



# High Tunnels

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# Presentation Plan

- Overview of high tunnels
  - Construction
  - Management
    - Temperature
    - Irrigation
    - Pests
- Discussion and questions



# Season Extension

- refers to anything that allows a crop to be cultivated outside of its normal outdoor growing season.



# Opportunity

- Season extension and out of season growth
  - Maximum yield and increased quality
  - Less insect and disease pressure
- Organic
- Locally grown
- Specialty crops



# Ways to achieve an extended growing season

- Greenhouse
- High tunnel or hoop house
- Plastic mulch
- Row covers
- Cultural practices



# High Tunnel

- Resembles a conventional greenhouse
- Crops are grown in the soil
- Season extension
  - Spring earliness
  - Fall extension
- Protects crops from adverse environmental conditions



# High Tunnel vs. Greenhouse

- Greenhouse

- Electrical input
  - Exhaust fans, evaporative cooling, heater, circulation fans
- Crops usually grown in containers
- Usually permanent
- Cost \$\$\$
- Crops grown year-round

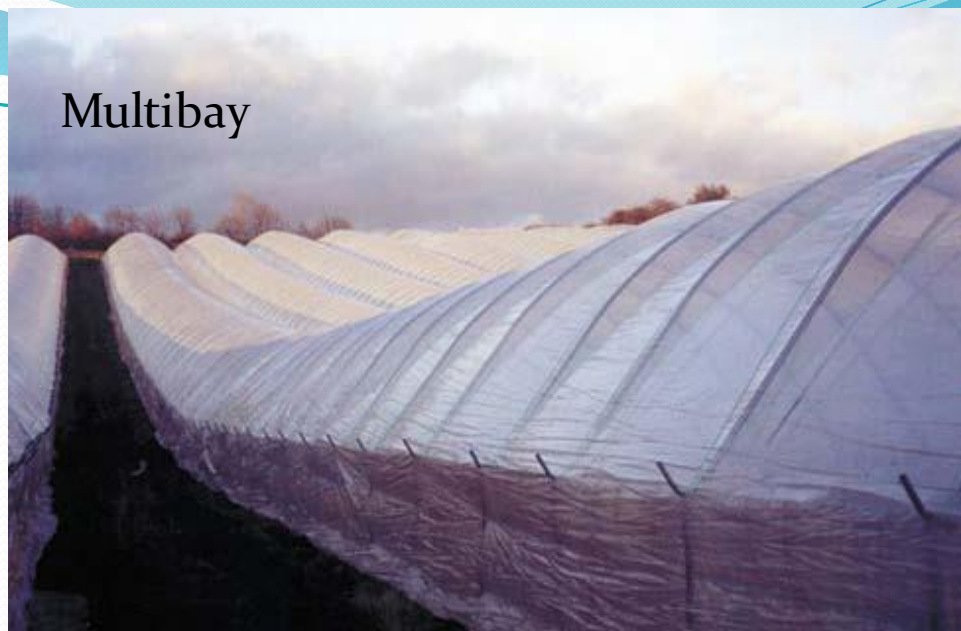
- High Tunnel

- No electricity
  - No automated systems - no fans, heater, controls
- Crops grown in the ground, conventionally
- Temporary
- Cost \$
- Functions to extend the growing season, limited

Single Bay



Multibay



**HIGH TUNNELS**



PVC



# Construction

- Metal
- Bows
- Purlins
- Ground Stakes
- Hardware
- Endwall braces
- Trusses





Brace →

Purlin →

Bow →

Ground Stake →

12.12.2002

# Getting Started

- Make sure you get what your suppose to get
- Good site
- Square up area
- Level where needed



$$A^2 + B^2 = C^2$$

$$\text{Ex. } 21'^2 \text{ W} \times 96'^2 \text{ L} = C^2$$

$$441 + 9216 = 9657$$

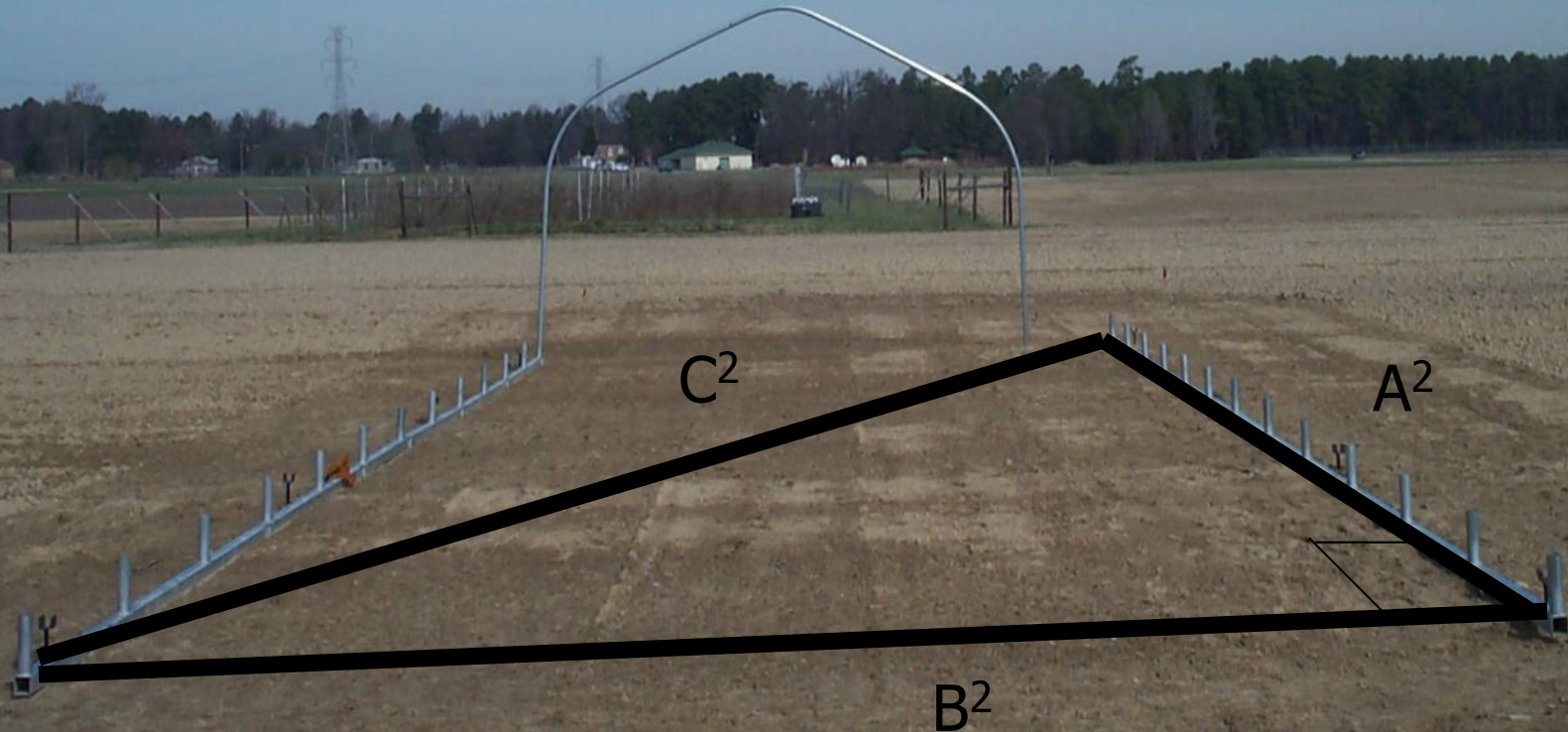
$$C = 98.3'$$

OR

Measure

the

Diagonals



String can be used for width and height guide



3.27.2002

# Ground Stakes



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10.14.2002





2.12.2002

# Baseboard, Hipboard, and Plastic Attachment

- Baseboard attaches to ground stake and bow
- Makes seal against ground
- Hipboard acts as base for poly attachment material



# Polyethylene Covering

- 6 mil
- 1 or 2 layers
- 4 year UV protected
- Greenhouse grade  
not construction  
grade
- Replaced every 4-5  
years







10.17.2002







# Endwalls

- Cover
- Framing
- Equipment movement
- People movement



# Side Curtain

- Cooling
- Roll up or down
- Usually 4-6'
- Manual
- Leaks



# High Tunnel Costs

- Materials = approximately \$3-4/SF
- Construction = \$1-2/SF
- Example
  - 26' x 96' round tunnel
    - materials \$8,735
    - construction \$3,744



# Management

- Environmental
- Irrigation
- Pests





# Environmental Management

- Temperature
  - Ventilation
  - Passive heating
- Light
  - Plastic layers
  - Shade cloth
- Humidity
  - Ventilation



# Temperature

- Most critical
- COLD and HOT
- Range optimums
- Can effect:
  - Yield
  - Crops growth
  - Nutrient/water uptake
  - Pollination
  - Fruit formation
  - pests

Crop	Growth stage	Optimum temperature (°F)	Maximum temperature (°F)	Threshold temperature for venting (°F)
Tomato	<i>Transplant-flowering</i>	70-75°F	85°F	75°F
	<i>Flowering-harvest</i>	70-75°F	85°F	65°F
Pepper	<i>Transplant-flowering</i>	70-80°F	85°F	75°F
	<i>Flowering-harvest</i>	70-80°F	90°F	75°F
Eggplant	<i>Transplant-flowering</i>	70-85°F	95°F	80°F
	<i>Flowering-harvest</i>	70-85°F	95°F	80°F
Cucurbits	<i>Transplant-flowering</i>	70-85°F	90°F	80°F
	<i>Flowering-harvest</i>	75-85°F	90°F	80°F
Leafy Greens	<i>Seeding-harvest</i>	60-65°F	75°F	55°F

# Temperature

- Venting ahead of the thresholds
- Closing curtains early
- Tall sidewall
- Ridge type vent
- Higher volume structure
- Shade cloth
- Know your crops



# Light Transmission

- Polyethylene sheeting
- Approximately 10% loss per layer
- Mostly 2 layers
- Shade cloth



# Pest Management

- Strategies slightly different in protected culture
- Less reaction time
- Exclusion
- IPM
- Beneficial Insect
  - Parasitoids
  - Predators



# Cut Flowers: Field vs. High Tunnel



## Why Grow Cut Flowers in a High Tunnel?

- Protection from rain, hail, and wind
- Season extension
- Can shorten production time
- Possible stem length manipulation
- Usually better quality
  
- “Hardening off” bedding plants

# Cut Flower Examples

- Snapdragons
- Lisianthus
- Stock
- Anemone
- Sweet pea
- Ranunculus
- Dutch Iris





# Snapdragon

- Can withstand cool temps.
- Winter and spring groups
- Harvest with 1/3 stalk open
- 6-8 weeks from transplant
- Don't lay on their side
- Potomac series















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# Lisianthus

- Keeps well for customers
- Think about buying plugs
- Need a layer of netting
- Mariachi and Echo series
- Maintain adequate moisture
- Add water soluble fertilizer through irrigation
- Harvest with 2-4 flowers open









5/21/05  
NO WHITE











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# Anemone

- Jerusalem series
- 4/5 and 5/6 size
- Day temps. <70° F
- Can handle slightly cooler temps. than ranunculus
- Frost fabric
- Well drained area
- Pre-germination treatment
- Approximately \$0.20 per corm



# Ranunculus

- La Belle series
- Well drained beds
- Do best with daytime temps.  $<70^{\circ}$  F
- Pre-germinate corms
- Plant corms with “fingers” down
- Frost fabric
- Approximately \$0.35 per corm



# Dutch Iris

- Blue and white varieties
- ‘Ideal’ and ‘White Wedgewood’
- Cut when “showing color”
- Want 20”+ stem length
- Little fertilization needed



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Thank You.

Questions?