Advanced High Tunnels

Plant Pathogen Issues in High Tunnels
Claudia Nischwitz, USU Extension

Overcoming Insect Pest Challenges
Marion Murray, USU Extension

Raspberry Cropping Systems for High Tunnels
Brent Black, USU Extension

High Tunnel Variations-Vegetable Production
Wayne Jones, University of Idaho Extension

High Tunnel for High Winds, and Medicinal Crops
Tony McCammon, Bloom Horticulture

Nobe Teepu Dooha- House Under Ground
Randy Emm, University of Nevada- Reno Extension

Plant Pathogen Issues in High Tunnels

Highlighting prominent plant diseases found in high tunnels.

Claudia Nischwitz

Associate Professor and Extension Plant Pathologist

Utah State University

claudia.nischwitz@usu.edu

I have been at USU since August 2010. I am an Associate Professor and Extension plant pathologist. I work on plant disease detection and management mainly for vegetables and tree fruit. I do diagnosis of pathogens on all crops.

Back to Top

Plant pathogen issues in high tunnels

Claudia Nischwitz

Associate Professor and Extension Plant Pathologist

Utah State University

Considerations using a high tunnel – Plant disease perspective

- Crops planted directly in field soil or in raised beds
- Weeds/crops in vicinity
- Transplants or plants grown from seed

Crops planted directly in field soil or in raised beds

- Planted in field soil
  - Problems in the past with soilborne diseases in field production?
  - If yes, problems can also occur in high tunnel

Soilborne disease problems

- Verticillium wilt
- Sclerotinia white mold
- Fusarium wilt
- Root-knot nematodes
- Damping-off

Verticillium wilt

- Symptoms:
  - Leaves start to wilt
  - Wilting may only occur on one side of the plant
  - Leaves may turn brown at tips (depending on plant species)
  - Vascular tissue in affected stems is discolored
- Hosts: Most vegetables with the exception of asparagus, beans, peas, carrots and sweet potato

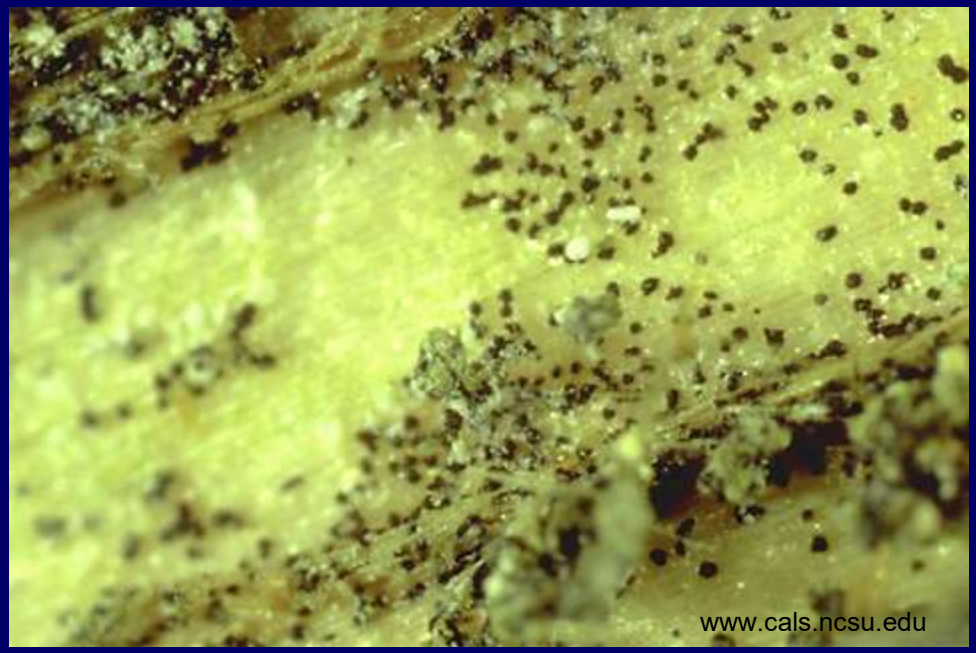

www.growingproduce.com


www.extension.umn.edu

Missouri Botanical Garden

Verticillium wilt

- Spread by spores produced on plants
- Microsclerotia residing in soil (can survive for many years in soil)



Verticillium wilt – Management high tunnel

- Use raised beds with either plastic mulch covering ground or raising the beds up above ground
- Use resistant varieties when available
  - Resistant varieties will either have “V” listed with disease resistance

Sclerotinia white mold or stem rot

- Symptoms:
  - Cottony mycelium growth on infected plant material
  - Rotting plants
- Hosts: Many vegetables including lettuce, cucumber, beans, carrots, tomato and celery

Sclerotinia white mold or stem rot

Sclerotinia white mold or stem rot

Sclerotinia white mold or stem rot

- Dispersal
  - Sclerotia in soil
  - Spores produced in cup-like fruiting structure

Sclerotinia white mold or stem rot - management

- Use raised beds with either plastic mulch covering ground or raising the beds up above ground

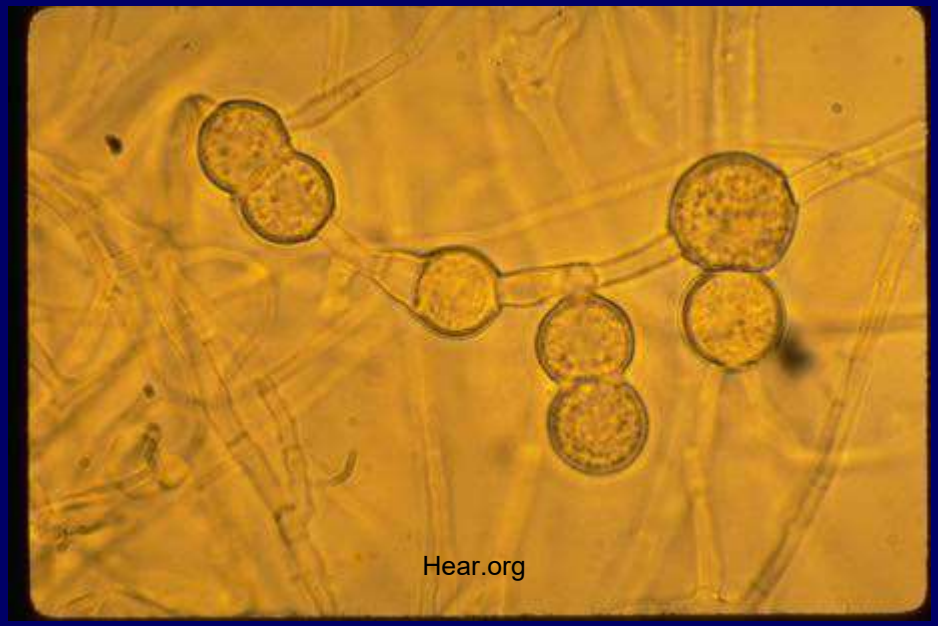
Fusarium wilt

- Causal agent *Fusarium oxysporum* formae speciales
  - Very host specific
  - Example: f.sp. lycopercici – tomato
    f.sp. capsici - pepper
- Symptoms (very similar to Verticillium):
  - Plant wilt during the hot part of the day, may recover initially when temperatures cool down
  - Vascular discoloration

Fusarium wilt

Fusarium wilt

- Dispersal:
  - Spores produced on infected plant material
  - Resting spores surviving in soil



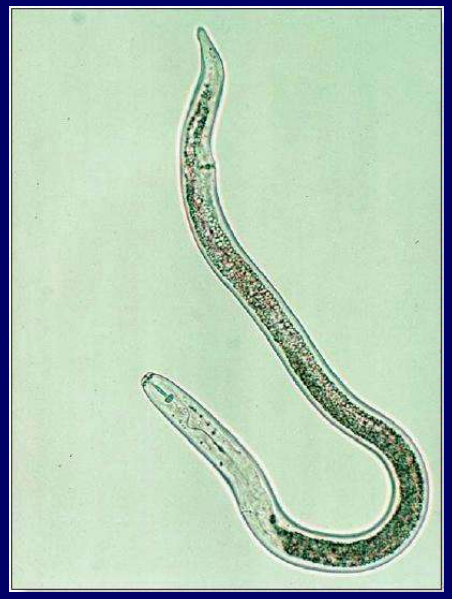
Fusarium wilt - Management

- Use raised beds with either plastic mulch covering ground or raising the beds up above ground
- Resistant varieties when available
  - Resistant varieties will either have “F” or “Fox” listed with disease resistance

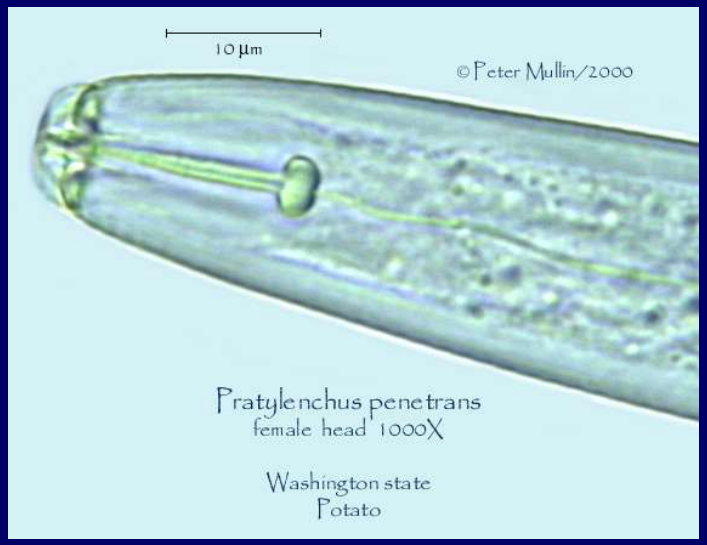
Nematodes

- Microscopic roundworms
- Nematodes are present in soil
- New introductions to fields occur by
  - Using contaminated equipment
  - Planting infected transplants or seed
- Many plants are infected by nematodes
  - Vegetables → Root-knot nematodes

Nematodes

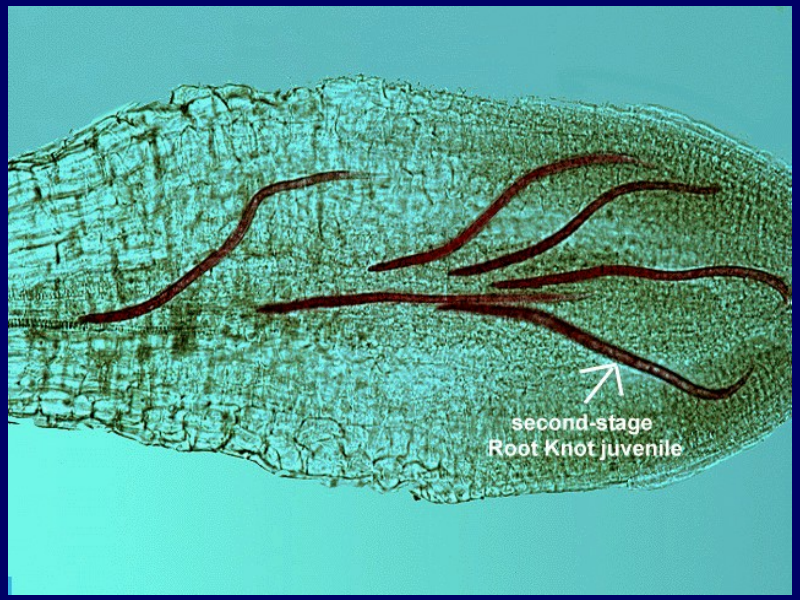


http://www.farmwest.com/index.cfm?method=library.showPage&librarypageid=150



http://www.nematode.net/

Root-knot nematodes



http://nematology.umd.edu/rootknot.html

Nematodes - Management

- Tolerant varieties
- Disinfect and clean equipment
- Use raised beds with either plastic mulch covering ground or raising the beds up above ground

Damping-off

- Symptoms
  - Seedlings turn brown/black at base and fall over

http://www.omafra.gov.on.ca/english/crops/hort/news/hortmatt/2007/03hrt07a2.htm

Damping-off management

- Damping-off
  - Sanitation: Use new or disinfected seedling trays
  - Use sterile or heat-treated soil
  - Place trays on plastic mulch
  - Do not over-water; Seedlings sitting in water are more susceptible
  - Do not plant seed too deep
  - Some seed may be treated with a fungicide to prevent damping-off

Viral disease problems

- Insects and viruses overwinter on weeds or volunteer crop plants
- Weeds in a high tunnel or within 30ft of the tunnel can be reservoirs
- Insect will manage to get inside the tunnel

Tomato spotted wilt virus


http://www.caes.uga.edu/topics/diseases/tswv/index.html

- TSWV is an important pathogens of tomato, pepper, tobacco and peanut in the U.S.
- It is becoming more and more frequent in Utah and established in the farmscape
- The virus is transmitted by thrips
- Thrips have to acquire the virus as larvae to be able to transmit it as adults. Once larvae are infected, thrips carry and transmit the virus throughout their entire lifespan

Tomato spotted wilt virus


http://www.caes.uga.edu/topics/diseases/tswv/index.html

- TSWV is not seedborne
- Plants get infected early in the season
- Symptoms:
  - Necrotic spots on leaves
  - Wilting
  - Stunting of plants
  - Necrotic rings on immature fruit
  - Chlorotic ringspots on mature fruit

Tomato spotted wilt virus

Tomato spotted wilt virus

Tomato spotted wilt virus


http://www.caes.uga.edu/topics/diseases/tswv/index.html

- Management:
  - Good weed control
  - Resistant tomato varieties (Finish Line, Fletcher, Crista, Red Defender, BHN 602 and Picus)
  - No resistant pepper varieties
  - Reflective mulch
  - Insecticides for thrips control

Seedborne diseases

- If plants are grown from seed in high tunnel use certified- disease free seed
  - Seedborne diseases:
  - Tobacco mosaic virus of tomato
  - Bacterial spot of pepper and tomato
  - Downy mildew of spinach

Tobacco/Tomato mosaic virus

- Seedborne in tomato and other plants
- Transmitted by handling infected plants or tobacco
- Survives for up to 50 years in plant debris, contaminated pots etc.

TMV/ToMV on tomato

TMV/ToMV on tomato

TMV/ToMV - Management

- Use certified seed
- Resistant varieties
  - Resistant tomato varieties are hybrids
- Disinfecting pots and tools
- Replace plant substrate in greenhouse beds
- Change gloves frequently

TMV/ToMV - Management

Tobacco Mosaic Virus/Tomato Mosaic Virus: Symptoms, Transmission and Prevention of Infection

Virus del mosaico del tabaco/Virus del mosaic del tomate

TRANSMISSION
La transmisión

TMV/ToMV is transmitted from handling contaminated tobacco products. TMV/ToMV is also transmitted by handling infected plants.

TMV/ToMV es transmitido por el manejar con las manos los productos de tabaco contaminados. TMV/ToMV también es transmitido por el manejar con las manos las plantas infectadas.

Once a plant is infected with TMV/ToMV the virus will contaminate the seeds and subsequently infect the seedling.

Una vez que la planta sea infectada con TMV/ToMV el virus contaminará las semillas de la planta misma y después infectará los semilleros.

SYMPTOMS IN TOMATO, PEPPER AND PETUNIA
Las síntomas en el tomate, pimiento y las petunias

TOMATO/TOMATE

- Symptoms vary by variety and TMV/ToMV strain.
- Brown rings or sunken lesions occur on susceptible fruit.
- Dark and light green modeling will occur on some varieties on leaves.

- Las síntomas de tomate varian por la variedad y la cepa de TMV/ToMV.
- Anillos marrones con un halo o lesiones sangrado marrones ocurren en fruta susceptibles.
- Síntomas de mosaico se producirán en algunas variedades en las hojas. A veces son difíciles de ver.

PEPPER/PIMIENTO

- Only leaves show symptoms.
- Oak leaf pattern.
- Yield loss of tomato and pepper plants is between 5-100%.

- En pimiento, sólo las hojas mostrarán síntomas.
- Es un modelo de la hoja de roble.
- La pérdida de rendimiento de las plantas de tomate y pimiento es entre 5-100%.

PETUNIA/PETUNIA

- Symptoms can be seen on flowers.
- On purple flowers darker spots appear.
- On other flowers white spots appear.

- En las petunias, las síntomas se ven en las flores.
- En flores de color púrpura aparecen manchas más oscuras.
- Otras flores manchas blancas se muestran. Las hojas no pueden mostrar síntomas.

MANAGEMENT AND PREVENTING TRANSMISSION
El mantenimiento y el evitar la transmisión

Transmission can be prevented by dipping tools into 20% powdered milk suspension before use.

Se puede evitar la transmisión al undir las herramientas en una suspensión de 20% leche de polvo antes de usar.

Transmission can also be prevented/managed by wearing clean gloves while working with plant.

Transmisión también puede ser evitado/mantenido al vestir guantes limpios cuando se trabaja con la planta.

Authors: Claudia Nischwitz, Brooke Olson, Rhett Taylor

Bacterial spot of pepper and tomato

- Caused by several species of *Xanthomonas*
- Bacteria are seedborne and they can survive in plant debris (primary infections)
- Spread from plant to plant: splashing water, wind and humans
- Symptoms:
  - Infected seedlings may not show symptoms but leaves can turn yellow and fall off
  - Older plants show develop brown, necrotic spots on leaves and fruit with a yellow halo

Bacterial spot of pepper and tomato

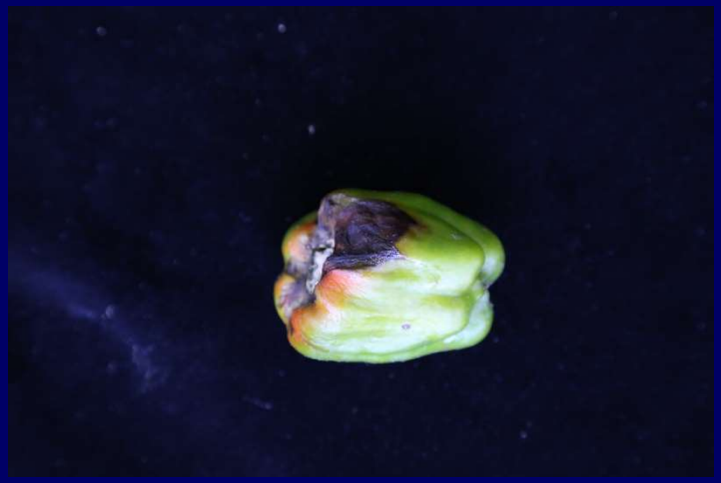
- Leaves eventually die
- Tomato: Dead leaves remain on plants
- Pepper: Dead leaves fall off

Bacterial spot - tomato

Bacterial spot - tomato

Bacterial spot - pepper

Bacterial spot - pepper



Bacterial spot - management

- Use certified disease-free seed or transplants
- Remove tomato and pepper plant debris from fields
- Crop rotation for one-two years
- Application of copper products when first spots are observed (several states have problems with bacteria resistant to copper)
- Resistant varieties:
  - Pepper varieties depending on the bacterial races present
  - No resistant tomato varieties

Downy mildew of spinach

- Symptoms:
  - Leaves turn yellow
  - Gray fungus growing on the underside of the leaf
- Host: Spinach
- High humidity and cool temperatures
- Dispersal:
  - Airborne spores
  - Seedborne and thought to be seed transmitted

Downy mildew of spinach

- Symptoms can develop and the pathogen can decay the leaf tissue while stored in bag when non-symptomatic leaves are harvested

Downy mildew of spinach

- Consists of many races
  - Newest race is race 16
- Management:
  - Fungicides need to be applied before symptoms occur: Aliette 80 WDG, Ridomil Gold, Revus or copper-containing products
  - Resistant varieties

    No variety is resistant to all races but several have resistance to many varieties

Downy mildew of spinach

Variety	High resistance	Intermediate resistance
3665 (F1)	Races 1-5, 8, 9, 11-12, 14	
Anna (F1)	Races 1, 3, 5	
Baker (F1)	Races 1, 3, 5, 8, 9, 11, 12, 14	
C2-606 (F1)	Races 1-9, 11-16	
C2-608 (F1)	Races 1-7, 9, 11, 13, 16	
Carmel (F1)	Races 1-11,13	
Corvair (F1)	Races 1-12, 13	
Emperor (F1)	Races 1-10	
F91-415 (F1)	Races 1-2	
Flamingo (F1)	Races 1-11	Races 12-13
Gazelle (F1)	Races 1-13	
Kookaburra (F1)	Races 1-13, 15	
Persius (F1)	Races 1-3, 5, 8, 9, 11, 12, 14, 16	
Red Kitten (F1)	Races 1-13, 15	
Reflect (F1)	Races 1-11	
Seaside (F1)	Races 1-12	Race 14
Space (F1)	Races 1- 3, 5-6, 8, 11-12	
Viceroy (F1)	Races 1-2	
Woodpecker (F1)	Races 1-15	

Russet mites on tomato

- Eriophyid mites
- Need a strong hand lens or dissecting microscope to see them
- Cream to pale orange colored

www.omafra.gov.on.ca

Russet mites on tomato

- Other hosts: Potato and pepper but usually not a problem on those hosts
- Symptoms:
  - Bronze discoloration of leaves and stems (russeting)
  - Severe infestations, stems will lose their hairs
  - Fruit: russeting and cracking od fruit, uneven ripening
  - Plants will die from severe infections

Russet mites on tomato

www.growingproduce.com

Russet mites on tomato

- Management:
  - Applications of sulfur or Abamectin
  - Remove alternate weed host like nightshade and morning glory

Thank you for your attention

Overcoming Insect Pest Challenges in High Tunnels

Most, but not all, insect pests are decreased through use of high tunnels. However, mites, thrips, aphids some caterpillars thrive in the high tunnel and can quickly get out of control. Learn about these challenges and options for overcoming them, including the use of exclusion systems and biocontrols.

Marion Murray

IPM Project Leader

Utah State University Extension, Logan

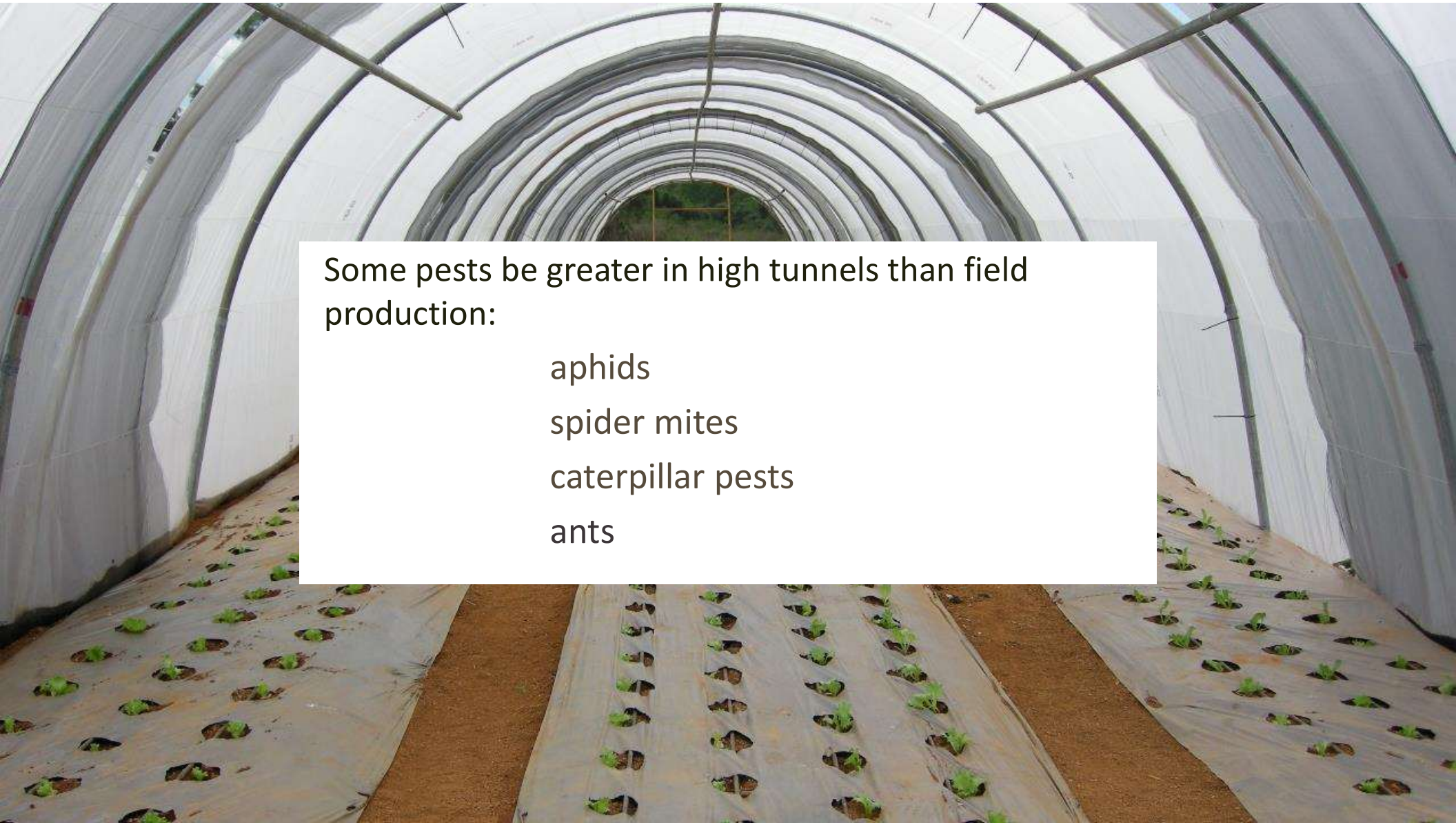
marion.murray@usu.edu

Marion has been the IPM Project Leader at Utah State University Extension, Logan, since 2006. She conducts outreach and research in IPM, with a focus on fruits and landscape ornamentals. She received her MS in plant pathology from Oregon State University and is originally from North Carolina.

Back to Top

Insect Pest Issues in High Tunnels

MARION MURRAY, USU IPM PROGRAM



Some pests be greater in high tunnels than field production:

- aphids
- spider mites
- caterpillar pests
- ants

Multiple generations - up to 12-15 / year

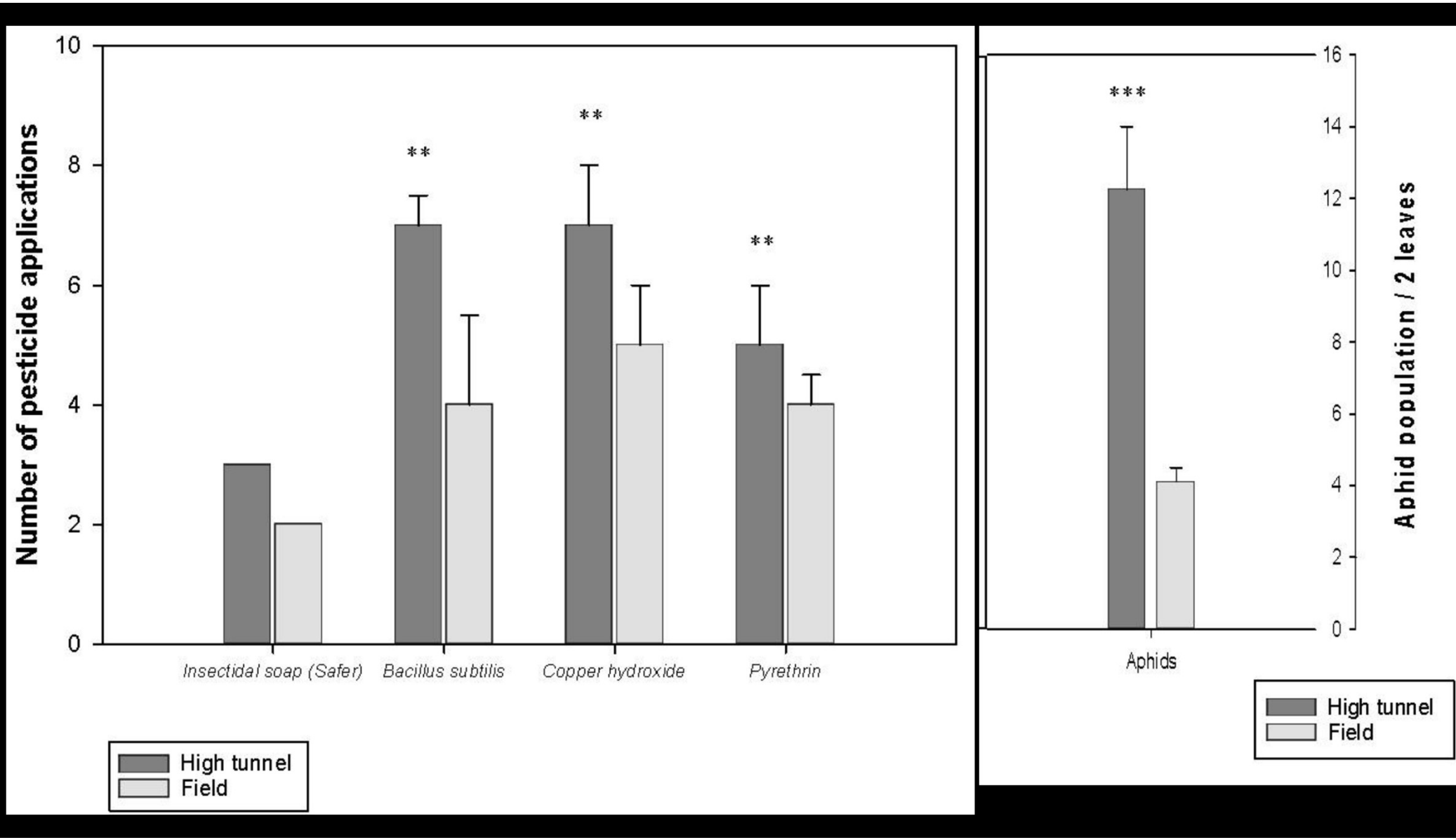
Limited natural enemies to reduce populations

Almost unlimited food

Improved environmental conditions

Some life stages are not susceptible to treatment

Some insecticide and miticide resistance


Number of pesticide applications
10
8
6
4
2
0
**
**
**
Insectidal soap (Safer)
Bacillus subtilis
Copper hydroxide
Pyrethrin
High tunnel
Field
***
16
14
12
10
8
6
4
2
0
Aphid population / 2 leaves
Aphids
High tunnel
Field

Components of an IPM Program

Knowledge of pest biology and behavior as well as knowledge of host plant

Monitoring for insect or disease occurrence

Knowing at what level control measures are needed

Using an integrated approach to treatments

Record-Keeping

Environmental health

Human health

Economic Benefit

Why Scout?

FOR MAKING PEST MANAGEMENT DECISIONS

Provides early warning of potential pest problems

When to apply control measures

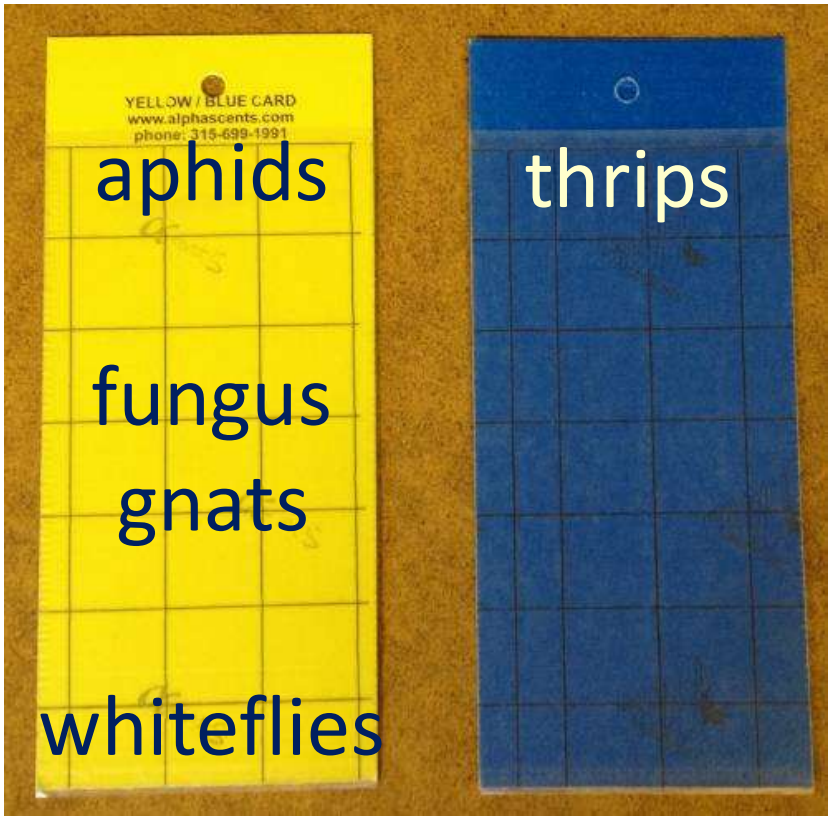
Provides immediate feedback about whether pest control activities are working

Historical data measures effectiveness of management

Scouting Tools

Scouting Tools – Sticky Cards

50% ↓



At least 1 card per 1,000 sq. ft

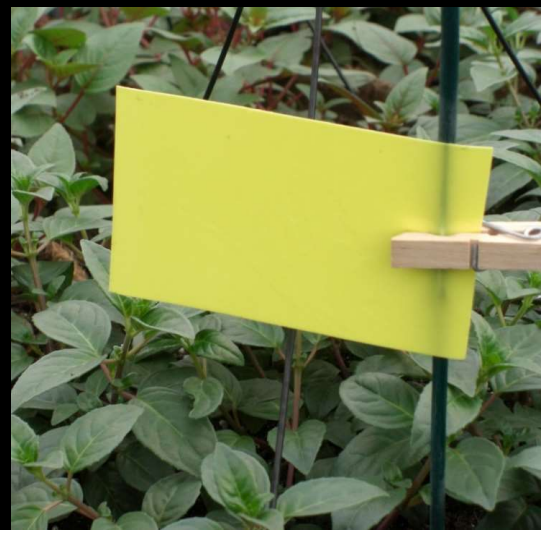
- minimum of 3

1-2 inches above plant canopy, near favored hosts

- include extras around entryways

Reduce number if releasing winged beneficial insects

Check and replace weekly & after a treatment



Unsure?

Send samples to your county Extension office, or to the Utah Plant Pest Diagnostic Lab (UPPDL) in Logan:

utahpests.usu.edu/uppdl

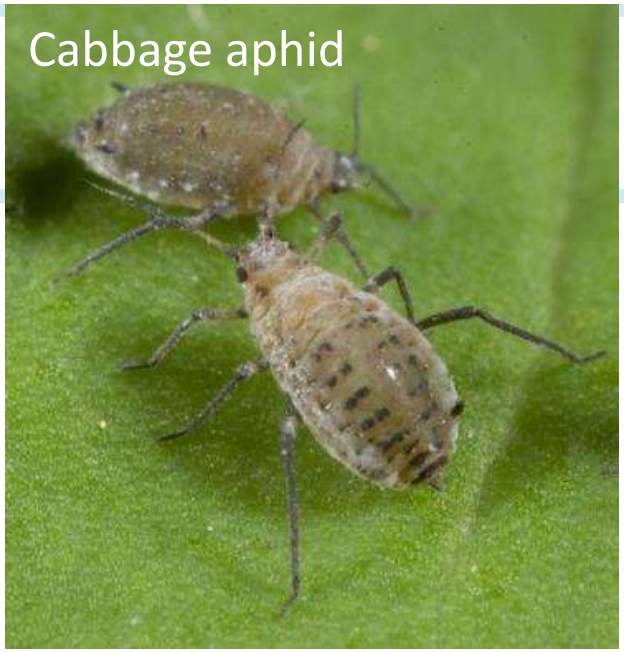
Aphids

Pear-shaped body

Cornicles = “tailpipes”

Green peach and potato aphids migrate in

Cabbage aphid overwinters as eggs in crop debris



Aphid Management

Monitor visually

- Check plants on edges or near openings first

Use sticky traps near openings

Weed management

Spring/summer

Fall/winter Greens –
9 per sq. ft. under row covers

single fall release – 98% control

Spring/summer

Aphid Biocontrol – Parasitoid Wasps

	Green Peach	Melon	Potato	
Aphidius colemani	x	x		Temp: 50 – 76°F
Aphidius ervi			x	Temp: Above 86°F

Use a combination of the two

ipmlabs
beneficials at work.

RINCON-VITOVA
INSECTARIES, INC.

Beneficial Insectary
PROVIDING A NATURAL BALANCE IN PEST MANAGEMENT

Green Methods.com
Biological Pest Control and Integrated Pest Management

Bioline™

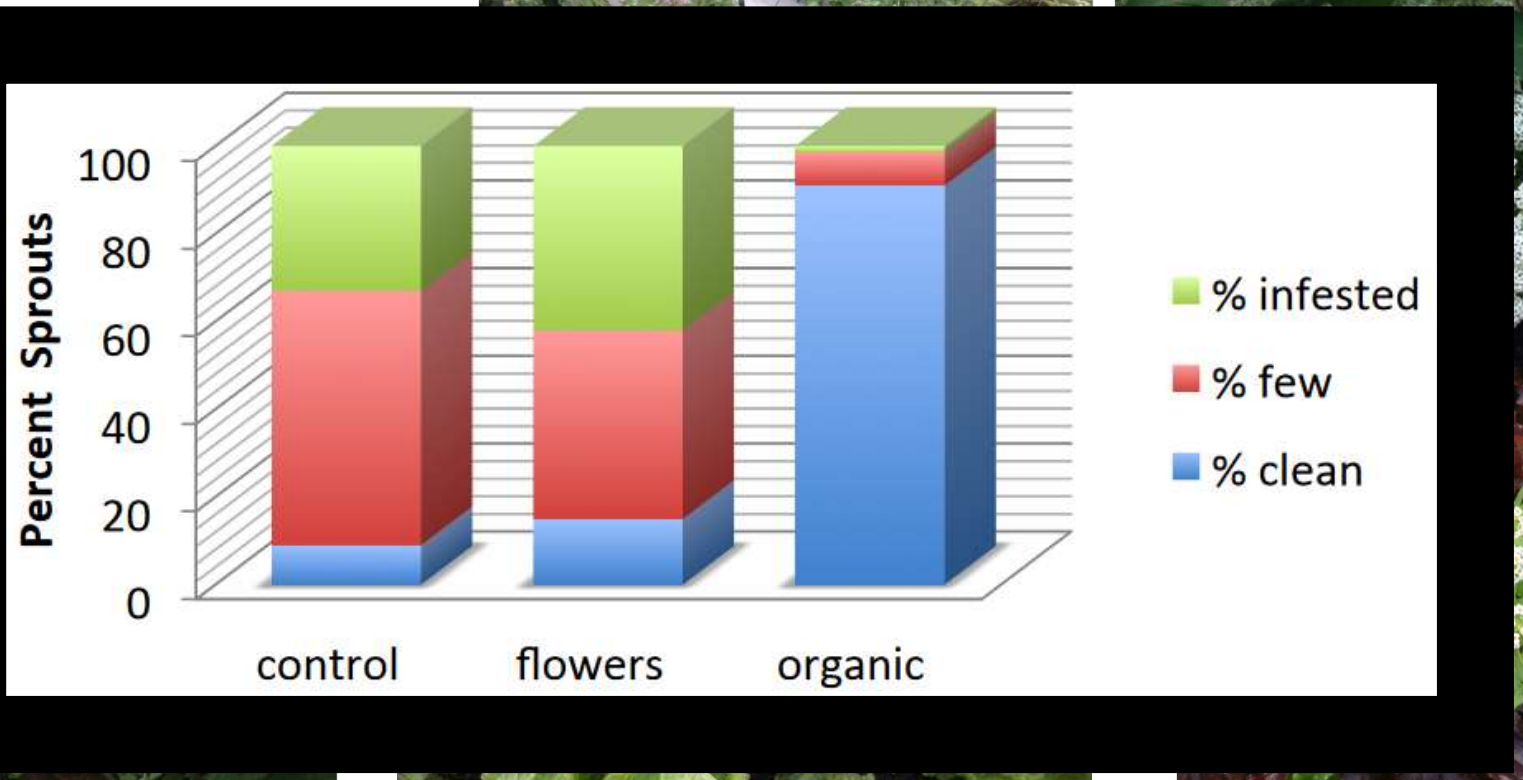
KOPPERT
BIOLOGICAL SYSTEMS

biobest®
SUSTAINABLE CROP MANAGEMENT

Habitat Plants

Pollen, nectar and shelter -

Alyssum, Marigold, Fennel, Dill



Aphid Management

Insecticides – Target **LOW** populations

- horticultural oil (alone or mixed)
- insecticidal soap

→ do not apply when temps > 85F

- *Beauvaria* (BotaniGard)

→ must come into contact with aphid

- pyrethrin (Pyrellin, Pyrigro)

→ used successfully in fall/winter production

- azadirachtin (Azatin, Neemix)
- fenoxycarb (Preclude)

not organic

→ insect growth regulators (IGR)

Spring Control Example:

- BotaniGard + azadirachtin
- Rotate with Pyrethrin + Oil

Two-spotted Spider Mite

Heat plus absence of rain

Peas, beans, tomatoes, peppers, cucumbers, strawberries, brambles

Spider Mite Management

Overwintering on crop debris:

- 35% of tunnels with crop debris harbor mites
- Remove all crop debris

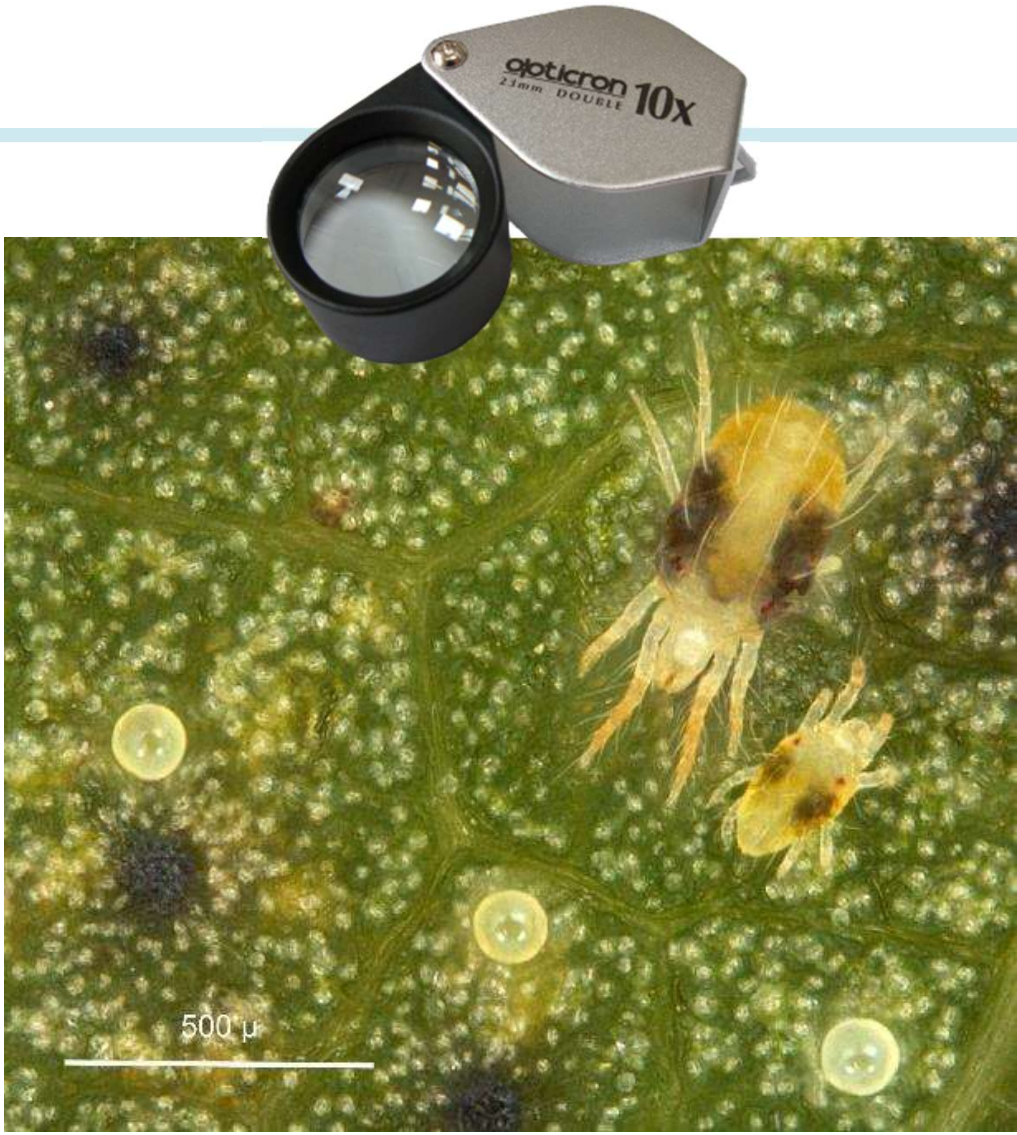
Overwintering on emerging weeds:

- henbit, wild mustard, and chickweed
- Remove weeds several weeks before planting

Spider Mite Management

Starting in spring, monitor regularly

Approximate treatment threshold: around 25% of leaves infested or 2 mites per leaf



Spider Mite Management – Predatory Mites


Bioline
syngenta

Spider Mite Management – Trap Plant

Bush beans

Spider Mite Management

Soft Controls:

- horticultural oil
- insecticidal soap

→ do not apply when temps > 85F
must contact mites

Miticides safe on biocontrols:

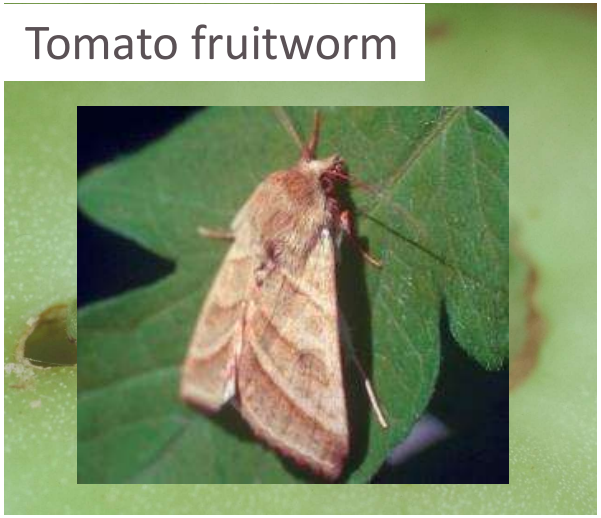
- Acramite (bifenazate)
- Oberon (spiromesifen)
- Savey (hexythiazox)
- Zeal (etoxazole)

→ check label for crop

→ work best when applied at lower mite levels

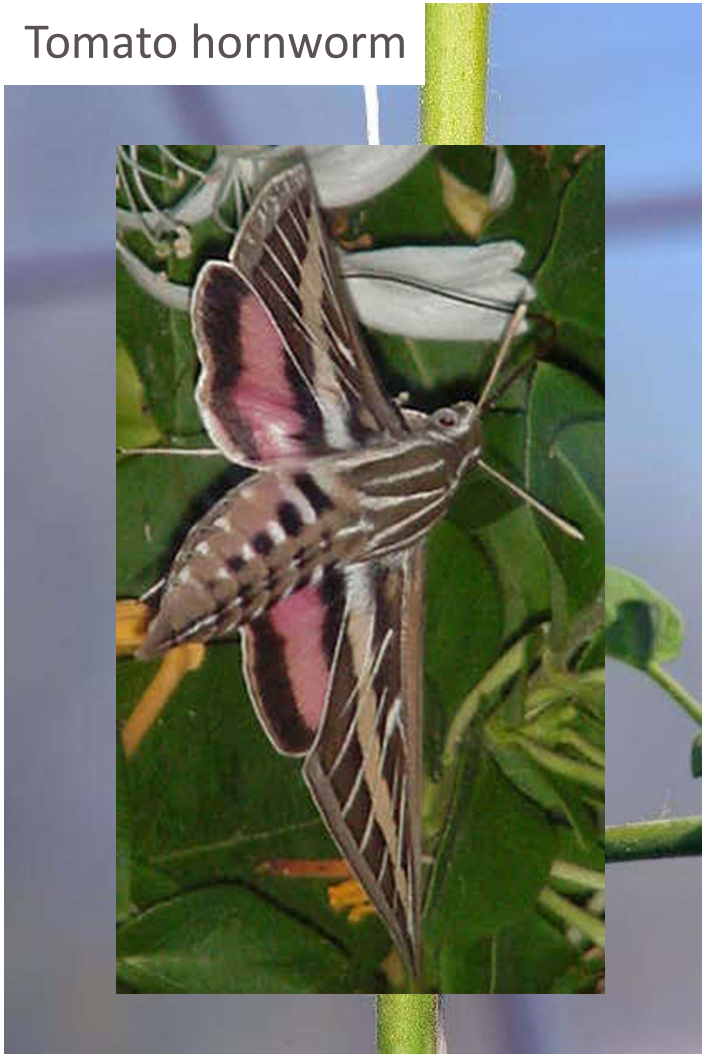
Caterpillar Pests

Tomato fruitworm



Cabbage Looper

Tomato hornworm



Diamondback moth

Cutworms

Caterpillar Pest Management

Monitor early and often

Insecticides:

- *Bacillus thuringiensis* (many brands)
- Spinosad (Entrust)

→ must be consumed
work best when larvae are small

Screening the roll-up or roll-down openings for side walls and all doors / end openings and vents

Caterpillar Management - Insect Screening

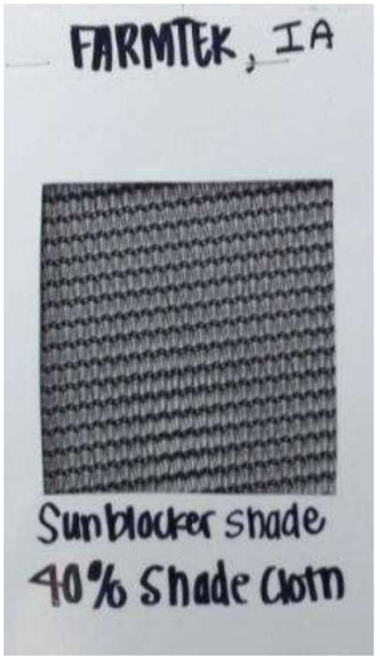
Considerations:

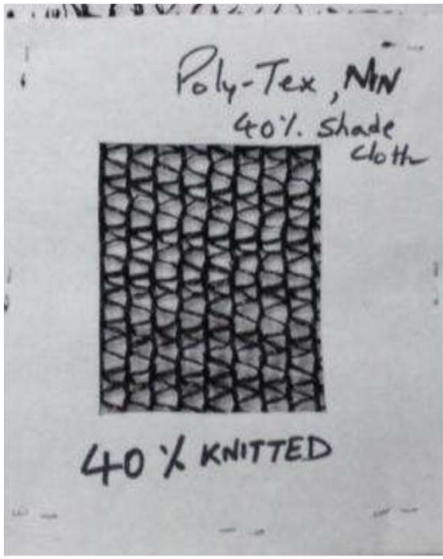
- Shading of plants may affect plant growth and maturity
- Loss of air movement leading to disease issues
- Trapped heat and humidity in the tunnel
- Loss of natural enemies due to non-selective exclusion
- Pollination
- **Goal**: inexpensive and long-lived

Caterpillar Management - Insect Screening

Southeast U.S. Research: 30 – 50% shade cloth

- **40% cloth** blocked moths, stink bugs, squash bugs, etc., while allowing lady beetles and smaller insects
- On average, 60% reduction
- Cost for 2 sidewalls and one endwall approx. $420





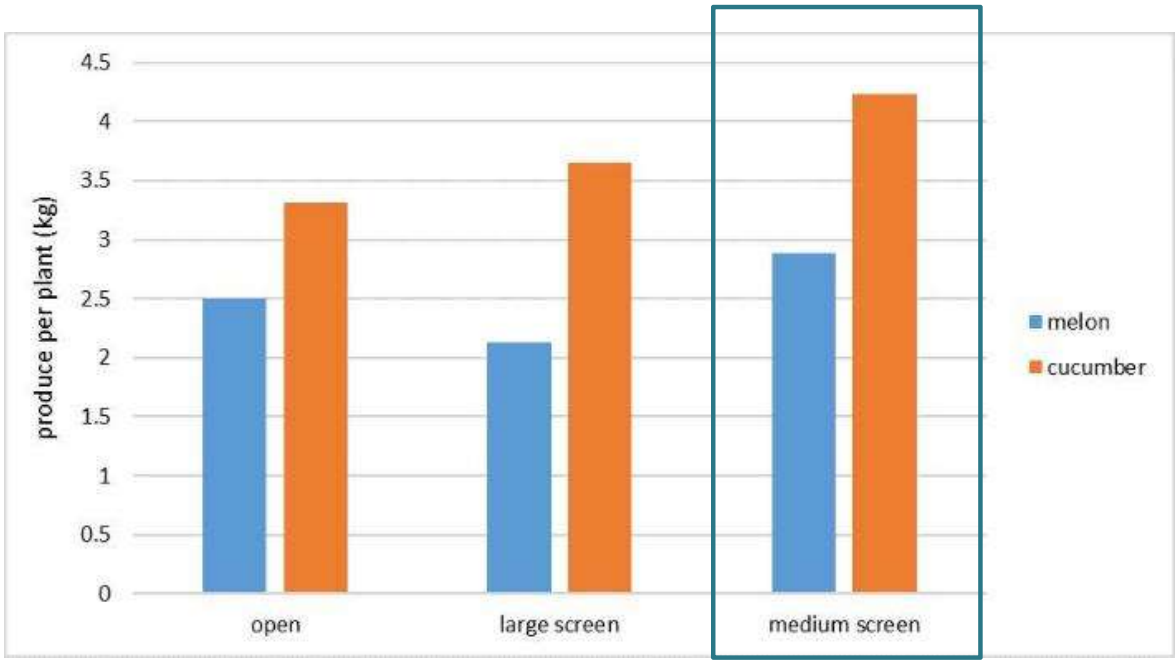
High Tunnel Pest Exclusion System; Ayanava Majumdar, Auburn University

Caterpillar Management - Insect Screening

Research out of Indiana

- Small screens - (0.40 x 0.45 mm) made the tunnels too hot

- Medium (0.26 x 0.82 mm) and large (1.00 x 4.00 mm) screens allowed for good air flow
  - eliminated cucumber beetle and larger-sized insects
  - 50% improvement in pest management
  - 25% improvement in crop quality



High Tunnel Screening for Insect Pest Management
March 15, 2017 - By: Laura Ingwell, Purdue University

Ants

Thrive under landscape fabric

Disrupt plant root systems

Ant Management

Consider mulch instead

Ant baits

- Terro outdoor baits
- Advion bait kit
- Grant's bait
- borax bait

Marion Murray
IPM Project Leader
Utah State University

marion.murray@usu.edu
435-797-0776

"Aphids! Aphids, Henry! ... Aphids are loose in the garden!"

"Holy moley, Loretta! Not only is it still there, look what it did to the end of my stick!"

Raspberry Cropping Systems for High Tunnels

A summary of 10 years of research on high tunnel raspberries

Brent Black

Extension Fruit Specialist

USU Extension

brent.black@usu.edu

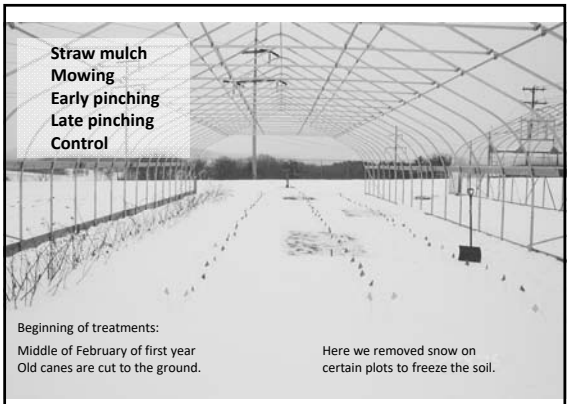
Dr. Brent Black is a Professor and Extension Fruit Specialist at Utah State University in Logan Utah. His interests include high-tunnel berry crop production, tart cherry orchard systems, orchard irrigation management, and alternative crops for small acreage diversification. Prior to coming to USU, he studied management systems and practices for strawberry, raspberry and blueberry production at the USDA research station in Beltsville Maryland. A native of southeastern Idaho, Brent completed his undergraduate degree in Plant and Soil Science at USU, a Master's degree in Horticulture at Michigan State University, and a Ph.D. in Plant Physiology at Oregon State University.

Back to Top

High Tunnel Systems: Raspberries

Brent Black,
Extension Fruit Specialist

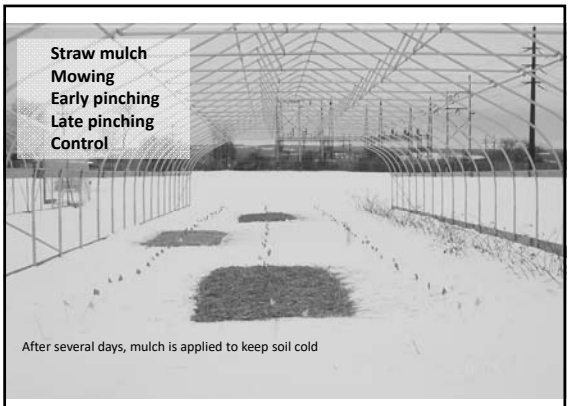
2018 Urban and Small Farms Conference



Beginning of treatments:

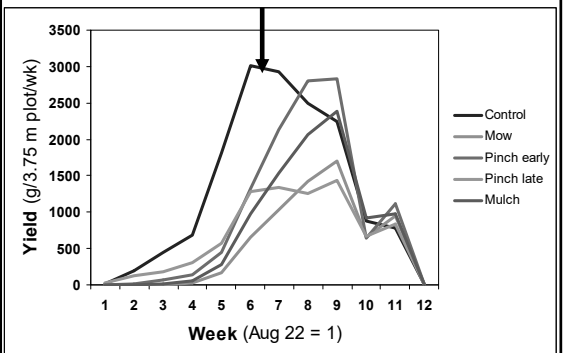
Middle of February of first year
Old canes are cut to the ground.

Here we removed snow on certain plots to freeze the soil.



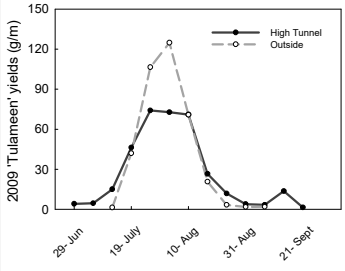
After several days, mulch is applied to keep soil cold

2006 data



Summer-bearers

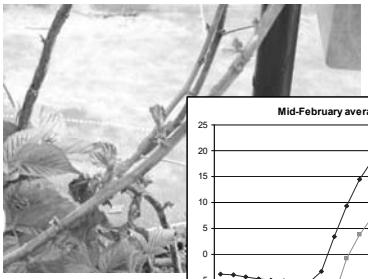
- Tulameen

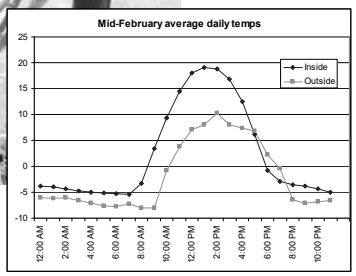


	Yield (g/m)	
	2008	2009
High Tunnel IG	500	1130
Field	80	1222

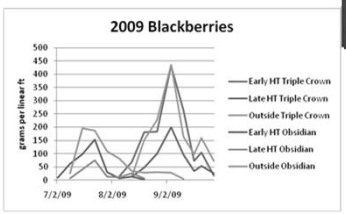
HT Fall raspberries = 3 to 4 kg/m

Summer Bearing Challenges





Blackberries?



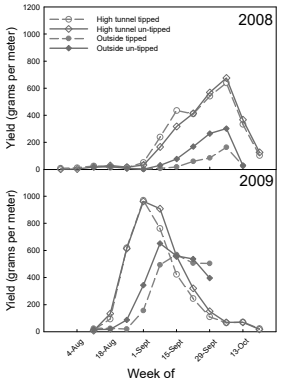
Blackberries?

Table 2. Total seasonal yield (lbs/plant) by cultivar over 4 years.

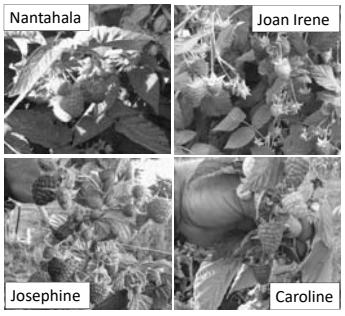
Type	Cultivar	2009	2010	2011	2012	4 yr Avg.
Primocane	Prime-Ark 45	0.0	0.0	0.1	2.0	0.5
Primocane	Prime Jan	1.0	0.3	1.5	4.1	1.7
Primocane	Prine Jim	0.6	0.7	6.2	2.8	2.6
Trailing	Metolius	1.6	0.8	1.5	3.7	1.9
Trailing	ORUS 1939-4	0.3	0.3	0.4	0.9	0.5
Trailing	Siskyou	0.0	0.2	0.1	0.5	0.2
Semi-erect	Chester	5.7	7.8	12.3	23.0	12.2
Semi-erect	Hull	7.3	15.7	0.6	24.1	11.9
Semi-erect	Lochness	3.9	7.7	8.1	11.4	7.8
Erect	Apache	0.1	0.6	0.6	2.4	0.9
Erect	Arapaho	3.8	1.9	1.3	1.9	2.2
Erect	Navaho	10.3	5.8	2.2	8.4	6.6

Caroline

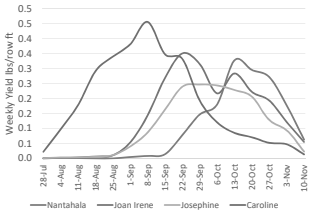
	Yield (kg/m)	
	2008	2009
High tunnel tipped	1.04	3.40
High tunnel un-tipped	1.16	3.81
Field tipped	0.42	2.30
Field un-tipped	0.92	2.61



Late Fall Production



Late Fall Production



Last date of harvest for the high tunnel and field-grown 'Caroline' and 'Josephine'

	HT	Field	Extended	< 32°F	< 27°F	< 22°F
2012	15-Oct	12-Oct	3	5-Oct	7-Oct	19-Oct
2013	17-Nov	14-Oct	34	6-Oct	16-Oct	22-Nov
2014	13-Nov	31-Oct	13	22-Oct	29-Oct	13-Nov
2015	6-Nov	6-Nov	0	6-Nov	7-Nov	17-Nov

Bear Lake

Laketown (87 frost free days)

Sept 2007

- **'Polana' raspberries**
- **Spring row covers**
- **Fall high tunnels**

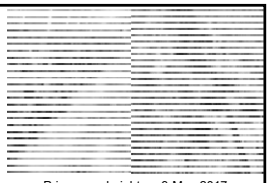
Treatment	**2007 marketable yields**
No cover or tunnel	**= 25 lbs (1,260 lbs/A)**
Spring cover, no tunnel	**= 122 lbs (6,300 lbs/A)**
Cover + fall tunnel	**= 242 lbs (12,500 lbs/A)**

In Cache Valley?

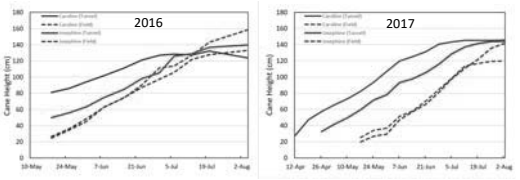
Tunnels with fall bearers
- Caroline and Josephine
- Cut back to ground level
- Tunnels and row covers in mid March
- Shade cloth during fruiting

Early Fall Bearers

- Cane growth



Primocane height on 3-May-2017



Early Fall Bearers

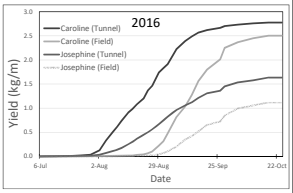
- Production season

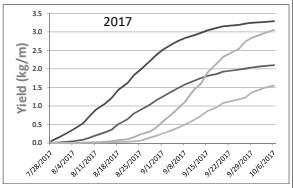
Harvest Season (Date of 20% yield)

2016	Inside	Outside	Dif.
Caroline	9-Aug	2-Sep	24
Josephine	18-Aug	6-Sep	19
2017			
Caroline	9-Aug	4-Sep	26
Josephine	18-Aug	4-Sep	17

2016 Marketable yield (%)

	Caroline	Josephine
Tunnel	92.4	94.7
Field	81.8	85.8





Early Fall Bearers

- Fruit Production

2016 Total Season Yield (lbs/ft)

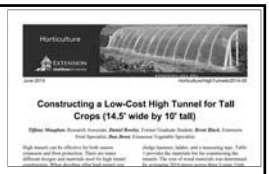
	Caroline	Josephine
Tunnel	1.87	1.10
Field	1.68	0.75

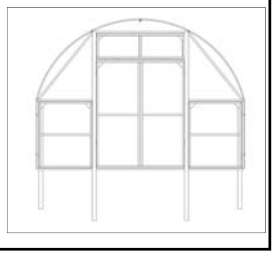
2017 Total Season Yield (lbs/ft)

	Caroline	Josephine
Tunnel	2.21	1.41
Field	2.05	1.04

Early Fall Bearers

- Low-cost tunnels
  - 45’ $ 960
  - 90’ $1,500
  - 140’ $1,800





High Tunnel Raspberries?

- Improve survival of cold sensitive cultivars? NO
- Push summer bearers earlier? NO
- Push Fall Bearers Later? YES
- Push Fall Bearers Earlier? YES

High Tunnel Variations - Vegetable Production

I will be discussing different ideas on high tunnel construction, Geo Air construction, and experiences in vegetable production

Wayne Jones

Extension Educator

University of Idaho

wjones@uidaho.edu

I have worked in Extension for over 25 years in Utah and Idaho. High tunnels have always been intriguing and have given me the chance to grow year around in Zone 4 conditions.

Back to Top

Advanced High Tunnels

Wayne Jones
University of Idaho

University of Idaho Extension

Season Extension Basics

- Cold frame/can be used with other systems
- Low tunnel/can be used with other systems
- High tunnel
- Walipini
- Geo Air

Cold frames

- Inexpensive
- Heat issues both + and –
- Allows many plants to survive
- Little/no growth during colder months

Low tunnels

- Can be used alone or in conjunction
- Each layer adds 1-1.5 USDA growth zones
- Inexpensive
- Wind issues when used alone
- Insect + and -

Walipini

- Can be very effective
- Functional in Bolivia
- Heating/cooling less of an issue
- Problematic here due to latitude
- Basically a hole in the ground w/clear cover
- Utilizes heat from the ground
- Several in Idaho Falls area

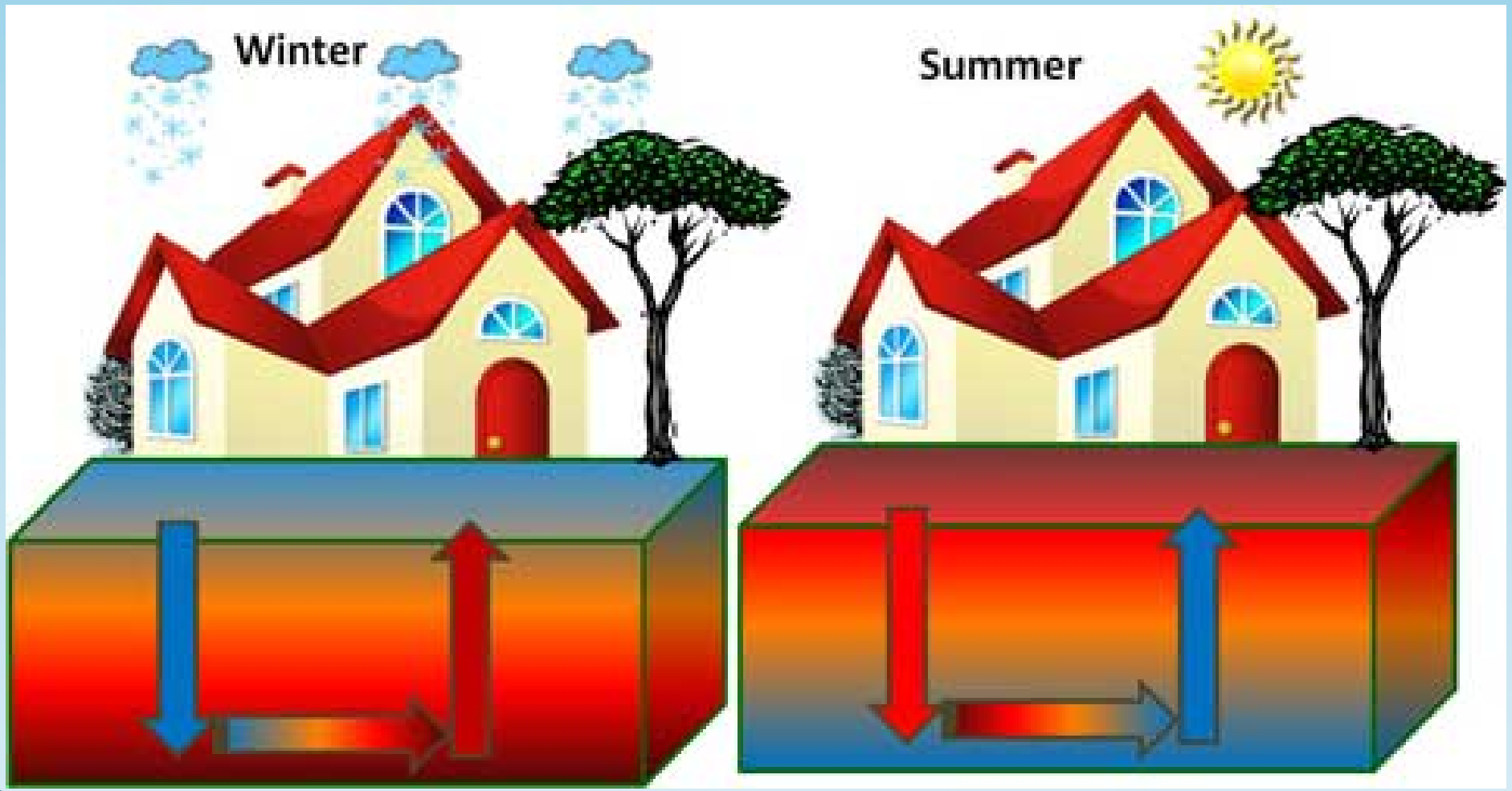
High tunnels

- Can be very effective
- Inexpensive for possibilities
- Can incorporate low tunnels
- Heating/cooling issues
- Diseases/insect issues
- irrigation

Passive thermal storage

- Viable
- Production high tunnels at 8,000 ft (CO)
- Water
- Rocks
- Concrete
- Insulate N. side big help (E-W greenhouse)

Geo Heat



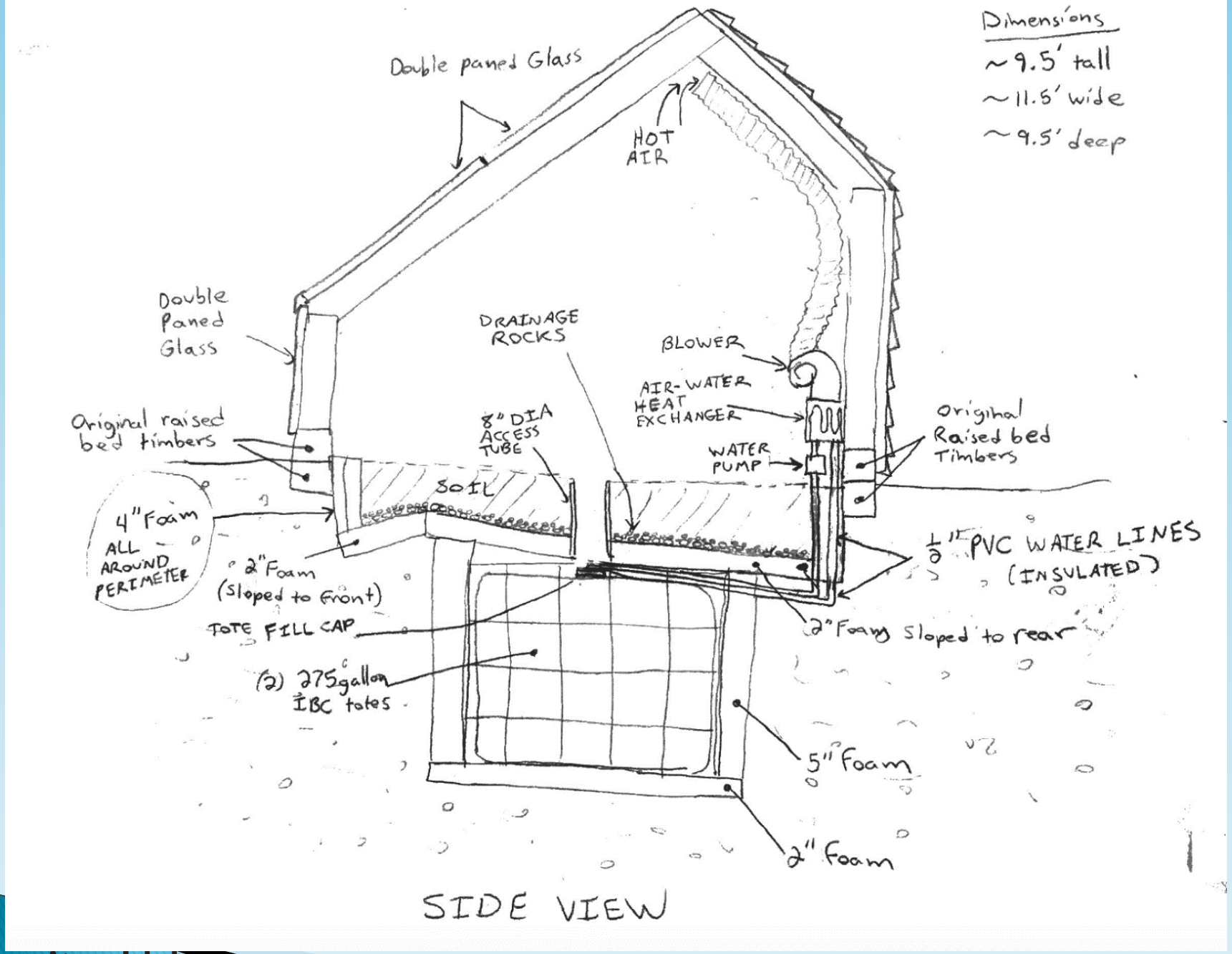
Geo Heat using water

- Water as heat bank/battery
- Water can be above and below ground
- Heat sinks inside greenhouse still of value – barrel heat transfer value of ~1, rock~.20

http://www.builditsolar.com/Projects/Sunspace/GreenhouseHX/HeatPumpEnergyStorage.pdf

University of Idaho Extension

University of Idaho Extension


Dimensions
~9.5' tall
~11.5' wide
~9.5' deep
Double paned Glass
HOT AIR
Double Paned Glass
DRAINAGE ROCKS
BLOWER
AIR-WATER HEAT EXCHANGER
Original raised bed timbers
8" DIA ACCESS TUBE
WATER PUMP
Original Raised bed Timbers
SOIL
4" Foam ALL AROUND PERIMETER
2" Foam (Sloped to Front)
½" PVC WATER LINES (INSULATED)
TOTE FILL CAP
2" Foam Sloped to rear
(2) 275 gallon IBC totes
5" Foam
2" Foam
SIDE VIEW

University of Idaho Extension

Geo Air/Geothermal

- Can heat greenhouses effectively
- Useful for year around growing
- Several different iterations
- Search Low grade heating and cooling (LGG)
- Geo air greenhouse/Geo thermal greenhouse
- Vertical ‘wells’ useful/combine with low tunnels
- Using heat of earth
- Sewer pipe w/air flow

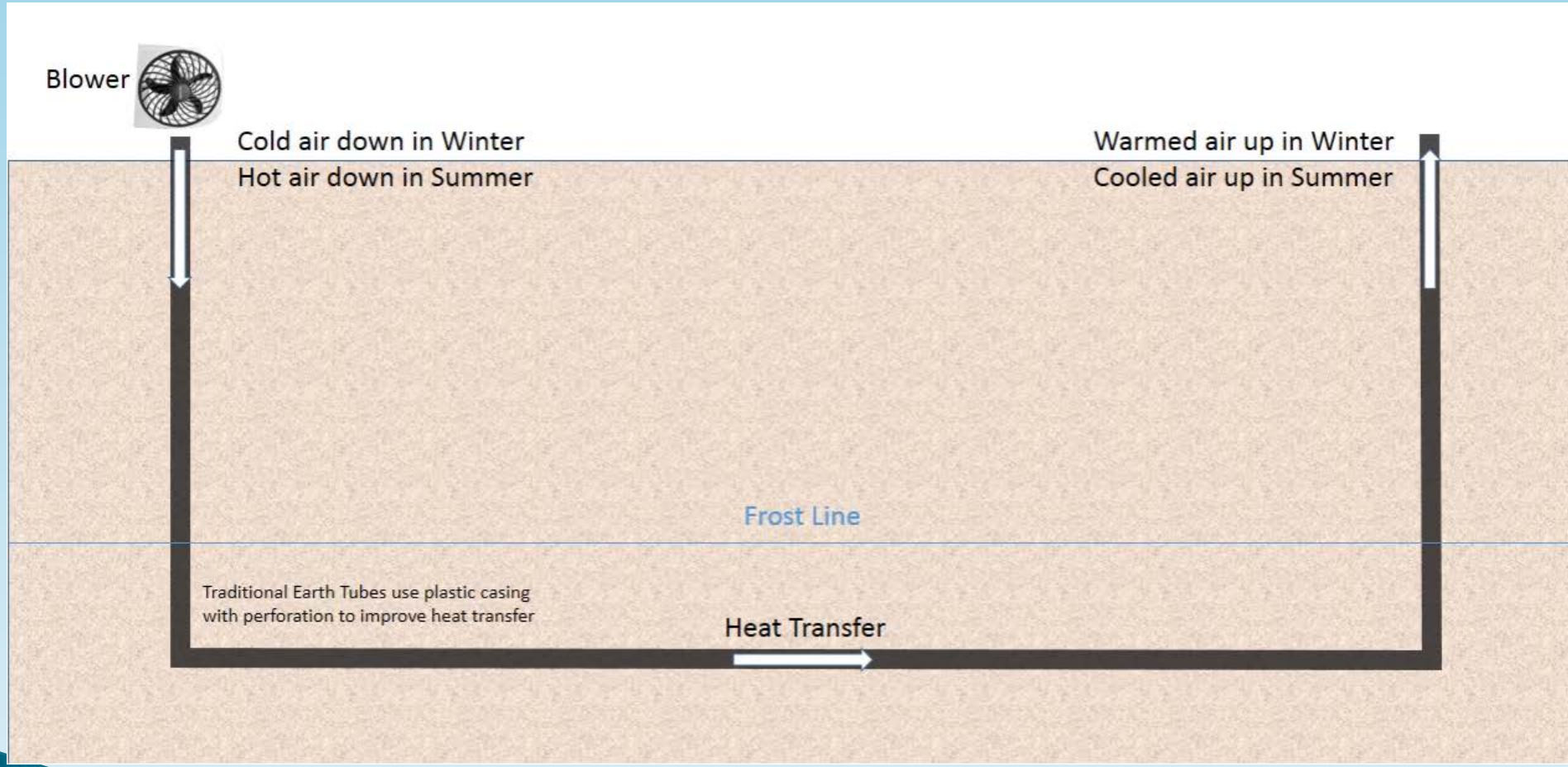
Geo Heat Pros and Cons

- Depth –below frost line
- Condensation on rock from greenhouse- helps transfer heat to rock
- Soil has constant temperature
- Geothermal wells with pex tubing
- Sewer tubing mold(?) fill with water
- Put gravel around air pipes to prevent crushing

Geo Heat Pros and Cons cont.

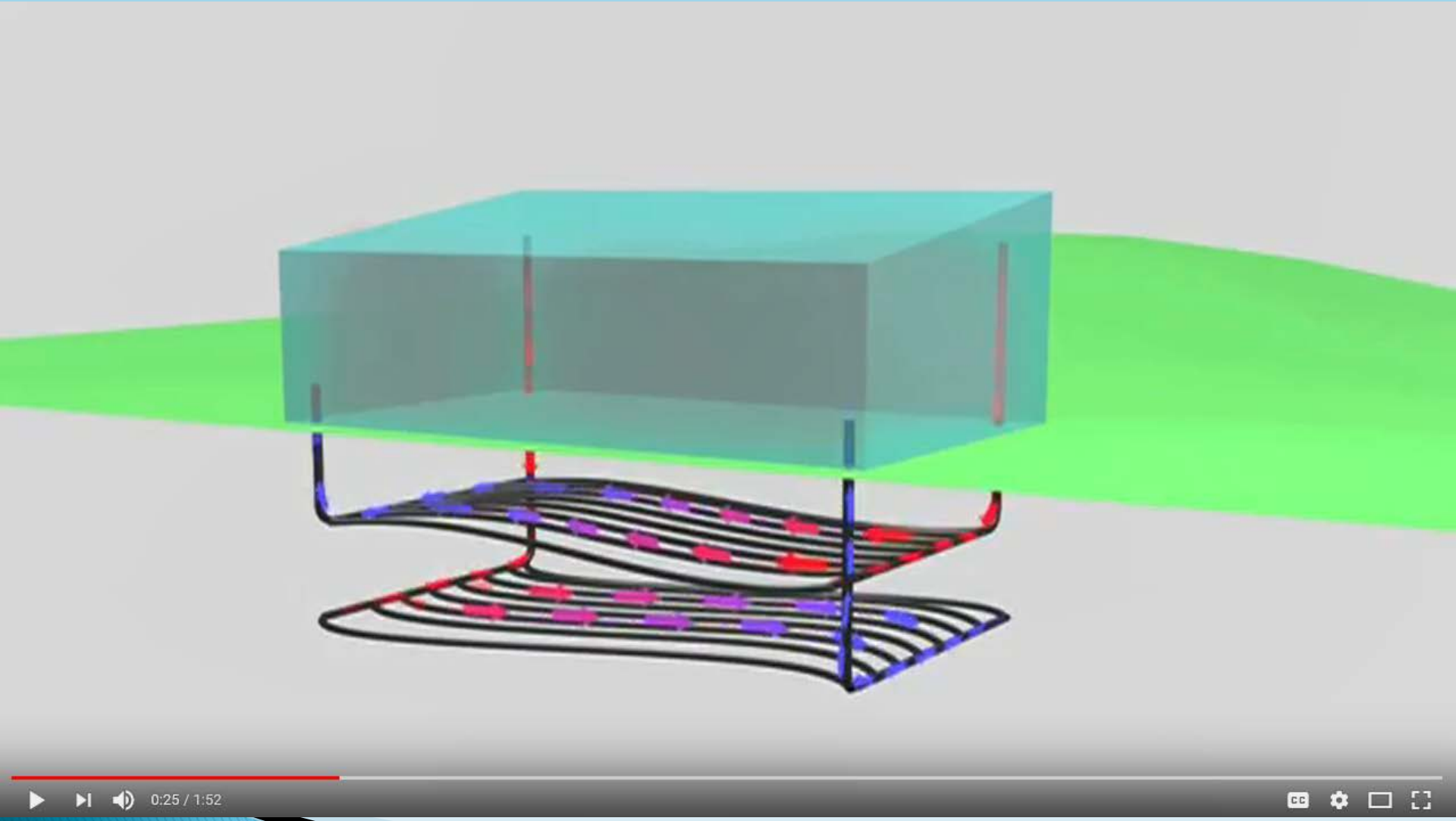
- Radon gas concerns
- Place radon gas barrier between soil and pipe/graves
- Sump pump for extra moisture in pipes/slant pipes downward

Vertical Geothermal Earth Tube Greenhouse Heating/Cooling



https://youtu.be/e8AosXQ3OaA


FEED



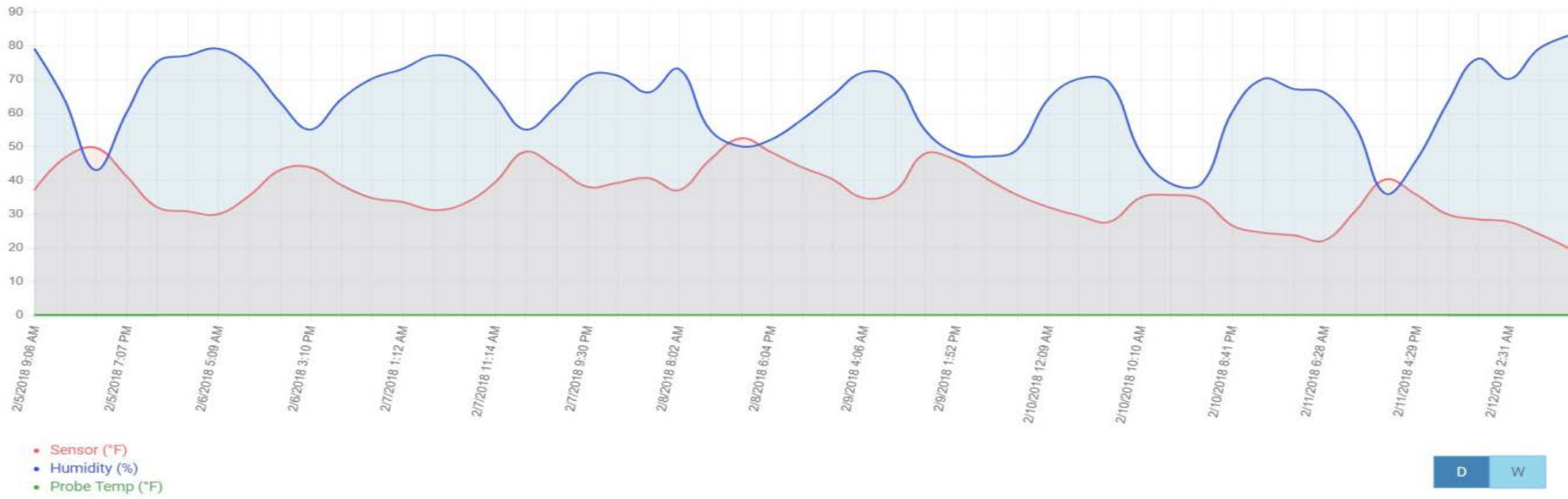
University of Idaho Extension

https://youtu.be/o2NtBCS2_WQ

Devices

Gillmore Outside

Last Week



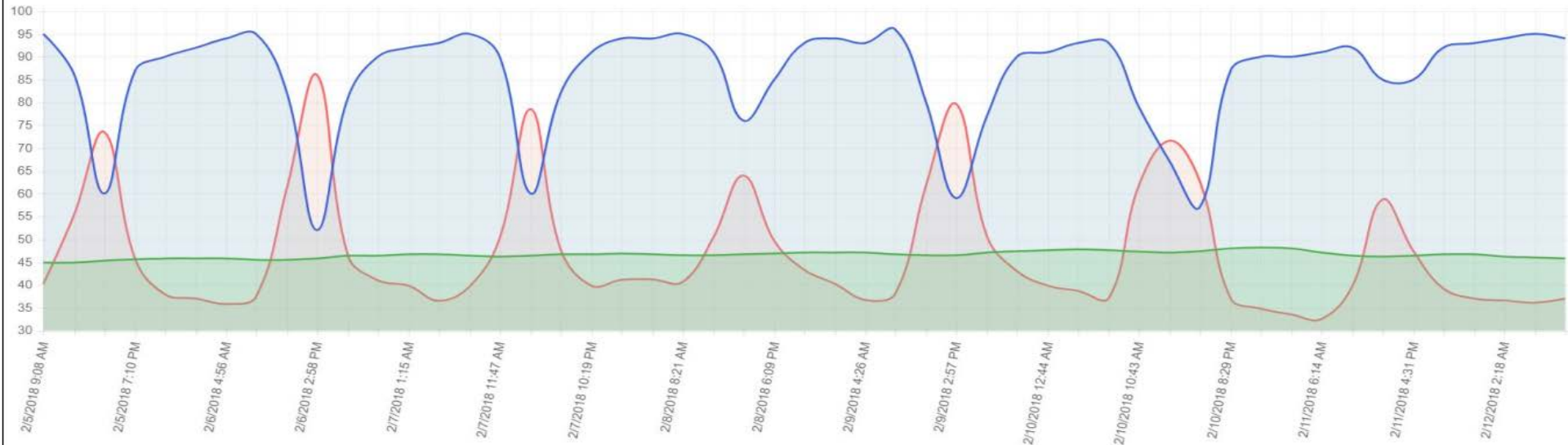
- Sensor (°F)
- Humidity (%)
- Probe Temp (°F)

D W

Devices

Gillmore South Geo

Last Week



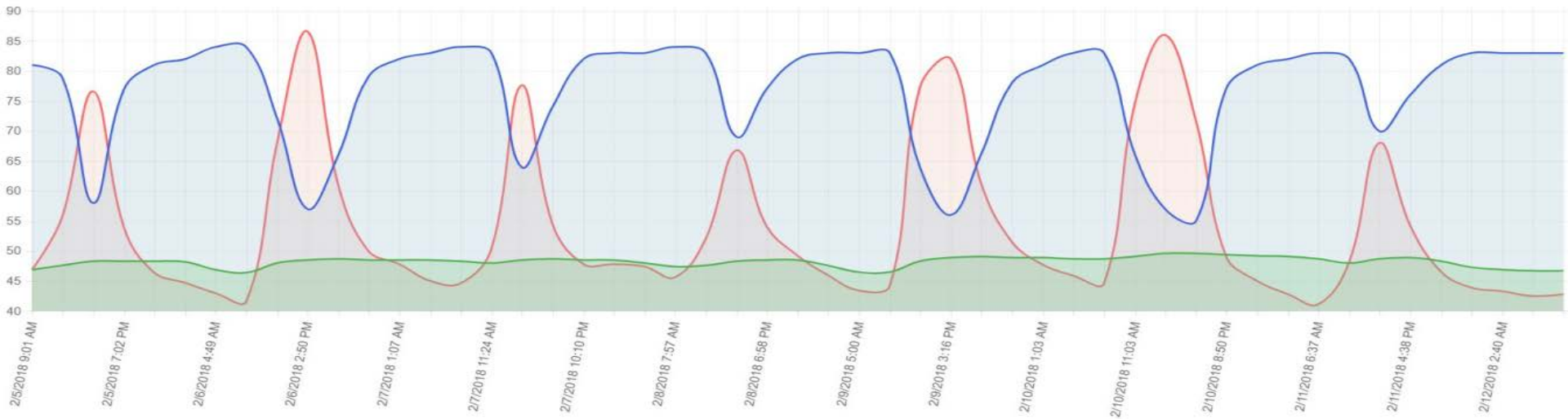
- Sensor (°F)
- Humidity (%)

D W

Devices

Gillmore North Geo

Last Week



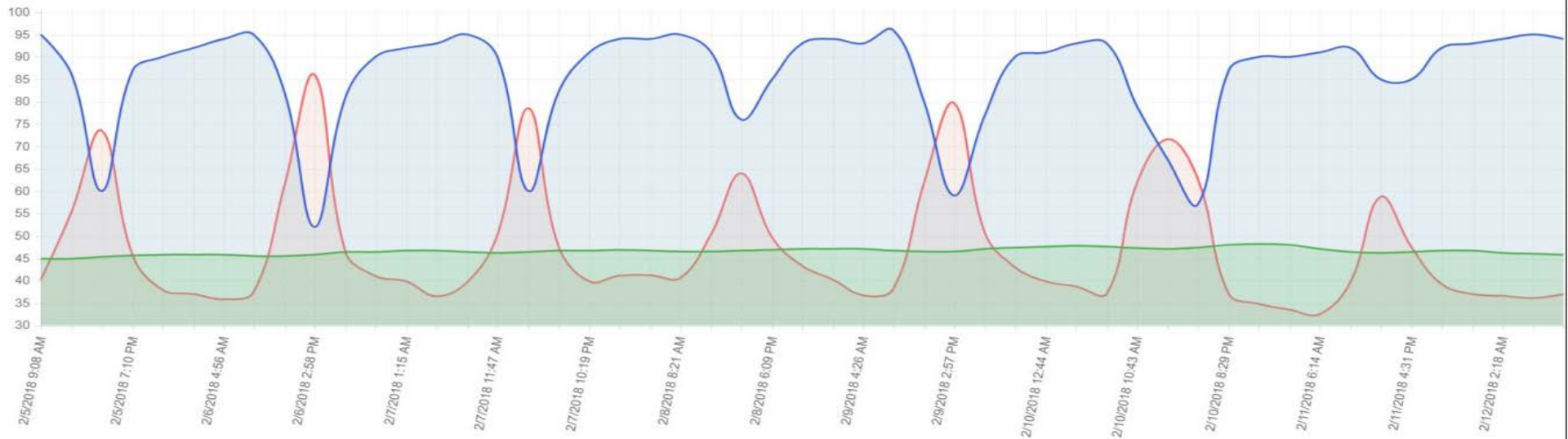
- Sensor (°F)
- Humidity (%)
- Probe Temp (°F)

D W

Devices

Gillmore South Geo

Last Week



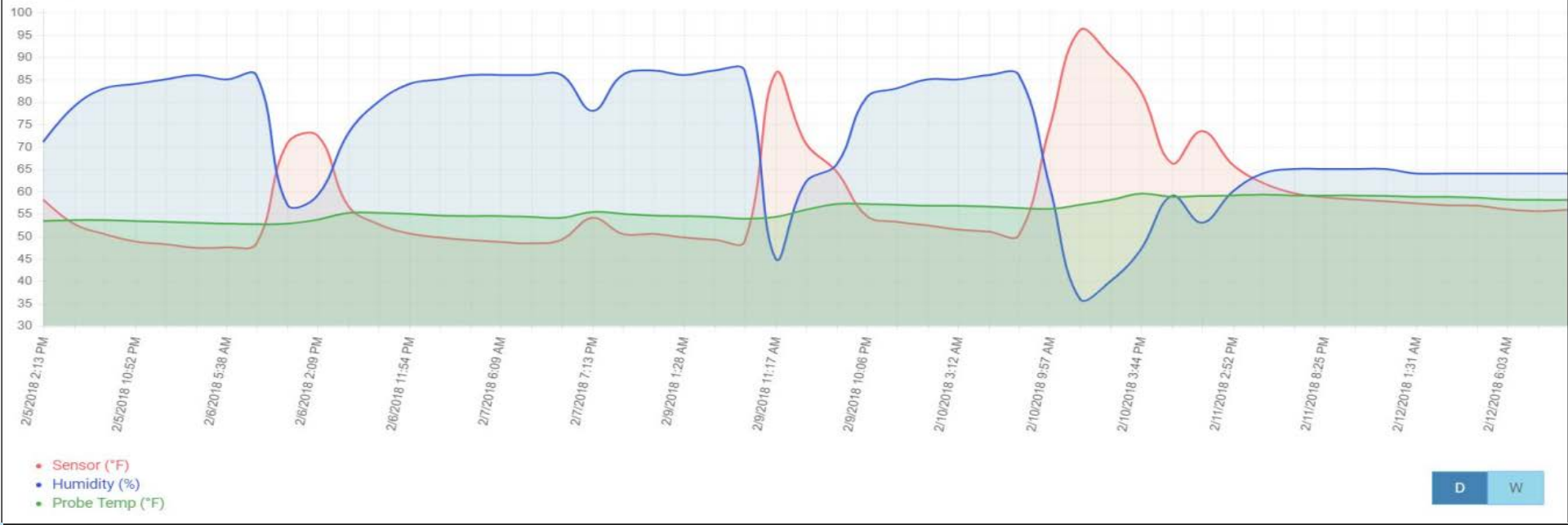
- Sensor (°F)
- Humidity (%)
- Probe Temp (°F)

D W

Devices

Smith GH/Heat Sink

Last Week



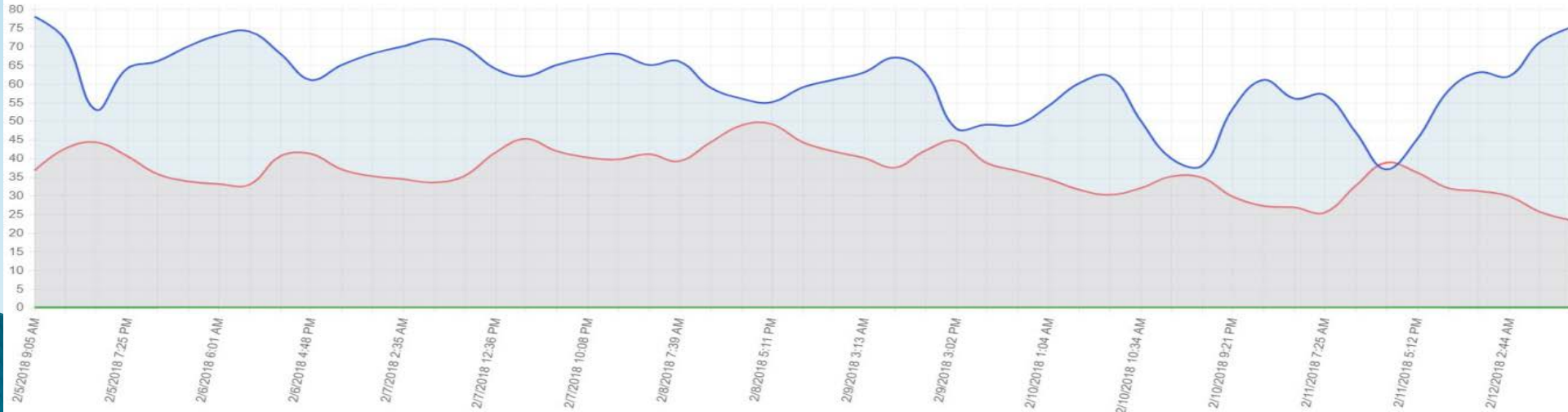
- Sensor (°F)
- Humidity (%)
- Probe Temp (°F)

D W

Devices

Smith Outside

Last Week



- Sensor (°F)
- Humidity (%)
- Probe Temp (°F)

D W

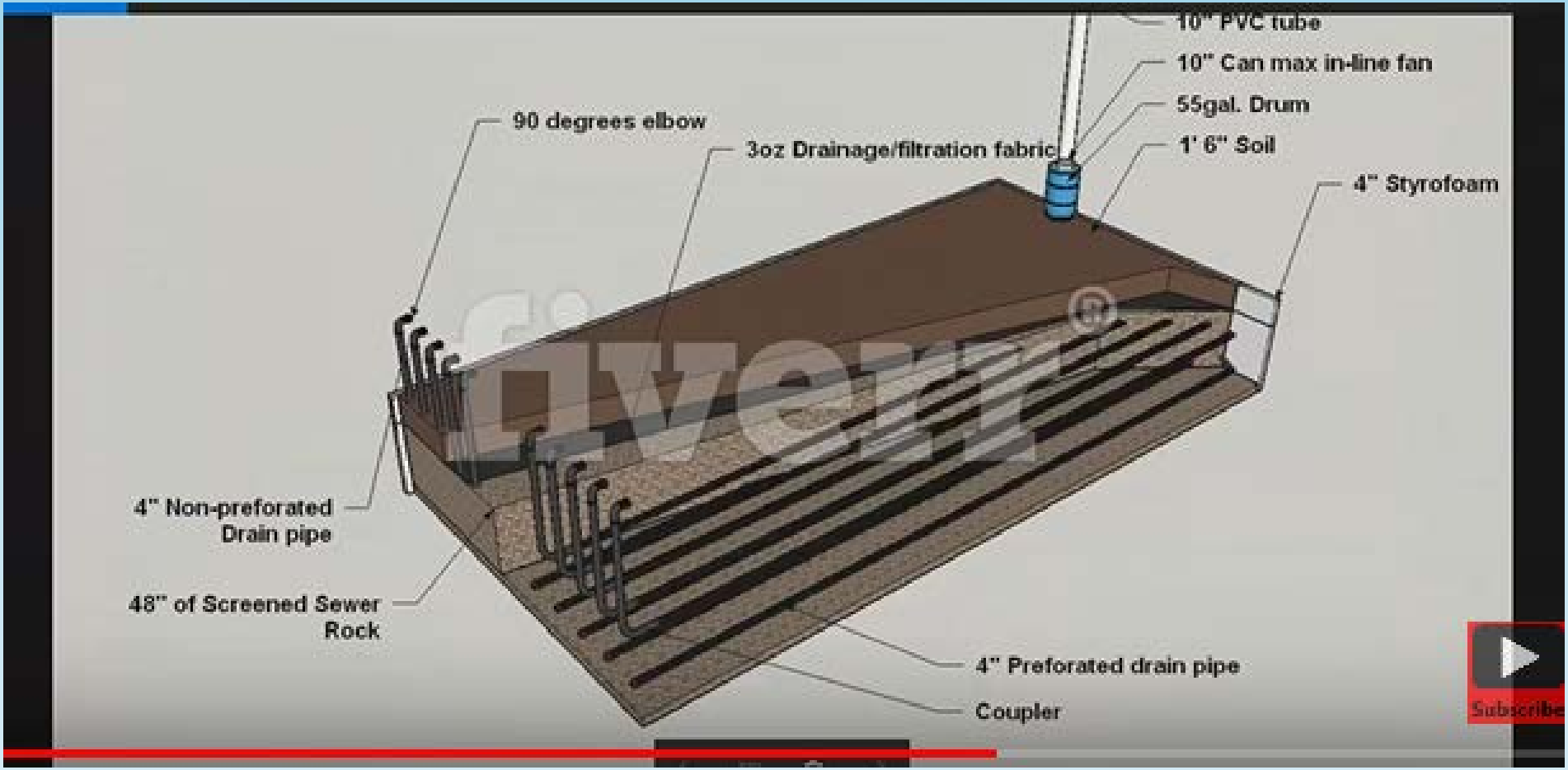
University of Idaho Extension


EKLY FEED

LDSPrepper geothermal rock heat sink

https://youtu.be/H1GrTZx2Vq4

University of Idaho Extension



University of Idaho Extension

University of Idaho Extension

University of Idaho Extension

University of Idaho Extension

University of Idaho Extension

University of Idaho Extension

University of Idaho Extension

University of Idaho Extension

University of Idaho Extension

Geo Heat Sink basic construction

- Dig 5.5 deep (6?)
- Add 6 in of rock for drainage and buffer
- First layer of pipe 5’ deep
- Add three feet gravel
- Lay other pipe (now 2’ feet below ground)
- Cover with soil
- 18 inches in which to grow

THE END

LDSPrepper discusses geo air greenhouse and mistakes made.
https://www.youtube.com/watch?v=zyiDXU60EqY&list=PL2cLVMJiux-nD4s7Ofby9ah835Xi9hnq8&index=2

https://blog.brightagrotech.com/low-grade-geothermal-heating-cooling-greenhouses/

General information on geo greenhouses
https://youtu.be/g6sqfQ-eda8?t=488

LDSPrepper contact information: (208) 360-5384
https://www.youtube.com/playlist?list=UUaPIUqAGuYXXMvI4iYxCT1g

High Tunnel Wind Design and Medicinal Crops

High winds are brutal for high tunnels. Many gardeners have had sleepless nights battening down the hatches. In our high mountain deserts periodic wind storms can take out freeway billboards and even a heavy structured greenhouse. Research was done at the University of Idaho from 2013-2016 to develop and test wind resistant high tunnels. Senior students in the UI engineering department worked closely with Extension educators to develop a solution for farmers in high wind areas. We will discuss this project as well as the successful medicinal plant crop system grown in the tunnels.

Tony McCammon

President

Bloom Horticulture Specialists

tony@bloomhorticulture.com

Tony has worked in horticultural for over 25 years. He received a MS in ornamental horticulture from the Utah State University. Tony has specialized expertise in woody plants, turfgrass, native plants, garden design, floraculture, aquaponics, and pest management. As a retired university professor Tony is an experienced lecturer, instructor and horticultural consultant. He has spoken to many groups nationwide and has appeared on several garden shows. Currently Tony is teaching horticulture classes and certification programs through his business Bloom Horticulture Specialists. He has been a professional consultant for start-up horticulture business and been highly sought after for his feng shui designing techniques using native, firewise, and edible plants.

Back to Top

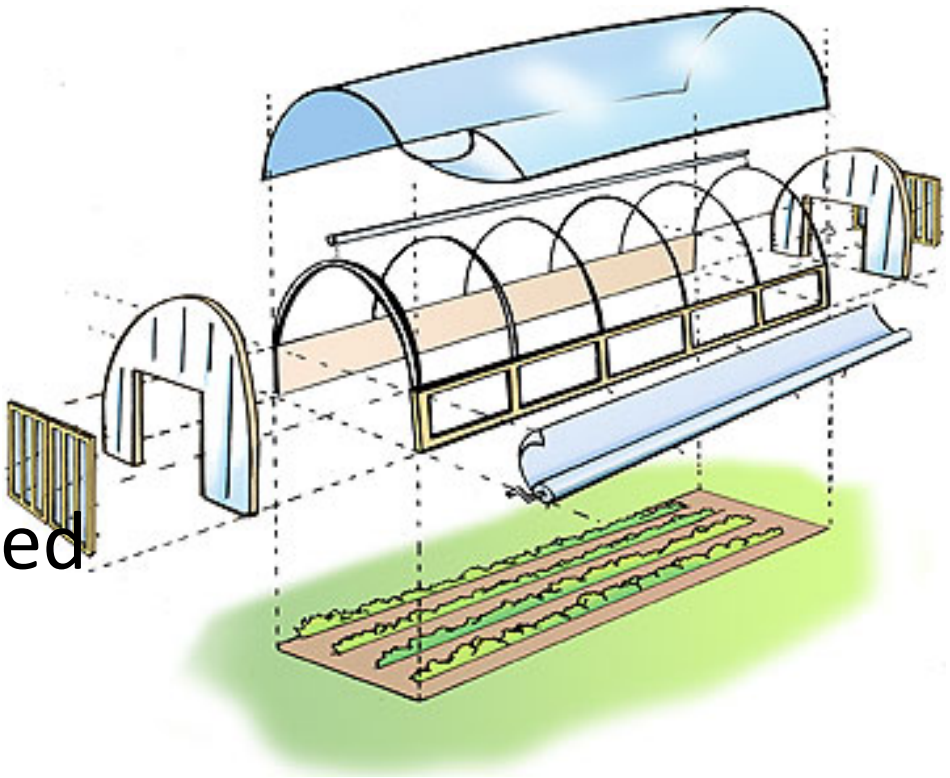
Idaho's High Tunnel

This project was developed at the specific request of small food producers in south Idaho. Beginning in 2010, a coalition of research and extension faculty and Idaho food producers initiated a collaboration to augment local food production. The ultimate goal is to achieve a level of 20% locally produced foods in Idaho by the year 2020.

Producers and buyers communicated that season extension is paramount to enhancing local food production. This project will increase the capacity for local food production by providing research into more effective and site-appropriate high tunnel season extension technologies.

Idaho has a unique range of climate conditions under which high tunnel technology must be evaluated (generally colder, shorter growing seasons, different annual percent sunshine, and/or higher average wind speeds than research previously evaluated).

Unique features of this research include an objective to augment knowledge on superior design specifications for high tunnels built and used in harsh climates.



POLY-TEX
Greenhouse & Display Systems

REVISED

Poly-Tex, Inc.
27725 Danville Avenue
Castle Rock, MN 55010
800-852-3443
Phone: 651-463-7009
Fax: 651-463-2479

24' Field-Pro Gable High Tunnel

Date: 5/1/2014
Quotation valid until: 5/31/2014
Prepared by: Liz Crombie

Quote: 1547-LC

Bill to: Tony McCannon
630 Addison Avenue West Suite 1600
Twinfalls, ID 83301

Ship to: Tony McCannon
630 Addison Avenue West Suite 1600
Twinfalls, ID 83301

Phone: 208-734-9590
Phone:

Fax:
Fax:

Email: tonym@uidaho.edu
Email:

Structure:	**24' FieldPro Gable High Tunnel**
Width (ft):	24
Length (ft):	40
Total Sq/Ft:	960
Frame Spacing (ft):	4
Side Wall Height (ft):	4
# of Purlins:	3
Anchoring Type:	Ground Stands

The Field-Pro™ High Tunnel is designed with the small fruit and specialty crop grower in mind. The frame goes up quickly and easily so you can get an earlier jump on the growing season. Durable roof poly and roll-up sides will provide an environment that will extend your growing season, protect your crop, and increase your yield and profits.

The Field-Pro™ High Tunnel will include the following equipment.

FIELDPRO GABLE HIGH TUNNEL FRAME **$2,151.92**
The structure will have 4ft high straight side walls and will be constructed from 14 gauge x 1.66" diameter galvanized tube. 24'0" wide frame sections include 3'0" ground stands, diagonal end bracing, and miscellaneous fittings and hardware for construction. Frames will be placed 4'0" on center.

SIDE WALL HARDWARE PACKAGE **$129.02**
Includes "U" clamps, "L" brackets, and screws attaching hardware to mount lumber supplied by customer.

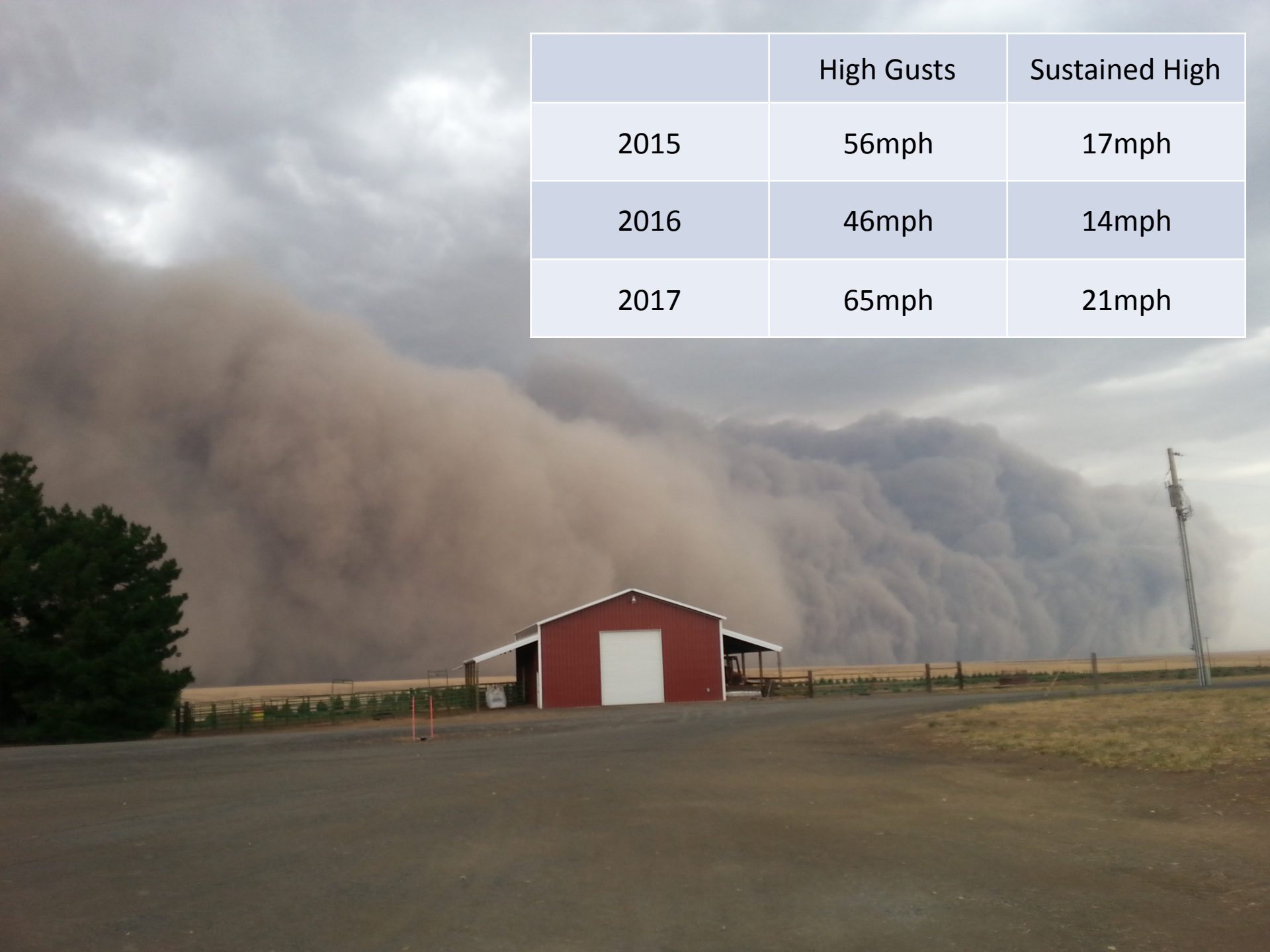
END FRAME HARDWARE PACKAGE **$82.30**
Includes "L" brackets, spike mount, and spike attaching hardware to mount lumber supplied by customer.

SIDE ROLL UP PACKAGE **$559.94**
Includes gearbox, 17gauge shaft running the length of the greenhouse, 60" 6mil clear poly roll-up curtain, and attaching hardware.


MID WEST

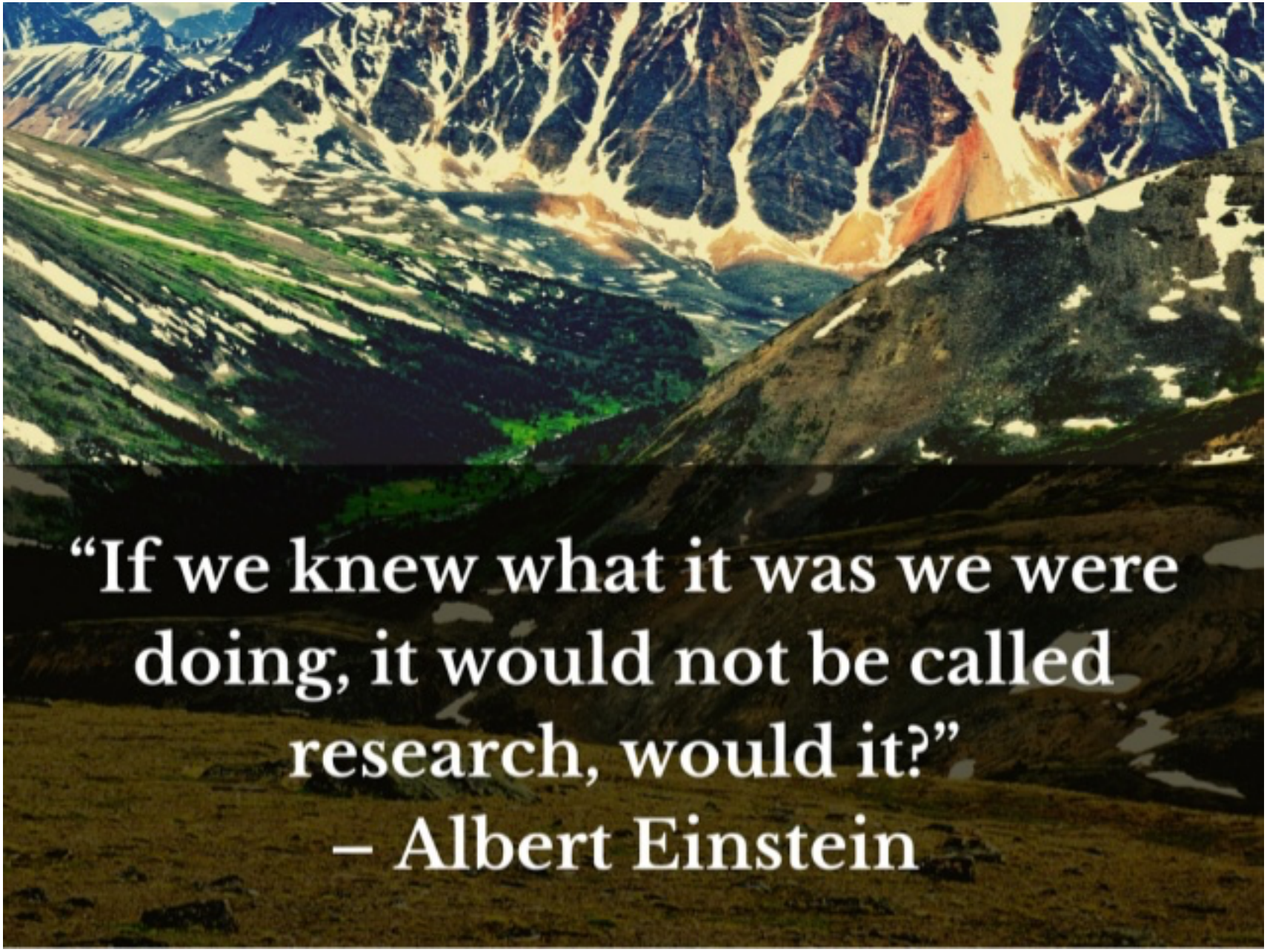

PLC 104

Magnetic locations on Windward side frame
Measures Gravitation Force on a 3 way axis
Farm cooperator placed instruments in locations during wind events



	High Gusts	Sustained High
2015	56mph	17mph
2016	46mph	14mph
2017	65mph	21mph


10
9
8
7
6
5
4
3
2
1
0
10/8/15
11/8/15
12/8/15
1/8/16
2/8/16
3/8/16
4/8/16
5/8/16
6/8/16
7/8/16
8/8/16
9/8/16
10/8/16
11/8/16
12/8/16
1/8/17
End Wall
Stndrd


"If we knew what it was we were doing, it would not be called research, would it?"
– Albert Einstein

BLOOM

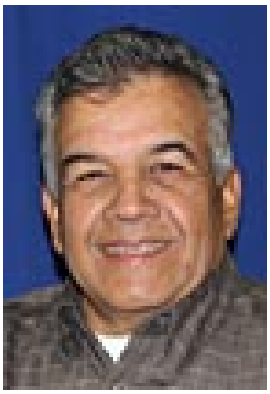
HORTICULTURE SPECIALISTS

BLOOMHORTICULTURE.COM

Tony McCammon
Horticulture Specialist
208-539-9276

Nobe Teepu Dooha – House Under the Earth

Randy will show the construction of an experience with Nobe Teepu Dooha (House Under the Earth). This is an underground tunnel. He will also share his experience growing various types of crops in tunnels.



Randy Emm

Coordinator Native Programs

University of Nevada Cooperative Extension

emmr@unce.unr.edu

I am the project coordinator for three Federally Recognized Tribal Extension Programs (FRTEP) in Nevada. The three projects are located on the Duck Valley Shoshone-Paiute Reservation (Northeastern Nevada and Southern Idaho), Pyramid Lake Paiute Reservation (Western Nevada), and the Walker River Paiute Reservation (Western Nevada).
The major goals of this project consist of:

• Increasing the production and consumption of fresh fruits and vegetables on the target reservations

• Decreasing the incidence of obesity on these reservations through the increased consumption of fresh fruits and vegetables and traditional cultural foods through classroom instruction and inter-generational activities

• Improving the ability of Native American farmers and ranchers to effectively, efficiently and profitably manage their agricultural enterprises consistent with the conservation of reservation historic and cultural resources.

• Informing the Native American farmers and ranchers of available USDA programming to further the sustainability of agricultural operations located on the various Indian Reservations located in Nevada.

Back to Top

University of Nevada Cooperative Extension

NATIVE PROGRAMS

NEWE • NUMA • NUWUVI • WASHESHU

WESTERN SHOSHONE • NORTHERN PAIUTE • SOUTHERN PAIUTE • WASHO

Nobe teepu dooha
(House under the earth)

Presented By
Randy Emm, FRTEP

Active Participants

- Randy Emm, Coordinator Native Programs
- Victor Williams, Community Based Instructor
- Jennifer Kintz, Mineral County Extension
- A.J. Kintz, Jennifer’s Husband

Goals

- Expand our existing hoop house project
- Grow year round
- Reduce the effects of the wind
- Grow in places having a short growing season(Duck Valley and Yomba)
- Develop a modified version (Three feet into the ground)

Equipment Used To Date

- Backhoe and /or Loader
- Shovels
- Battery operated drills and saw
- Tape Measure
- Level
- Cutting Torch and grinder
- Hammer nails, screws

Materials Used

- 4 x 8 Railroad Crossing timbers
- 3’ x 14’ Metal Sheeting (Rigid and thicker than used for roofing etc.)
- Lumber 2x12’s, 2x4’s, and 2x6’s (Roof Frame)
- Six 20 ft sections of ¾” pipe
- Plastic covering for roof allowing sunlight (8 mil woven plastic)

Dimensions

- Twelve feet wide
- Fourteen feet long
- 168 square feet

Site Selection

- No obstructions from the southerly exposure
- Close to a water supply
- Do not select an area with a high water table
- Do not select an area with underground gas and water lines or septic tanks and leaching areas without first knowing where they are

Topsoil

- All soils used for growing purposes must be brought in
- Excavating has removed the existing topsoil of this area


3
CASE INTERNATIONAL
8840


CASE INTERNATIONAL


SPINACH

Contact Information

Victor Williams

Email williamsv@unce.unr.edu

Phone Home (775) 773-2360

Cell (775) 232-2342

Randy Emm

Email emmr@unce.unr.edu

Phone (775) 316-1184