweaks and estimated costs

- Long-term high tunnel soil test \$ 30
- Add drip lines \$ 200
- Add gable vents to endwalls \$ 1,000
- Install HAF fans \$ 1,200
- Install automatic roll-up sides \$ 3,000

Total cost = 21% of average yield/price revenue **\$ 5,430**

**If yield increases ~10% then payback is 2 years**

# More tunnel tweaks and estimated costs

- Long-term high tunnel soil test \$ 30
- Add drip lines \$ 200
- Add gable vents to endwalls \$ 1,000
- Install HAF fans \$ 1,200
- **Purchase grafted plants** \$ 2,500
- Install automatic roll-up sides \$ 3,000
- **Install root zone heat if planting in cool soil** \$ 5,000

Total cost = 50% of average yield revenues

**If yield increases 20% payback is 2.5 years**

**\$13,000 +/-**



thank you