

Tips and Tricks for Growing Low Energy Annuals

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Where Greenhouse Operations Use Energy?

Annual Energy Use

- Heat 70-80%
- Electricity 10-15%
- Truck and Tractor 5-10%

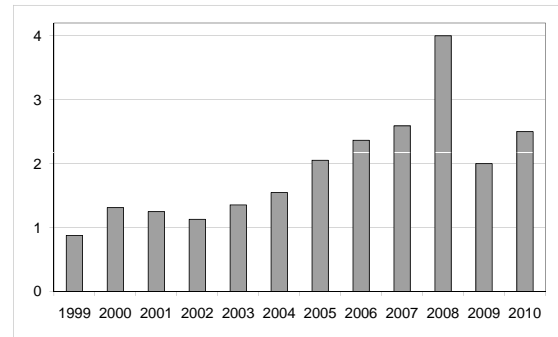
Source: John Bartok, University of Connecticut

How much will a gallon of gas cost by spring 2012?

- A) \$3 / gallon
- B) \$3.50 / gallon
- C) \$4.00 / gallon
- D) \$4.50 / gallon
- E) \$5.00 / gallon

The Problem: Rising Energy Costs

\$ for one gallon of #2 Fuel Oil



Source: U.S. Energy Information Administration <http://www.eia.doe.gov/>

Can you grow bedding plants and hanging baskets with no heat?



High Tunnels

- Used for season extension
- Some frost protection
- Much warmer day temperatures
- Ventilation required
- Protection from rain/elements



Rimol high tunnel, showing louvered vents in endwall, and roll-up sides

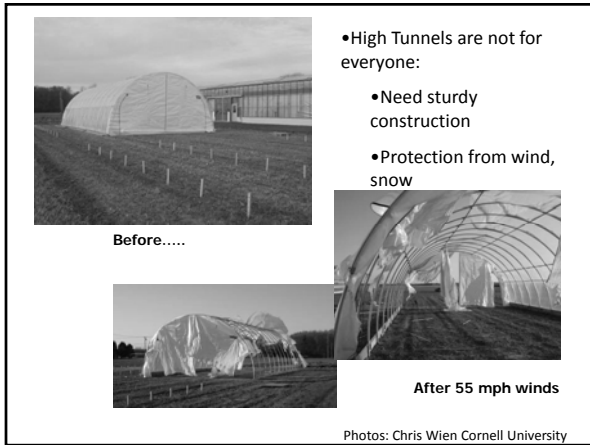
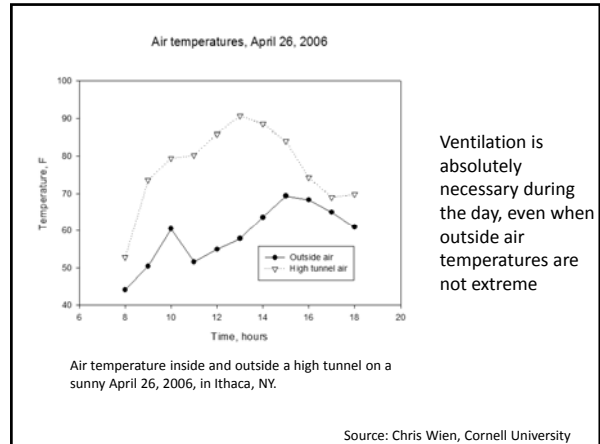


West Haven Farms, Ithaca, NY

Photos: Chris Wien Cornell University

High tunnels more info

- High tunnel = unheated poly-house or hoop house
 - taller and more uniform temp than a cold frame
- Cost to construct \$1-3 per square foot
- For overwintering plants typically adds 2 USDA hardiness zones additional protection
- Usually covered with a single layer of plastic
 - double layer may be used / or additional covering inside
- Some are erected on skids so that the structure can be moved during the production cycle



Do you currently grow **some** of your spring crop with no heat?

A) Yes, some
 B) Yes, all
 C) No, but minimal heat for some crops
 D) No

Finishing Bedding Plants in a High Tunnel

Cornell Trial

5 bedding plants
 Transplant April 1 into 4” pots

Target: Ready for Mother's Day

Temperatures April 1 – May 15

	Average	Minimum	Maximum
Greenhouse	66°	55°	89°
High Tunnel	61°	30°	107°
Outside	51°	26°	85°

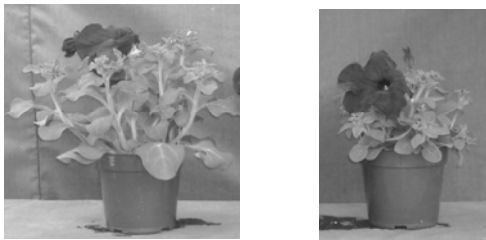


Which plant came from the High Tunnel?

- A) Plant on Left
- B) Plant on Right



Petunia 'Dreams Midnight'

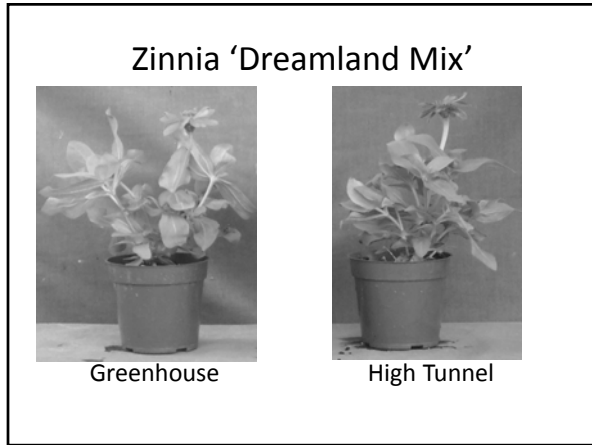
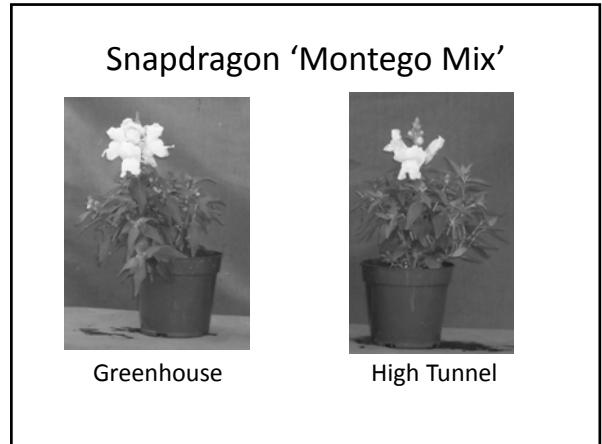
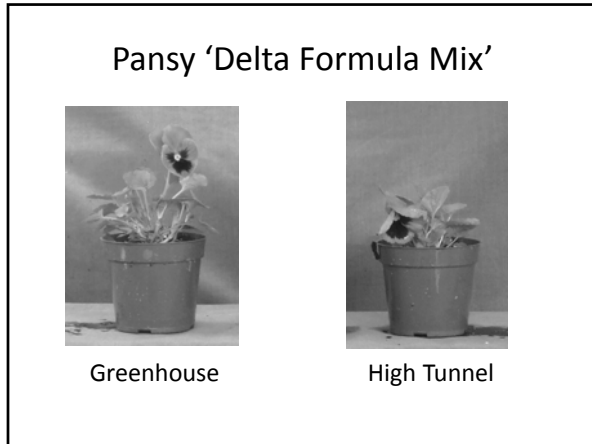


Marigold 'Safari Orange'



Greenhouse

High Tunnel



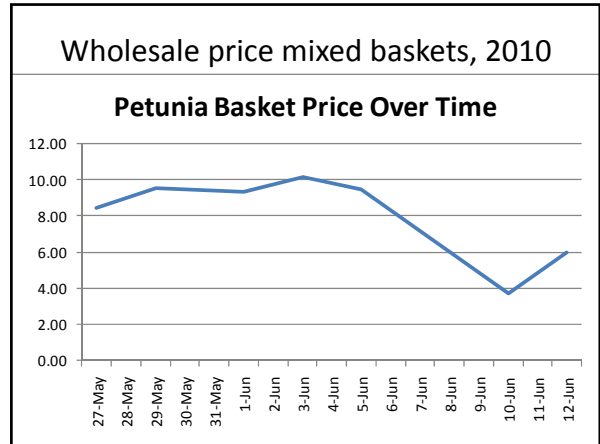
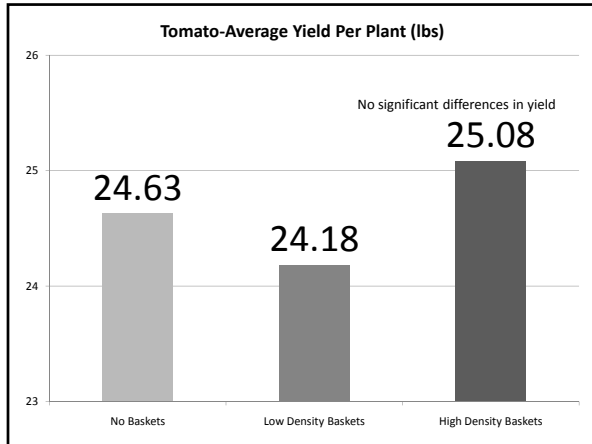
Finishing in High Tunnel
(avg flower date)

	Greenhouse flower date	High tunnel flower date
Marigold 'Safari Orange'	April 26	May 1
Pansy 'Delta Formula Mix'	May 9	May 10
Petunia 'Dreams Midnight'	April 29	May 4
Snapdragon 'Montego Mix'	May 4	May 11
Zinnia 'Dreamland Mix'	April 30	May 6

Plant Size (Fresh weight in grams)

	Greenhouse FW	High tunnel FW
Marigold 'Safari Orange'	46.6 g	47.0 g
Pansy 'Delta Formula Mix'	20.6	25.4
Petunia 'Dreams Midnight'	13.5	15.0
Snapdragon 'Montego Mix'	15.5	17.8
Zinnia 'Dreamland Mix'	14.3	12.1





More on hanging baskets

- Petunia 'Purple Wave' experiment
- transplanted on April 8
 - 144, 288, or 512 cell plugs
 - 12" pots had 3, 4, or 5 plants
- Fertilized weekly with 21-5-20 at 400 ppm N
- assessed marketability on May 27
 - flower #, plant width, visual index

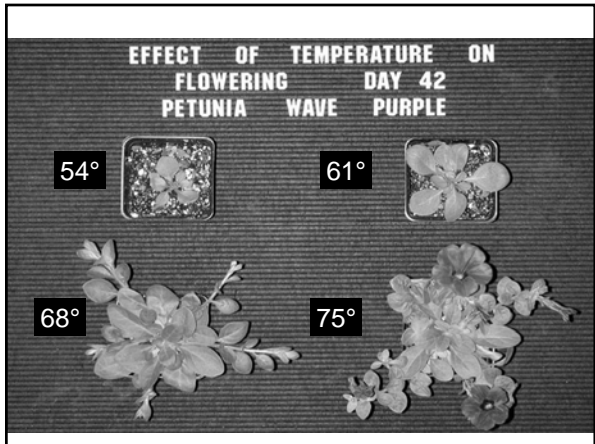
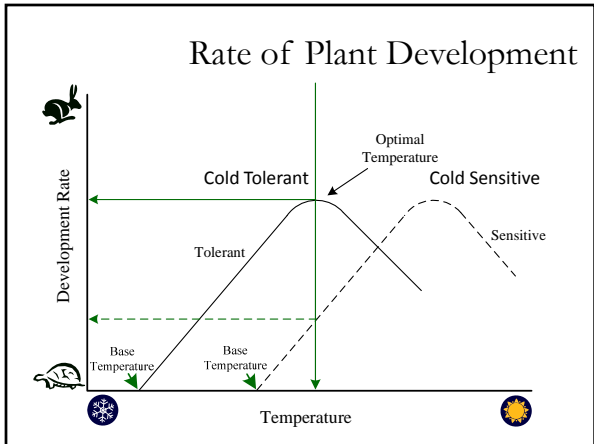
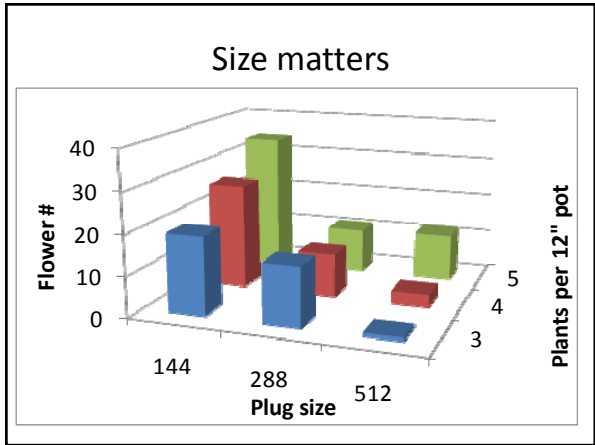
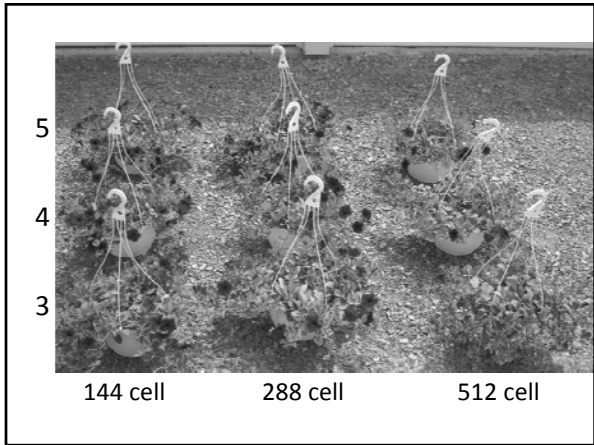
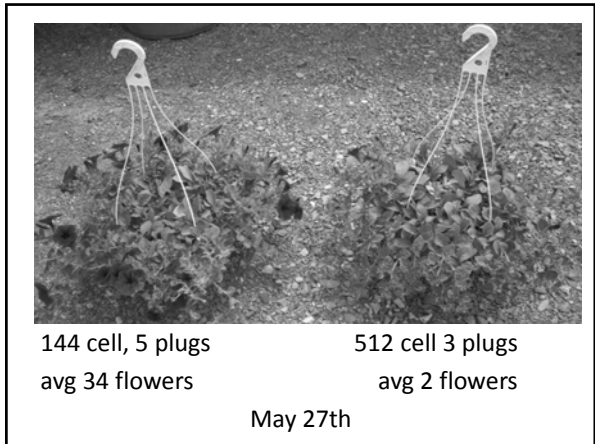
What plug size do you use for most your petunia hanging baskets?

- A) Liners
- B) 72-cell plugs
- C) 144-cell plugs
- D) 288-cell plugs
- E) 512-cell plugs



Does (cell) Size Matter?

A) Yes
B) No



Cold Sensitive Crops

- African violet
- Alocasia
- Angelonia
- Banana
- Begonia (fibrous)
- Blue salvia
- Caladium
- Hibiscus
- New Guinea impatiens
- Peppers
- Phalaenopsis orchid
- Poinsettia
- Purple fountain grass
- Tomato
- Vinca (*Catharanthus*)

Cold Tolerant Crops

- Ageratum
- Alyssum
- Broccoli
- Campanula
- Cineraria
- Cyclamen
- Easter lily
- Gaillardia
- Lettuce
- Leucantherum
- Marigold (French)
- Miltoniopsis orchids
- Nemesia
- Osteospermum
- Pansy
- Petunia
- Rudbeckia
- Scabiosa
- Schizanthus
- Thanksgiving cactus

Results from Penn State Trials (crop groupings)

72 Cell plugs from 15 species planted in 4" pots
Planted on March 10 and March 31

Which bedding plants are most suitable to high tunnels?

Source: Jay Holcomb and Robert Berghage GPN June 2010

Group 1

Plants that tolerated production in an unheated tunnel (0-1.5 wks)

- Dianthus
- Lavender
- Linaria
- Lobelia
- Pansy
- Petunia
- Stock

Greenhouse High Tunnel

Source: Jay Holcomb and Robert Berghage GPN June 2010

Group 2

Plants that tolerated production in an unheated tunnel but suffered greater delay (2-3 wks)

- Bacopa
- Calibrachoa
- Dusty Miller
- Osteospermum
- Snapdragon
- Thyme

Greenhouse High Tunnel

Source: Jay Holcomb and Robert Berghage GPN June 2010

Group 3

Plants that were intolerant of unheated high tunnel conditions
— delay 1-3 wks, but quality unacceptable

- Verbena
- Vinca

Greenhouse High Tunnel

*Note: for any type of plant, cultivars may respond differently!

Source: Jay Holcomb and Robert Berghage GPN June 2010

Should you consider high tunnels?

- Do you grow plants that need heat year round?
 - don't use for those plants (poinsettias, propagation)
- Do you have extra space
 - i.e. less crop turns per house than in a heated greenhouse
- Do you need to target specific ship dates?
 - If so, high tunnels are risky
 - If you retail out of your facility may be okay
- Can you handle the risk of frost?

If you need to heat year-round, consider:

Heating Cost to Produce 1 Million BTUs

- #2 fuel oil @ \$2.50 = \$24.0
- natural gas @ \$1.40 = \$18.6
- propane @ \$3.00 = \$43.2
- cooking oil @ \$1.50 = \$17.9
- corn @ \$5.40 = \$17.8
- hard coal @ \$180 = \$12.0
- wood pellets @ \$210 = \$16.0
- graded wood chips \$50 = \$12.5
- seasoned hardwood @ \$150 = \$12.5

Adapted from John Bartok, University of Connecticut

Install a thermal curtain

- Approximately 80% of heat is used at night
- Retractable curtains not only reduce heat loss but also increase plant temperature by reflecting IR
- Closed-weave curtains can reduce heat loss by 30 to 50% at night



Avoiding Risk

Under Bench Heating



temporary heating for cold nights





Solar Greenhouses in China



Be Creative - doesn't have to be a high tunnel





Based on this talk do you think you may trying growing more plants with no heat?

- A) Yes
- B) No, doesn't fit my space
- C) No, doesn't fit my schedule
- D) No, Neil is CRAZY

Trials planned for Spring 2011

- Does an earlier transplant date (ex: March 15) significantly improve high-tunnel finish date?
- Does secondary cover (reemay fabric) improve finish date and/or improve plant survival if exposed to frost?
- Does the commercial product, Freez-Pruf, improve plant survival if exposed to frost?
- Are controlled release fertilizers suitable for high tunnel bedding plants?

Resources

- www.hort.cornell.edu/hightunnel/
 - Business & Marketing → Example Crop budgets
- www.hightunnels.org
- <http://www.attra.ncat.org/>
 - search for high tunnels
 - also see video: Hoop Houses for Crop Extension

Thank you and any questions?

Northeast Sustainable Agriculture Research and Education – grant for hanging basket work

NYSFI Research and Education Fund – grant for bedding plant work

Wessels' Farms – plugs for Ithaca work

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www.greenhouse.cornell.edu