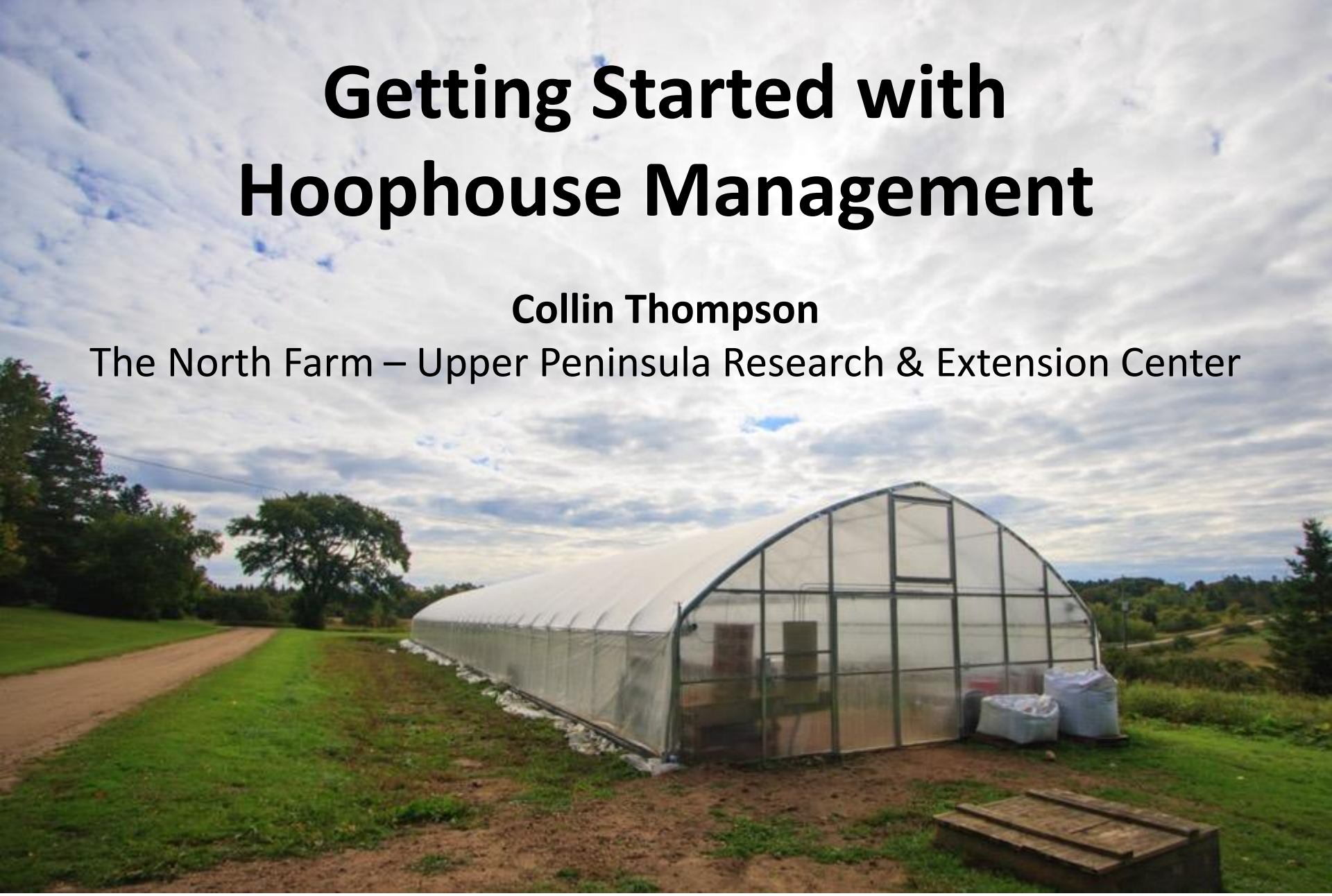
Getting Started with Hoophouse Management

Collin Thompson
The North Farm – Upper Peninsula Research & Extension Center



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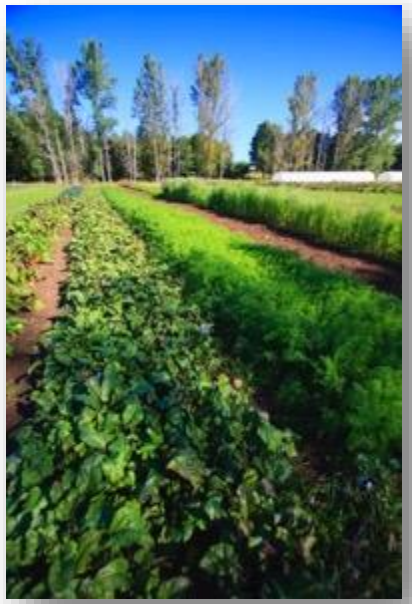
The North Farm

- Education, Research, Production
- Challenging Climate
  - 46.35° N
  - 180” annual snowfall
  - 95-106 day growing season
- 11,400 square feet under plastic
  - Another 2,400 in 2017
- Approximately 10 acres of field production (including CC and rental plots)
- Emphasis on season extension, storage crops




Nykanen Rd
Rock River Rd
MSU North Farm
Rock

Overview

- Site and Structure Considerations
- Fertility and Water Management
- Crop Selection and Timing
- Video Walk Through

Site and Structure Considerations

- Site Considerations
- Structure Considerations
- System Considerations

Terminology

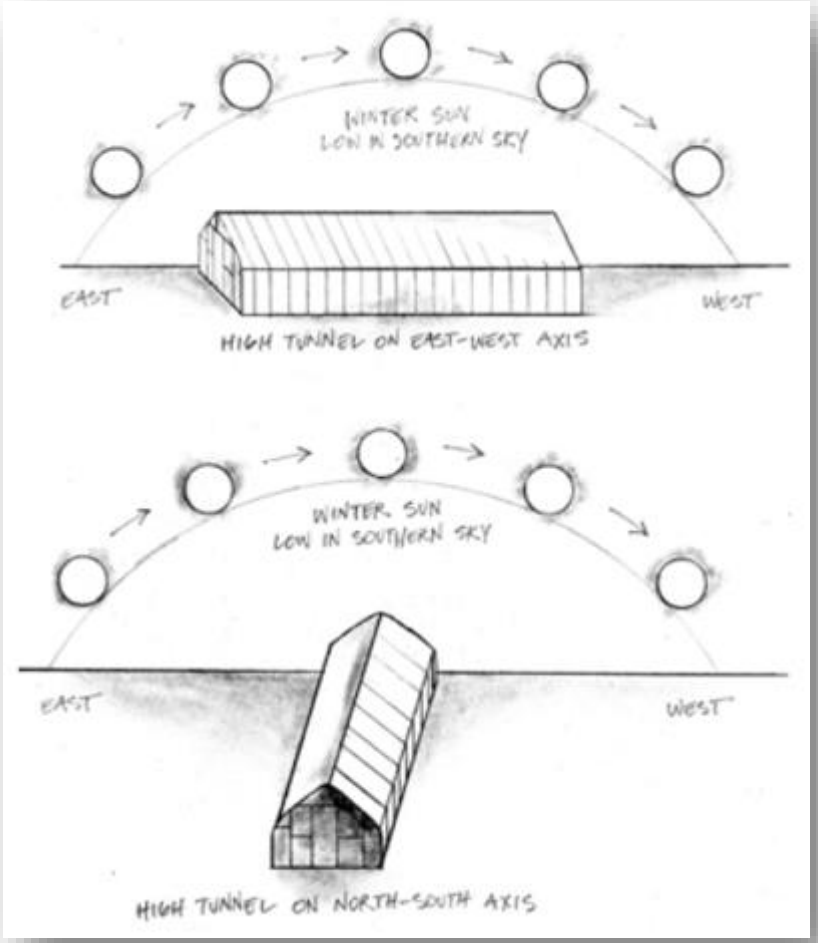
- **Hoophouse** – Structure glazed with polyethylene (greenhouse plastic) that is used to extend the growing season
- **High Tunnel** – Same as hoophouse. Term used to emphasize importance of low tunnel use inside high tunnel
- **Greenhouse** – Typically a more permanent structure, often with supplemental heat

Site Considerations

- Light & Shade
  - Orientation
- Drainage
- Access, Utilities, Future Expansion
- Wind & Snow
- Stationary & Movable

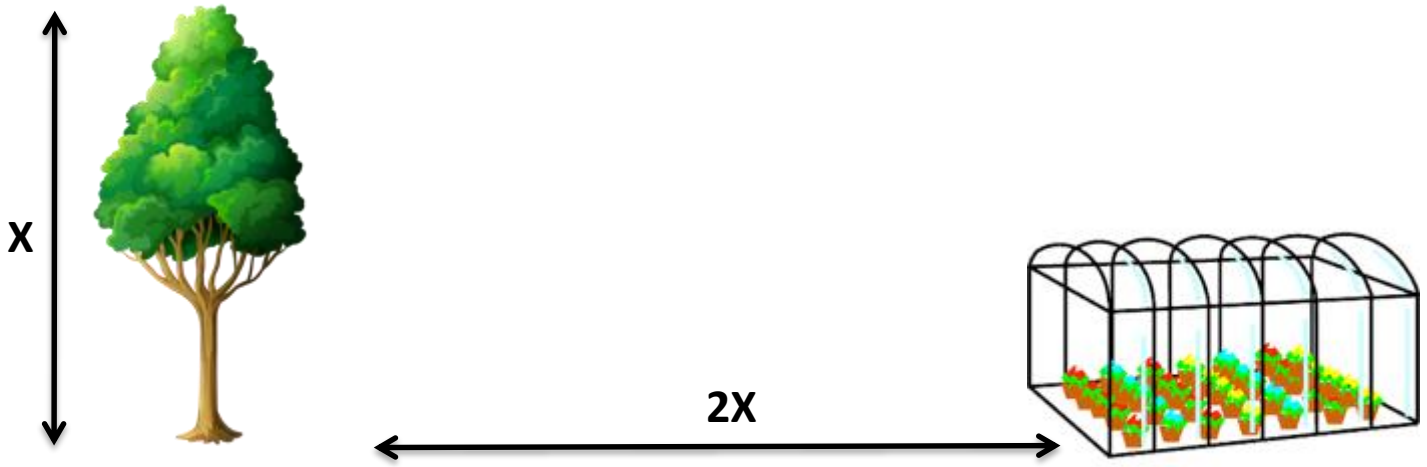
Light & Shade

- Light = Essential for Growth and Heat
- Factors for Light Transmission
- Orientation of Structure
  - Impacts of Orientation



Light & Shade

- Shading from other structures
  - 2x height = distance from structure
  - Most essential in fall-spring
- Bed orientation/tunnel orientation
  - Depends on cropping plan (tall crops vs. short crops)



Drainage

- 1” of rain on 1500 ft^2 = 935 gallons of water
- Move water away from structure
- Options:
  - Swales
  - French drains
  - Rainwater collection
  - Ditches

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Access, Utilities, Future Expansion

- Water will be necessary
  - Hoses vs. Hydrant
- Electricity? Gas?
- Future hoophouses?
  - Build with access to current and future structures in mind
  - Think about setbacks for multiple structures

Wind & Snow

- Snow
  - Space for snow removal
  - Strong frame
  - Spring/fall ventilation
- Wind
  - Use of windbreaks
  - Prevailing winds and orientation


Management!

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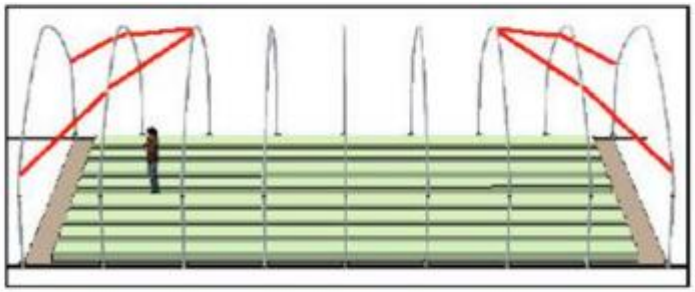
Structure Considerations

- Bracing
- Roof Geometry
- Endwalls
- Covering

Bracing

- Types:
  - Corner Bracing
  - Purlins
  - Truss Kits
- Considerations
  - Steel thickness and diameter
  - Attachment mechanism
  - Hoop spacing

Note: Ensure hardware is installed so it will not come in contact with plastic.



Begin at Peak of Hoop 3 and Work Toward Corners

Install Using 2-3/8" Brace Bands And 5/16 x 1-3/4" Carriage Bolts

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Roof Geometry

Quonset

Cathedral

Gable

Gothic

Endwalls

- Materials:
  - Prefabricated metal
  - Metal construction
  - Wood construction
- Coverings:
  - Solid
  - Polycarbonate
  - Poly/Superpoly

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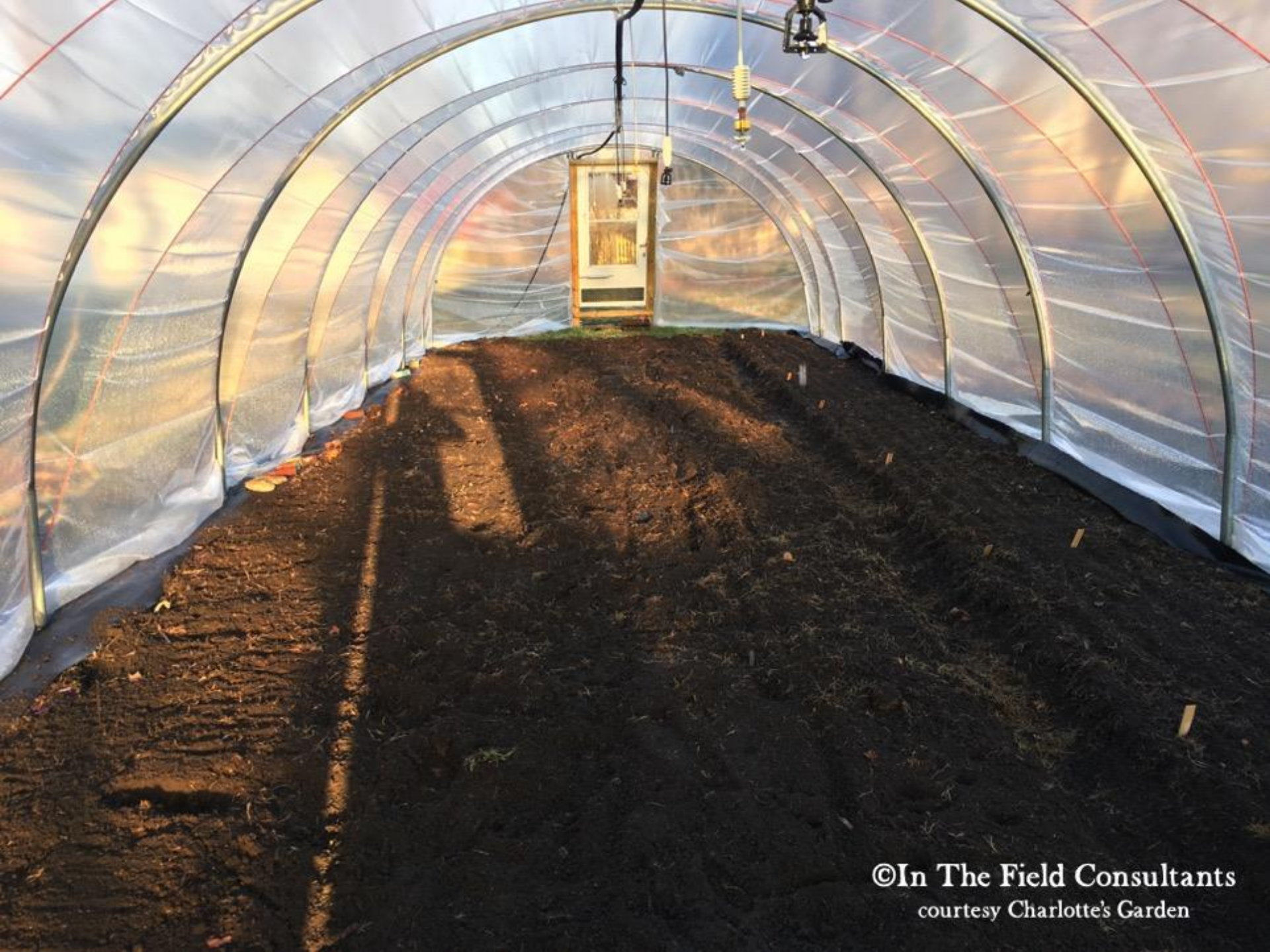
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Coverings

- 6mil Poly
  - Standard UV Treated
  - AC/IR Treated
  - LD Treated
- Double Layer Poly
- Polycarbonate
- Solawrap

Double Layer Poly

Solawrap

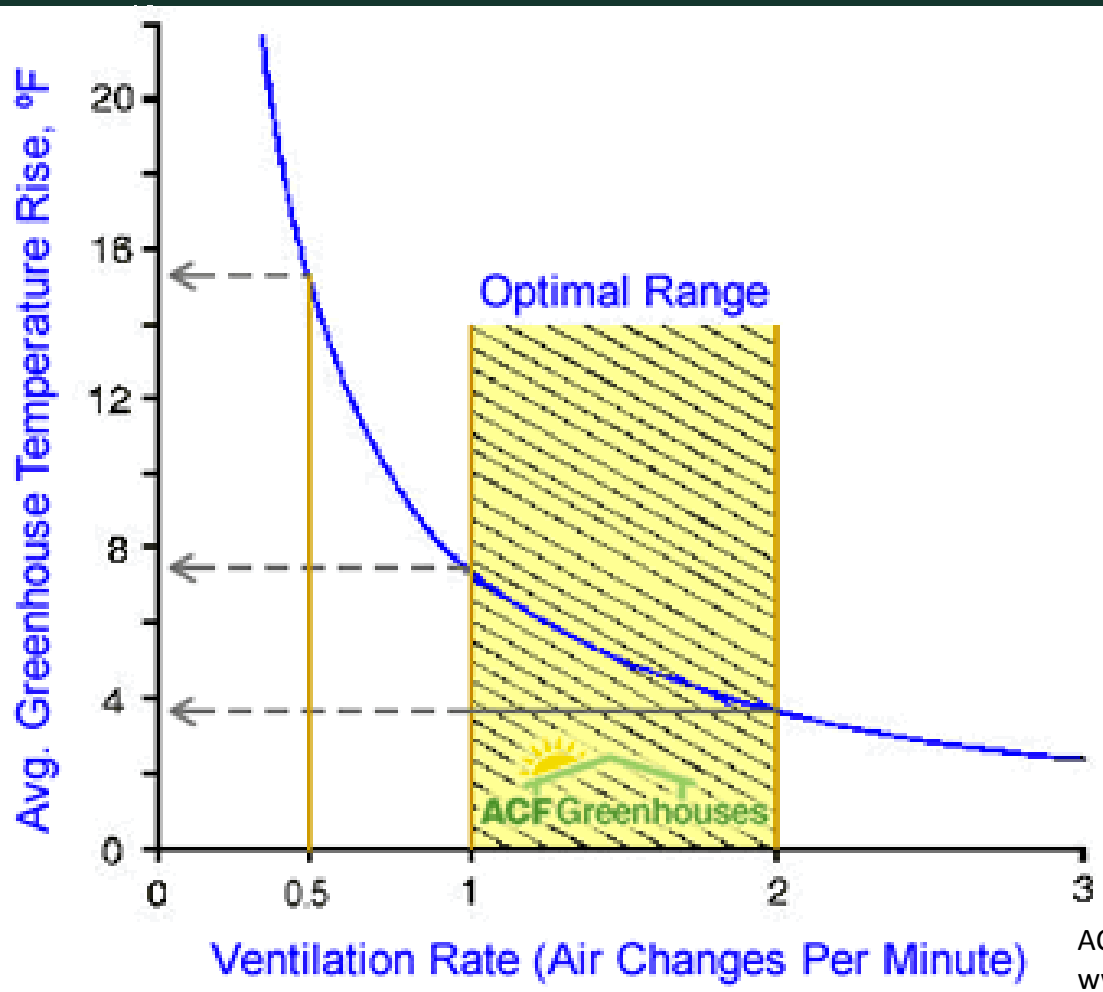
System Considerations

- Ventilation
- Circulation
- Heating

Ventilation

- Types:
  - Ridge
  - Endwall
  - Roof
  - Sidewall
    - Roll-Up
    - Drop Down
- Considerations
  - Weather – wind, rain, snow
  - Electrical access
  - Cropping plan (warm vs. cool)
  - Manual vs. automated

Ventilation

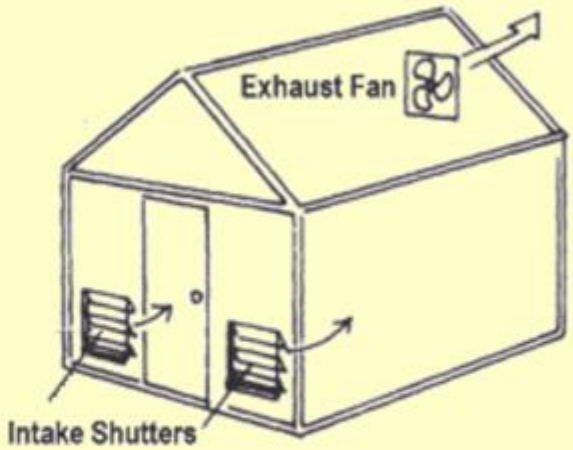


ACF Greenhouses
www.littlegreenhouse.com

Exhaust Fans

Greenhouse Fan CFM Calculator

30	ft.	**Length of Greenhouse**
96	ft.	**Width of Greenhouse**
14	ft.	**Peak Height of Greenhouse**
Calculate		**W x L x H**
40320		**Fan CFM Needed** - This is the optimal exhaust fan CFM (Cubic Feet per Minute) rating for your greenhouse. A fan this size will exchange the air in your greenhouse at least once per minute which is recommended for venting small greenhouses.



ACF Greenhouses
www.littlegreenhouse.com

Exhaust Fans

JavaScript Greenhouse Exhaust Fan CFM Calculator		
Do This	**JavaScript Calculator**	**Example**
Measure the **height** of your greenhouse.	14	You measured a floor to ceiling height of 8 feet.
Determine the **width** of your greenhouse.	30	You measured the width at 8 feet.
Find out the **length**.	96	You enjoy a medium sized greenhouse, measuring 16 feet long.
Multiply the height by the width by the length.	calculate	Your greenhouse measurements were 8'H, 8'W, and 16'L.
Look for this **minimum ventilation fan CFM rating** to keep your greenhouse healthy year round.	40320	8'H x 8'W x 16'L = 1024 cfm
This is the **optimum ventilation fan CFM rating** many growers use.	60480	8'H x 8'W x 16'L x 1.5 = 1536 cfm

Our 12" Exhaust Fan provides 760 CFM. We can also special order larger fans. A 16" fan is rated at 1,250 CFM, and a 20" fan is rated at 3,000 CFM.

The Greenhouse Catalog
www.greenhousecatalog.com

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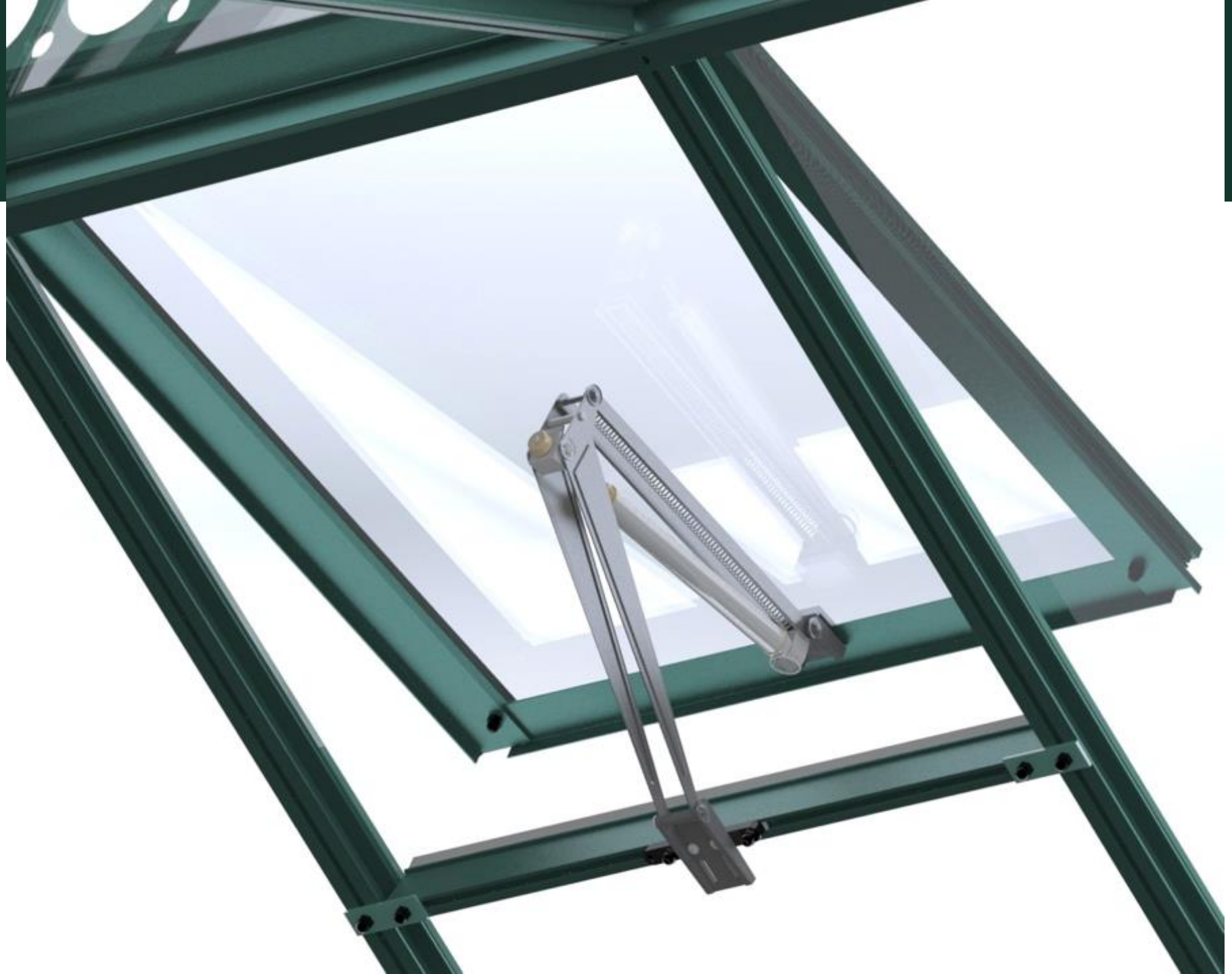


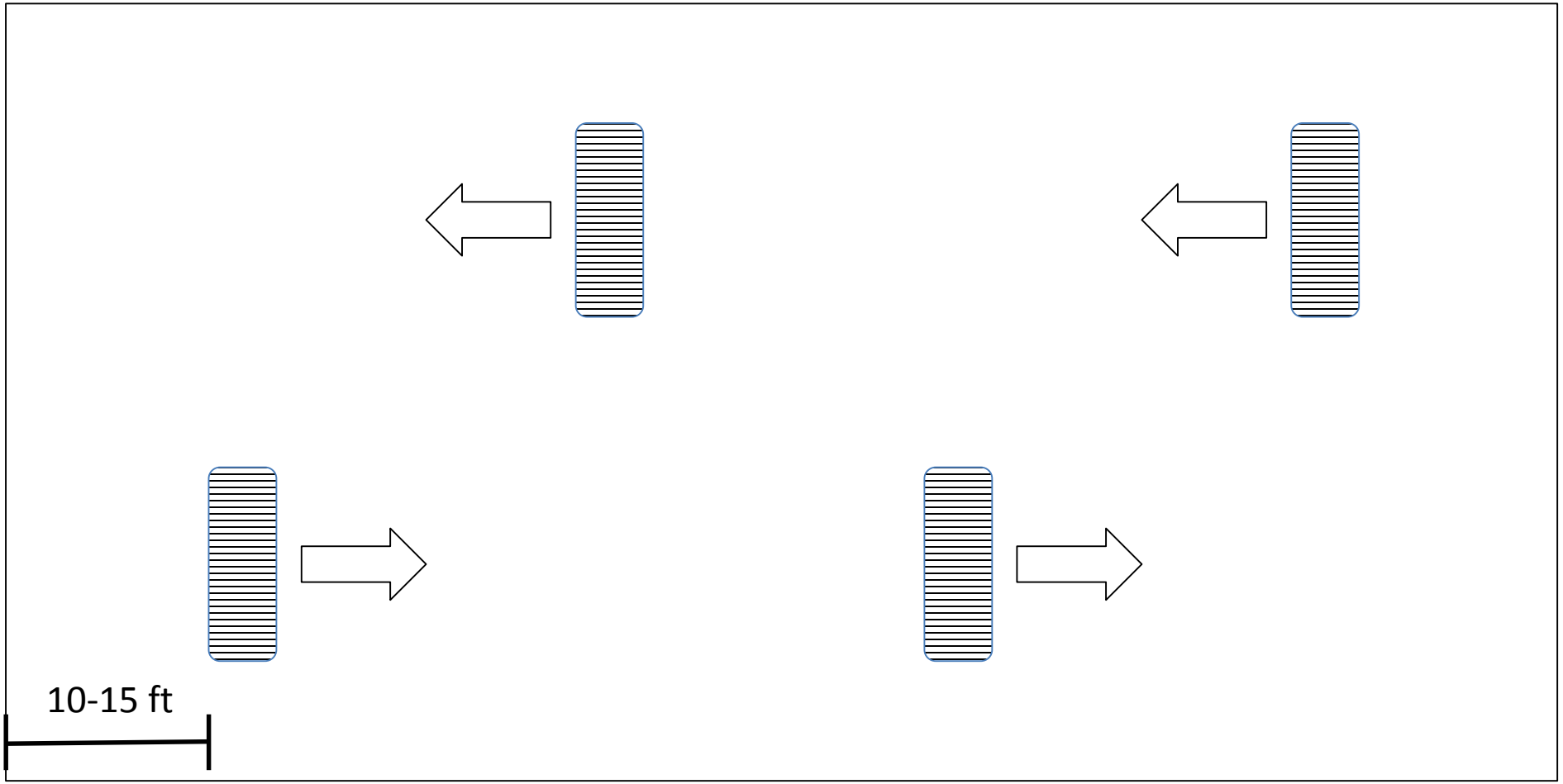
Circulation

- Horizontal Air Flow (HAF) - avoid extreme temperature differentials
- Constant movement in horizontal pattern - reduced energy inputs
- Proper fan sizing
- Proper fan placement

Calculating HAF CFM

- Fan capacity = 2x floor area
  - 30’ x 96’ = 2880 ft2
  - Total HAF capacity = 5760 CFM
    - 5760/4 fans = 1440 CFM/fan
- Fan arrangement
  - Create circular air flow
  - 7-8’ above ground
  - Even distribution

Fan Placement



Heating

- Types of Heaters
  - Fuel Type
  - Efficiency Rating
  - Wet vs. Dry
  - Forced Air vs. Radiant

Sizing Heaters

Greenhouse Heater Size Calculator

4947 **Area of Structure -** This is the total square feet of exposed surface area (this is not length x width) your structure has (don't include floor). To find out the area of one of our greenhouses, click here. If you have a different greenhouse, click here to use our greenhouse area calculators.

15 **Minimum Outside Temperature -** You will want to enter the lowest temperature expected for your area. Not sure? Use the USDA Zone Map to find the average minimum temperature for your area (Use the lower of the 2 numbers in the range given in Fahrenheit).

65 **Inside Temperature** - This is the temperature you would want to maintain in your greenhouse when heating.

.7 **Heat Loss Value** - Check the list below to find the heat loss value for the covering used on your greenhouse. Some values may vary with manufacturer. If you know the R-value of your covering, you can convert it to a heat loss value using this formula: Heat loss value = 1 / R-value.

Area x (In - Out) x Heat Loss

Calculate

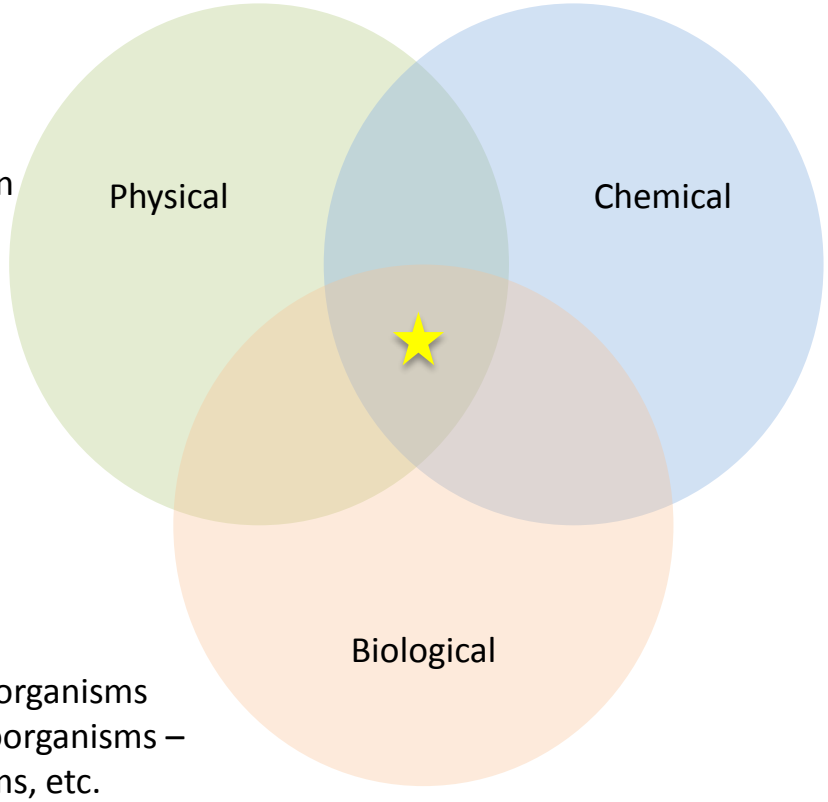
4 mil polyethylene	1.20	4 mm (5/32") twinwall polycarbonate	.70
6 mil polyethylene	1.15	4 mm roof & single poly walls (EasyGrow Clear View)	.95
6 mil poly double layer (inflated)	.70	6 mm (1/4") twinwall polycarbonate	.62
11 mil woven polyethylene	1.05	8 mm (5/16") twinwall polycarbonate	.58
3 mm (1/8") glass (single layer)	1.13	10mm (3/8") twinwall polycarbonate	.53
Double layer insulated glass	.45	10 mm (3/8") triple wall polycarbonate	.48
6mm polycarbonate roof & glass walls	.90	16 mm (5/8") 5 wall polycarbonate	.33
Polycarbonate / fiberglass (single layer)	1.20		

173145 **Minimum BTU Needed** - This is the minimum amount of **BTU output** the heater you use should have. If the heater only has a BTU input rating, use the following formula. BTU output = (heater efficiency) * (BTU input). View Our Selection of Greenhouse Heaters

ACF Greenhouses
www.littlegreenhouse.com

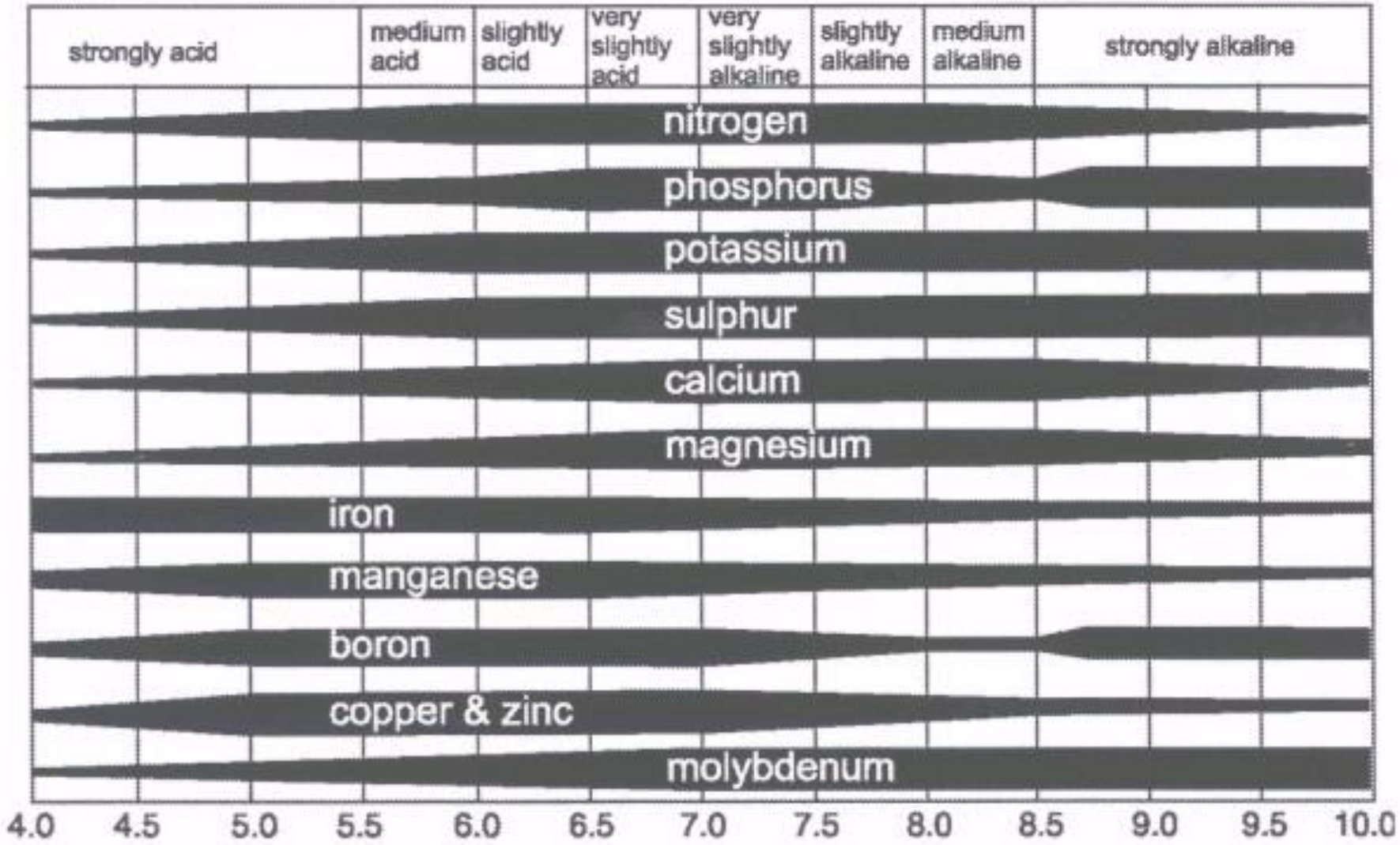
Soil Health

Physical
- Aggregate Stability
- Soil Structure
- Soil Porosity
- Bulk Density - Compaction
- Water Infiltration
- Water Holding Capacity



Chemical
- Cation Exchange Capacity (CEC)
- Nutrient Holding Capacity
- pH
- Nutrient Cycling

Biological
- Soil Microorganisms
- Soil Macroorganisms – earthworms, etc.
- Particulate Organic Matter
- Soil Respiration
- Soil Enzymes


strongly acid
medium acid
slightly acid
very slightly acid
very slightly alkaline
slightly alkaline
medium alkaline
strongly alkaline
nitrogen
phosphorus
potassium
sulphur
calcium
magnesium
iron
manganese
boron
copper & zinc
molybdenum
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0

Fertility Demands

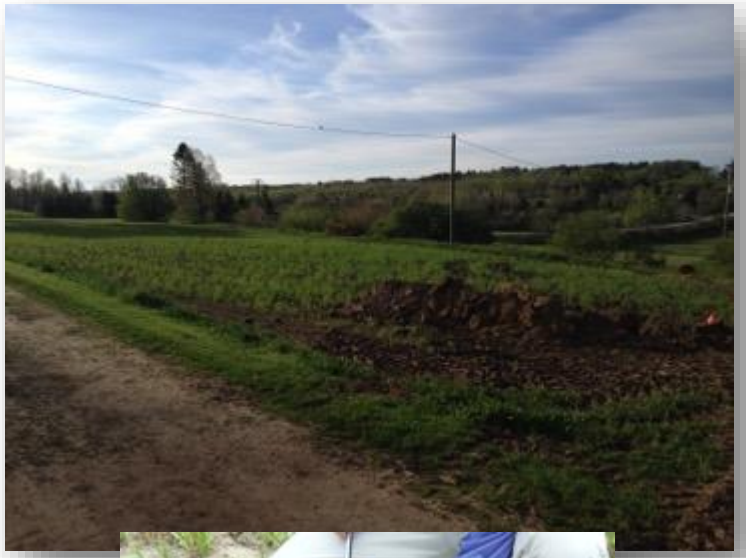
High Demand
- Tomatoes
- Cucumbers
- Eggplant
- Peppers

Medium Demand
- Strawberries
- Raspberries
- Beans
- Carrots

Low Demand
- Greens

Soil Fertility Management

- Know where to start
  - Soil Testing
  - Water Testing
- Match fertility inputs to fertility needs
- Build SOM



Compost Considerations

- Source material greatly impacts nutrient load
- Plant based vs. animal based
- Compost – purchased versus farm-made

Compost Considerations

Plant Based – SOF

(C:N = 3:1 by volume)

- 1 Grass Hay (1st cutting)
- 1 Alfalfa Hay (2nd/3rd cutting)
- 2 Straw
- 2 Leaves
- 2 Wood Shavings
- 1 Soil
- 1 Peat (optional)

Compost Considerations

Plant Based – SOF

- ~$30/yd for materials
- Labor/fuel cost
- Small piles – hand
- Large piles – mechanical
- Obtaining/moving feedstocks

Compost Considerations

Purchased Compost

- $40/yd – Dairy Doo
- Delivery dependent - $50/1.5 yd (less bulk)
- NOP certification documents
- Analysis and fertility info
- Potential residual pesticides

Compost Considerations

Application Rates

- Per 100 sqft
  - 25-40 gallons
  - 5-8 cubic feet
  - 0.2-0.3 cubic yards
- Per 1000 sqft
  - 2-3 cubic yards
- Per 30x96 tunnel (65% bed space)
  - 3.6-5.4 cubic yards

Dry Fertilizers/Amendments

- Sulfur
  - 2.5 lbs/100 sqft (.5 ton/A)
- Gypsum (Calcium Sulfate)
  - 5 lbs/100 sqft (1 ton/A)
- Lime
  - Dolomitic – 25% Ca and 10% Mg
  - Calcitic – 38% Ca, no Mg
- Blood Meal (12-0-0)
  - Very quick release
- Bone Meal (5-12-0)
  - 22% Ca
  - Immediate P availability
  - Good as early season

Dry Fertilizers/Amendments

- Fish Meal (9-3-0)
  - Excellent nutrient source
  - Slow to moderate release
- Granite Dust (0-0-6)
  - Used to mineralize soil with micros and potassium
- Greensand (0-1-7)
  - Contains 3% Mg
- Kelp Meal
  - NPK ratio slightly variable
  - Includes B, Cu, Fe, Mn
- Soybean Meal (6-1-1)
- Alfalfa Meal (3-1-5)
- Sul-Po-Mag (0-0-22-11 Mg)
- Potassium Sulfate (0-0-50)

Fertigation

- Application of fertility through irrigation
  - "Nutrient Spoon Feeding"
- Post planting organic fertility application is often challenging
- Liquid fertility – soluble nutrient source
- Water – Feed - Water

Water Management

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Units of Measure

- **Acre inch** – the volume of water necessary to cover one acre of land with one inch of water. Equivalent to 27,154 gallons.

- **Gallons per minute (gpm)** – the flow rate of an irrigation system, measured by the amount of gallons being transferred per minute. The flow of a system determines the capacity of the system and the type of equipment that is supported.

- **Pounds per square inch (PSI)** – a common measurement unit of pressure. The pressure of a system determines the type of emitter and transfer lines that can and should be used in an irrigation system.

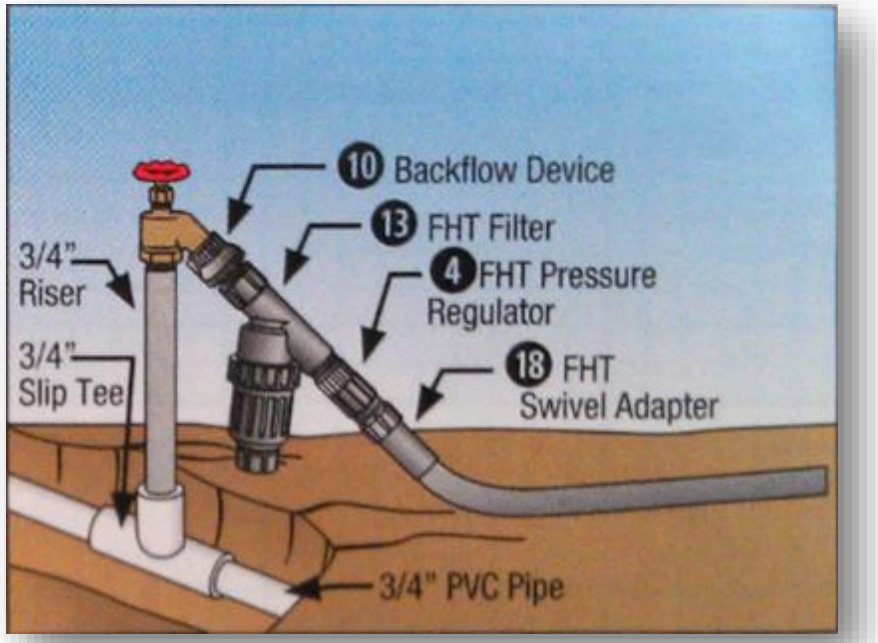
- **Distribution uniformity (DU)** – a unit of measure that describes the uniformity of water application of an irrigation system. This is relevant when discussing overhead irrigation systems and drip systems on uneven terrain.

Terms

- **Evaporation** – surface water loss as liquid water converts to gaseous water vapor.
- **Transpiration** – release of water by plants through tissues.
- **Evapotranspiration** – total loss of water within a system due to evaporation and transpiration.
- **Cone** – vertical water footprint originating at point of application through soil. The shape of the cone is determined by flow rate and type of soil.
- **Drainage** – movement of water through soil out of root zone.

Components of System

- Water Source
- Pump
- Filter(s)
- Backflow Prevention
- Injectors
- Pressure Control
- Irrigation Lines
- Emitters



Determining Moisture

- Terms
  - Soil Saturation
  - 100% Field Capacity
  - **50-60% Field Capacity**
  - 50% Field Capacity
  - Permanent Wilting Point

Determining Moisture

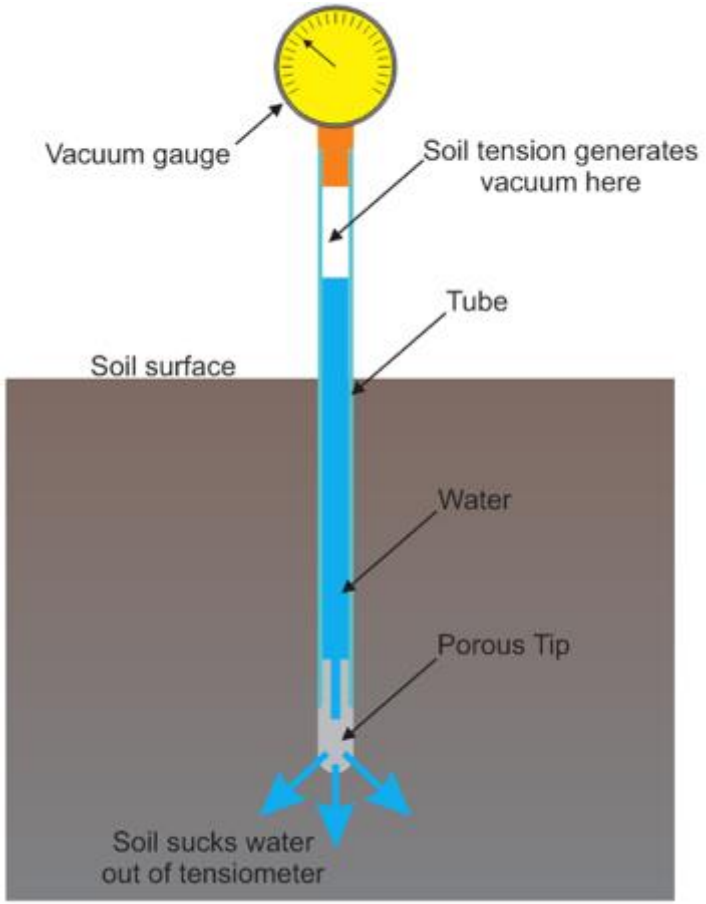
- Visual Analysis
  - Wilted plants?
  - Stunted growth?
  - Reduced yields?
- Measure by Feel

- Measure with Equipment

Measure By Feel

0–25% No available soil moisture. Plants wilt.	Dry, loose, single grained, flows through fingers. No stain or smear on fingers.	Dry, loose, clods easily crushed and will flow through fingers. No stain or smear on fingers.	Crumbly, dry, powdery, will barely maintain shape. Clods, breaks down easily. May leave slight smear or stain when worked with hands or fingers.	Hard, firm baked, cracked. Usually too stiff or tough to work or ribbon[1] by squeezing between thumb or forefinger. May leave slight smear or stain.
25–50% Moisture is available, but level is low.	Appears dry; will not retain shape when squeezed in hand.	Appears dry; may tend to make a cast[2] when squeezed in hand, but seldom will hold together.	May form a weak ball[2] under pressure but will still be crumbly. Color is pale with no obvious moisture.	Pliable, forms a ball; will ribbon but usually breaks or is crumbly. May leave slight stain or smear.
50–75% Moisture is available. Level is moderate to high.	Color is darkened with obvious moisture. Soil may stick together in very weak cast or ball.	Color is darkened with obvious moisture. Soil forms weak ball or cast under pressure. Slight finger stain, but no ribbon when squeezed between thumb and forefinger.	Color is darkened from obvious moisture. Forms a ball. Works easily, clods are soft with mellow feel. Will stain finger and have slick feel when squeezed.	Color is darkened with obvious moisture. Forms good ball. Ribbons easily, has slick feel. Leaves stain on fingers.
75% to field capacity (100%) Soil moisture level following an irrigation.	Appears and feels moist. Color is darkened. May form weak cast or ball. Will leave wet outline or slight smear on hand.	Appears and feels moist. Color is darkened. Forms cast or ball. Will not ribbon, but will show smear or stain and leave wet outline on hand.	Appears and feels moist. Color is darkened. Has a smooth, mellow feel. Forms ball and will ribbon when squeezed. Stains and smears. Leaves wet outline on hand.	Color is darkened. Appears moist; may feel sticky. Ribbons out easily, smears and stains hand, leaves wet outline. Forms good ball.

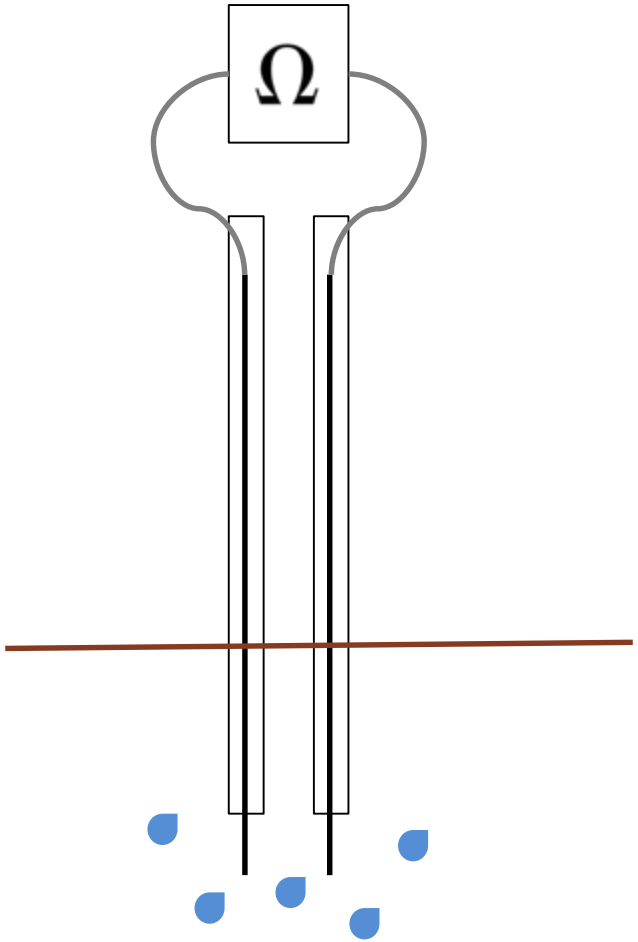
Measure With Equipment



Tensiometer

- A reading of 0 kPa (kilopascals) = saturated soils
- Most tensiometers operate to a maximum of 75 kPa.
- 30-40 kPa – ideal range for sandy soils
- 50-60 kPa – ideal range for loamy and clay soils.

Measure With Equipment



Dialectric Moisture Meter

- Purchased or homemade:
  - 2 conductive wires installed at rooting depth
  - Ohmmeter used to read conductivity
    - ++ reading = ++ soil moisture

Types of Irrigation Systems

Drip Irrigation

- Efficient use of water
- Low flow/pressure requirements
- Can be used with mulches
- Can interfere with weed management
- Works best on loamy-clay soils

Overhead Irrigation

- Mimics rain
- Higher flow/pressure requirements
- Even wetting of soil surface
- More evaporation = less efficient
- Works better on sandy soils

Calculating Water Needs

Necessary Information

1 Acre inch = approx. 27,000 gallons

1 Acre = 43,560 Ft^2

Flow Rate and Pressure of System

Flow Rate and Type of Irrigation

- Drip/Overhead
  - Calculate by length or area and time
- Hose and Breaker
  - Fill a bucket

Estimating Your Flow

Seconds to fill a 1 gallon container	GPH*
5	720
6	600
7	450
8	400
9	360
10	300
11	240
12	180
13	120
14	90

*If filling a 5 gallon container multiply the GPH by 5

Irrigation Scheduling - Drip

Constants for System

- 8 mil drip line
- 12 inch emitter spacing
- 0.22 gpm/100 linear feet

Flow Rate/Bed

- 30” (2.5’) x 140’ beds = **350 ft^2**
- 2 drip lines/bed = **280 linear feet**
- 280 linear feet = **0.616 gpm**

Water Requirements/Bed

- 1 Acre Inch Equivalent / bed
  - 350 ft^2/43,560ft^2 = 0.008 acres/bed
  - 27,000 gallons * 0.008 = **217 gallons/week/bed**

Irrigation Scheduling - Drip

Constants from Previous Calculations

- 0.616 gpm
- 217 gallons/week/bed

Irrigation Time

- 217 gallons/0.616 gpm = **352 minutes**
- 352 minutes/60 minutes = **5.8 hours**

Options:

- 7 days @ 50 minutes
- 5 days @ 70 minutes
- ***3 days @ 117 minutes***
- 2 days @ 176 minutes

Irrigation Scheduling - Overhead

Constants for System

- Mini-wobbler overhead sprinkler
- 20’ spacing
- 0.5 gpm/wobbler flow rate

Area

- 40’ diameter, overlapped pattern
- 30’ x 140’ = **4,200 ft²**
- 140’ length = 6 wobblers * 2 lines = **12 wobblers**

Water Requirements/Plot

- 1 Acre Inch Equivalent / plot
  - 4,200 ft^2/43,560ft^2 = **0.1 acres/plot**
  - 27,000 gallons * 0.1 = **2,700 gallons/week/plot**

Irrigation Scheduling - Overhead

Constants from Previous Calculations

- 0.5 gpm/wobbler
- 2,700 gallons/week/plot
- 12 wobblers

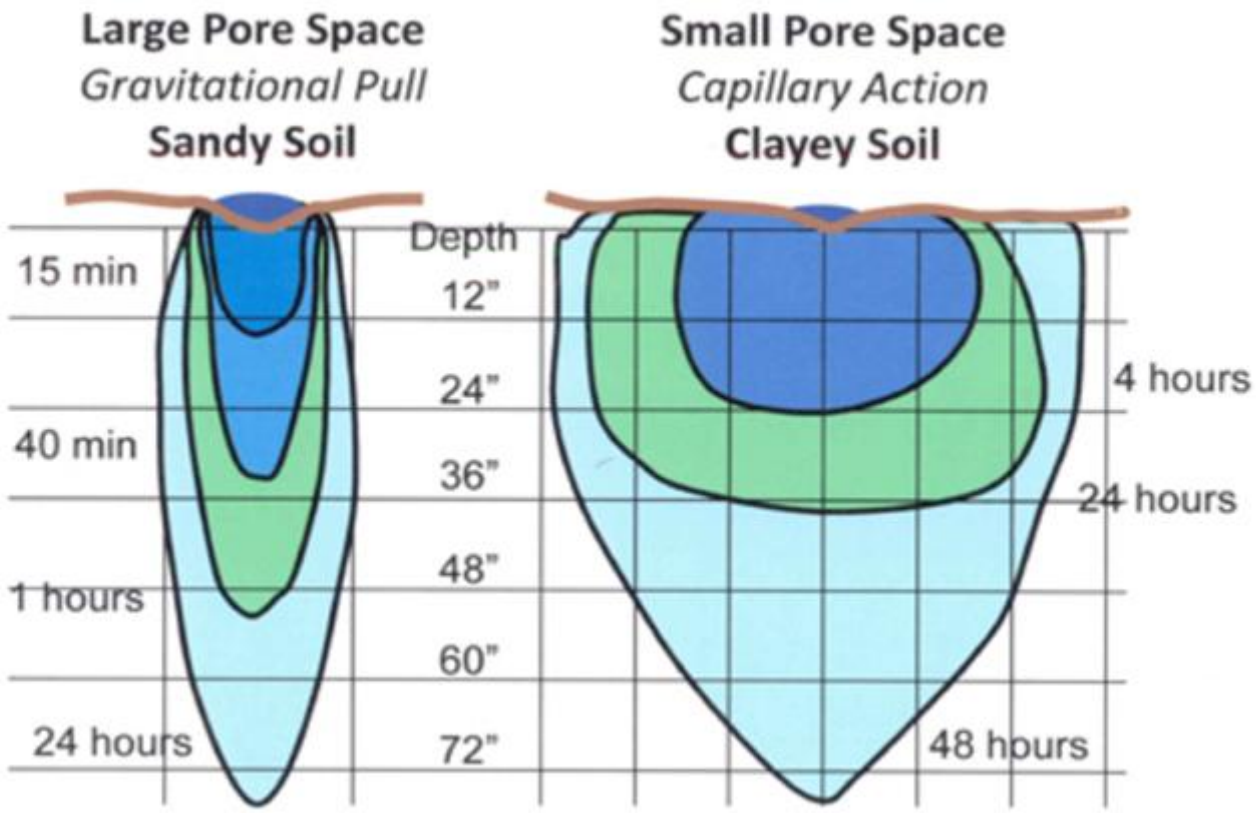
Irrigation Time

- .5 gpm * 12 wobblers = **6 gpm**
- 2,700 gallons/6 gpm = **450 minutes**
- 352 minutes/60 minutes = **7.5 hours**

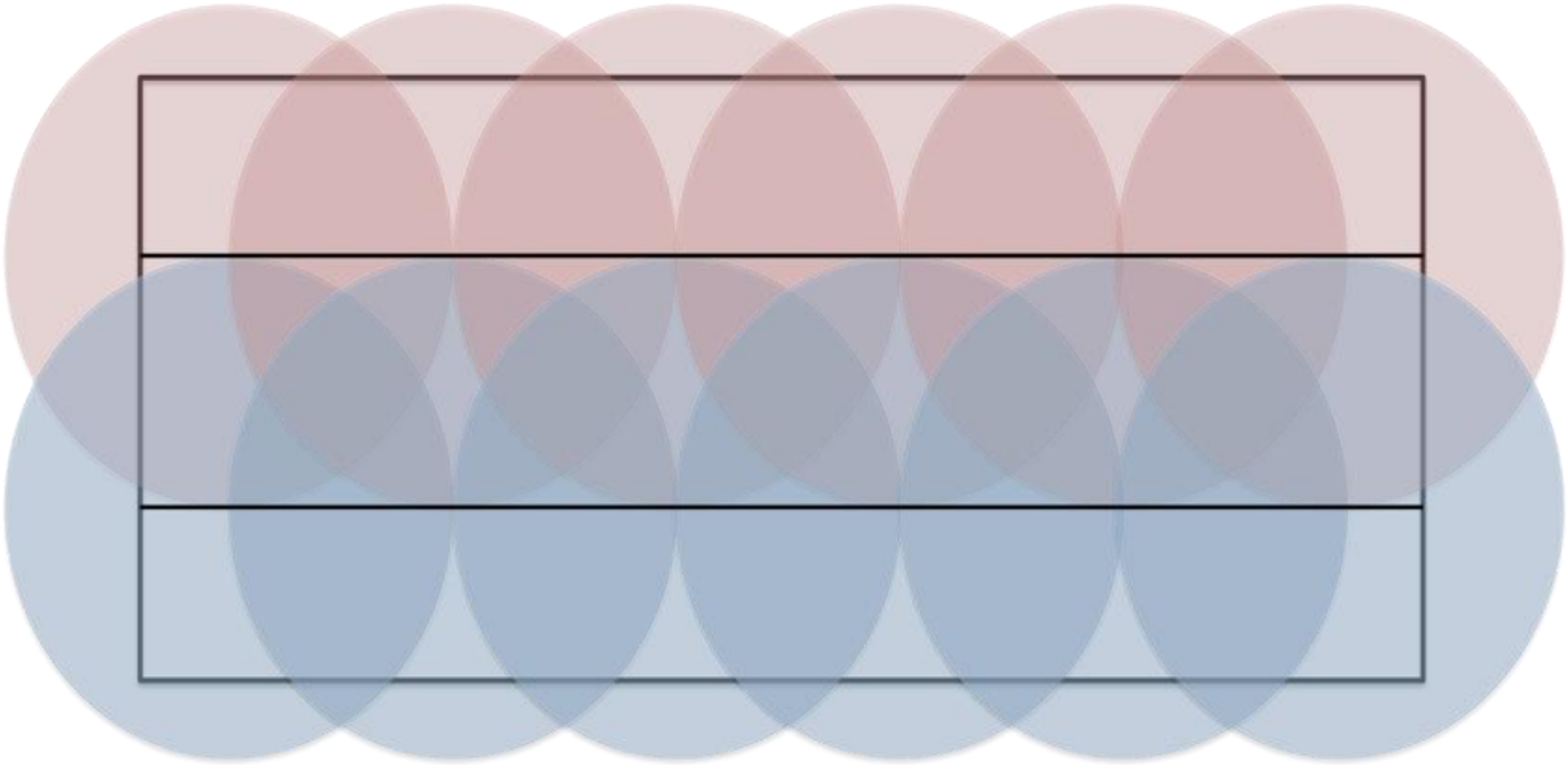
Options:

- 7 days @ 64 minutes
- 5 days @ 90 minutes
- ***3 days @ 150 minutes***
- 2 days @ 225 minutes

Soil Considerations



Layout Considerations



Crop Selection and Timing

- Any crop can be grown in a hoophouse. But should it?
- Select crops based on market value – high value growing space.
- Compare apples to apples:
  - $/ft^2/week
- Look for cold-hardy varieties
- Cool season crops
  - Spinach, kale, chard, arugula, lettuces, radish, carrots, beets, Asian greens
- Warm season crops
  - Tomatoes, peppers, eggplant, cucumbers, ginger, flowers

Crop Selection

- Work backwards from transplant, harvest, etc.
- Successions – make use of the valuable space!
- Rotations within a structure
- Rotations with movable structures
- Transplants for outdoor production
- Plant for the season

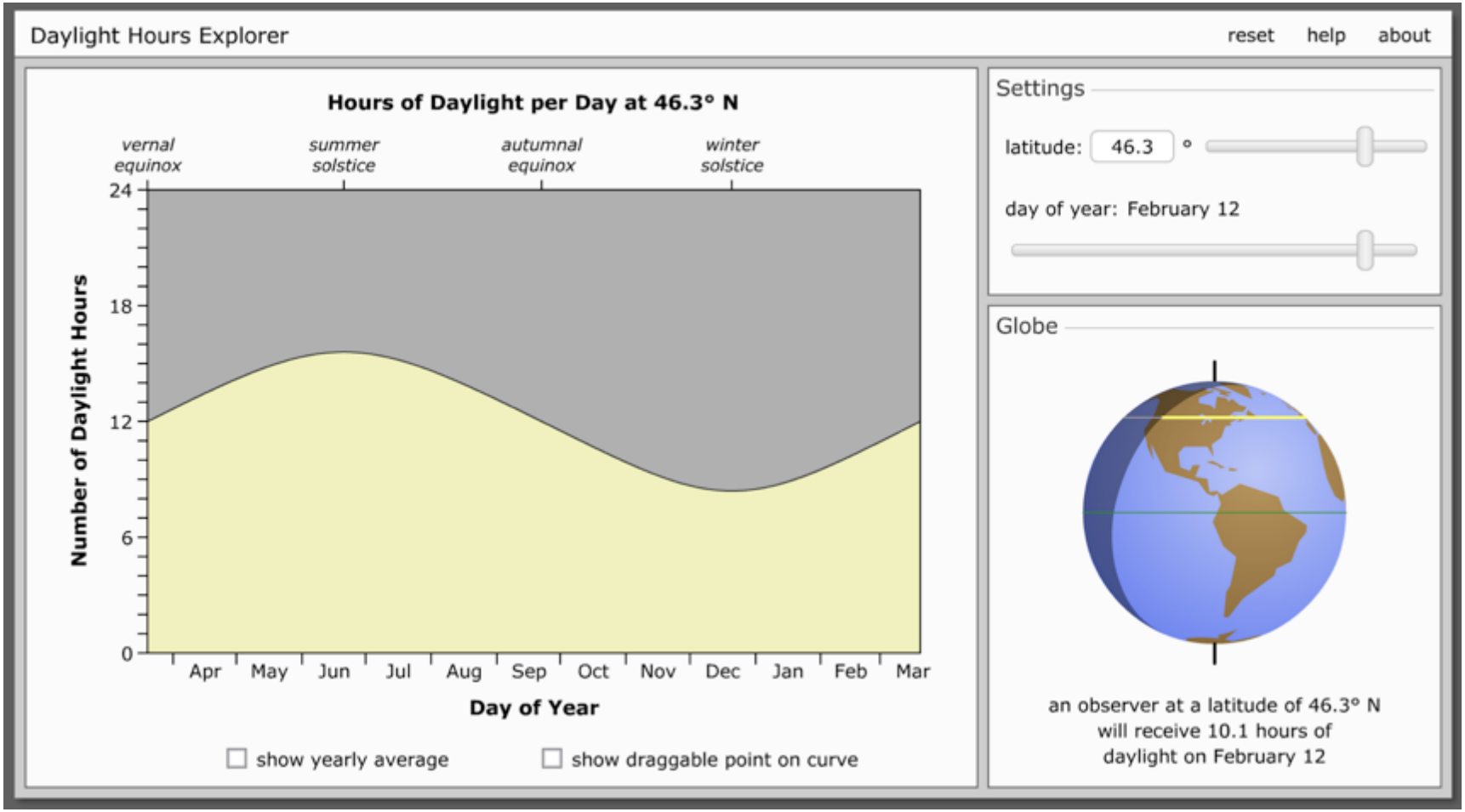
Crop Selection

- Spring
- Summer
- Fall
- Winter
  - Winter Production
  - Overwintered

Crops Selection and Timing - Spring

- Spring
  - First Direct Seeding/Transplant Date: Feb 15-March 1 (unheated)
  - Roots, Spinach, Baby Greens
  - 1-3 layers AG-19

Determining Daylight Hours



http://astro.unl.edu/classaction/animations/coordsmotion/daylighthoursexplorer.html

Spring Varieties

- Lettuce
  - Red – Skyphos, Refugio, Garrison, Salanovas, Red Tide
  - Green – Lettony, Winter Density, Salanovas
- Greens
  - Kales – Winterbor, Toscano, Dwarf Green Curled, Red Russian
  - Chard – Bright Lights, Ruby Red
  - Komatsuna (Carlton), Yukina Savoy, Mizunas, Mustards, Arugula
  - Spinach – Space, Corvair, Tyee
- Roots
  - Carrots – Mokum, Nelson
  - Turnips – Hakurei
  - Beets – Early Wonder Tall Top
  - Radish – Celesta, Rover, D'Avignon

Spring Varieties (minor)

- Kohlrabi
  - Quickstar
  - Kolibri
- Peas
  - Sugar Ann
  - Sugar Sprint
- Heading Greens
  - Bok Choy
  - Napa Cabbage
- Cilantro
  - Santo
- Fennel
- Chicories
- Scallions
  - Evergreen Hardy White
  - Deep Purple
- Leeks

Crops Selection and Timing - Summer

- Summer
  - Transplanted May 1-21
  - Tomatoes, Peppers, Eggplants, Cucumbers, Ginger, Turmeric
  - AG-19 as needed


ROSEMOUNT
FOOTBALL
I AM
SO
EFFING
STRONG.

Summer Varieties

- Tomatoes
  - Cherries – Sun Gold, Black Cherry, Indigo Cherry Drop
  - Grape – Nova, Five Star
  - Red Slicer – Geronimo,
  - Heirloom – Red Zebra, Green Zebra, Cherokee Purple, Brandywine, Amish Paste
- Eggplant
  - Jaylo, Angela
- Peppers
  - Islander, Red Knight, Ace, Gourmet, Canary Bell Carmen, Escamillo
- Cucumber
  - Corinto, Socrates, Diva, Tasty Jade
- Ginger
  - Bubba Blue
- Turmeric
  - Indira Yellow

Summer Varieties - Minor

- Squash
  - Dunja
  - SlickPik
  - Y-Star
  - Zephyr
  - Safari

- Beans
  - Rocdor
  - E-Z Pick
  - Velour
  - Fortex
  - Provider
- Basil
  - Genovese
  - Sweet Thai
  - Dark Opal

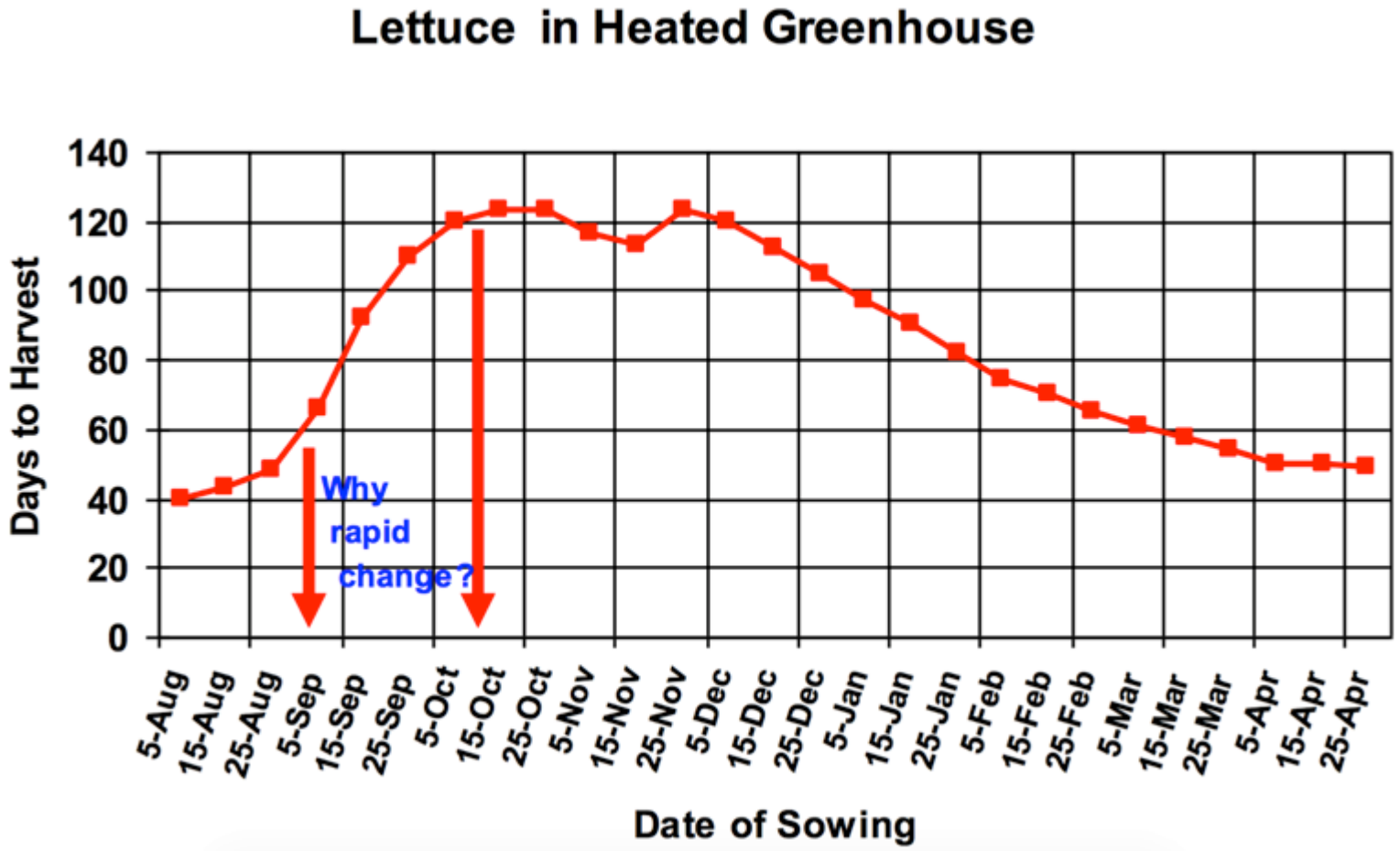
Determinate Tomato Trial

- Early Season
  - January 20 seeding
  - March 13 planting
- Heated Space
  - 50 degrees, early row cover
- Varieties
  - Gold Nugget, Washington Cherry, Celebrity, Oregon Spring, Polbig, Taxi

Crops Selection and Timing – Fall/Winter

- Fall Planted Baby Greens
  - Overwintered
    - Final Transplant Date: 11/15
    - Final Direct Seeding Date: 10/21
  - Winter Harvest
    - Final Transplant Date: 9/30
    - Final Direct Seeding Date: 9/7

Winter Lettuce Production



Groups of Greens

- Fast
  - Kales
  - Mizuna
  - Arugula
  - Mustards
- Slow
  - Lettuce
  - Mache
  - Claytonia

- Moderate
  - Beet
  - Spinach
  - Tokyo Bekana
  - Sorrel

Fall Varieties

- Lettuce
  - Red – Skyphos, Refugio, Garrison, Salanovas, Red Tide
  - Green – Lettony, Winter Density, Salanovas
- Greens
  - Kales – Winterbor, Toscano, Dwarf Green Curled, Red Russian
  - Chard – Bright Lights, Ruby Red
  - Komatsuna (Carlton), Yukina Savoy, Mizunas, Mustards, Arugula
  - Spinach – Space, Corvair, Tyee
- Roots
  - Carrots – Mokum, Napoli
  - Turnips – Hakurei
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  - Radish – Celesta, Rover, D'Avignon

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- Cilantro
  - Santo
- Fennel
- Chicories
- Scallions
  - Evergreen Hardy White
  - Deep Purple
- Leeks

Overwintered Varieties

- Lettuce
  - Red – Refugio, Garrison, Salanovas, Dark Red Lollo Rossa, Rouge D'Hiver
  - Green – Lettony, Winter Density, Salanovas, Sparx
  - Blends – Yankee Hardy, DMR Blend
- Greens
  - Kales – Winterbor, Toscano, Dwarf Green Curled, Red Russian
  - Chard – Bright Lights, Ruby Red
  - Komatsuna (Carlton), Yukina Savoy, Mizunas, Mustards
  - Spinach – Space, Corvair, Tyee
- Roots
  - Carrots – Napoli

Have the Right Protection!


AGRIBON+

Cold Weather Protection

Row Cover Impact on Greens Production (28 Days of Growth)

Inner Cover	Mizuna		Tatsoi		Salad Mix	
	Height (inches)	Weight (oz)	Height (inches)	Weight (oz)	Height (inches)	Weight (oz)
Plastic	7	5.9	5.5	6.9	4	2.8
Typar	4.75	3.7	4	0	2.5	0
None	2.75	0	4	0	1.75	0

Effects of row covers on plant

6 mil plastic

Typar (nonwoven polypropylene fabric)

No cover

CEFS

Low Tunnels

Frost protection versus light transmission		
Product name	**Frost protection**	**Light transmission**
Covertan CP-17	4°	90%
Agribon AG-19 Agrofabric Pro 17	4°	85%
Covertan CP-30	6°	80%
Agribon AG-30 Agrofabric Pro 30 Typar T-518	6°	70%
Agribon AG-50 Agrofabric Pro 50	8°	50%
Tufbell	10°	95%

Video Tour of The North Farm

Questions?

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