Tweaking Your Tomato High Tunnel

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

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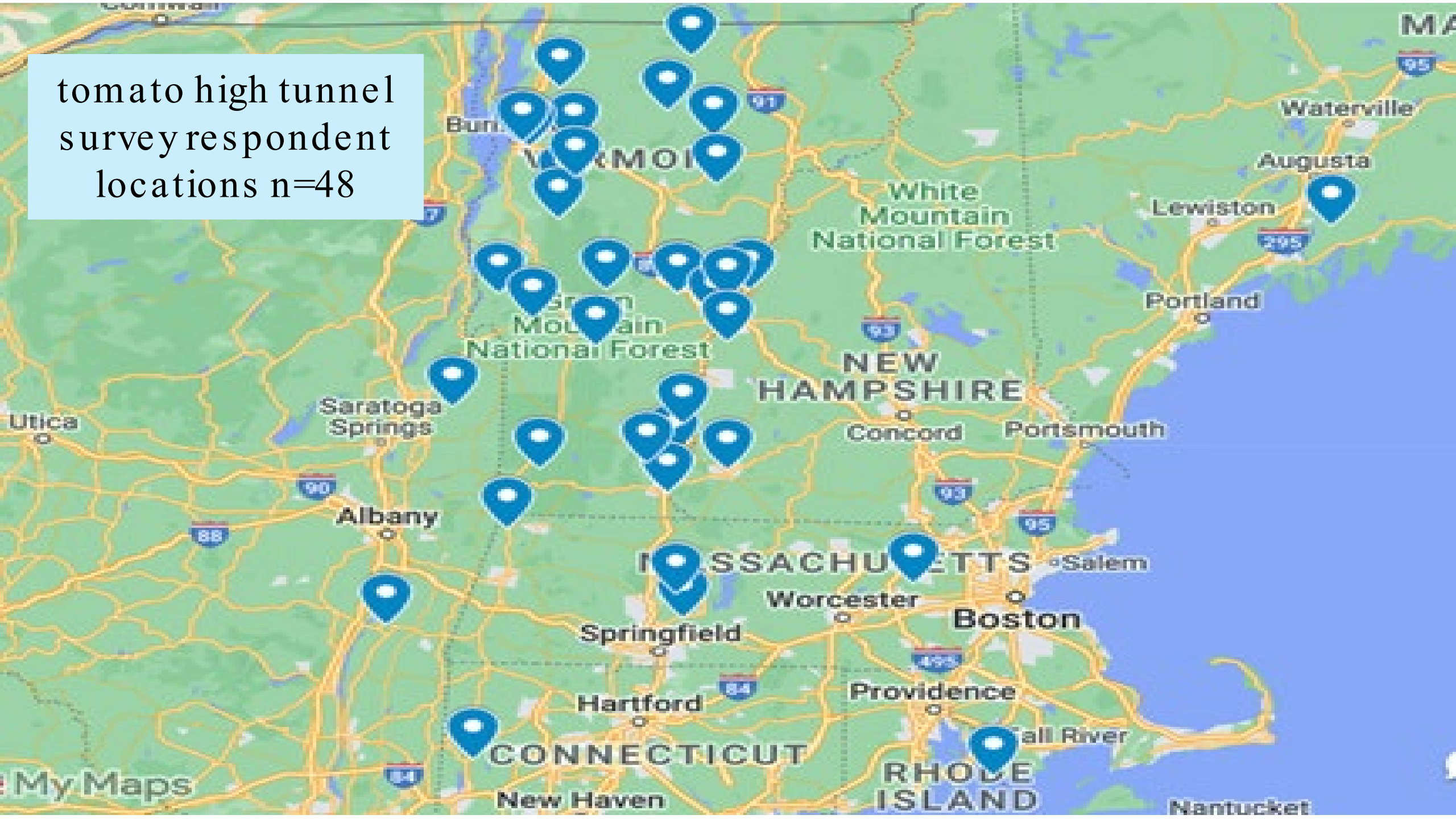
THE UNIVERSITY OF VERMONT EXTENSION

What are your peers doing?
2024 high tunnel tomato benchmarking survey

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

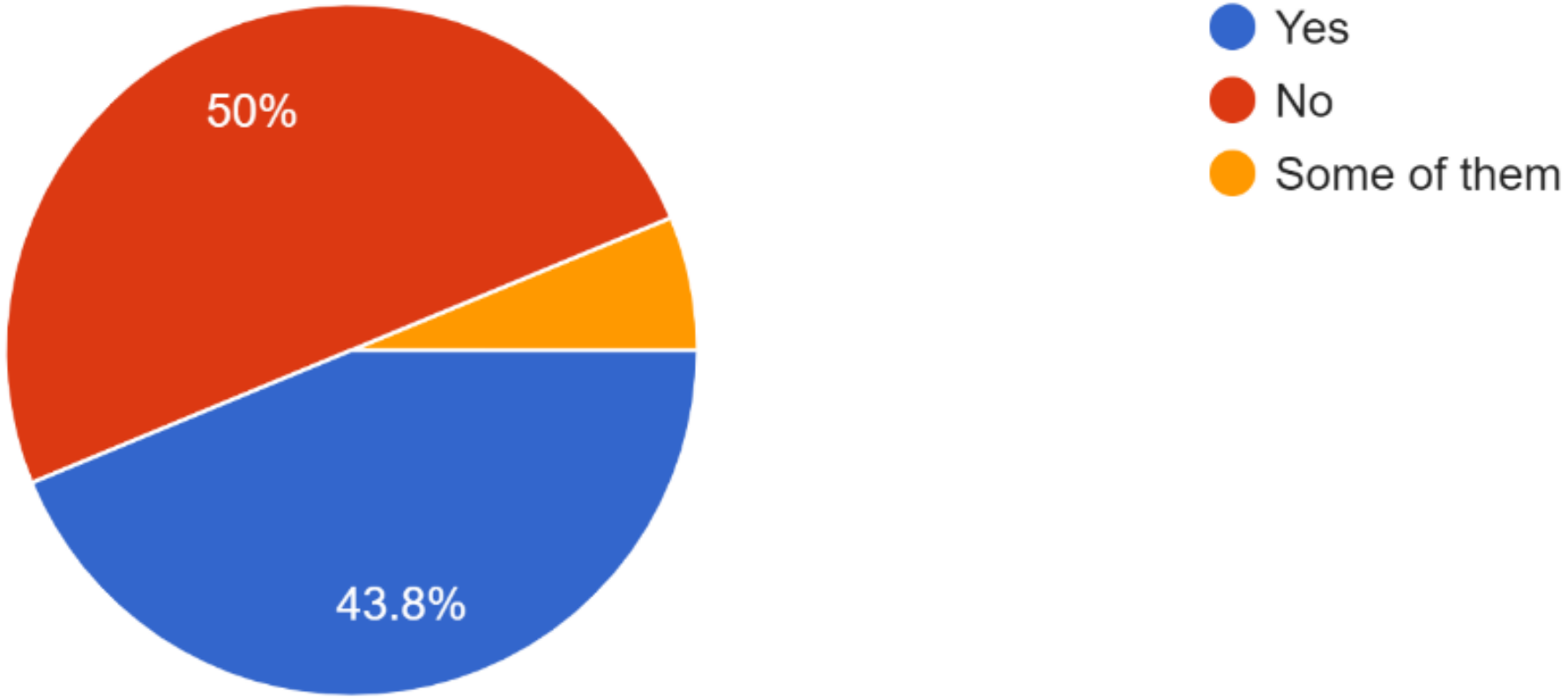

tomato high tunnel survey respondent locations n=48
White Mountain National Forest
NEW HAMPSHIRE
Concord
Portsmouth
Portland
Lewiston
Augusta
Waterville
Saratoga Springs
Utica
Albany
Springfield
Worcester
Boston
Salem
Providence
Hartford
CONNECTICUT
New Haven
RHODE ISLAND
Fall River
Nantucket
My Maps

"slicing" cultivars grown

Geronimo is grown on 42% of farms

Are the tomato plants grafted?

48 responses



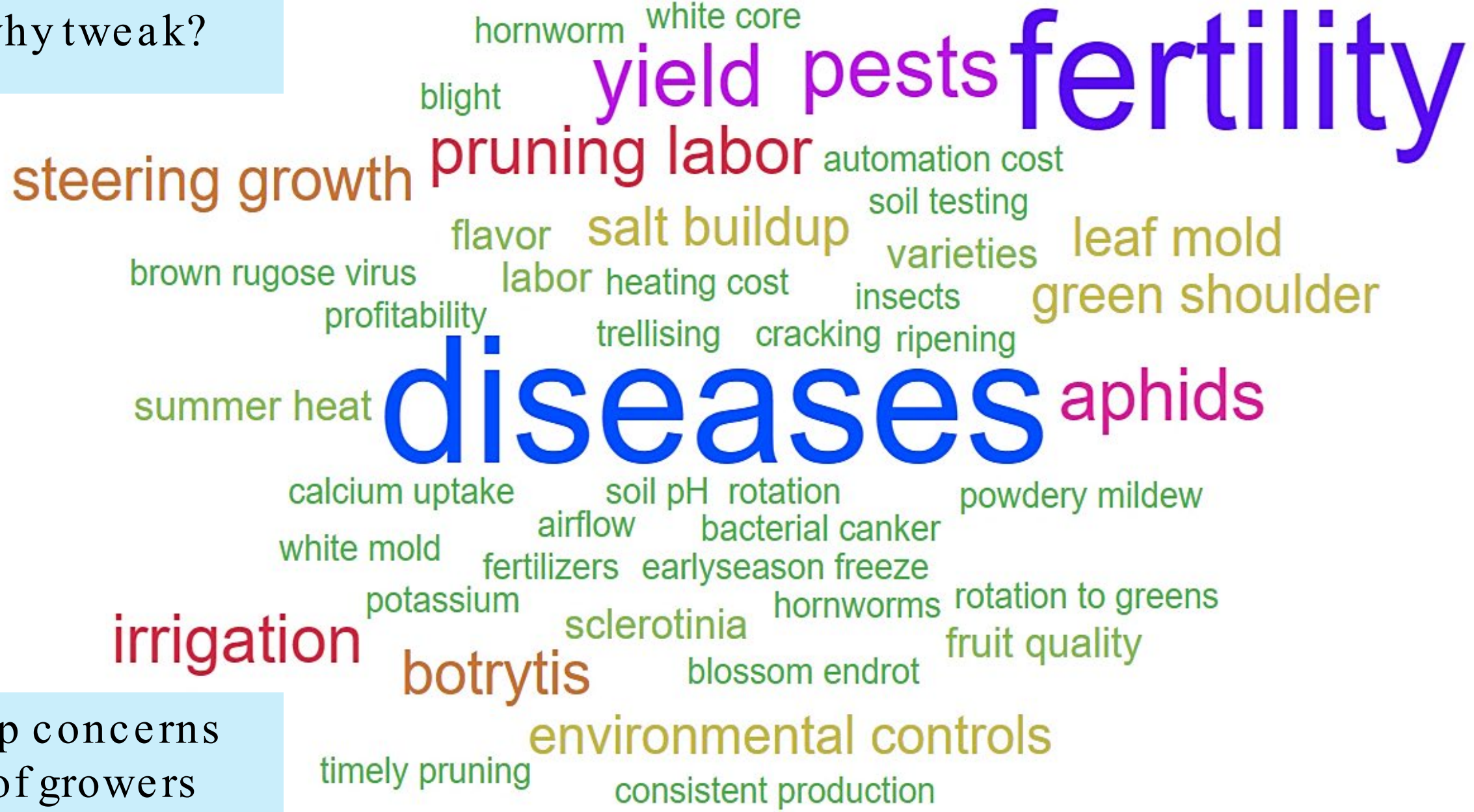
half the growers use grafted plants

grafting rootstocks used

Maxifort is by far the most popular rootstock

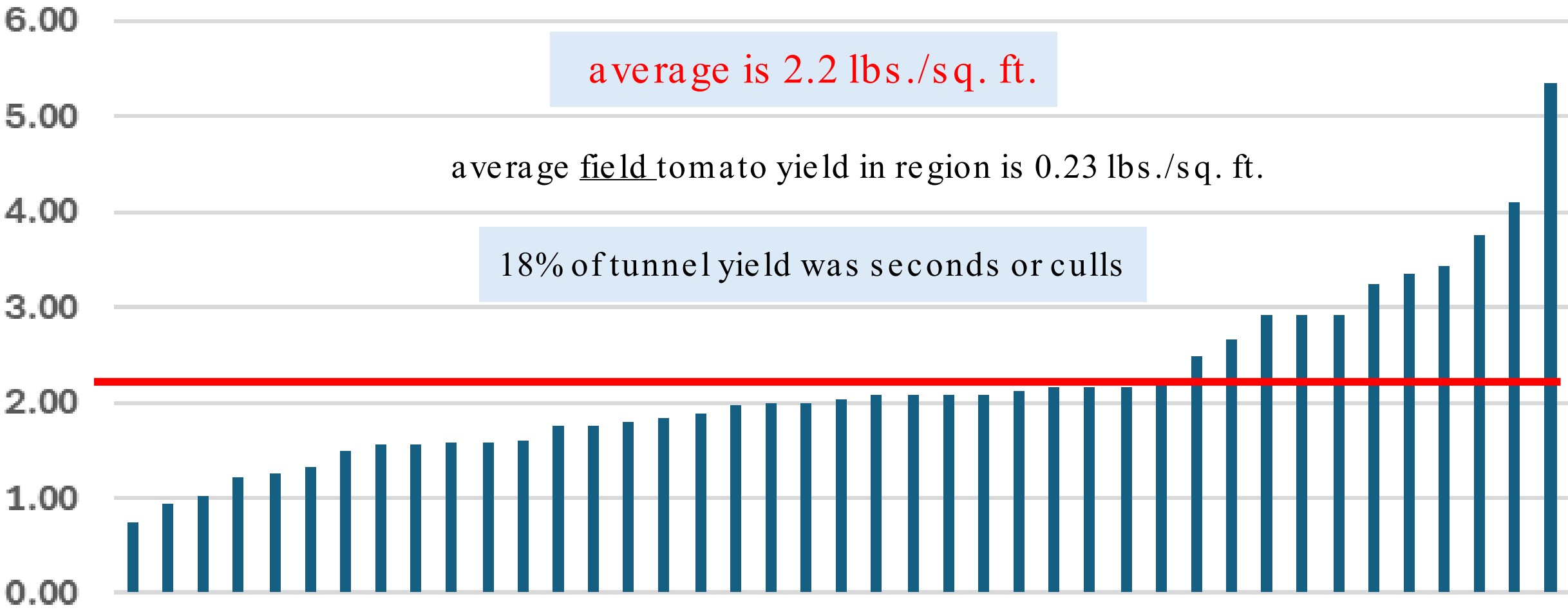
high tunnel area (sq. ft.)

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

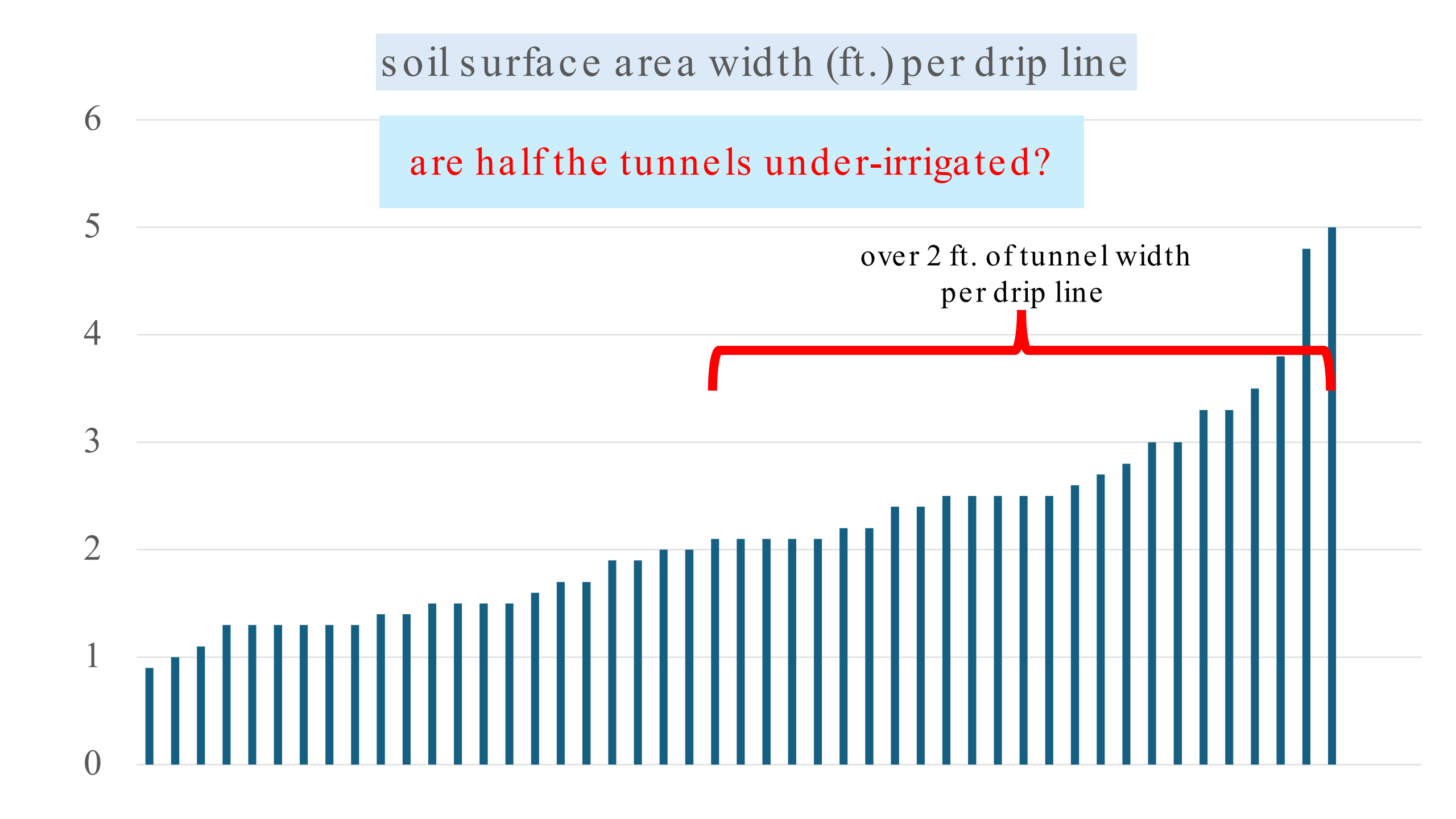
optimize yield
with “many little tools”

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

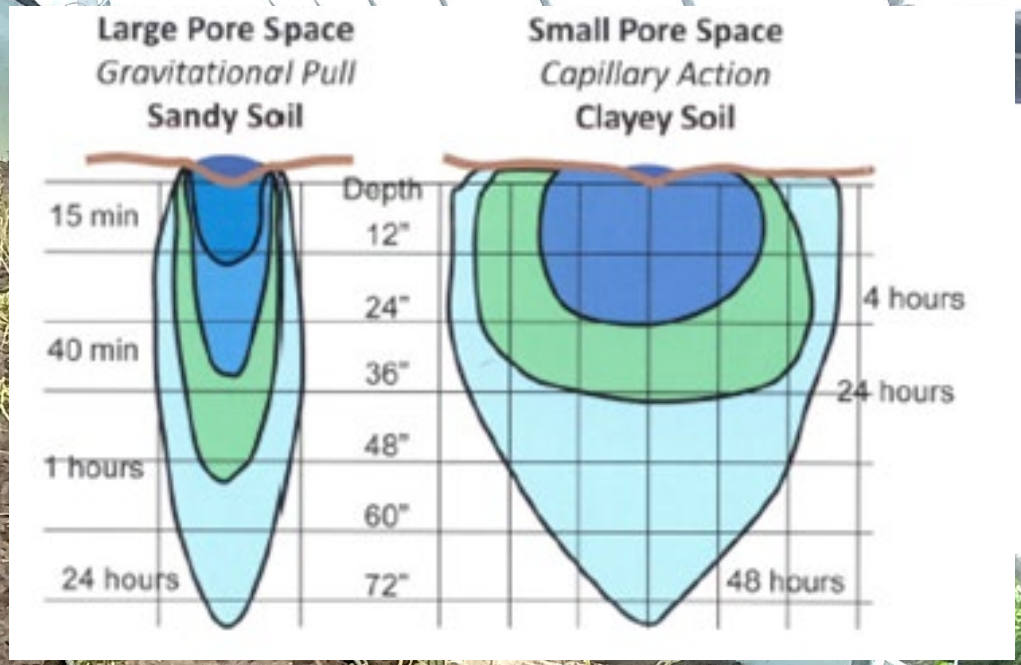
	top 10	all others	difference
total yield per sq. ft.	3.5 lbs.	1.8 lbs.	94%
tunnel width per drip line	1.6 ft.	2.3 ft.	44%
area per leader (density)	5.0 sq. ft.	5.6 sq. ft.	12%
ventilation area: tunnel area	0.37	0.34	9%
days of growth in tunnel	169	156	8%

top 10 yielding tunnels vs. all others

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

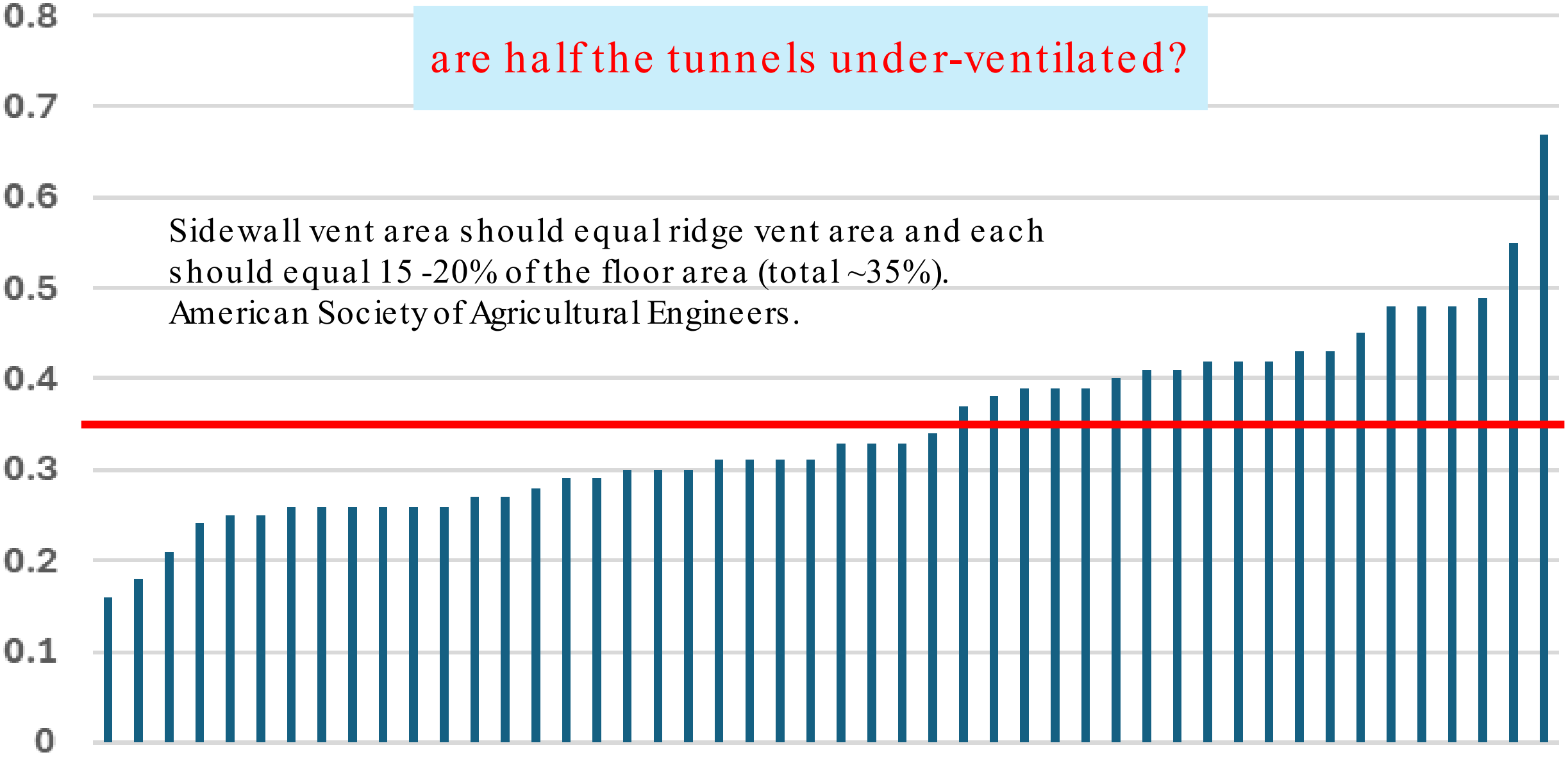

soil surface area width (ft.) per drip line
are half the tunnels under-irrigated?
over 2 ft. of tunnel width
per drip line
6
5
4
3
2
1
0

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



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

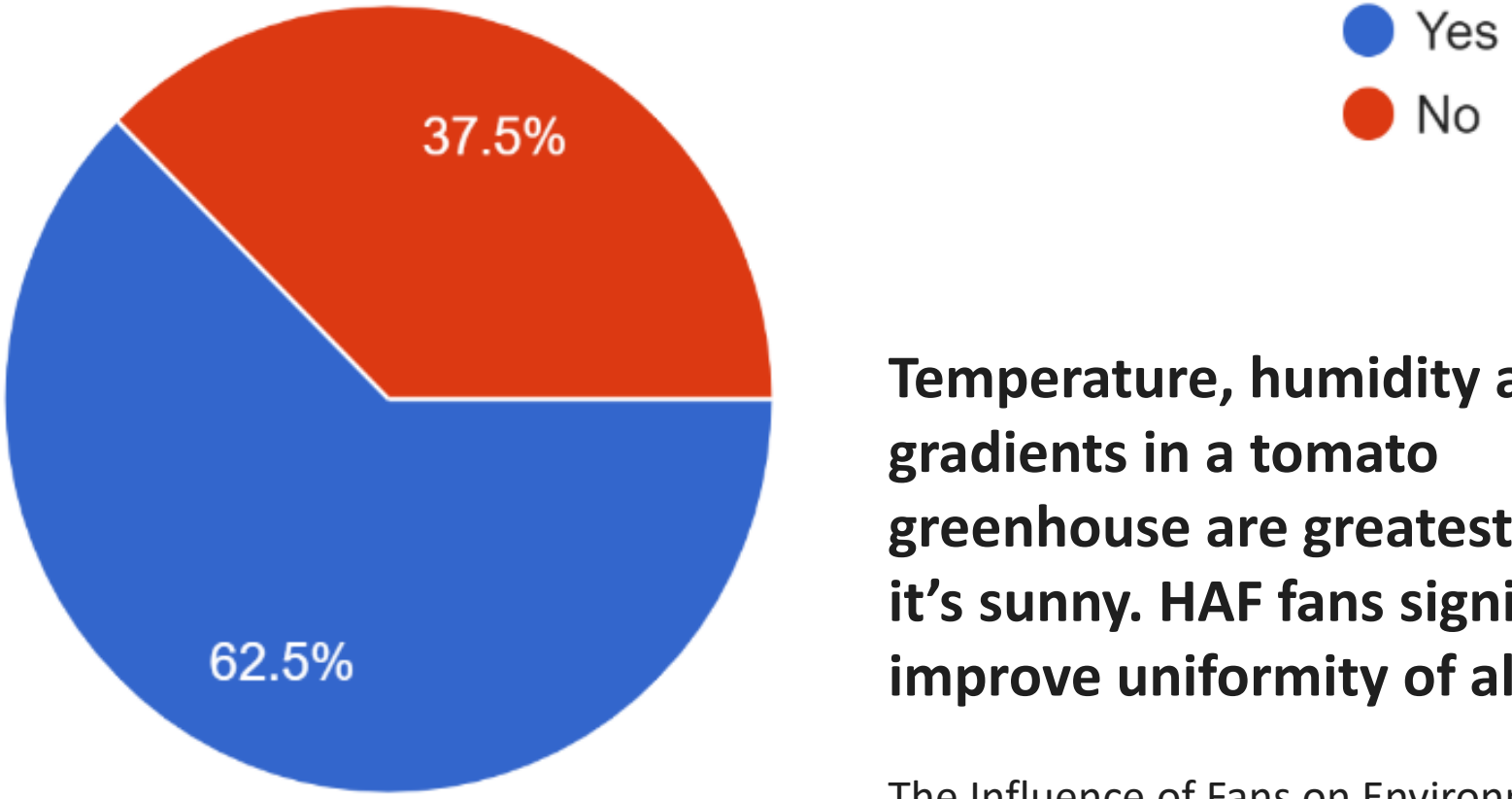
gear cranks, hand or drill
add ~ $200-500

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?



Temperature, humidity and CO_2 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.

38% of tunnels lack HAF fans

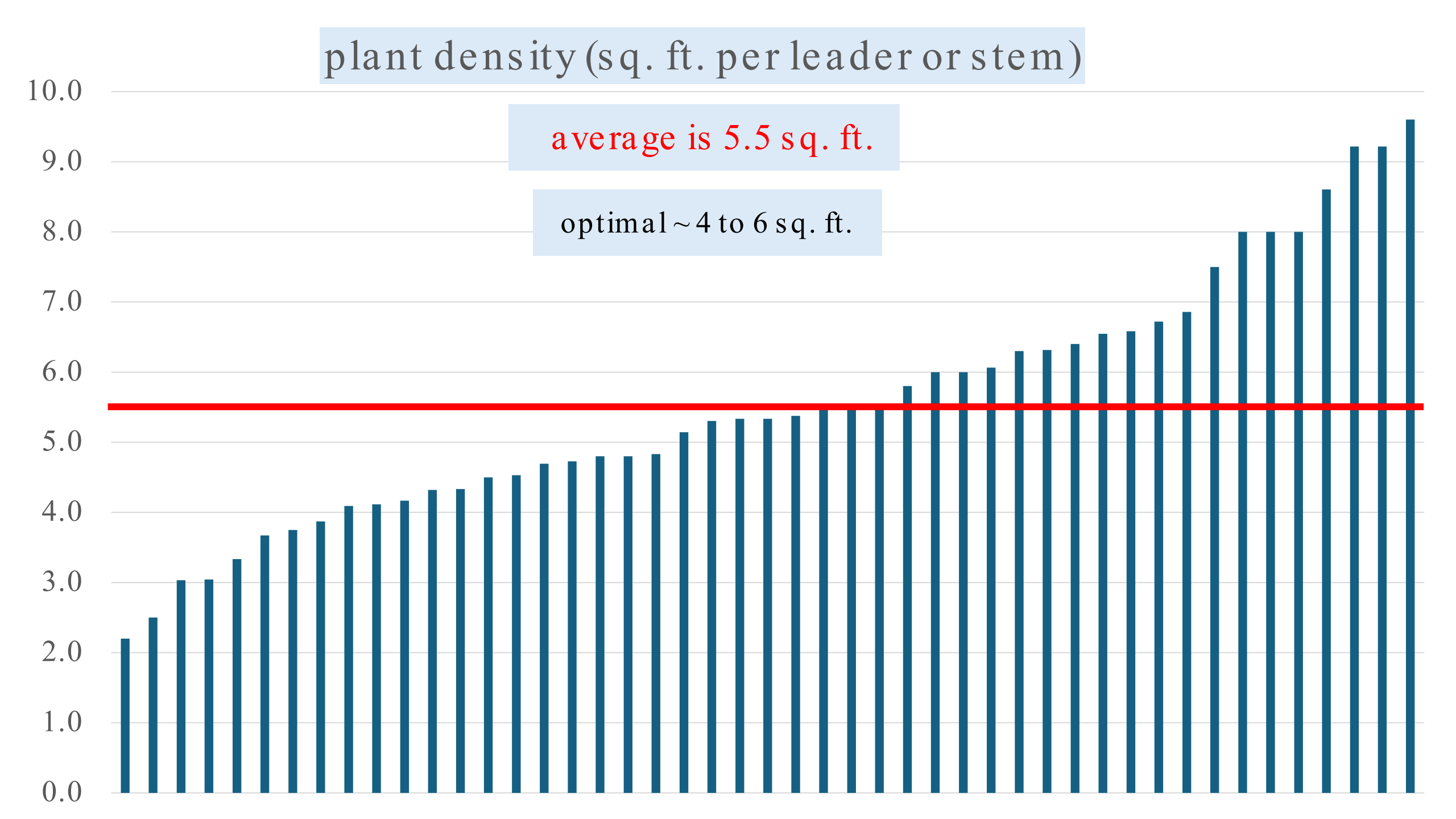
optimize air circulation and mixing--in addition to ventilation

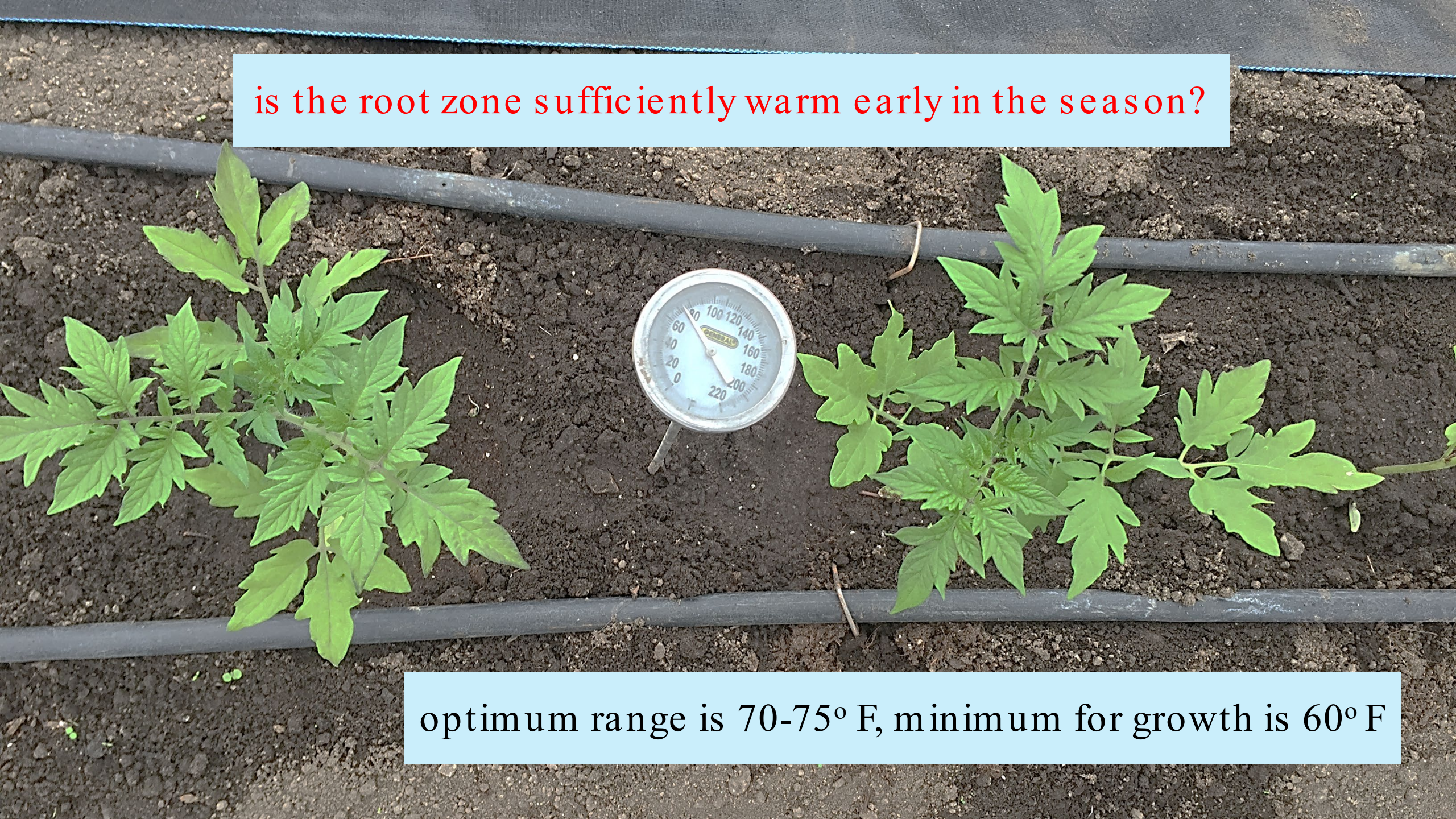
4 high quality fans $1,200 +/-

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

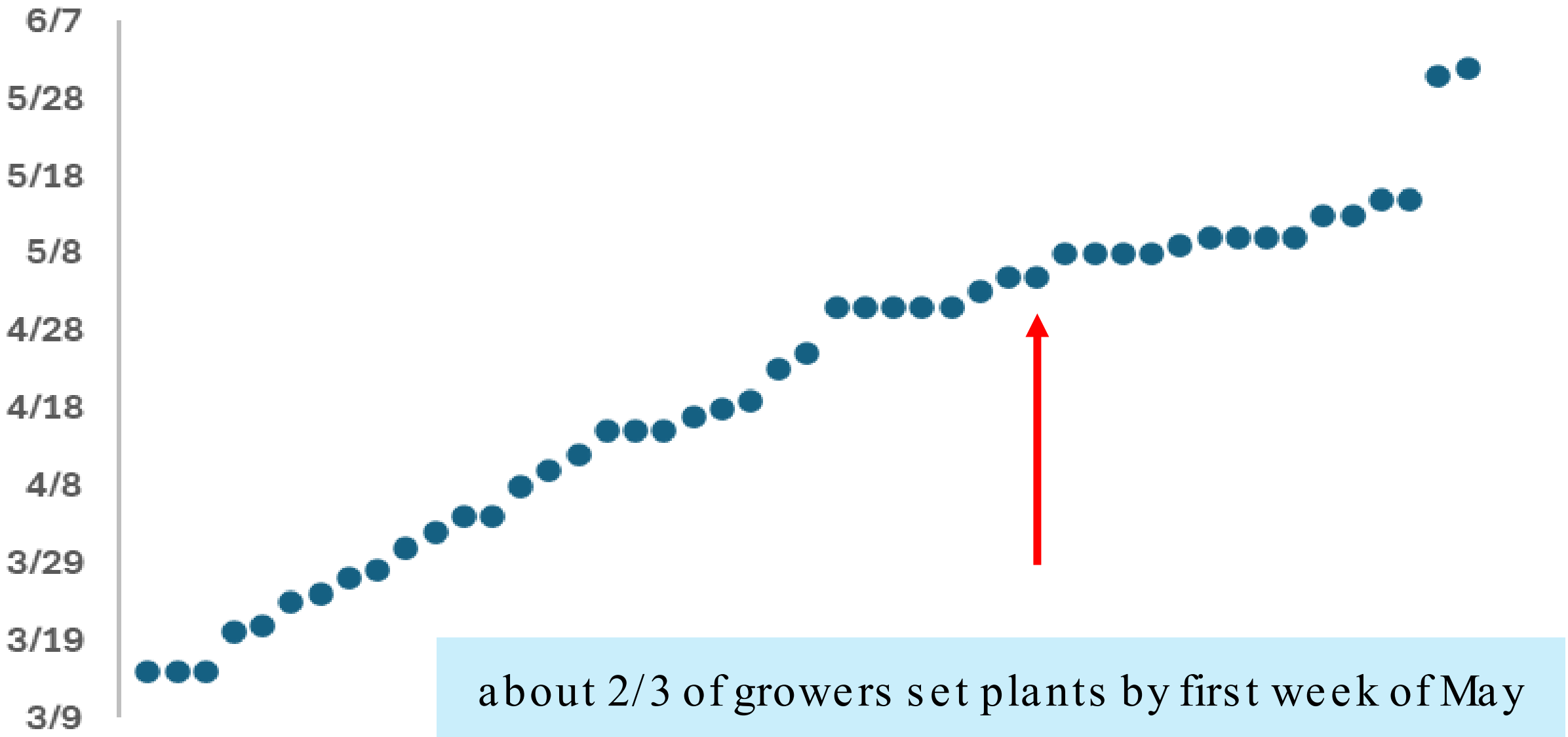
https://blog.uvm.edu/cwcallah/protected-culture/

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

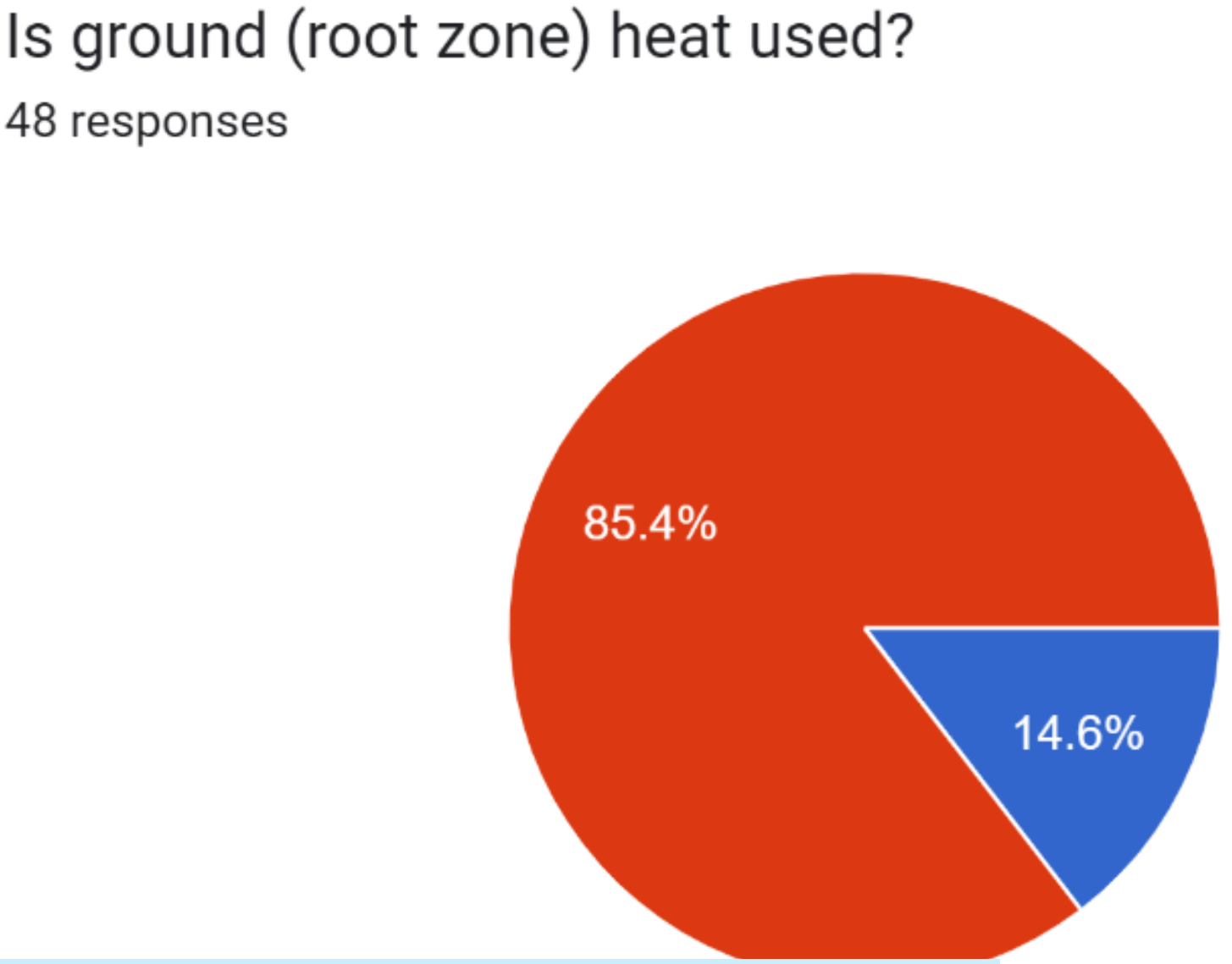

plant density (sq. ft. per leader or stem)
average is 5.5 sq. ft.
optimal ~ 4 to 6 sq. ft.
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0


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



about 2/3 of growers set plants by first week of May



Only 15% of tunnels have ground heat

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.

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

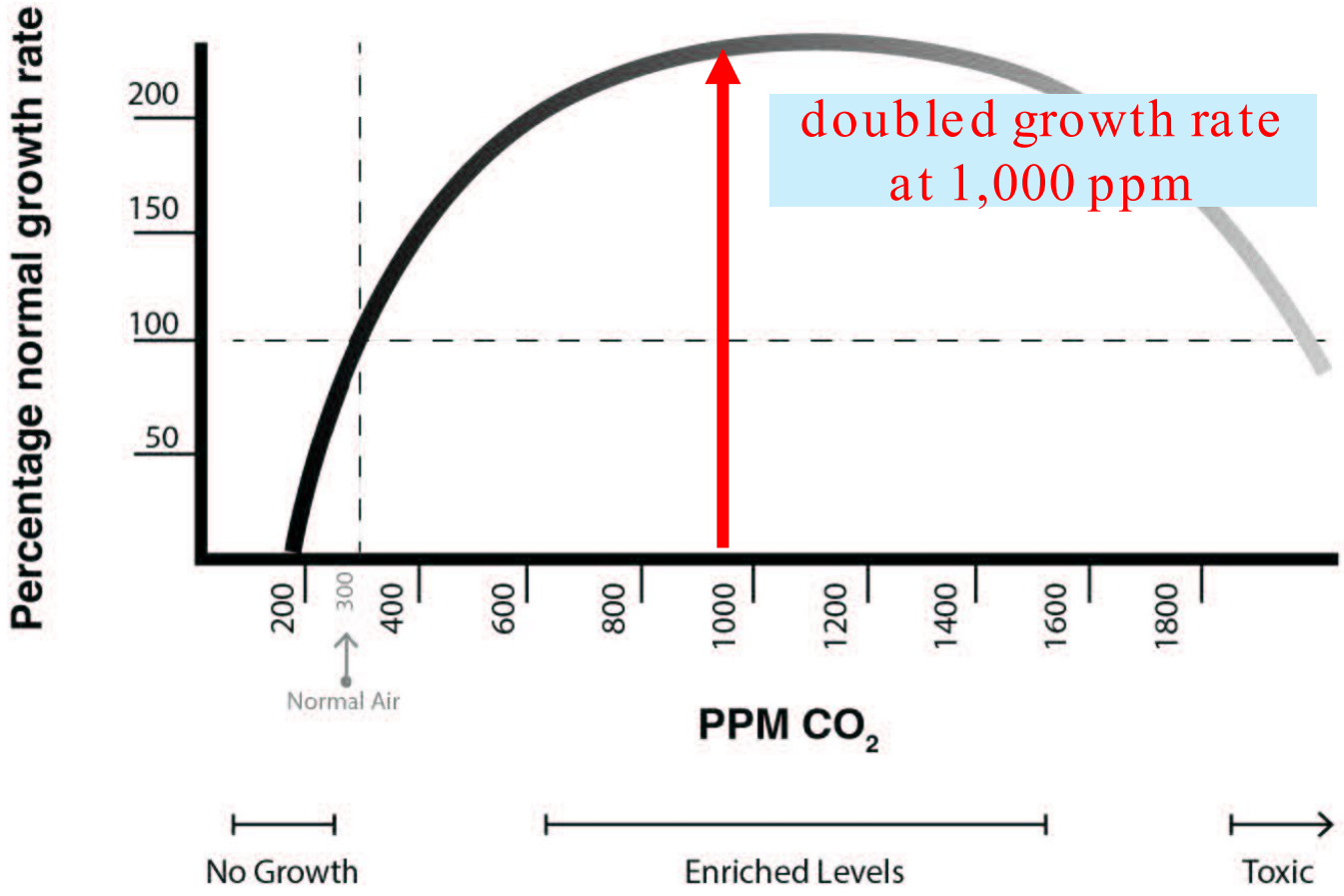
single zone
heating and vents
=$1,000 +/-

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

multi-zone
irrigation
=$150 +/-

what about carbon dioxide enrichment? in theory...

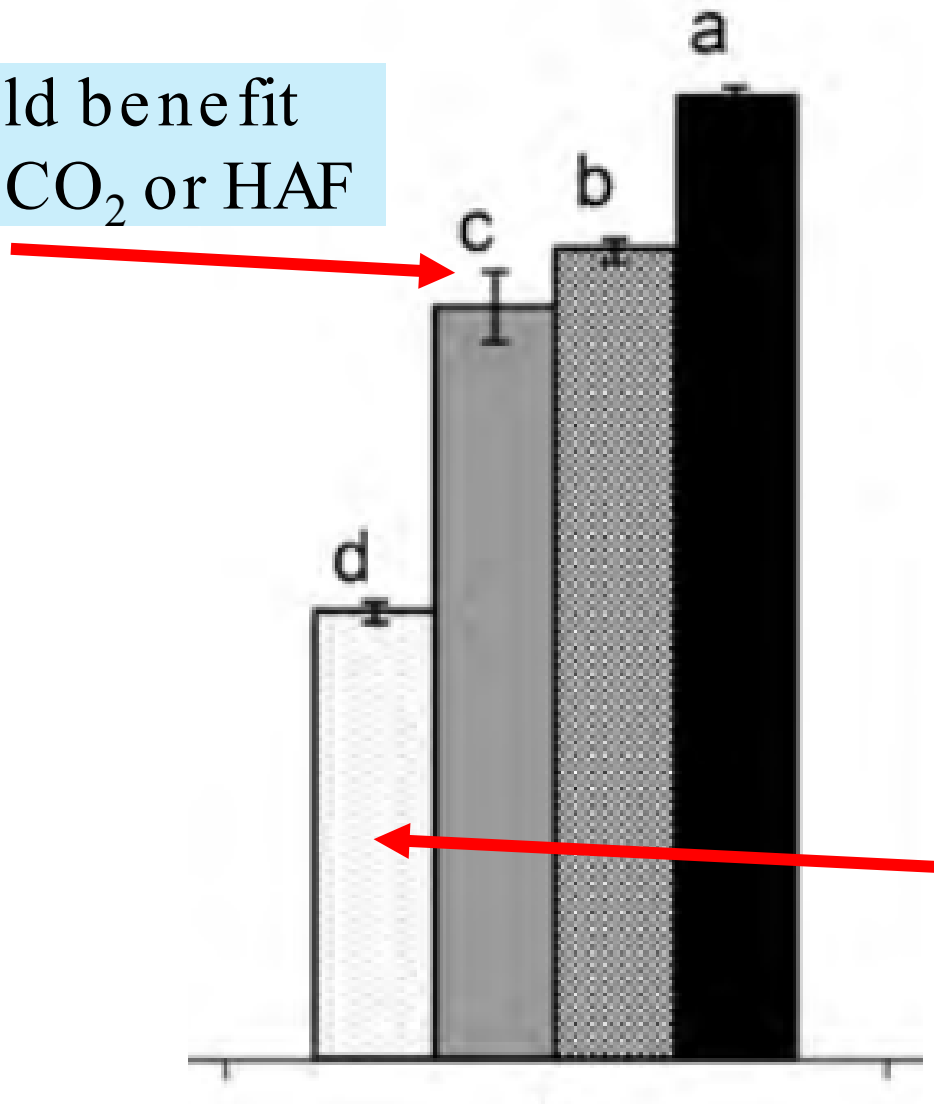
CO_2 generator = $1,700 +/- plus propane used. For up to 4,800 sq. ft.



Ontario Ministry of Ag: **maintain CO_2 levels ~1000 ppm on sunny days and 600 - 700 ppm on cloudy days, when vents are closed; 400 ppm when vents are open > 10%**

CO2 and air circulation effects on photosynthesis of tomato seedlings

similar yield benefit from added CO_2 or HAF



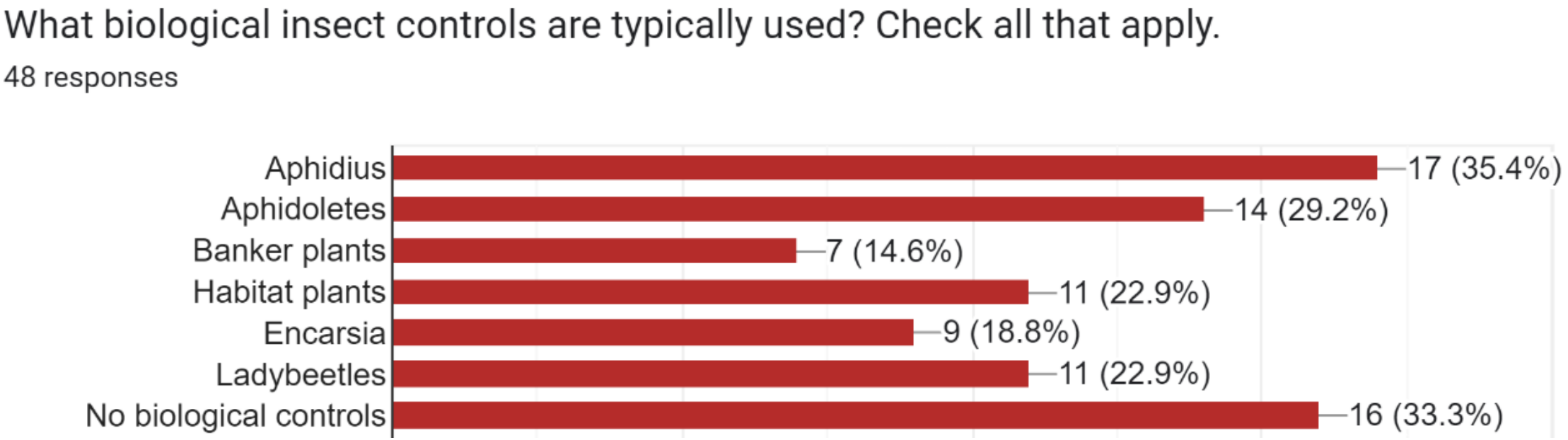
a = high CO2, high circulation

b = high CO2, low circulation

c = low CO2, high circulation

d = low CO2, low circulation

Thongbai, Kozai, and Ohyamaa. 2010. CO2 and air circulation effects on photosynthesis and transpiration of tomato seedlings.

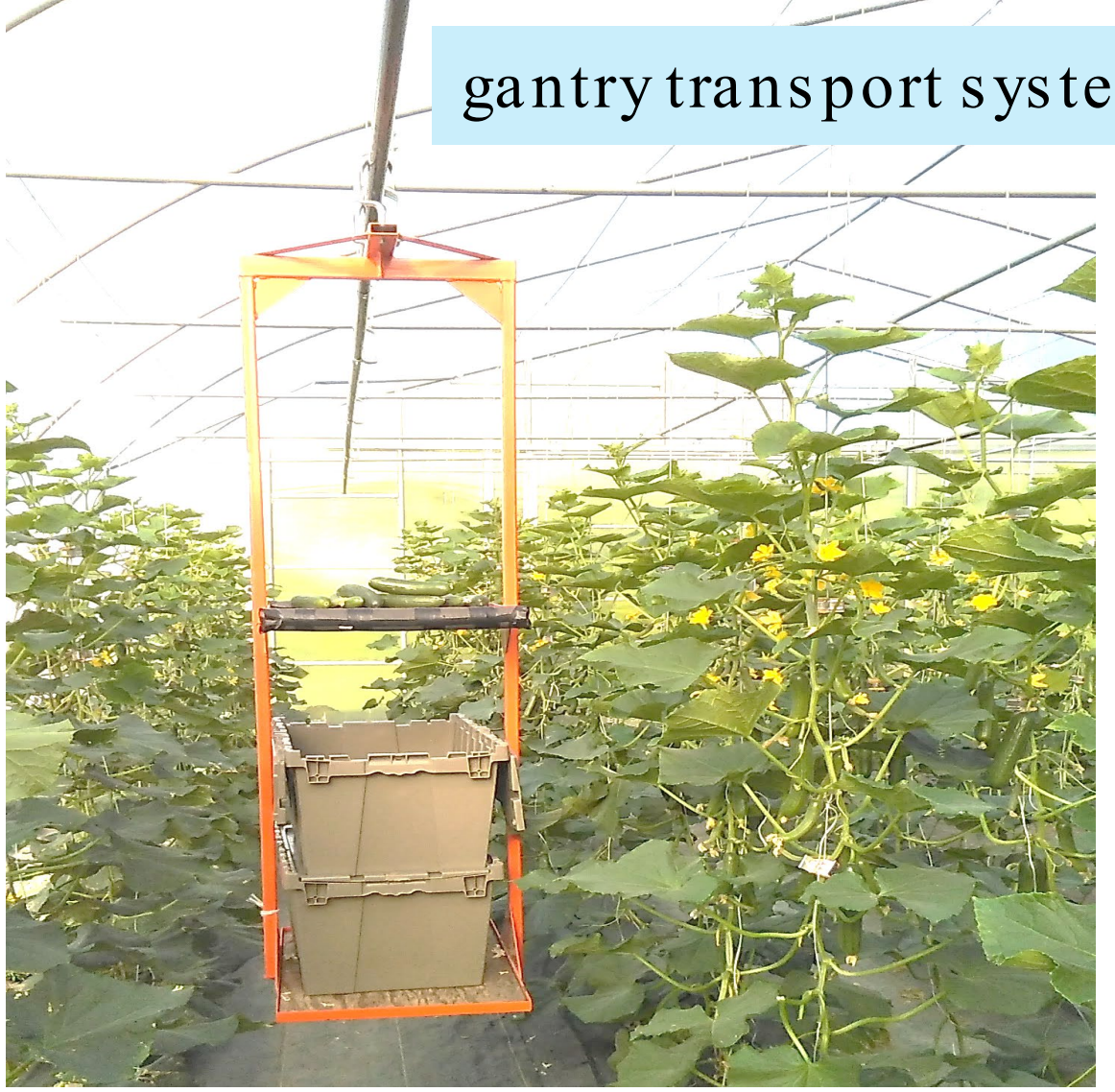


1/3 of growers do not any use bio-controls.

Only 23% of growers use habitat plants

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

gantry transport system to save labor



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

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

- Andy Jones
Intervale Community Farm
Burlington, Vermont

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 $13,000 +/-

If yield increases 20% payback is 2.5 years


thank you