Optimizing Your High Tunnel Investments and Outcomes

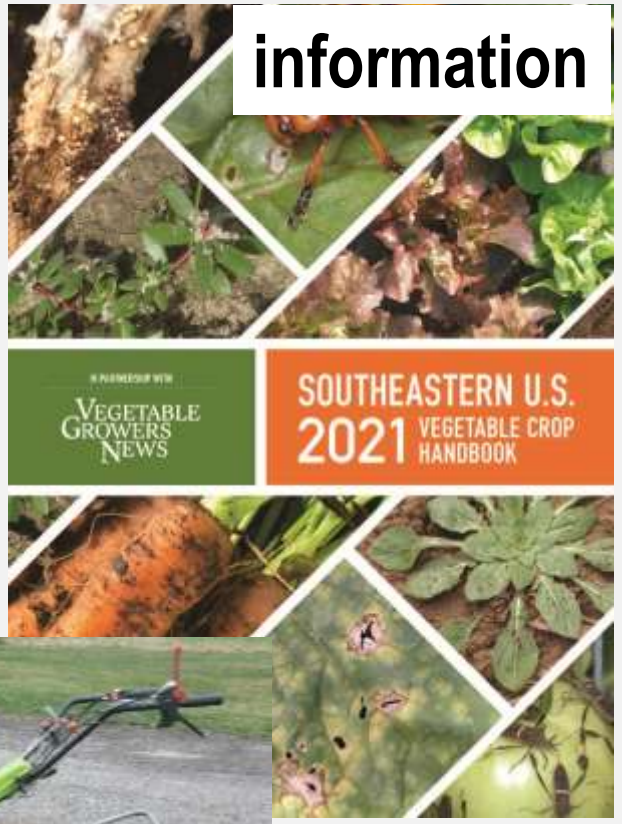
Pick TN Conference
Franklin, TN; Feb 18, 2022

Matt Kleinhenz
Extension Specialist

The Ohio State University
College of Food, Agricultural, and Environmental Sciences

Today's Focus

crops



information

structures

tools, equipment

Today's Focus

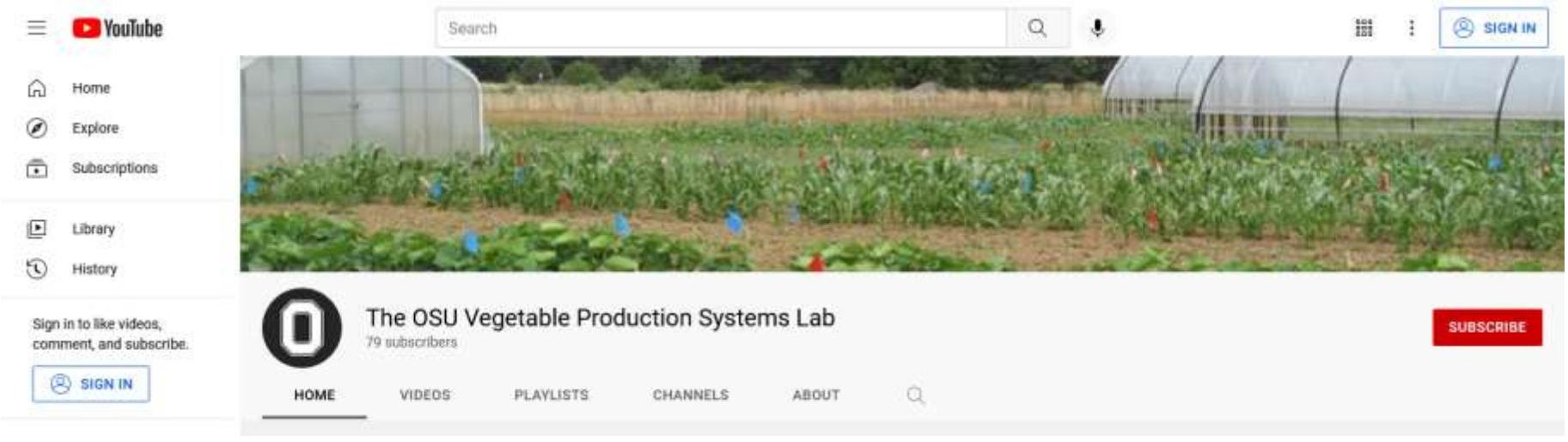
crops - information - tools, equipment - structures

HT Environment

- soil moisture
- temperature

Major Stages

- select, site, install structure
- select crops and varieties
- monitor and manage soil, crop, other conditions
- repair, maintain structure
- adjust practices, as needed



Starting Right in High Tunnel Production ▶ PLAY ALL

5 Reality Checks to Consider Before Starting High Tunnel Production

Starting High Tunnel Production (Reality Check 1)

The OSU Vegetable Production S...
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Starting High Tunnel Production (Reality Check 2)

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Starting High Tunnel Production (Reality Check 3)

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Starting High Tunnel Production (Reality Check 4)

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High Tunnel Site Selection Tips

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https://go.osu.edu/vegeprosystemslab

Why we make the effort, expense is familiar.

In most cases, installing a high tunnel is a long-term commitment, including to a soil upon which you will rely significantly and is your first investment.

Optimizing High Tunnel Investments and Outcomes

Burdens on high tunnel soils can be heavy.

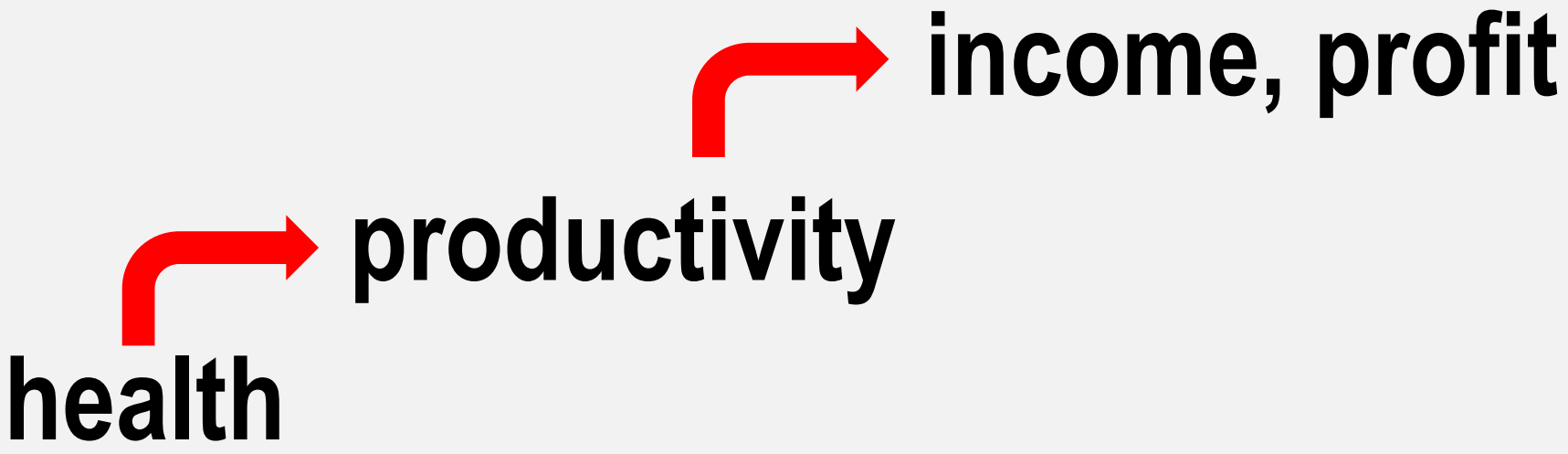
The (HT) Soil Health Risk Cup

(load we expect soils to carry)

- fertilizer, chemical usage (e.g., fertigation)
- small, shallow root systems
- short rotations
- drip irrigation
- little crop residue return to soil
- placing pressure on and aggressively disturbing soil, especially when it is wet
- unique temperature, moisture profiles

A. The health of soils often shows in their productivity.

B. Soil productivity is key to income and profit



HT Soil Health Issues:

huge impact and meaning

↓ structure, organic matter

↑ compaction, salinity, flooding, nutrient imbalances, disease inoculum

Partial Solutions to HT Soil Health Issues:

- soil testing (various aspects)
- anaerobic soil disinfestation (ASD) or solarization
- grafted plants
- rotate and cover crop (may require secondary irrigation system)
- amend
- treat irrigation water
- till deep
- flood
- move
- cover-less fallow
- containerize

Drainage

The best time to ensure drainage is ideal in- and outside the HT is before and when it's being installed. Still, later steps are possible and often required.

image courtesy S. Bogash

flooding in the HT a function of unwanted water entering from outside it then infiltrating slowly due to poor soil condition (internal drainage)

image courtesy S. Bogash

image courtesy S. Bogash

Penn State Univ Research Farm

swales or sub-surface drainage to collect and channel water away from the HT can be very helpful

inexpensive, 13 mil vinyl aprons sized to order have eliminated weeds outside the sidewall and all water entering the HT when the sidewall is down.

alternative soft poly ‘baseboard’ is inexpensive, waterproof, versatile, and easily repaired and replaced.

locally-made stainless steel gutter (2019) has been very effective and durable. Dr. Jett of WVU also very knowledgeable.

U TN Organic Research Unit (2018)

HO-120

University of Kentucky
College of Agriculture, Food and Environment
Cooperative Extension Service

Off the Grid: Ultra-low Pressure Drip Irrigation and Rainwater Catchment

for Small Plots and High Tunnels

Brent Rowell and Krista Jacobsen, Department of Horticulture

Under Pressure

All forms of irrigation need a push or pressure to move water from its source to its destination. Water sources include wells, springs, lakes, creeks, canals, rivers, cisterns, elevated tanks, or municipal water supplies. The amount of pressure or push required depends on many things including the height water must be lifted, length and size of the delivery pipe(s), crop and size of the area to be irrigated, and the distance water needs to be moved from the source to the field, greenhouse, or tunnel.

Pressure to move water and operate an irrigation system is created in several ways including all sorts of pumps. Pumps include diesel- or gasoline-fueled motorized pumps or electric pumps powered by an electricity grid, batteries, or directly from solar photovoltaic (PV) panels. Pumps vary greatly in size, power, pressure and capacity, so growers need to first estimate their crop size and water requirements and work backwards to determine power requirements, pump size and type.

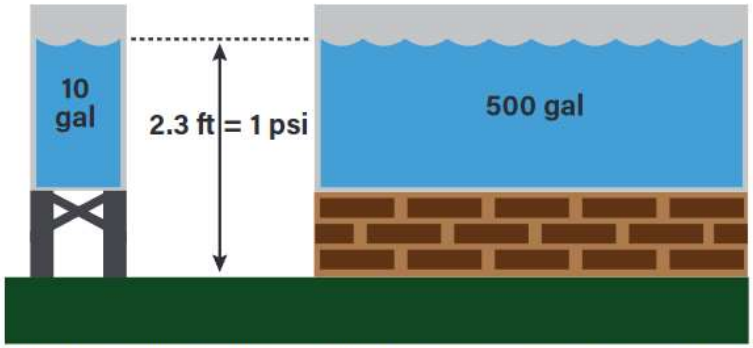


Figure 1. Large and small tanks at the same height will have the same pressure (about 1 psi in this example).

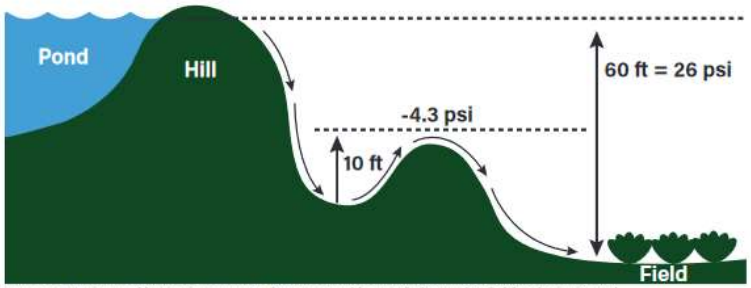


Figure 2. Gains and losses in pressure from a pond located above the field to be irrigated.

http://www2.ca.uky.edu/agcomm/pubs/HO/HO120/HO120.pdf


gravity-fed
irrigation can be
effective in
high tunnels
Kenya (2012)

High Tunnel Structures

- select
- setup
- manage

Choice in High Tunnel Design and Add-on Components continues to Increase

Modifications of Standard High Tunnel Design and Components

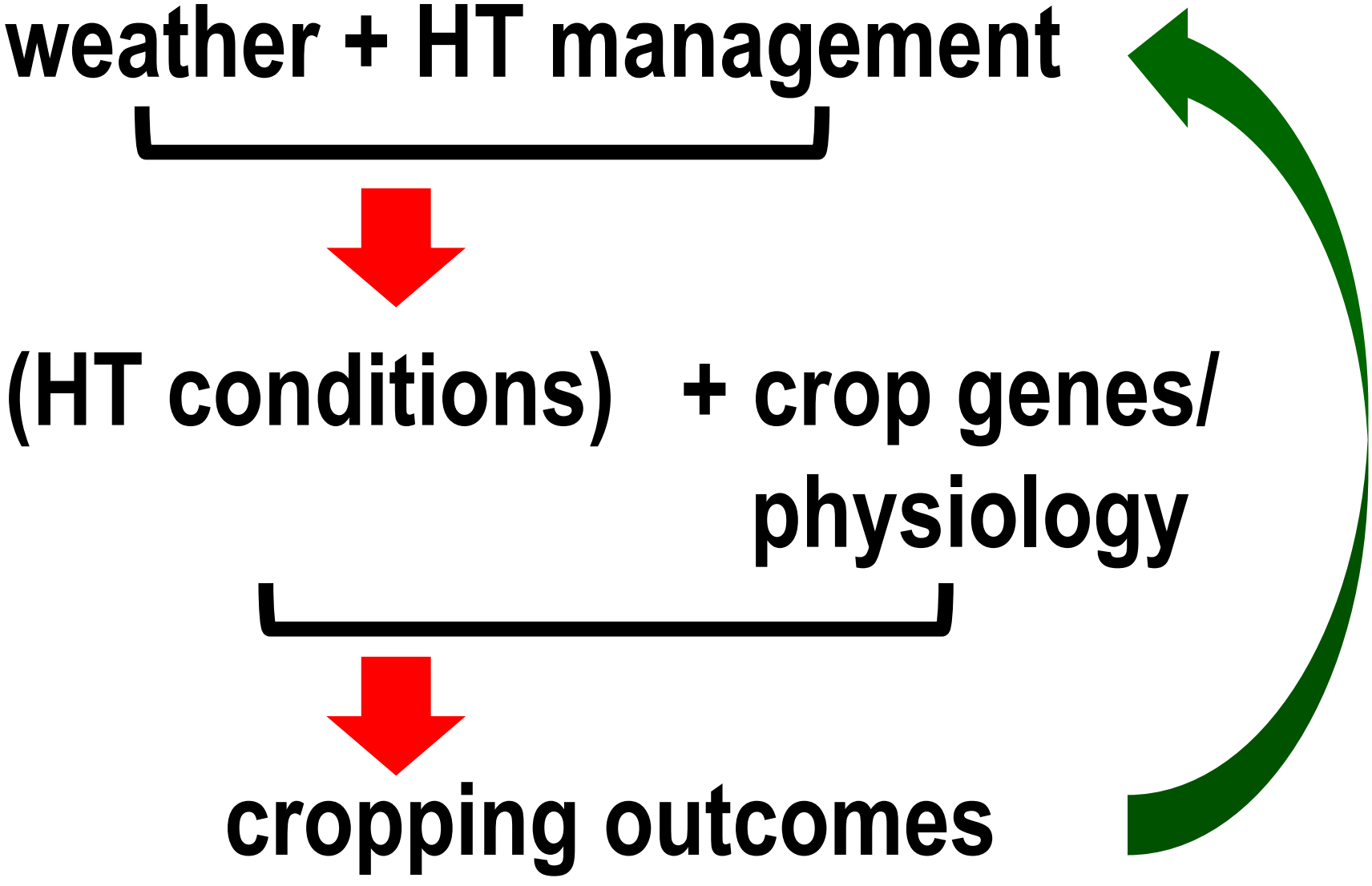
- **greater, and more efficient and strategic environmental control**

… **including semi- or fully-automated environmental monitoring and HT ventilation**

High Tunnel Environments

- temperature
- (relative) humidity
- light
- wind
- soil moisture, other

High tunnels are not climate-controlled greenhouses. Still, paying close attention to environmental control in the HT like is common in greenhouses can be useful to HT growers.

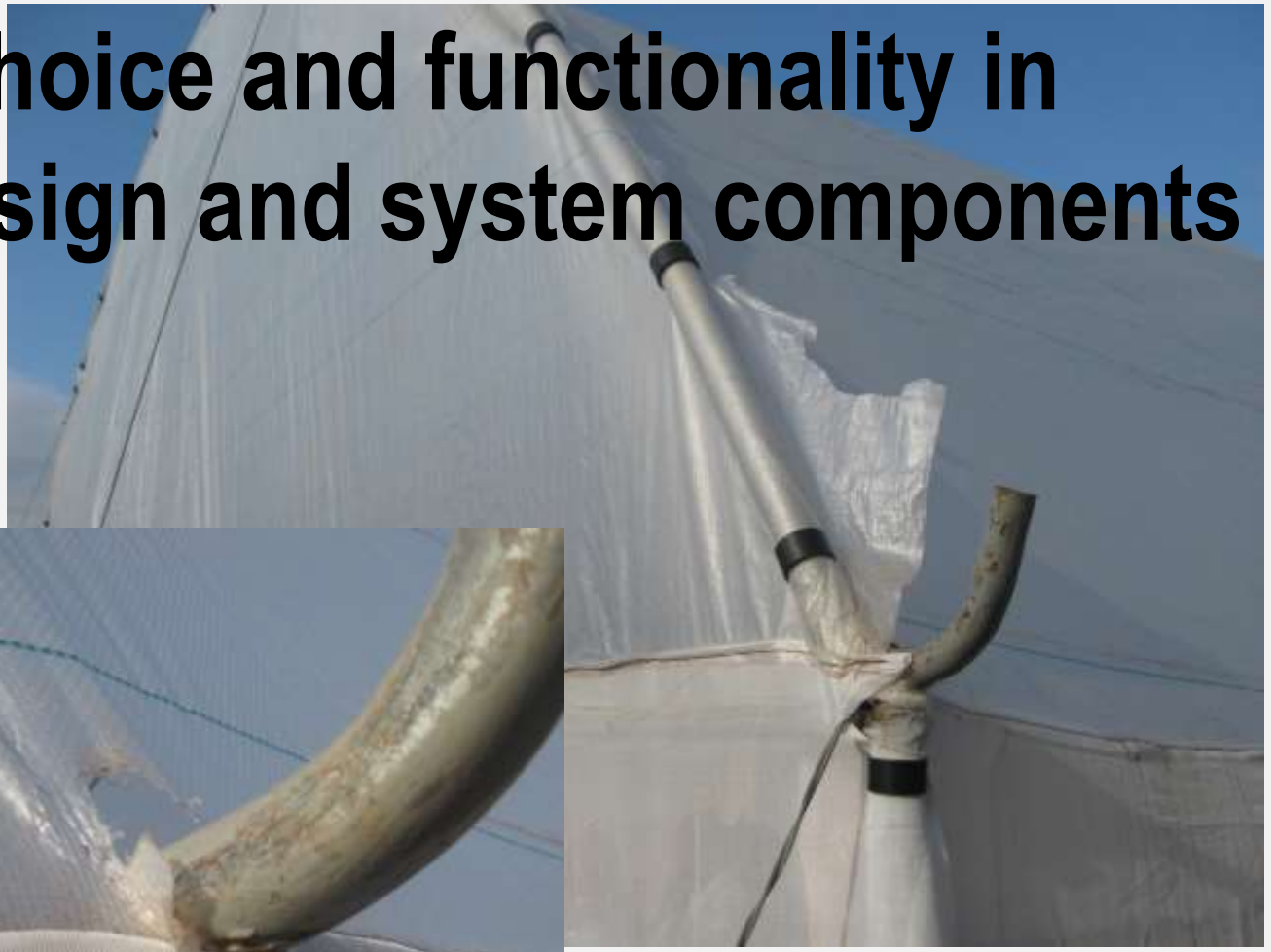

weather + HT management
(HT conditions)
+ crop genes/
physiology
cropping outcomes

Selected Examples of Tools and Practices High Tunnel Growers Can Use to Improve Outcomes from their Initial Investment in High Tunnel Production

High Tunnel Environments

- temperature
- (relative) humidity
- light
- wind
- soil moisture, other

Greater choice and functionality in tunnel design and system components



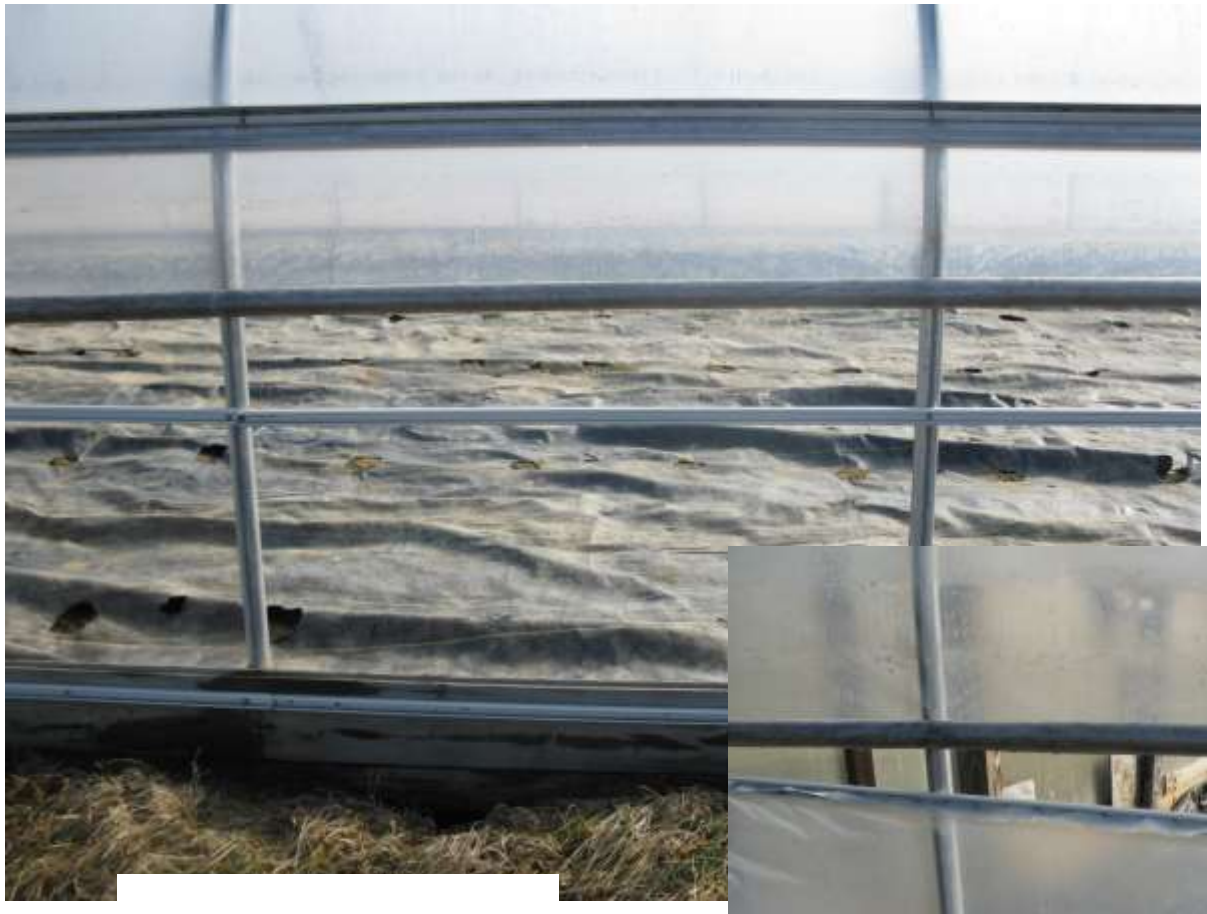
variable covers:
traditional, emerging

Most ventilation accomplished via vents, end wall doors, and sidewalls.

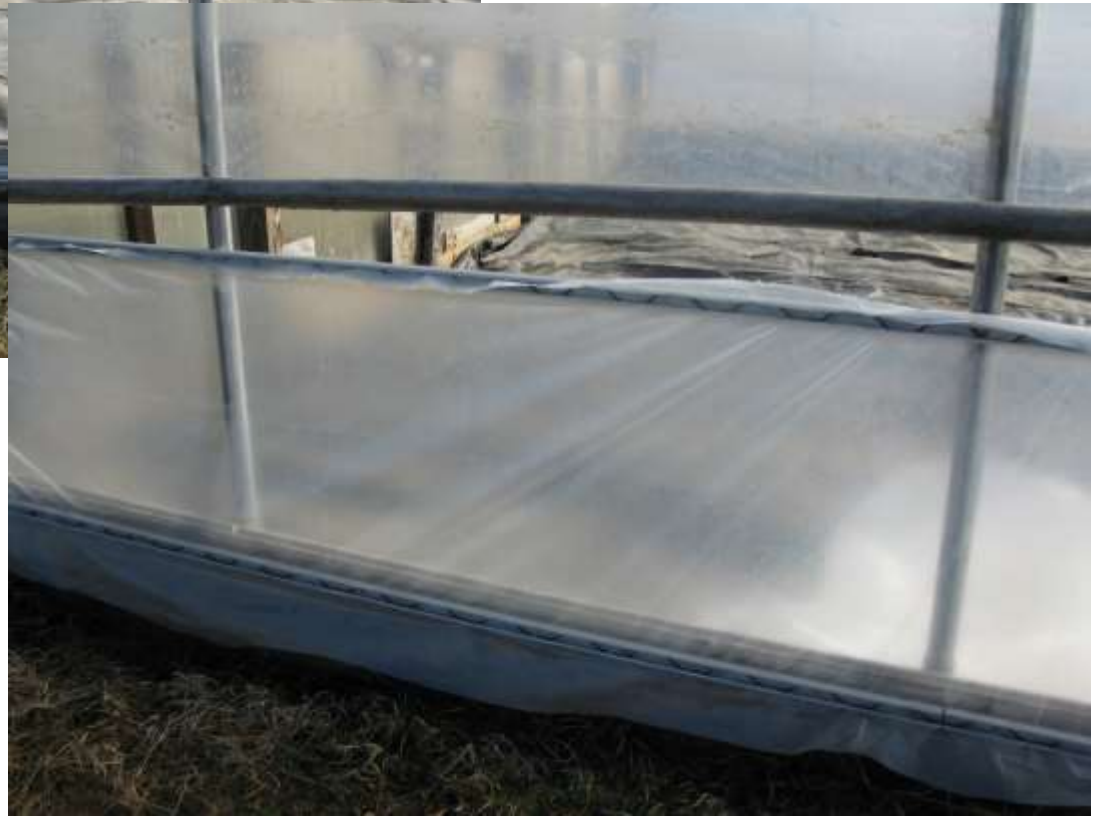
Ventilation capacity, level, timing, duration impacts outcomes significantly.

U TN Organic Research Unit (2018)

“kneewalls” allow ventilation when cold outside but above the soil and young plants



“kneewall” installation



- simple
- fast
- cheap

Access to electricity: not essential, but can be useful.

solar, wind power

- improving
- accessible
- potential asset

solar- or wind-charged battery(ies) can power small fans, motors, pumps, control panels, etc.

images courtesy of UVM Extension Ag Engineering

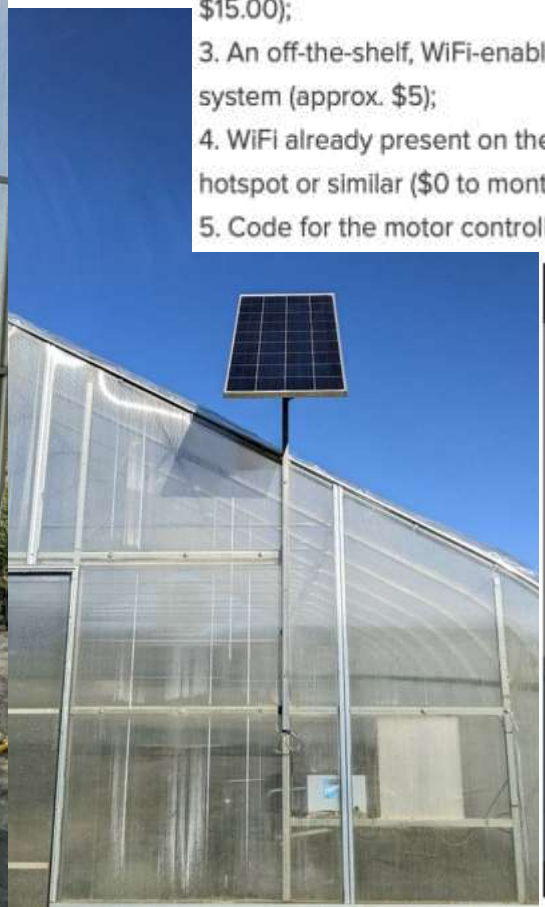
images courtesy of Tunnel Vison Hoops

moveable, double-layer, solar-powered,
30 ft x 48 ft high tunnel
(Rimol Greenhouses, Inc)

19 December 2021

A Simple, Inexpensive, DIY System for Controlling the Height of High Tunnel Sidewall Rollbars Remotely

1. Standard sidewall motors powered by a battery-solar panel combination, as described above;
2. A standard voltage-regulating unit converting 12 volts from the battery to 24 volts needed by the motors (approx. $80.00);
2. A motor controller (available at electronics stores or online for approx. $15.00);
3. An off-the-shelf, WiFi-enabled microcontroller to act as the brains of the system (approx. $5);
4. WiFi already present on the farm property or wireless access with a hotspot or similar ($0 to monthly charge typical of a mobile phone plan); and
5. Code for the motor controller (no charge).



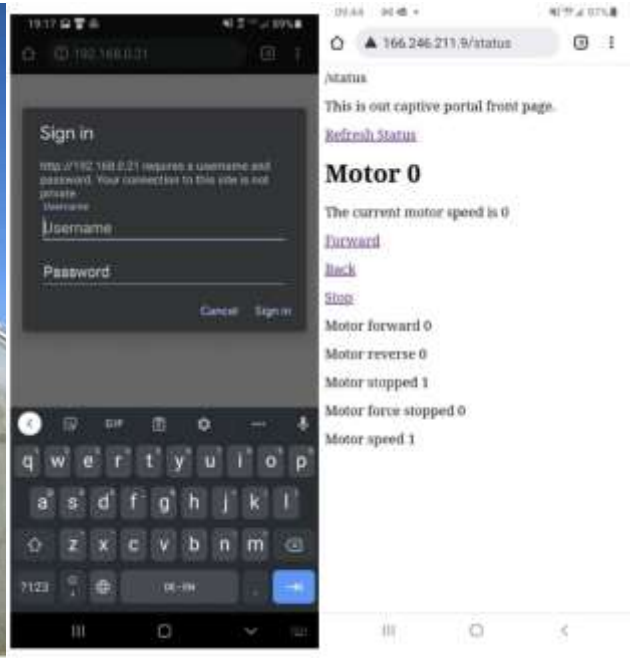


Image courtesy of Vegetable Growers News

Image courtesy of Fogsis

Image courtesy of Val-Co

Image courtesy of Gothic Arch Greenhouses

Image courtesy of Novagric

Image courtesy of AM Leonard

Image courtesy of Tunnel Vision Hoops


Images courtesy of Missouri Extension - Baker


Image courtesy of Missouri Extension - Baker

Image courtesy of USU Extension

White on Black, embossed

Image courtesy of Grower's Solution

Images courtesy of Harris Seeds

Image courtesy of Dubois

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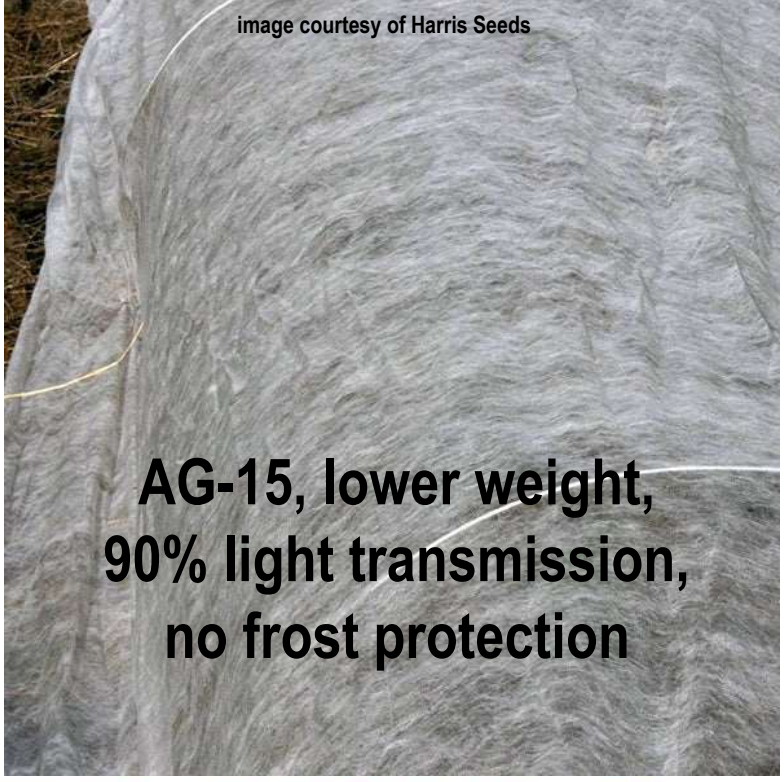
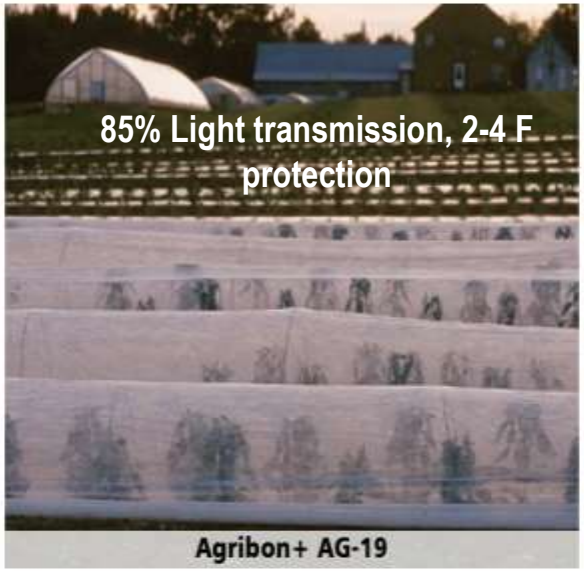
images courtesy of Harris Seeds





images courtesy of Johnny's Seeds

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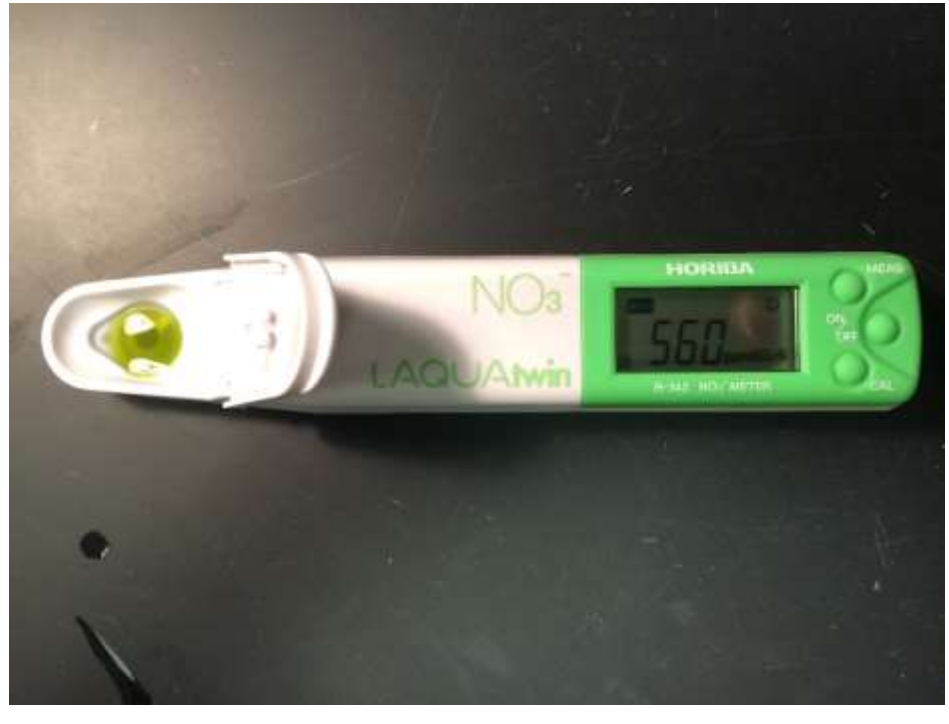

Use of grafted (tomato) plants in HTs, especially ones managed organically, is rising sharply.

rotate and cover crop (may require secondary irrigation system)

overhead sprinkler for situations in which drip is inefficient or ineffective

CFAES

Horticulture and Crop Science Series No. 881
February 2021

Installing an Overhead Irrigation System in a High Tunnel

Mark Spigos, Nicole Wright, Dr. Matthew D. Kleinhenz, Department of Horticulture and Crop Science, Vegetable Production Systems Laboratory, The Ohio State University

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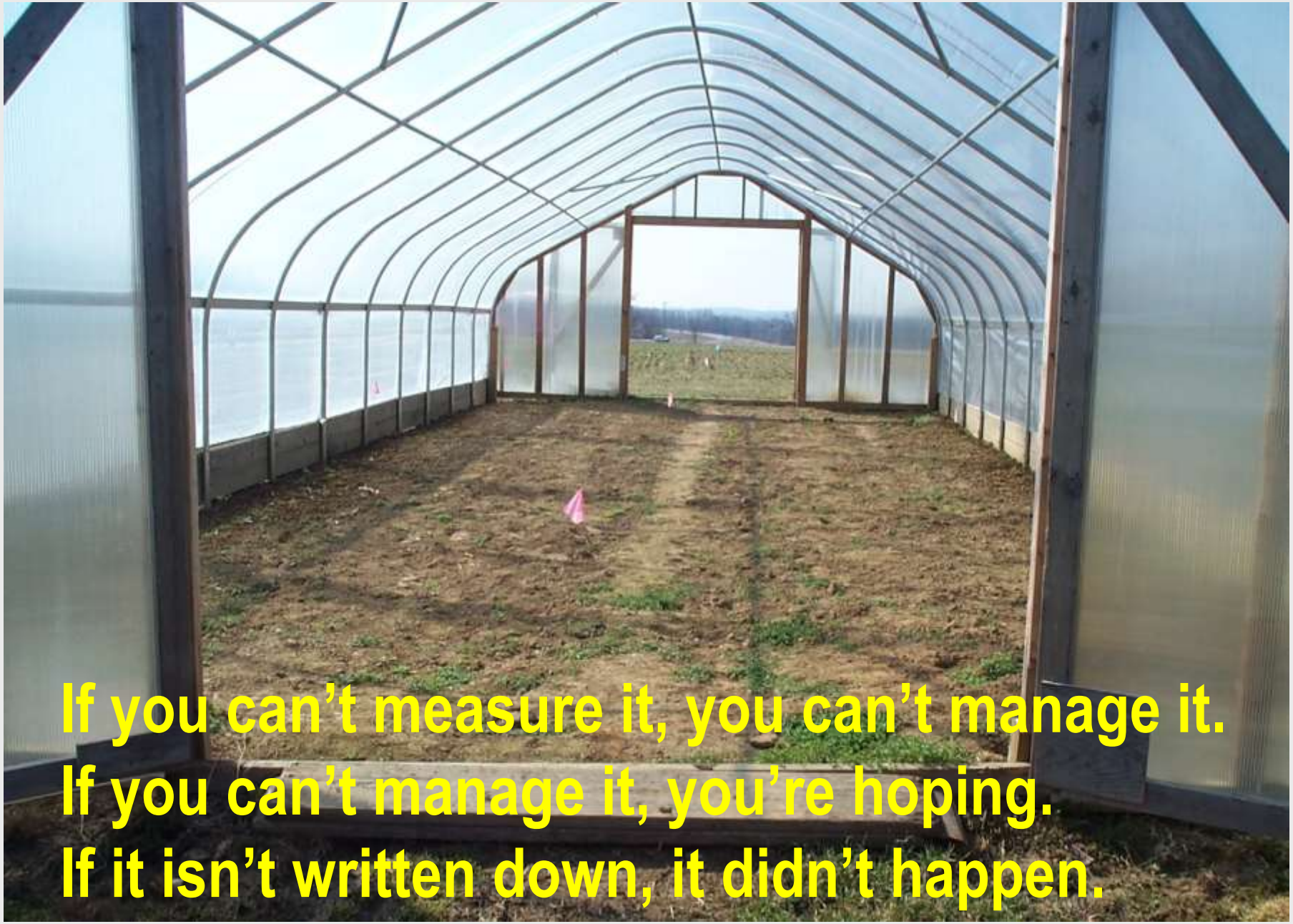
https://u.osu.edu/vegprolab/

materials cost for overhead irrigation system (21 ft x 48 ft tunnel) = $152

https://u.osu.edu/vegprolab/

https://cpb-us-w2.wpmucdn.com/u.osu.edu/dist/9/24091/files/2021/06/ht-overhead-irrigation-guide-21-1.pdf

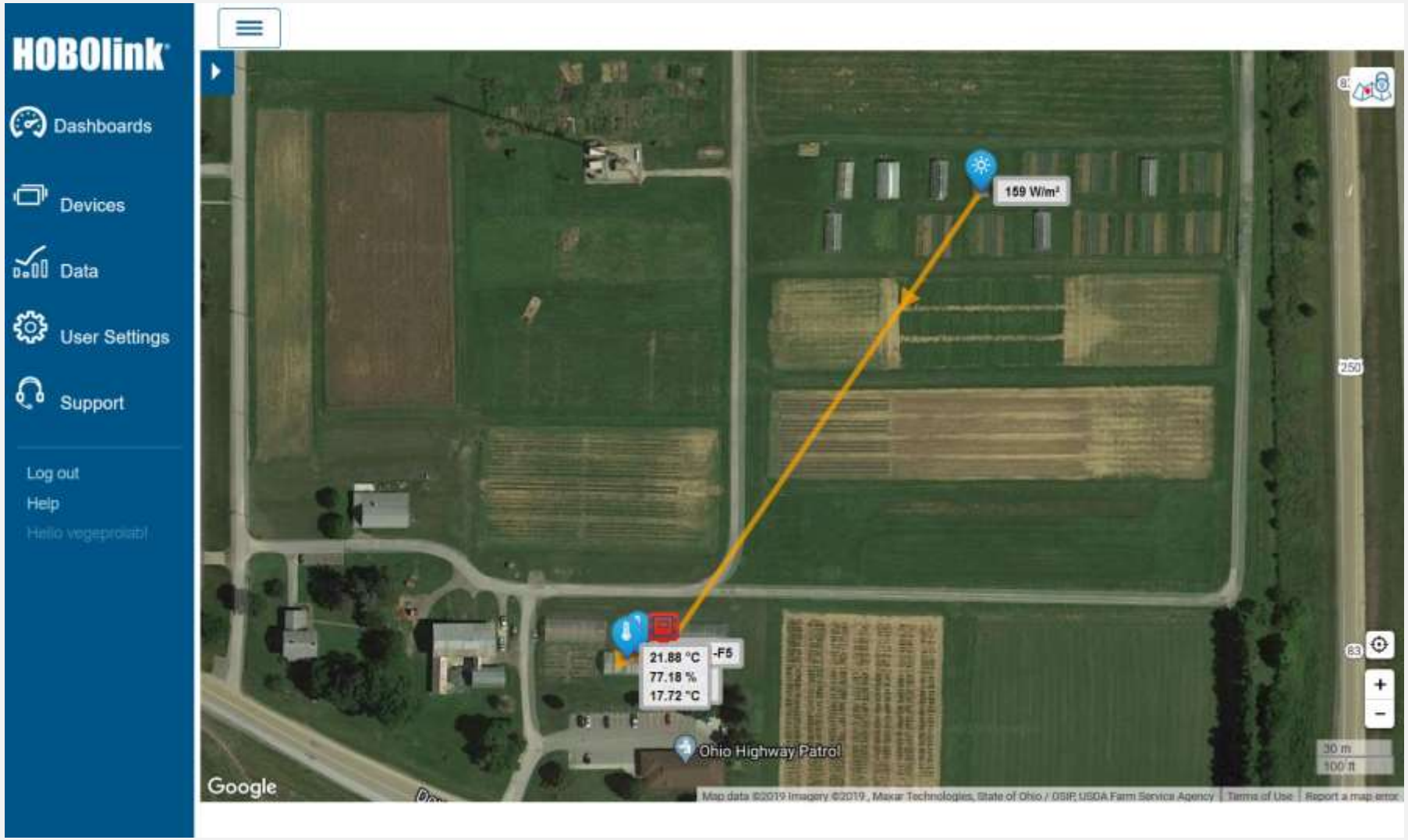

If you can’t measure it, you can’t manage it.
If you can’t manage it, you’re hoping.
If it isn’t written down, it didn’t happen.

HOBOlink Web-Based Display/Readout

HOBOlink is a web-enabled software platform that makes it easy to view and to manage your data remotely.

temperature
sensors

data storage and upload to cloud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Dashboards
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Help
159 W/m²
21.88 °C
77.18 %
17.72 °C
-F5
Ohio Highway Patrol
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250
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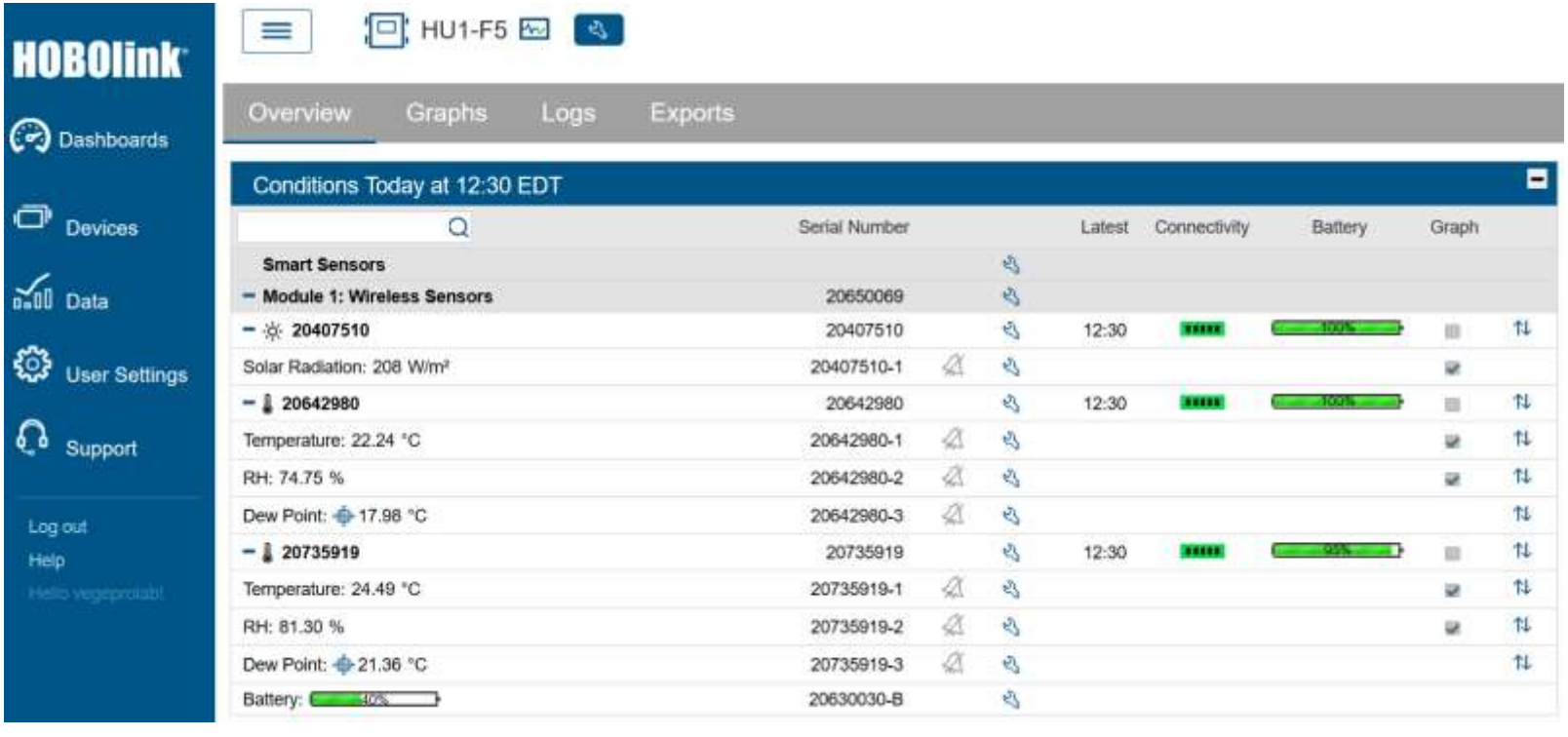
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Conditions Today at 12:30 EDT
Serial Number
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Connectivity
Battery
Graph
Smart Sensors
Module 1: Wireless Sensors 20650069
20407510 20407510 12:30 100%
Solar Radiation: 208 W/m² 20407510-1
20642980 20642980 12:30 100%
Temperature: 22.24 °C 20642980-1
RH: 74.75 % 20642980-2
Dew Point: 17.98 °C 20642980-3
20735919 20735919 12:30 95%
Temperature: 24.49 °C 20735919-1
RH: 81.30 % 20735919-2
Dew Point: 21.36 °C 20735919-3
Battery: 20630030-B

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Mahoning
Mt Vernon (89-99)
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Daily Overview
Precipitation and Soil Temperature Graphs
Comfort Index Graphs
GDD and Precipitation Calculator
Historical Records
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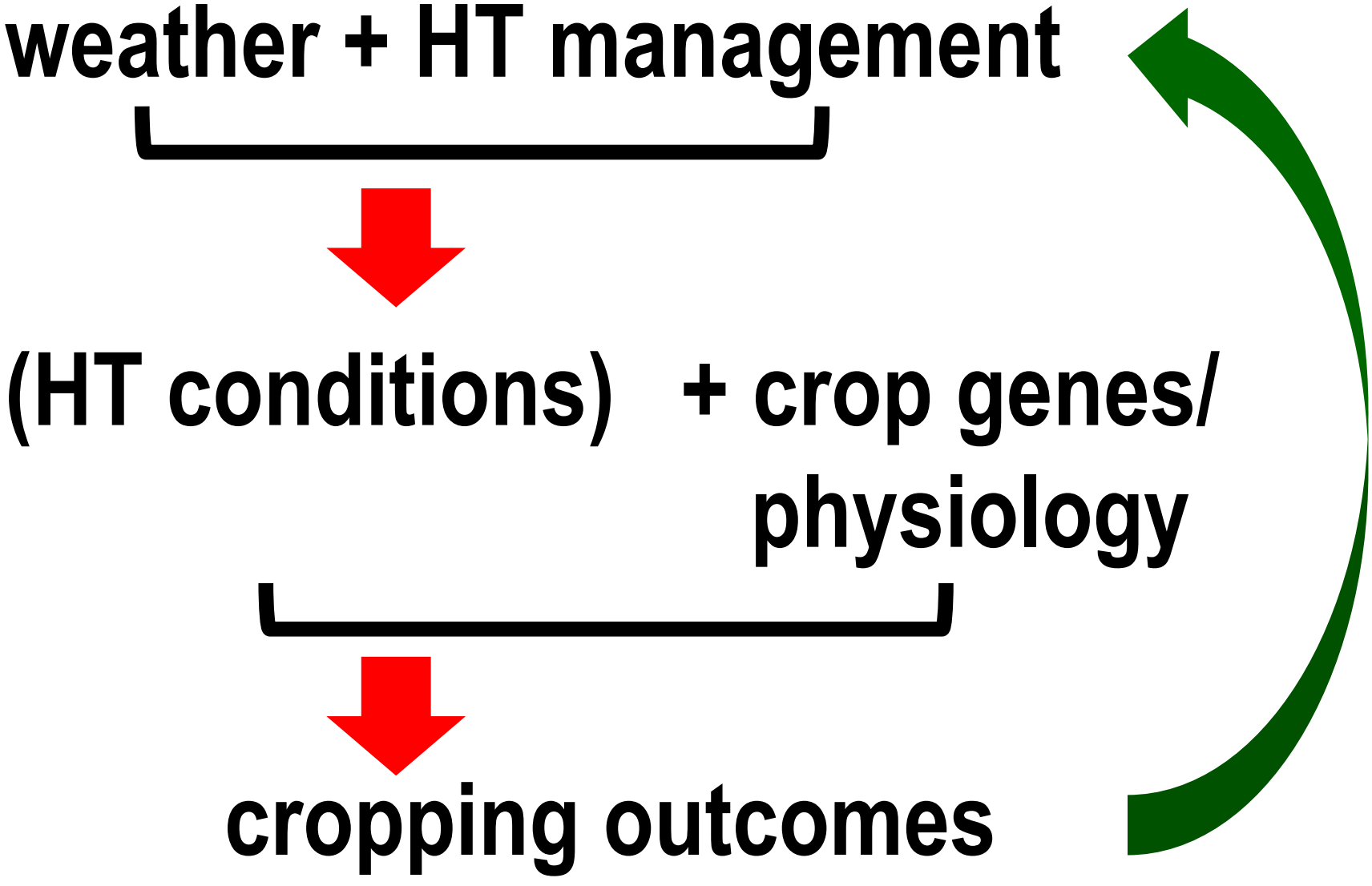
FAQ

OARDC


weather + HT management
(HT conditions)
+ crop genes/
physiology
cropping outcomes

data-driven decisions

The OSU Vegetable Production Systems Laboratory

(http://u.osu.edu/vegprolab/)

High Tunnels

- six, 21 ft x 48 ft
- one, 30 ft x 48 ft (moveable)
- three, 30 ft x 80 ft

Mid-Tunnels

- 22, 4 ft x 30 ft

Help maximize the value, impact, and sustainability of high tunnel production.

SUMMARY

However you choose to approach it, remember ...

Whatever HT you begin with, remember …

1. You paid for the opportunity to include HTs in your business. Get the most from it.
2. The simplest HT is sufficient. Still, some modifications can be useful.
3. Regardless, maintaining soil health and using advanced, proven decision aids and tools are key to benefitting fully from your HT(s).
4. Stay tuned.

THANK-YOU
and
GOOD LUCK!

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QUESTIONS?

Dr. Matt Kleinhenz
Professor, Extension Vegetable Specialist
Dept. of Horticulture and Crop Science
The OSU-OARDC
Phone: 330-263-3810
E-mail: kleinhenz.1@osu.edu
Web: u.osu.edu/vegprolab
YouTube: https://go.osu.edu/vegeprosystemslab
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