

# Toward year-round produce markets: Combining low-cost technologies for year-round production in high tunnels in the Gulf States

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# Our Research

- Testing internal row covers in high tunnels for winter production of warm season vegetables
  - None, Polyethylene, Frost Blanket, MasterScape
  - Two planting dates, three years
  - Model Crops: Tomato and Zinnia or Dianthus
  - Monitoring: air and soil temperatures, growth, yield, time and cost of activities

# Covers, crop layout, and temperature sensors



# Our Extension and Outreach

- Two on-farm tunnel sites
- Website
- Electronic Publications
- Field Days
  - March 2010 and 2011
  - NRCS Trainings
  - Fall Flower & Garden Fest
- Presentations



# Our Teaching and its Outcomes

- Two graduate students
  - Economics – nearing completion of M.S.
  - Production – M.S. Awarded 2011
- Tunnels used by undergraduate teachers for lecture and lab sessions
- Performance here led to funding of S-SARE funded M.S. student
- Train-the-Trainers: over 100 direct impacts

# Research Outcomes

- Production
  - 2010 tomatoes and zinnias survived until
  - coldest three days in Jackson history
  - 2011 harvested ripe tomatoes Jan. 3 after 18 F on three nights
  - Testing summer squash after tomatoes
  - Zinnias proving too sensitive to cool, switched to dianthus for 2011-12
- Environmental
  - Soil and air temperatures and growing degrees increased substantially by tunnels, less by row covers
- Economics
  - Tunnel construction averaging \$2-4 per sq. ft.
  - Construction labor a big expense; +/- 100 h each
  - Preliminary budgets completed, more data pending
- Papers at ASA, ASHS, SSAWG, Food Dist. Res. Soc.



# Magnitude of temperature changes in high tunnel and row cover systems

12/3/2009-12/31/2010

T	<u>OAT</u>	<u>None</u>	<u>POL</u>	<u>AGR</u>	<u>FB</u>	<u>MS</u>
MAX	57	16.6	16	15.9	15.7	16.2
MIN	<u>36.3</u>	<u>3.9</u>	<u>6.7</u>	<u>6.8</u>	<u>7.5</u>	<u>6.6</u>
AVG	45.4	7.1	8.4	8.4	8.7	8.3

1/5/2010

MAX	41.9	32.9	30.3	27.9	27.6	28.9
MIN	<u>15.1</u>	<u>6.4</u>	<u>11.9</u>	<u>12.2</u>	<u>13.8</u>	<u>12.5</u>
AVG	26.7	14.2	16.2	16.2	17.2	16.9

1/8/2010-1/10/2010

MAX	34.4	33.7	29.7	29.5	29.8	30.1
MIN	14.2	6.7	11.4	11.8	13.9	12.6
AVG	22.6	14	16.3	16.2	17.7	17.3

OAT – Outside air temperature; None - Control, no secondary cover; POL – Polyethylene; AGR – Agribon;  
 FB - Frost Protection Blanket; MS – Masterscape Ground Cover

Presented to ASHS Ann. Mtng., Aug. 2010

# Food Distribution Research Society

## Exploring the Potential for Increasing Revenues of Small Farms in Mississippi: Utilizing High Tunnel Technology for Market Season Extension.

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Department of Agricultural Economics

### ABSTRACT

This poster evaluates the potential for increasing revenues for small tomato farms in Mississippi, due to an extended marketing season. Using average production yields for high tunnel grown tomatoes and average historical price data from the Atlanta terminal market, a hypothetical case is developed to show potential for increasing crop revenues due to price differentials between early and late market windows and the traditional market window for Mississippi grown tomatoes.

### INTRODUCTION

- Mississippi is not known for fruit and vegetable production. Fruit and vegetable production in Mississippi ranks 11<sup>th</sup> out of the state's 13 reported agricultural commodities. However, commercial fruit and vegetable producers, mostly small scale, generated an estimated \$80 million, or 2% of the total value of agriculture, in the state in 2010. (1) Most of the fruit and vegetable growers in Mississippi are small scale operators with an average of less than 200 acres of production. (2)
- Small scale producers command a small share of the fruit and vegetable market and as a rule lack sufficient market power to impact price. Mississippi is a rural state with few large metropolitan areas. As such many growers are not located close to large concentrated population centers. Generally the producers sell product at local direct market outlets such as on farm markets, road side stands, and farmers markets. These markets typically provide better prices than the wholesale grocery markets available to many small scale rural producers.
- Producers selling at the wholesale level to grocery stores usually deal with the store's produce manager and compete with wholesale prices paid at regional terminal markets. Mississippi producers will generally be quoted prices similar to the reported daily average price paid at the Atlanta, Georgia, terminal market. Growers have little bargaining power when dealing with grocery produce managers due to the perishable nature of the produce and the grower's ability to source other produce supplies. Direct markets, such as farmer's markets, generally offer the grower higher prices for the produce sold but require more handling and time marketing the produce. Another problem small scale growers confront with at direct markets is over-supply of fresh produce at peak harvest time. In rural areas many consumers have home gardens or know someone with a home garden. These home gardens often flood the local markets at the peak harvest time, driving prices down.
- In theory, high tunnel technology allows growers to harvest produce earlier and later than traditional growing season harvest times. These early and late harvests allow growers to enter the market earlier and return later than traditional harvest times. This would allow growers to enter the market when the supply of tomatoes is restricted. As a such, high tunnel growers would be expected to receive higher prices than traditional field grown tomato producers.



A high tunnel is defined as a "free standing or gutter-connected covered structure, without heating or electrical power, using passive ventilation for air exchange and cooling, and an irrigation system for crop production" (MSU defines, 2010). The primary objective of high tunnels is to extend the crop season. The NRCES specifies some key advantages such as improved crop quality, an average of 4-6 weeks extended growing season, frost and insect protection, reduced nutrient and pesticide transportation, and compatibility with many production soils.

High tunnel systems help the crops withstand variations in temperatures. For instance, the prolonged periods of cool temperatures in northern states limits the growth of winter crops. Whereas in the mid-south, climatic conditions are favorable enough to grow winter crops, but sudden drops in temperatures put the crops in danger. These risks can be mitigated by utilizing low-cost high tunnels.

Research on high tunnels, initiated by the USDA and land grant institutions, examine the benefits of high tunnels. Previous and ongoing research, at Washington State University, Colorado State University, the University of Kentucky, Mississippi State University, and Cornell University, to name a few, indicates the potential importance of this technology. However, this research seems to lack interest among agricultural economists, whose assessments in terms of economies of size and efficiency are critical to the adoption decision process of end users (i.e. farmers—especially small scale farmers).

### DISCUSSION

The total estimated annual cost, both variable and fixed, per tunnel is \$2,633. (Table 1) Therefore, total cost per square foot is \$0.91, and total cost per ft. is \$0.43. The fixed cost was estimated using an initial investment of \$5,482 per 30 ft. by 90 ft. high tunnel (Table 2). It was estimated the tunnel would yield 307 twenty pound boxes of tomatoes.

Table 1. Estimated Total cost of production per 30' x 90' tunnel, Mississippi, 2010.

Item	Annual Cost/Tunnel	Cost/Sq.Ft.	Cost/ft.
Total Fixed cost	5,227	0.43	0.28
Total Raw materials/inputs	494	0.17	0.08
Total Labor cost	858	0.30	0.14
Interest on Operating capital	54	0.02	0.01
<b>Total Cost</b>	<b>2,633</b>	<b>0.91</b>	<b>0.43</b>

(1) Mississippi Statistical Budget for High Tunnel Tomato Production - 6 November, 2011

TABLE 2. HIGH TUNNEL (30' X 90') PURCHASE PRICE, USEFUL LIFE, AND ANNUAL FIXED COST

Item	Purchase Price	Useful Years	Annual Depreciation	Interest	Tax and Insurance
High Tunnel Material	3744	10	374	150	75
Irrigation/Fertilization	1275	5	255	51	26
Thermometer	20	5	4	1	0
Back pack sprayer	100	5	20	4	2
High Tunnel Insulation	343			14	
<b>Total</b>	<b>5482</b>		<b>653</b>	<b>219</b>	<b>103</b>
Other Fixed Costs					
Electricity	42				
Telephone	100				
Repairs and Maintenance@25%	110				
<b>Annual Fixed Cost (Ownership Cost)</b>					<b>1227</b>

(1) Mississippi Statistical Budget for High Tunnel Tomato Production - 6 November, 2011

Weekly price data, for fresh market 25 lb. boxes of vine-ripe tomatoes, were collected for the Atlanta terminal market. The data covered a 10-year period beginning January 2001 and ending December 2010. Weekly price data were converted to monthly average price per pound and used to construct the 10-year monthly average price trend graph.

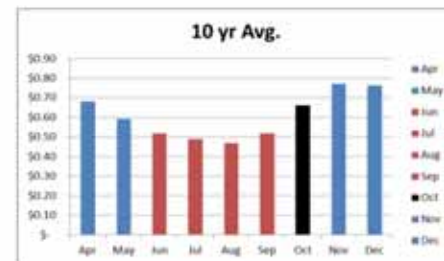
Traditional harvest for field grown tomatoes in Mississippi begins the last week in May and ends the last week in July. Fall crop tomatoes begin harvest the last week in September and ends with first frost, generally third week of October. High tunnel production allows harvest to begin the first week in May for the spring crop while high tunnel systems can extend fall crop harvest into the second week of December in Mississippi.

A 10-year price trend graph shows the 10-year average monthly prices, per pound, received for tomatoes at the Atlanta, GA, terminal market, 2001 through 2010. The 10-year average prices paid for tomatoes was consistently higher prior to and post traditional harvest periods in Mississippi.

The 10-year average price paid for tomatoes during the traditional harvest period for Mississippi, depicted by red columns on graph, is consistently at or below \$ 50 per pound. The black column represents a crossover month when traditional field grown tomatoes can be harvested depending on temperatures. The blue columns represent the possible season extended periods for tomatoes grown utilizing the high tunnel technology. The prices received at the Atlanta terminal in the months depicted in blue were consistently higher than the traditional harvest time prices.

### ATLANTA TERMINAL PRICE PATTERNS

Monthly Average Price per Pound for Vine-Ripe Fresh Market Tomatoes 10-Year Price Trends: 2001-2010



Source: USDA, ARS, Fruit and Vegetable Market News, <http://www.ars.usda.gov/mnsw/>

### CONCLUSION

The possibility of entering the market earlier and producing later into the fall merits further study. Small scale tomato producers in Mississippi may be able to increase revenues due to higher prices if they are able to enter the market earlier and later than the traditional market window for Mississippi field grown tomato production. It appears from the historical price data associated with the Atlanta terminal market that high tunnel technology could provide producers the access to market windows traditionally unavailable to Mississippi tomato producers.

### REFERENCES

- (1) Mississippi Table of Production Estimates December 2010, Division of Agriculture, Forestry and Secretary of State, Mississippi State University.
- (2) USDA, 2007 Census of Ag.
- (3) Unpublished enterprise budgets for high tunnel tomato production in Mississippi, 2011. <http://www.msstate.edu>

### ACKNOWLEDGEMENTS

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# Extension and Outreach Outcomes

- Web
  - [www.msucare.com/crops/hightunnels](http://www.msucare.com/crops/hightunnels)
  - [twitter@npkveg](https://twitter.com/npkveg)
- Publications
  - 6 Electronic/PoD
  - Popular: Delta Farm Press, Mississippi Farming, The Meteor, LandMarks, Farm Week....
- Grower site development
- Trainings, workshops, field days
  - Train the trainer, grower, student, gardeners, new growers
  - Chief White and Sec. Merrigan
- Total direct contacts exceed 7,000 in USDA FY 10 and in FY 11

# MSUCARES.com/crops/hightunnels

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Insects-Plant Diseases-Pesticides-Weeds

**High Tunnel Crop Production Project**

High tunnel is low-cost version of a greenhouse that most people are familiar with. The definition of high tunnel was given as a freestanding or gutter-connected covered structure, without heating or electrical power, using passive ventilation for air exchange and cooling, and an irrigation system for crop



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start

2 Nov... 7 Micr... 2 Micr... High Tu... Microsof... Adobe A...

Internet 100% 9:06 AM

# Local Impacts

- More than 100 High Tunnels in Mississippi
- Growth in vegetable industry
  - Farmers Markets, Direct Sales, Specialty Crops
- Growth in local production/availability
  - Dozens of new farmers!
- Information exchange with growers, NRCS, MSU, and urban farms/community and school gardens
- Visibility for MSU and USDA from the project
- Elevated perception for Truck Crops Branch
- Leveraged Funds

Funding (\$)	Title	Funding agency
15,000	Year-round production in high tunnels: crop selection, scheduling and culture	USDA SCBG
22,530	Investigation of different high tunnel systems for specialty cut flower production in	USDA SCBG
42,350	Specialty Cut Flower Risk Management Education in the Mid-South	USDA S-RMA
15,000	Investigation of best management practice for specialty cut flower production in	USDA SCBG
149,812	US-China Partnership for Strengthening Research, Education and Extension in Season Extension Production and Marketing	USDA ISE
43,700	Investigation of best management practice for specialty cut flower production in	MAFES SRI
2,000	Season Extension Technology for Sustainable Production of Specialty Crops	ORED
28,500	Organic Production of Specialty Crops in High Tunnels	USDA SCBG
496,921	Toward year-round produce markets: Combining low-cost international technologies for year-round production in high tunnels in the	USDA-CSREES-NRI
15,240	Organic production and subsequent field performance of greenhouse-grown seedlings and transplant	MAFES SRI
15,000	Year-round production in high tunnels: Crop selection, scheduling and culture	USDA SCBG
54,984	Investigation of fertility management to improve nutrient use efficiency in high tunnels	MAFES SRI
<b>Total \$901,037</b>	<b>12 grants awarded</b>	

# USDA Challenge Area

## Impacts

- Keep American agriculture competitive while ending world hunger
  - Our temperature data being presented at scientific meetings is among the most detailed to date anywhere
- Improve nutrition and end child obesity
  - Many Mississippi, Arkansas and Tennessee tunnels are being built in rural areas, and bringing food to the “fattest” states in the nation
  - Spin off projects and relationships helping school and rural clients
- Radically improve food safety for all Americans
  - Indirect impacts?
- Secure America’s energy future through renewable biofuels
  - N/A
- Mitigate and adapt agriculture to variations in climate
  - High tunnels proving valuable in this. Our data is yielding formulate scientifically-sound recommendations. Grower cooperator has bought three tunnels and has first season tomatoes in his county now

# Pending Milestones

- Additional temperature and yield data
- Final Enterprise budgets
- Web cam installation – local tech challenges
- Completion of graduate education
- More field days
- Refereed publications, more outreach publications

# Intended Future Impacts

- Provide sound information for production and economic science of high tunnels
- Continue to serve local growers and be a significant part of the growth in local food systems in the Gulf States
- Add value and relevance to MSU agricultural programming

