

Season Extension



2022 Pilot

Small Farm Bootcamp Information

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Growing Small Farm Bootcamp is an eight module program helping small-scale farmers gain knowledge in production on their land. This curriculum was developed by the Growing Farm Capacity Work Group of the North Carolina Cooperative Extension Local Food Program Team. This program was developed and piloted in 2021.

Introduction to North Carolina Cooperative Extension

**We Grow
North Carolina
through
Education and
Research**



AGRICULTURE &
FOOD



HEALTH &
NUTRITION



4-H YOUTH
DEVELOPMENT



Learning Objectives

- Understand the advantages and disadvantages of season extension
- Recognize different types of season extension
- Develop base knowledge in management practices (irrigation, fertilization, weeds)
- Become familiar with the resources for purchasing and implementing season extension

Agenda

- What is season extension?
- Advantages and disadvantages
- Types of season extension/crops grown with each system
- General management (site selection, irrigation, fertilization, weed control)
- Season extension in your area
- Questions?

What is season extension?

“Anything that allows a crop to be grown beyond the normal growing season.”

Also considered “Off Season Growing”

Think-Pair-Share Activity

What challenges are you facing on your farm?

Do you think season extension could help alleviate any of these challenges?

**If you have not started a farm, try to think preemptively

Advantages

- Year round income
- Retention of customers
- Gain new customers
- Higher prices at times of year
- Higher Yield/Better quality
- Extended employment for workers

Disadvantages

- Less break in yearly work schedule
- Increased management demands
- Higher Production costs
- Plastic disposal issues

Two primary goals for extending growing and harvest season

Protect crops from extreme heat or cold damage

Enhance growth for quicker maturity and higher quality under adverse weather conditions



**Often one technique will affect more than one strategy – row cover protect the crop from a frost, but can also prevent the crop from pollination or proper hardiness.*

Types of season extension

- Cultivar selection
- Windbreaks and shade
- Transplants
- Plastic mulch
- Row covers/low tunnels
- High tunnel
- Cold frames
- Soil and moisture management (irrigation)



Soil and Moisture Management (irrigation)

Add organic matter

Tillage vs no-till

Raised beds

Drainage improvement



Irrigation

Overhead irrigation protects the crop from freezing

Increase/decrease water to enable tillage, aid in germination, root zone management

Water via drip & furrow can help to prevent frost damage on some crops



Windbreaks

Cold protection from winter winds

Shelters not only plants but also structures

May harbor pests or disease

May deter light or cast shade



Shade cloth

Varying weights and colors

- White, black, green, red, aluminet (reflective)

20% shade to complete black out

Can help control temperatures in conjunction with other methods



Transplants

3-4 week head start on season

Maximize germination

Earlier harvest

Jump ahead of weeds or diseases

Leaf canopy establishes earlier

Avoid other pests: birds, insects,
fungus



Shade

Creates a cooler microclimate

Prevents bolting

May hasten germination

Protect from intense sun



Can be done with permanent or annual plantings, vines on cattle panel, shade cloth, or full canopy

Cultivar Selection

Number of days from planting to maturity of harvest varies per cultivar

Some cultivars germinate better in cool soils

Stagger planting dates combined with use of cultivars extend one crop

Heat or cold tolerant varieties



Sanjun Gu

Cultivar Selection (cold tolerant, bolt tolerant)



Astro Organic Salad Arugula Seed

Product ID: 2015G

Early, heat tolerant.

A selection of standard arugula. Leaves are less deeply lobed and exhibit a more strap-leaf shape.

- Edible Flowers: Harvest the white flowers with dark-pink veins as they appear. Sprinkle them over salads or add to vegetable stir-fries. Flavor is spicy and nutty. Popular choice for brightening up salad mixes.

USDA Certified Organic. Avg. 15,200 seeds/oz. Packet: 500 seeds.

Less 
Johnny's Selected Seeds

Plastic Mulch for Season Extension

Enhanced plant growth
Temperature
Carbon dioxide

Reduced cultivation &
weed growth

Reduced fertilizer leaching



Plastic Mulch for Season Extension

Greater initial costs

Laborious removal and disposal

Increased monitoring



Types of Plastic Mulch for Season Extension

Black – absorber & radiator, 3-10°F higher

Clear – absorbs little but transmits 85-95% solar radiation

White or reflecting – slight decrease soil temp, -2° compared to bare

Infrared-transmitting – blue-green or brown (in-between black & clear for soil temp, <weed problem)

Red – like black; 12% increase in fruit yield in PA; conditions ideal no response

Installing Plastic Mulch for Season Extension

Puncture small holes
just big enough for
planting

Tractor mounted and
small scale options

Don't forget the
drip-tape!



Alternatives for Plastic Mulch

Biodegradable plastic – made of various formulations of wheat, potatoes, and corn starches

Paper – benefits similar to plastic

Recycled Kraft paper – low cost, break down so add hay

Planters paper – porous to water, low stretchability



Plasticulture for Season Extension

An integrated system that includes: plastic film mulches, drip irrigation tape, row covers, low tunnels, & high tunnels

- Reduced soil & wind erosion
- Potential decrease in some diseases & insects
- Fewer weeds
- Opportunity for multiple crop cycles
- Earlier crop production (7-21 days)
- Higher yield per acre (2-3 times)
- Cleaner produce
- Efficient use of water & fertilizer

Row covers and low tunnels

Two main types

1. Floating row covers: lie directly over the crop, may cover multiple rows
2. Hoop-supported row covers: sometimes referred to as low tunnels, cover a single row

Two types of materials

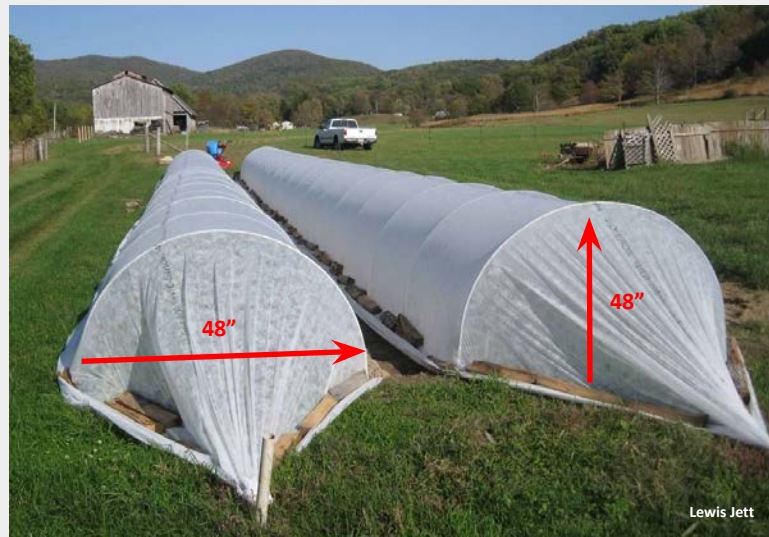
1. Clear polyethylene (plastic)
2. Spunbonded polyester or polypropylene (fabric)

◦

Row covers and low tunnels

Retain heat created during the day

Can increase temperatures from
2-10 degrees



Sanjun Gu

Lewis Jett

Row covers and low tunnels

Varying thickness = varying levels of protection

Impede pollination

Can also be used as insect barriers at lighter weights



Sanjun Gu

AdobeStock/tetiana

Row covers and low tunnels crops

Typically used with cold weather crops

- Cabbage, broccoli, cauliflower

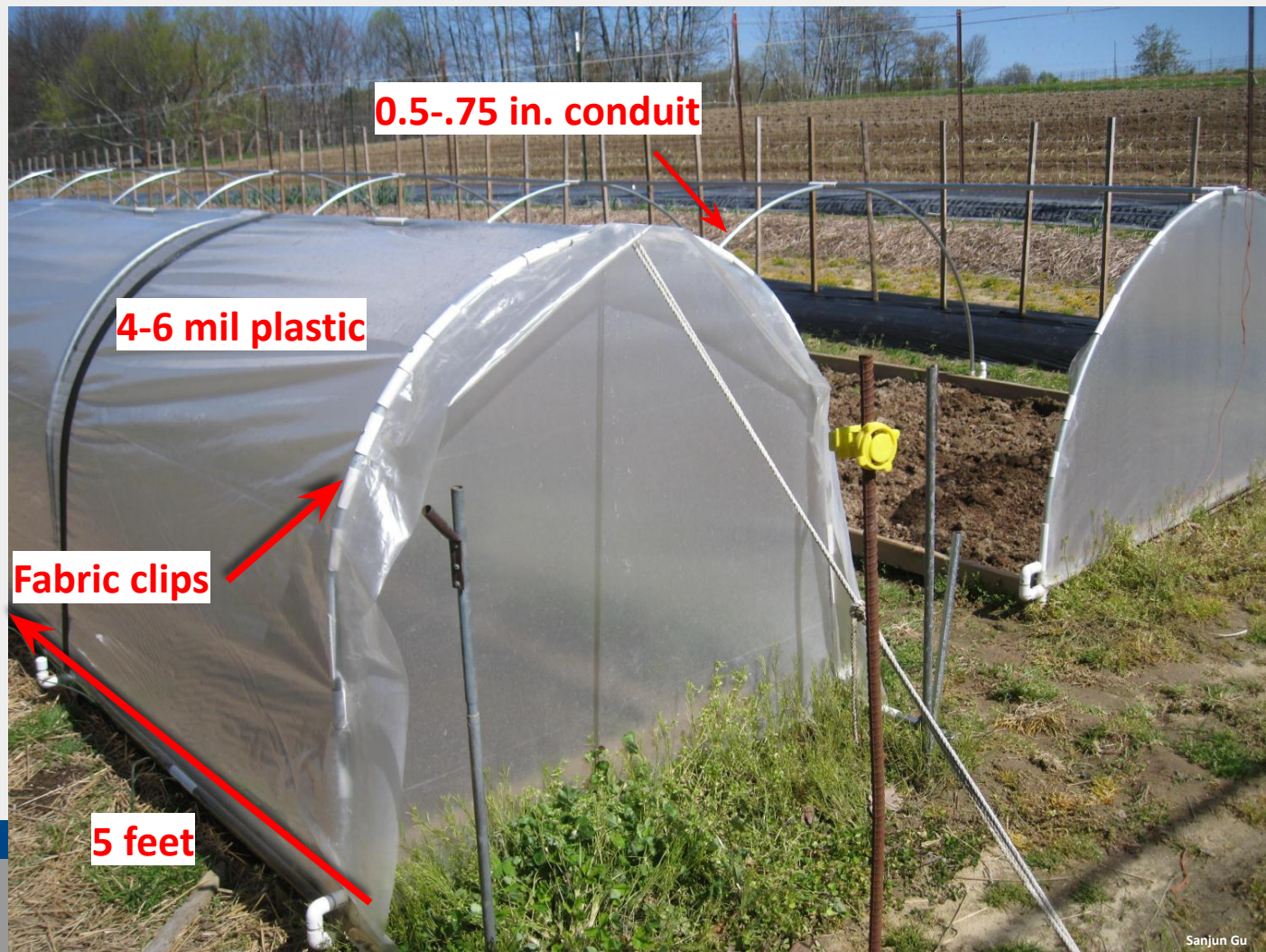
Popular with cut flower growers

- Examples - lisianthus, snapdragon, rudbeckia

Used in the spring along with plasticulture

- Strawberries, tomatoes, etc.





0.5-.75 in. conduit

4-6 mil plastic

Fabric clips

5 feet

Without row cover



With row cover



Credit: Steve Moore

Break



High tunnel

An arched or hoop-shaped frame covered with clear plastic

High enough to stand in or drive a tractor through

Solar-heated (no additional heating systems)

Often have roll-up sidewall curtains for ventilation

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Sanjun Gu

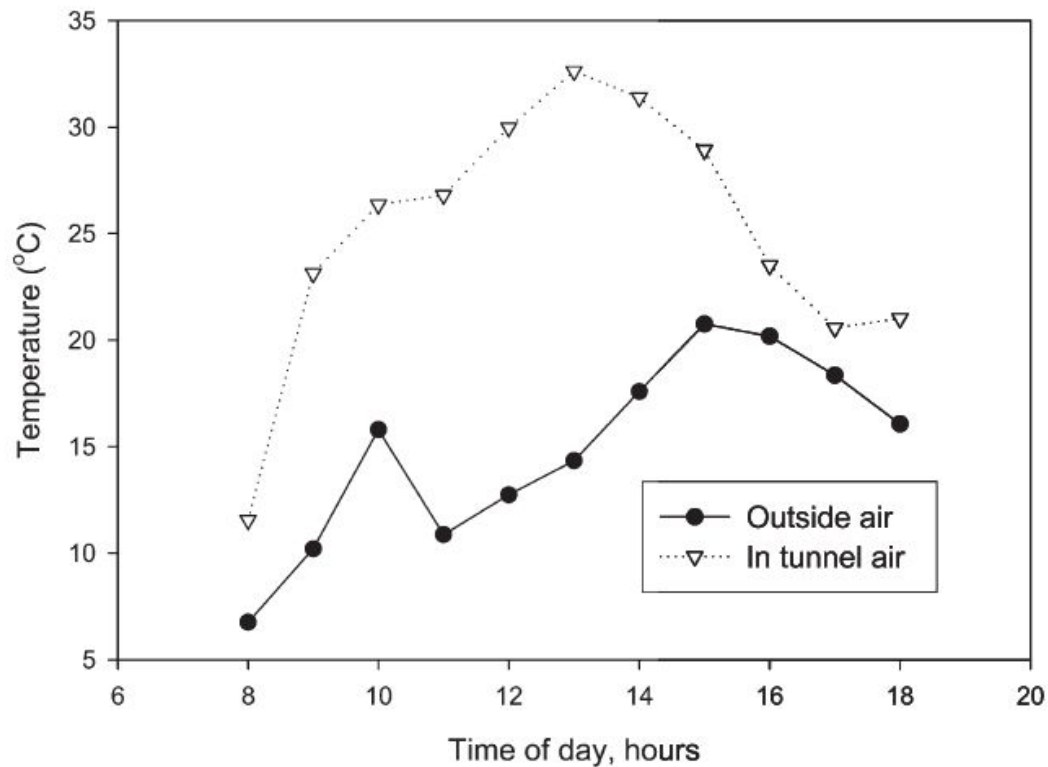
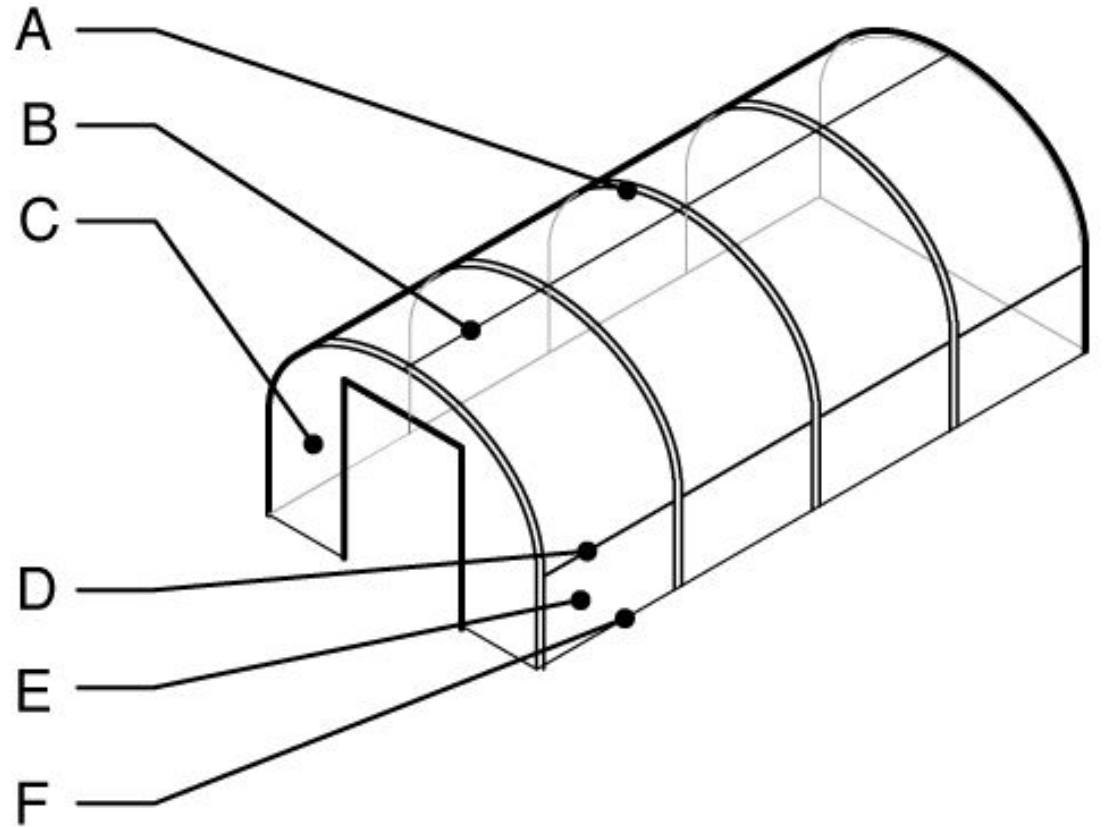


Fig. 1. Air temperature (°C) inside and outside a high tunnel on a sunny day in April 2006 in Ithaca, NY.

High tunnel

- A: Bow or Hoop
- B: Purlin or Ridge Pole
- C: End Wall
- D: Hip Board
- E: Side Wall
- F: Base Board

***Brace/truss to
strengthen structure***



High Tunnel Construction

Gothic vs Quonset

Gothic style:

- More expensive
- Greater height overall and especially near sidewalls
- Sheds snow



Photo credit cornell.edu

High Tunnel Construction

Wind can pull plastic off in a single gust

Not all designs are able to hold snow

Bracing may be needed to combat environmental concerns



Caterpillar tunnel

Bow or Hoop installed over pipe or bar driven into ground

Covering held in place by ropes/strapping

Open ended

More temporary/portable than high tunnels

Can be covered with polyethylene, frost blanket, insect netting or shade cloth



www.hightunnels.org

High Tunnel Covering

Polyethylene plastic

Sold by thickness in mils (1 mil = 1/1000 of an inch)

- 6 mil plastic for covering

Additives to plastic

- Ultra-Violet (UV) stabilizing
- Anti-fog surfactants
- Infrared (IR) radiation-blocking
- Photosensitive films



High Tunnel Covering

Double layer polyethylene

- Pros:
 - Better heat retention
 - If inflated protects high tunnel from wind
- Cons:
 - Lower light penetration
 - 2 times the cost of one layer



Sanjun Gu

High tunnel covering

Roll up or down sides critical for temperature control



Multi-bay high tunnels

- Wide expanse of protected area
- Not designed to hold snow
- Often used for perennial crops



Eric and Katherine Hanson

High Tunnel Sites

- North of 40° latitude;
ridge runs EAST to WEST
- South of 40° latitude:
ridge runs NORTH to SOUTH
- Other considerations:
Shading
Prevailing winds
Elevation



https://www.gedonlineclass.net/Curric/geo3longitude_and_latitude.htm

High Tunnel

- Higher quality crops
- Grow throughout winter
- Out of season produce yields higher prices



Kaitlyn Lamaster

High tunnel cropping

- In-ground or Container
- Plasticulture
- Cover crops
- Succession planting
- Interplanting
- Drip irrigation



High Tunnel Crops

- Higher quality crops
- Grow throughout winter
- Out of season produce yields higher prices

Planting Calendar for N.C. Coastal Plains

Category	Crop	Type	Jan			Feb			Mar			April			May			June			July			Aug			Sept			Oct			Nov			Dec		
			1	11	21	1	11	21	1	11	21	1	11	21	1	11	21	1	11	21	1	11	21	1	11	21	1	11	21	1	11	21	1	11	21	1	11	21
Cold season	Spinach, beets, turnips, tatsoi, pac choi, pea (shoots), Swiss chard, greens	Direct Seed																																				
		Harvest																																				
	Spinach, Brussels sprouts, kohlrabi, kale, cabbage, Chinese cabbage, tatsoi, pac choi	Transplant																																				
		Harvest																																				
	Carrot, green onion, potato, pea (pods)	Direct Seed																																				
		Harvest																																				
Cool season	Onion, garlic, leek, shallot, cauliflower, broccoli, lettuce, celery	Transplant																																				
		Harvest																																				
	Beans, sweet corn	Direct Seed																																				
		Harvest																																				
	Cucumber, muskmelon, summer squash, bell pepper, tomato, sweet corn	Transplant																																				
		Harvest																																				
Warm season	Eggplant, English cucumber, hot pepper, cherry tomato, okra, watermelon, ginger, turmeric	Transplant																																				
		Harvest																																				
Hot season		Transplant																																				
		Harvest																																				

Figure 4-3: Suggested vegetable planting calendar for coastal plains of North Carolina.

PAGE

High Tunnel Farming - Sanjun Gu, North Carolina A&T State University

Optimize growing space in high tunnels



Cold frames

Southern exposure

Unheated

- Increase 5-10°F

Harden off plants, start seeds early, or over-winter storage

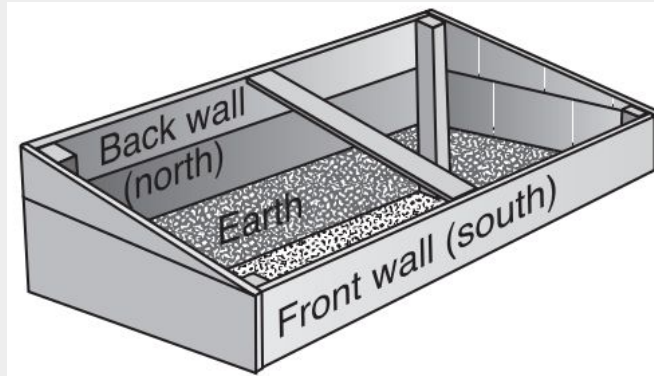


Figure 1. General structure of a newly built frame.



Managing Fertility in Covered Production

Typically a more intensive cropping system, needs more inputs than field production

Use soil tests, with testing for salt build up, to manage fertility

Cover crops are an option, even in high tunnels



Be careful of salt build up in the soil

Watch for salts, especially if using compost or manure based fertilizers with drip irrigation. Excess salts can negatively impact crop growth.

Ways to manage salt build up in the soil:

- Movable tunnels

- Remove plastic over the winter

- Flush soil using overhead irrigation

Disease Management in High Tunnels

- Management practices to reduce disease pressure:
 - Good sanitation practices - REMOVE DEAD and DISEASED plants
 - Irrigation
 - Ventilation
 - Variety selection
 - Crop rotation

Some common disease issues: Lettuce drop (*Sclerotinia sclerotiorum* and *S. minor*), powdery mildew, downy mildew, gray mold (*Botrytis cinerea*), leaf mold (*Passalora fulva*), soil-borne diseases

Pest Management in High Tunnels

Management practices:

- Scouting
- Pest exclusion systems (i.e. protect-net or shade cloth)
- IPM practices
- Use beneficial insects
- Physical removal
- Chemical treatment

Some common high tunnel pests: aphids, thrips, spider mites, white flies, tomato hornwoms



Season extension by region

Mountains

Piedmont

Coastal



Piedmont season extension

Used to overwinter/ get a jump
start on crops

A little bit goes a long way

Clay vs. sand



Mountain season extension

Extra cold protection may be needed

Double protection with high tunnel and low tunnel combo

Structures for winter production need to be designed to handle snow - gothic style hoops, extra braces, etc.



Charlotte Thurston, University of Minnesota

Mountain season extension

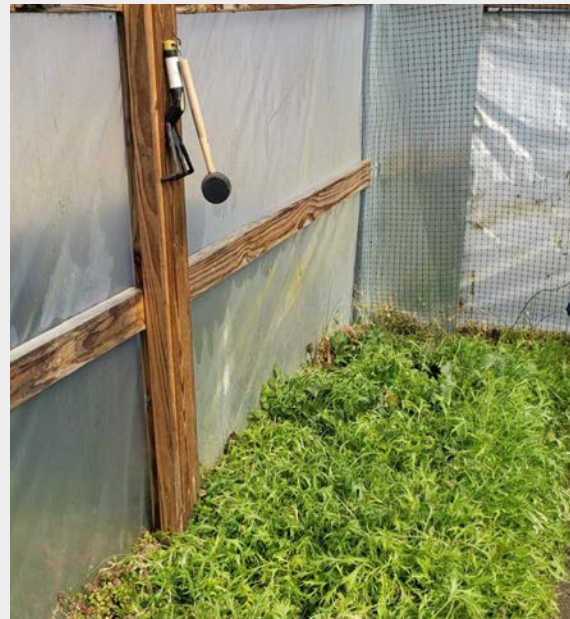
Low tunnels CANNOT handle snow

Covering must be taken off for winter



Coastal Season extension

- Soil types widely variable
 - Loamy sand, sandy loam
 - Wetlands - hydric
 - Blacklands - mineral.
- Some vegetable crops can be grown year round in the field
- Wiregrass, very common in this area can be very invasive along high tunnels walls.
 - A fast-growing cover crop planted densely around the inside perimeter of a high tunnel may be effective.
 - Maintaining a grass-free perimeter around the outside of the high tunnel



Coastal Season Extension

Cautions:

- Ventilation is critical in summer months
 - Automated side curtains
 - Louvered vents in top of endwalls
 - Horizontal air flow (haf) fans
- Insects present year round and thrive in protected climate.



Coastal Season Extension

- Protected culture:
 - High Tunnel
 - Caterpillar Tunnel
 - Row Covers
- Second layer of plastic can be beneficial for protecting high tunnel from wind damage
- Freeze Dates:
 - Last Spring: March 19- April 8
 - First Fall: October 27 - November 23



Obtaining season extension structures

High tunnels

- Environmental Quality Incentive Program (EQIP) -USDA NRCS
- High Tunnel Kits
- Second-hand
- DIY

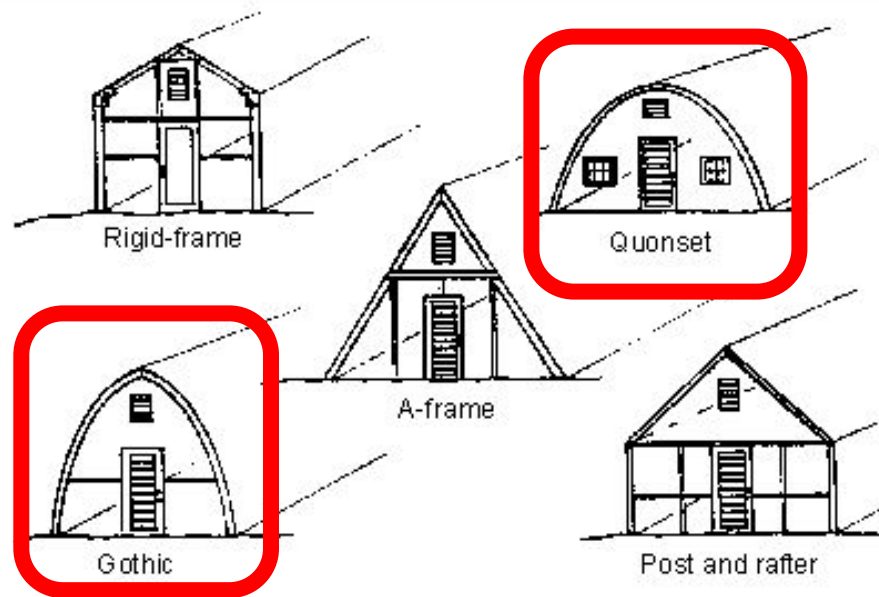


Figure 3. Greenhouses can have a variety of different structural frames.

Think-Pair-Share Activity

What are two season extension strategies you might use on your farm?

What are the advantages and challenges of using these strategies? (25 minutes)

Thank you!

Links for more information

N.C. A&T - High Tunnel Farming

- <http://online.fliphtml5.com/nbdy/vsse/#p=1>

ATTRA – Season Extension for Market Gardeners -

<https://attra.ncat.org/product/season-extension-techniques-for-market-gardeners/>

Season Extension: Introduction and Basic Principles (Growing Small Farms) -

<https://growingsmallfarms.ces.ncsu.edu/growingsmallfarms-seasonextension2012/>

Resource list (Growing Small Farms) -

<https://growingsmallfarms.ces.ncsu.edu/growingsmallfarms-seasonextensionlist/>