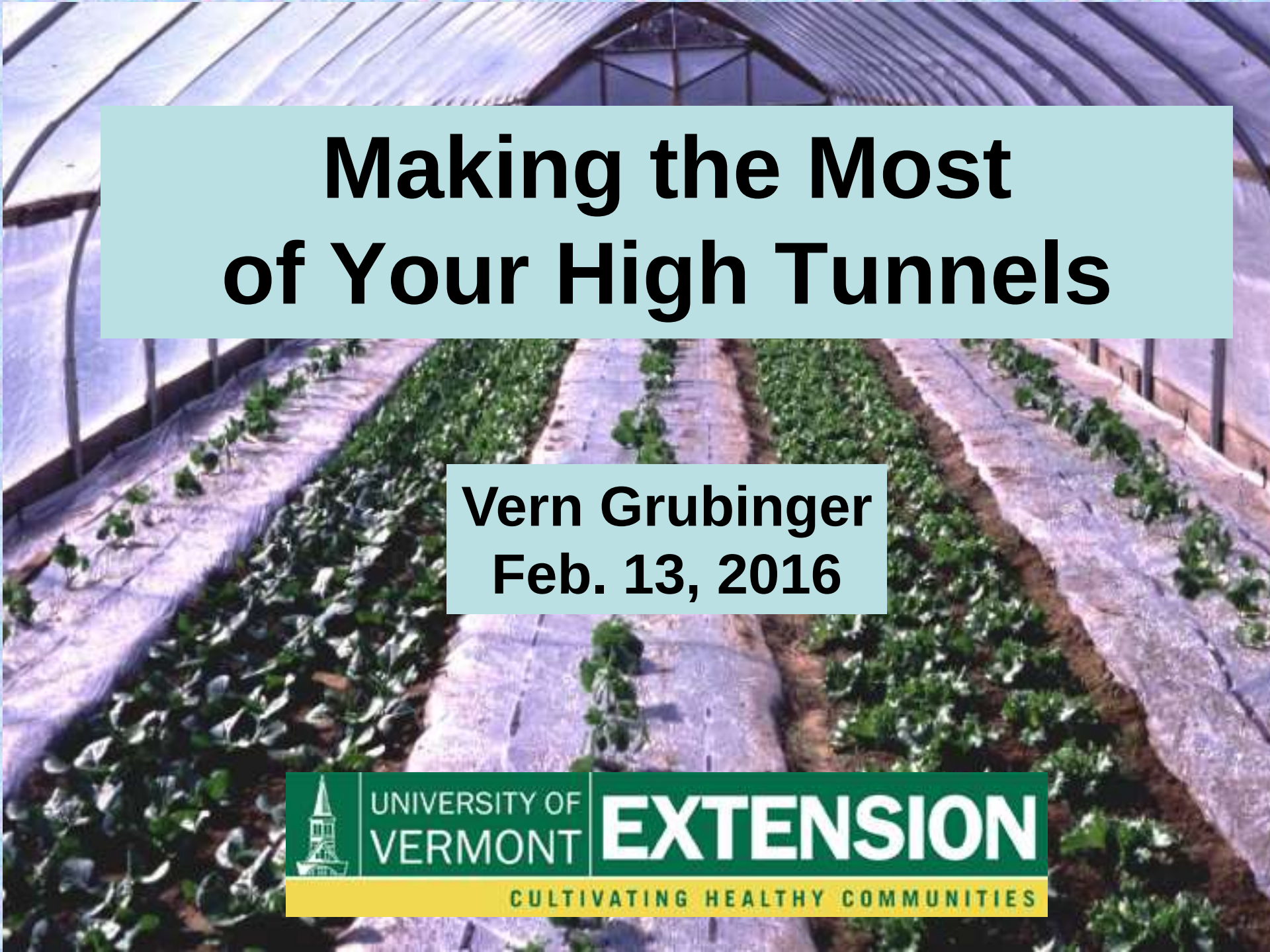


Making the Most of Your High Tunnels

Vern Grubinger

Feb. 13, 2016

UNIVERSITY OF VERMONT EXTENSION

CULTIVATING HEALTHY COMMUNITIES

many types of tunnels; many common issues


cropping systems / environmental controls vary
unheated, passive ventilation


heated ‘summer’ crops
HUG YOUR
FARMER
VINE
RIPENED


unheated, passive ventilation, plus covers in winter


‘ground heat’ for winter greens


‘season extension’ of perennials

Key Considerations

- Site
- Structure
- Temperature
- Ventilation
- Soil Fertility
- Irrigation
- Pest Management
- Costs and Returns


got drainage, compaction, future shading?


perimeter drainage may be needed:
to move water from frozen ground
NEW HOLLAND

perimeter insulation keeps tunnel edges warmer

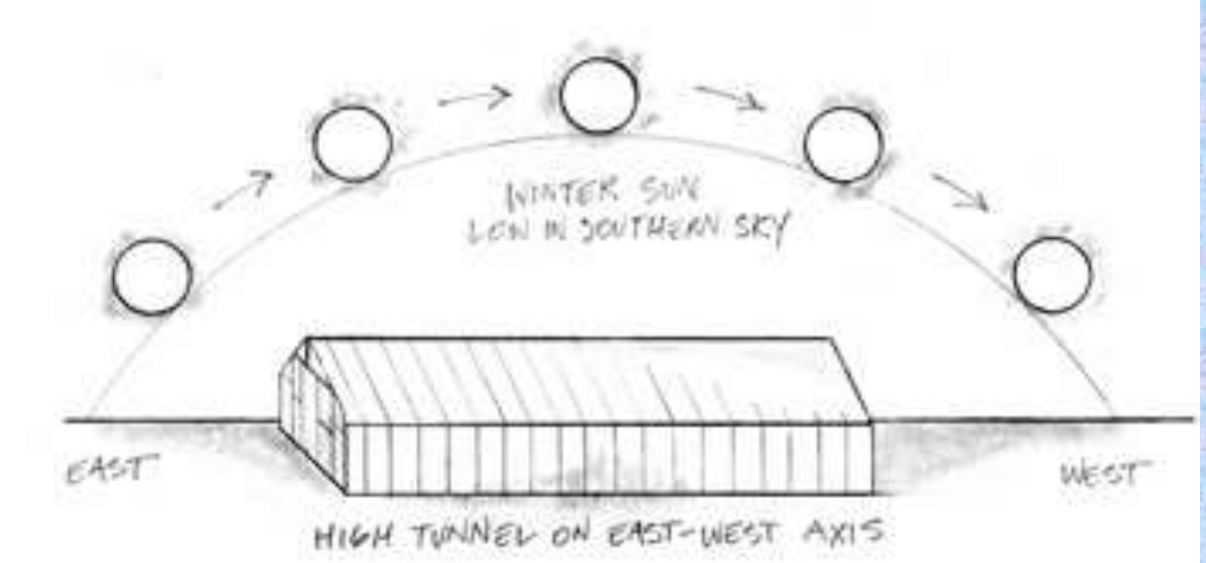
zero-wood construction for longevity and stability


equal roof pitch on each side - for snow load

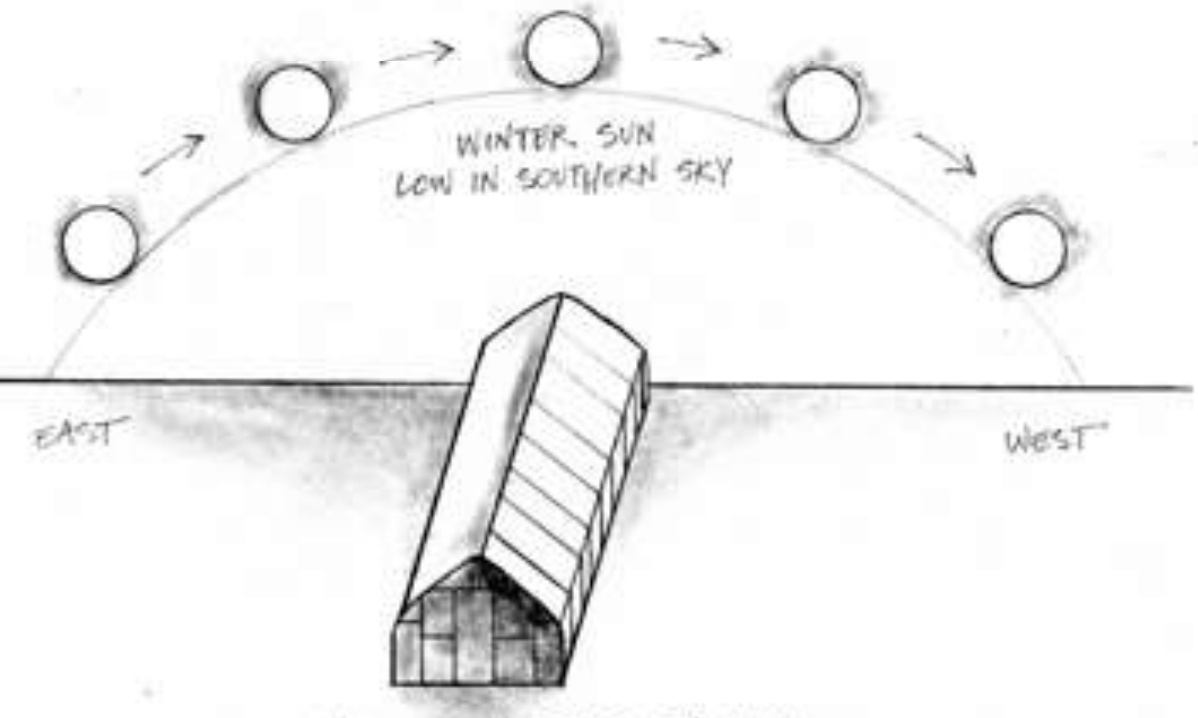
greenhouse covering

- consider the options: anti-condensate, bee-friendly, energy reflecting
- PAR declines over time as plastic degrades, gets scratched. More important to change often for ‘non-summer’ growing
- double poly for insulation and wind stability


adequate space between tunnels:
shading, snow removal, mowing



HIGH TUNNEL ON EAST-WEST AXIS



HIGH TUNNEL ON NORTH-SOUTH AXIS

Ideal orientation for max sunlight:

N/S for summer sun

E/W for winter sun

Build for worst case snow and wind

http://www.uvm.edu/vtvegandberry/factsheets/PreventGreenhouseCollapse.html

larger, taller tunnels

- allow hot air to rise above crop to vent
- less likely to overheat
- store and release more heat at night
- lower cost per sq. ft. to construct

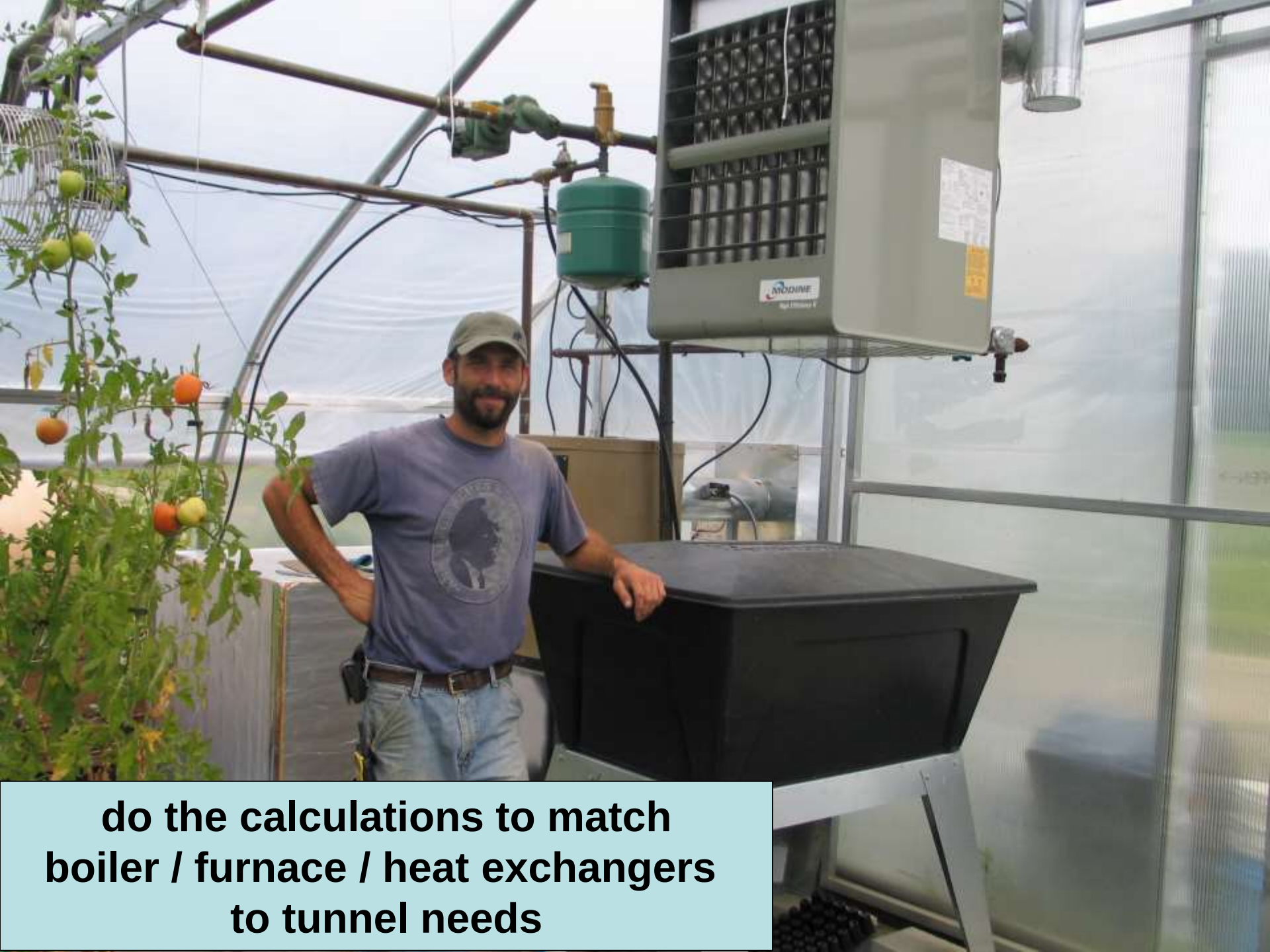
hot and humid = open as much as you can for disease management, photosynthesis

limited water supply? gutter and cistern

side curtain/skirt and corner panels to seal out wind/snow from roll up side


heat rises; install vents near peak


Fans pull air with the least resistance



do the calculations to match boiler / furnace / heat exchangers to tunnel needs

keep the heat in:
small cracks matter


knee wall insulation; heated benches

for automated heating / venting
use step controllers or accurate thermostats


there are many options for temperature alarms
fahrenheit
30
40
50
60
70
80
90
100
celsius
-5
0
5
10
15
20
25
30
35
40
THERMALARM
THERMALARM PRODUCTS INC


most efficient row arrangement:
lengthwise not perpendicular

many systems for winter covering;
Ideal is close to crop canopy, easy to move, not frozen to crop

how much cold protection is needed?
1 < 2 < 3 layers of cover
closer to the ground = warmer
open in middle to avoid frozen edges

many options for surface mulches

plastic vs. landscape fabric mulch – same day, same farm


with in-ground heat, light-reflecting mulch may be more important, at least early in the growing season


in-ground soil fertility / crop nutrition

saturated media extract (SME) test vs. field soil test: soluble vs. reserve nutrients

ANALYSIS OF SATURATION EXTRACT

pH: 6.9
Soluble Salts (mS/cm): 2.27

Macronutrients	mg/L
Nitrate-N (NO3-N):	162
Ammonium-N (NH4-N):	3
Phosphorus (P):	8
Potassium (K):	112
Calcium (Ca):	211
Magnesium (Mg):	116
Sulfur (S):	96

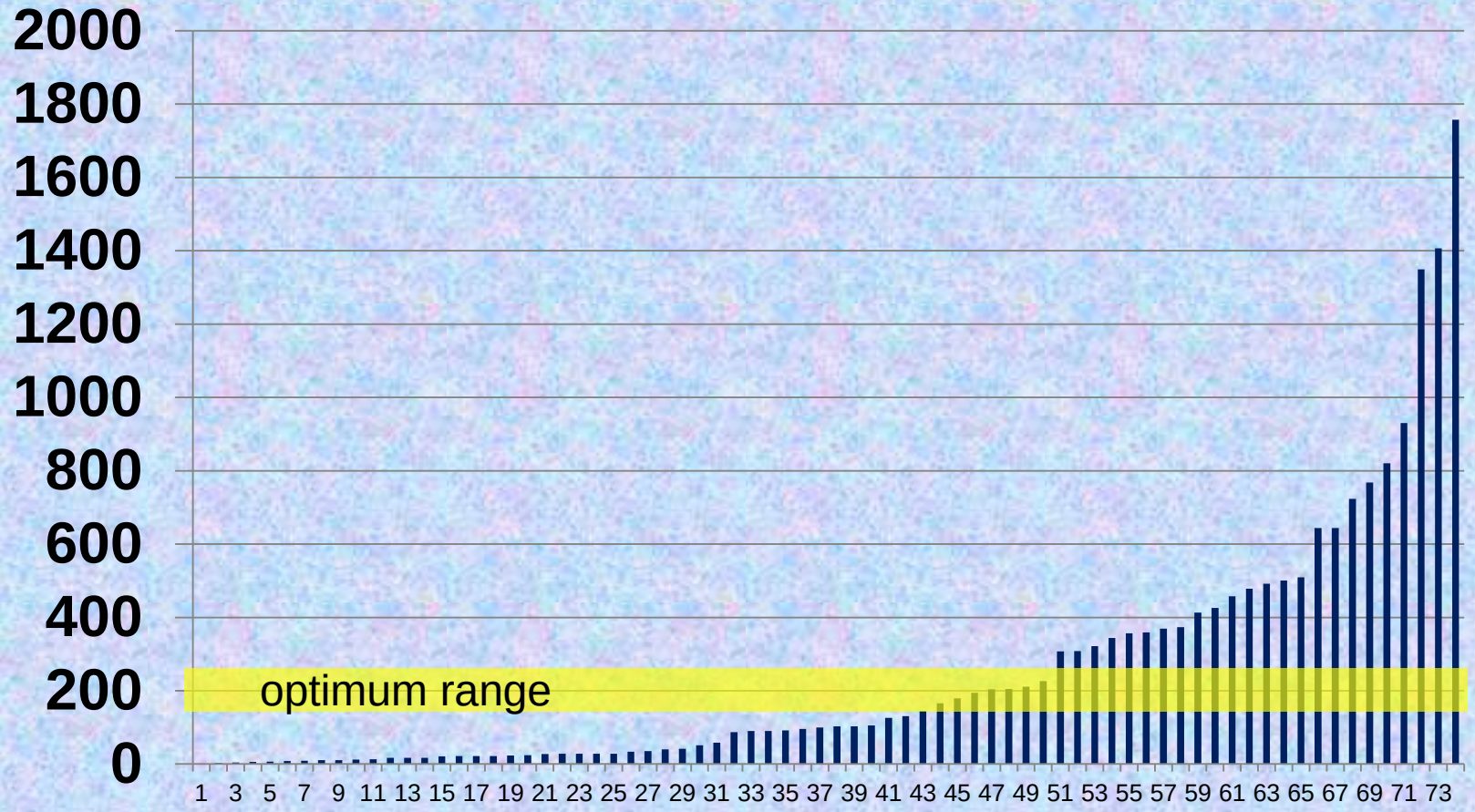
Micronutrients	mg/L
Zinc (Zn):	0.04
Boron (B):	0.18
Manganese (Mn):	0.04
Copper (Cu):	0.10
Iron (Fe):	0.69
Sodium (Na):	83.19

UMaine soil testing lab: long term high tunnel test. $22
http://anlab.umesci.maine.edu/soillab_files/prices/index.html

UMass saturated media test $15 plus organic matter $5

K in tunnel soils

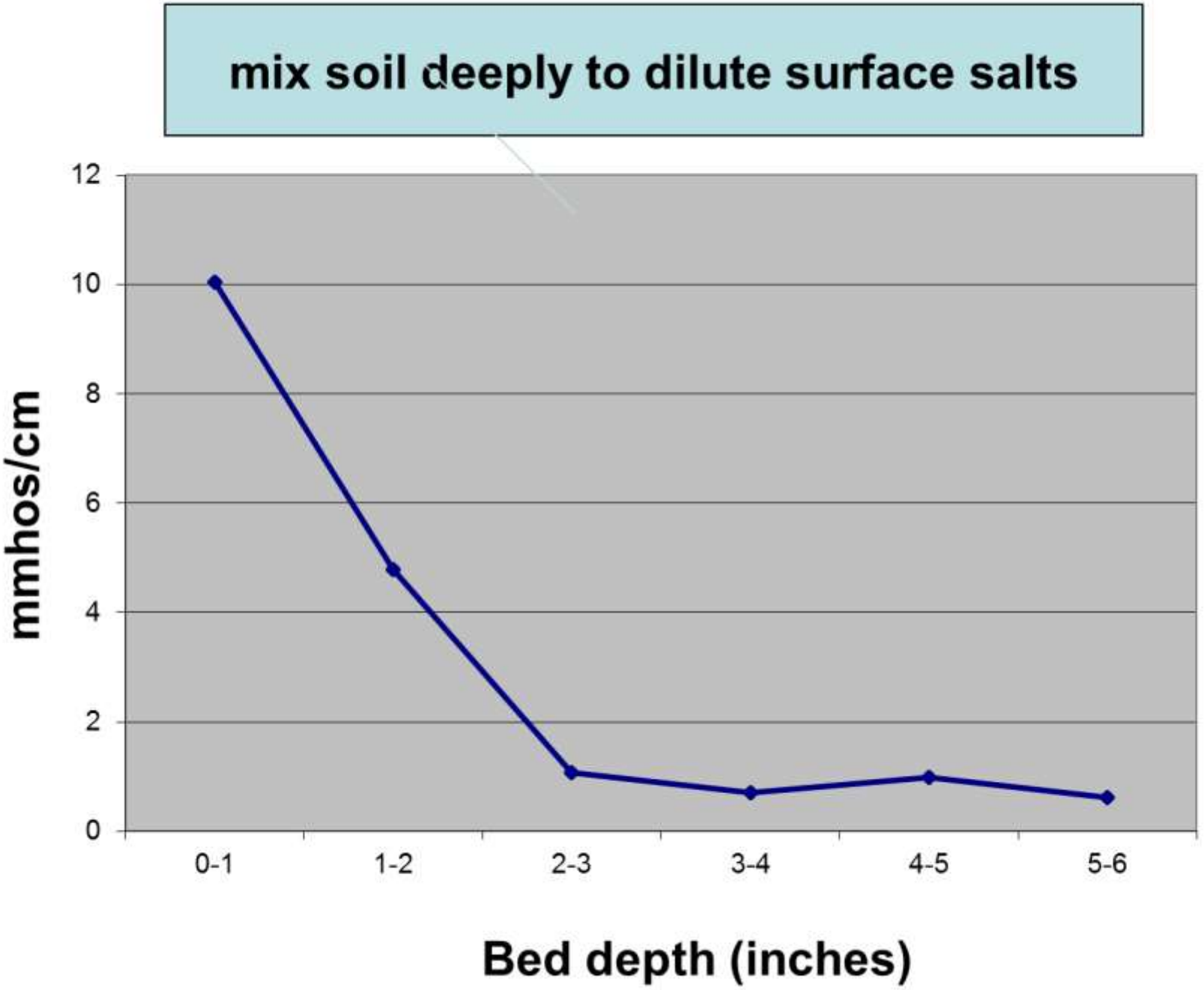
75 SME samples 2008-09



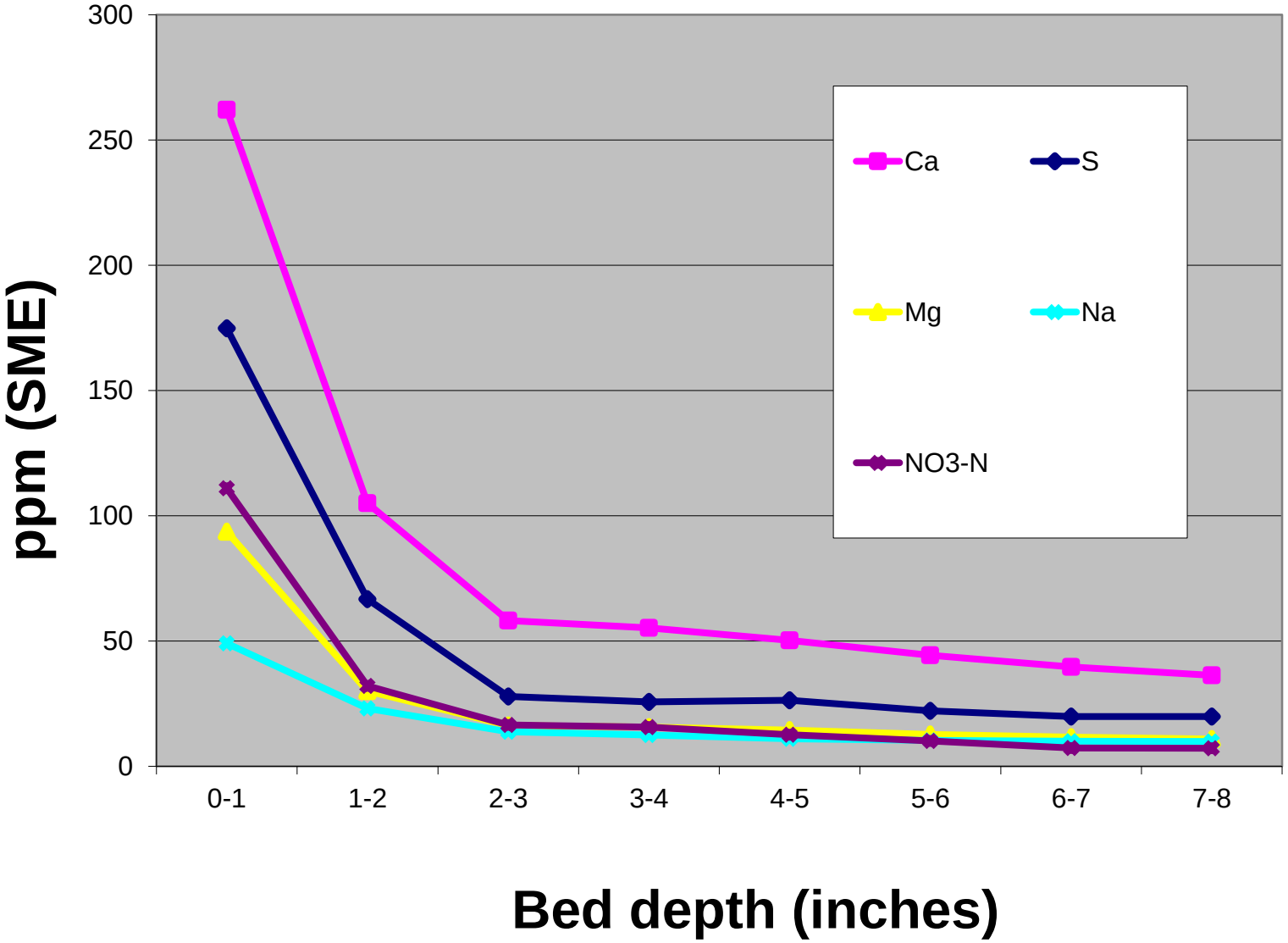
common organic soil amendments

- **N**: soy or peanut meal, Chilean nitrate (sidedress)
- **P**: bone meal, bone char (?)
- **K**: potassium sulfate, sul-po-mag,
- **Ca**: lime, gypsum
- **Mg**: lime, sul-po-mag, epsom salts
- **Blends**: ProGro, Cheep-Cheep, alfalfa meal etc.
- **Micros**: compost, borax, Azomite
- **Organic matter**: compost, peat moss


spread soil amendments materials evenly!


mix soil deeply to dilute surface salts
12
10
8
6
4
2
0
mmhos/cm
0-1
1-2
2-3
3-4
4-5
5-6
Bed depth (inches)

mix soil deeply to distribute nutrients

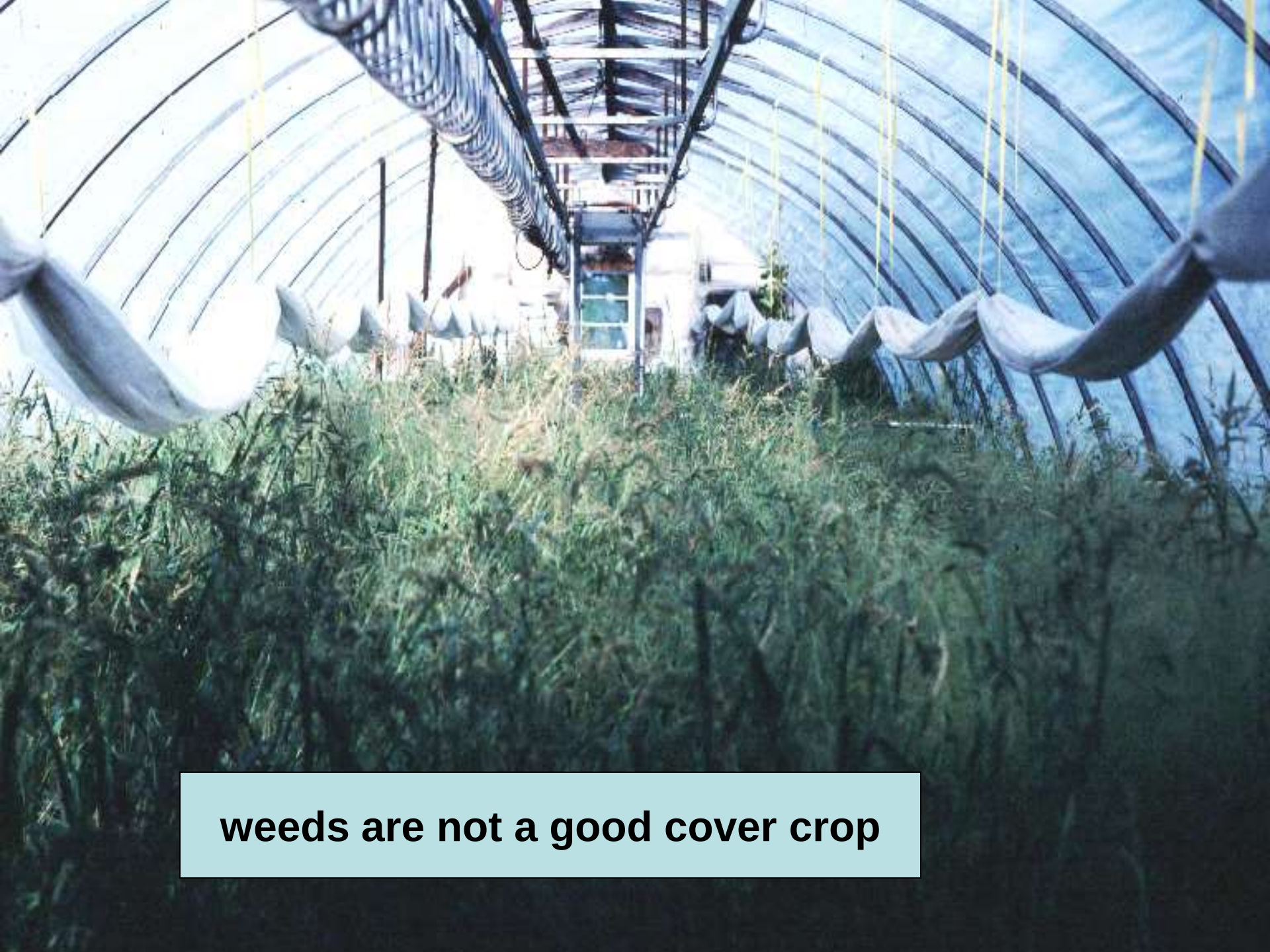



maintain OM: compost, peat moss, and/or cover crops
H&S


oats


cowpeas


buckwheat


weeds are not a good cover crop


for insect management it may best
to use a ‘clean fallow’ between crops
eliminate all
weeds...


maintain short turf around tunnels


avoid diseases: no hoses on the ground

more drip lines may be needed to wet entire root zone

roots able to grow near surface: warm, fertile, O_2

gutters can make use of available vertical space


but be aware of shading, dripping


monitor for flying insect pests
greenhouse sticky card insect count report form
https://ag.umass.edu/sites/agcenter/files/pdf-doc-ppt/StickyCardsForm.pdf

using yellow sticky cards

- number cards, and place in a grid pattern
- 3–4 cards per 1,000 sq. ft.
- some cards near doors, vents, sidewalls
- clothespins / stakes to attach cards 4–6″ above crop canopy
- move cards up as plants grow
- change the cards weekly
- place new cards in the same areas
- record insect counts at least weekly


marigolds for monitoring thrips


bush beans for monitoring spider mites

show me the money

Ledgewood Farm data 2011

21’ x 96’ unheated high tunnel for early season production

	Cut flowers	Jingle peppers	Sandwich onion	Tomatoes
Number of plants	1,350	630	3200	360
Total crop produced	2,700	25,200	3200	3,000
Unit size	10 stems	each	each	Pound
Price/unit	$3.00	$.20	$.79	$3.99
Gross income	$8,100.00	$5,040.00	$2528.00	$11970.00
Income/foot ^{2}	$4.01	$2.50	$1.25	$5.94
Time of season	6/25-9/5	6/30-9/5	6/25-8/10	7/15-9/5

high tunnel enterprise budgets - 2011

Washington State Univ.

Table 3. Estimated Net Return at Various Prices and Yields of High-Tunnel Grown Tomatoes

20 x 96 unheated

Marketable Yield (pounds/tunnel)	Price ($ per pound)				
	$1.50	$2.00	$2.50	$3.00	$3.50
2,500	-$2,953.95	-$1,703.95	-$453.95	$796.05	$2,046.05
3,000	-$2,394.84	-$894.84	$605.16	$2,105.16	$3,605.16
3,500	-$1,835.73	-$85.73	$1,664.27	$3,414.27	$5,164.27
4,000	-$1,276.62	$723.38	$2,723.38	$4,723.38	$6,723.38
4,500	-$717.51	$1,532.49	$3,782.49	$6,032.49	$8,282.49

http://cru.cahe.wsu.edu/CEPublications/FS090E/FS090E.pdf

Table 4. Estimated Net Returns ($/tunnel) at Various Prices and Marketable Yields of High-Tunnel Grown Strawberries

28 x 96 unheated

Marketable Yield (pounds/tunnel)	Price ($ per pound)				
	2.50	3.00	3.50	4.00	4.50
500	-2,700	-2,450	-2,200	-1,950	-1,700
750	-2,377	-2,002	-1,627	-1,252	-877
1,000	-2,053	-1,553	-1,053	-553	-53
1,250	-1,730	-1,105	-480	145	770
1,500	-1,405	-655	95	845	1,595

Note: Shaded area denotes a positive profit based on the combination of yield and price.

http://cru.cahe.wsu.edu/CEPublications/FS093E/FS093E.pdf

Cornell high tunnel enterprise budgets - 2009

http://www.hort.cornell.edu/hightunnel/business/budget.htm#recordkeeping

crop	type of high tunnel		net income	net per sq. ft.
tomato	unheated	20 x 100	$7,029	$3.61
winter spinach	unheated	20 x 100	$6,351	$3.18
winter greens	heated	30 x 120	$8,187	$2.27
winter greens	unheated	20 x 120	$4,340	$1.81
colored peppers	unheated	26 x 144	$530	$1.18
sweet potato	unheated	34 x 144	$419	$0.10


www.uvm.edu/vtvegandberry