

# Evaluating No-till Tomatoes within a High Tunnel in West Virginia

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## Introduction:

Tomatoes are the most widely grown vegetable crop in high tunnels across the U.S. In West Virginia, high tunnels are used primarily for early season tomato production. High tunnels facilitate earlier planting and protect the crop from extremes in precipitation and temperature. Heirloom tomatoes, many which have an origin in Appalachia, are very difficult to grow in open-field conditions due to significant fruit cracking and disease. Heirloom varieties, which are most indeterminate types, have better flavor than traditional hybrid tomatoes. The reason heirloom tomatoes are not widely grown for commercial production is that they are believed to have lower marketable yields relative to hybrids. If the marketable yields of heirloom tomatoes are significantly increased, high tunnels could be the optimal controlled environment structure for production.

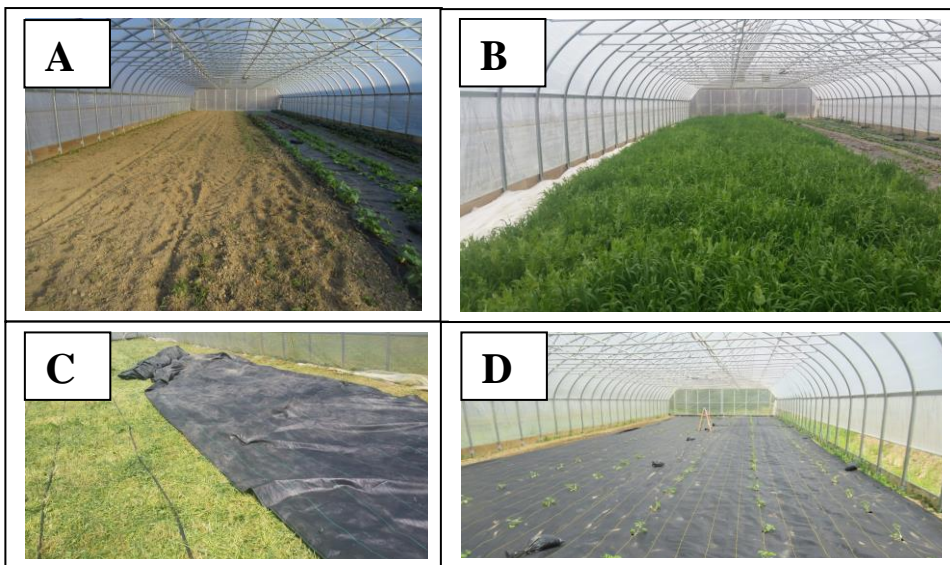
Tillage is routinely performed in high tunnels which use a soil-based growing system. For each crop, the soil could be tilled at least three times. No-till production using cover crops and minimal tillage would be beneficial to the soil health within high tunnels.

The objective of this research project was to evaluate a mixture of heirloom and hybrid slicing tomato varieties within a high tunnel using a no-till production system.

## Materials and Methods:

Eleven tomato varieties were seeded in 288-cell trays filled with *ProMix* Organic media on February 15, 2018 (Table 1). The tomatoes were transferred to 4.5-inch diameter pots after 4 weeks and grown for an additional 5 weeks in the WVU Greenhouses in Morgantown, WV. The plants were grown as organic transplants and fertilized with 2-4-1(200 ppm N) fertilizer each week. The high tunnel used for this evaluation was a 30 ft. x 96 ft. high tunnel which had been seeded in winter cover crops (triticale and winter pea) the preceding November. The soil in the

high tunnel was a silt loam with a pH of 6.6. The cover crops were allowed to grow through the winter. In early April, 2018 the cover crops were mowed with a string trimmer. A light top dressing of feather meal fertilizer (13-0-0) was applied (0.7 lbs. /100 ft<sup>2</sup>), and a 4 mil black landscape fabric was placed over the cover crop residue. The fabric was pinned with 6 inch sod staples. Two weeks later, the tomato plants were planted on April 20, 2018 by cutting planting holes in the fabric and planting with a bulb planter. A 4-inch soil core was removed and the tomato transplant placed in each hole and back-filled with compost. Each tomato was planted 30 inches apart with rows 48 inches apart. The tomato varieties were planted in plots containing 3 plants. The plots were randomized within 4 blocks with each row serving as a block within the high tunnel. From May 15 onward, conventional fertilizers were used to provide supplemental nitrogen and potassium to the tomato crop. The crop was irrigated 3 times per week and fertigated with calcium nitrate, potassium nitrate, and Epsom salt each week through harvest. Beginning at flowering, the tomatoes were pruned to 2 stems and trellised using clips and string. Harvest commenced on July 10, 2018 and continued through October. However, for data collection, harvest was recorded from July 10 through September 20, 2018. Each tomato was graded as U.S. No. 1, U.S. No. 2 or culls and weighed. At mid-harvest, soluble solids were measured for each cultivar.



**Figure 1** **A.** Cover crop seeding in early November; **B.** Cover crop growth in early spring; **C.** Tarping the cover crop in early April; **D.** Planting tomatoes 2 weeks later.

Nine varieties were evaluated in Fayette County, West Virginia in a commercial high tunnel. The varieties were planted 30 inches apart on rows with a 48 inch center. Marketable yield was measured on each variety by grading the tomatoes into No. 1 and No. 2 categories.

**Table 1.** Varieties of hybrid and heirloom tomatoes evaluated in 2018.

Variety/Cultivar	Days to Harvest	Source	Comments
Big Beef	73	Johnny's Seeds	Hybrid red slicer variety
Caiman	80	High Mowing Seeds	Hybrid red slicer variety
Brandywine	80	Baker Creek Seeds	Pink fruit; heirloom beefsteak
Cherokee Purple	72	Baker Creek Seeds	Heirloom purple/black fruit
Kellogg's Breakfast	80	Baker Creek Seeds	Heirloom yellow beefsteak
Mortgage Lifter	85	Baker Creek Seeds	Heirloom pink beefsteak
Mountaineer Pride	80	WVU	Hybrid variety with late blight resistance
Mr. Stripey	80	Sow True Seeds	Striped or bicolor variety
Pineapple Premiere	80	SeedWay	Red/yellow heirloom
Striped German	78	Johnny's Seeds	Red/yellow heirloom
Willard Wynn	80	Sustainable Mountain Agric. Center	Red/yellow heirloom

**Results:**

Approximately 8 weeks after transplanting, harvest commenced. Marketable yield of tomatoes were recorded over a 10 week period. 'Big Beef' has been a popular hybrid tomato for high tunnel production. However, this cultivar will have yellow shoulder disorder. Any symptoms of yellow shoulder were classified as a cull and unmarketable. 'Big Beef' produced the highest marketable yield of all cultivars evaluated, but also had significantly more yellow shoulder. 'Caiman' is a greenhouse hybrid tomato cultivar, and in this trial had significantly higher yield than the majority of heirloom varieties. 'Caiman' had a similar fruit size to 'Big Beef' but brix and informal flavor evaluations indicated that flavor was not as high as 'Big Beef' (Table 2). 'Caiman' also has tolerance to leaf mold which could be a devastating disease of high tunnel tomatoes. No leaf mold was observed with any tomato variety grown in 2018. 'Mortgage Lifter' is a native heirloom variety in West Virginia. While there are at least a dozen strains of 'Mortgage Lifter', the Logan County, West Virginia strain has a large, pink fruit with smooth skin and excellent flavor and yield (Table 2, 3). 'Mortgage Lifter' was the highest yielding heirloom tomato variety in this trial in both locations with approximately 20 lbs. of marketable fruit per plant and over 80% marketable (Table 2, 3). 'Mortgage Lifter' did exhibit

magnesium deficiency on the lower leaves of the plant which was treated with MgSO<sub>4</sub>.

‘Brandywine’ is a popular heirloom variety and had excellent fruit quality in this trial.

‘Brandywine’ typically exhibits significant fruit cracking when grown in the open environment, but almost no cracking was observed in this trial.

‘Kellogg’s Breakfast’ is a yellow/orange beefsteak heirloom native to West Virginia. This variety was soft, but had excellent yield and flavor.

Four striped varieties were evaluated and included ‘Mr. Stripey’, ‘Pineapple Premiere’ ‘Striped German’ and ‘Willard Wynn’. Striped or pineapple varieties add color diversity to tomato sales.

‘Striped German’ had the highest marketable yield but was not the most flavorful, striped tomato. ‘Pineapple Premiere’ produced a large fruit with excellent flavor. ‘Mr. Stripey’ had a ‘significantly high No. 2 yield. ‘Willard Wynn’ produced large, striped fruit with excellent flavor.

‘Mountaineer Pride’ was not productive in this trial. ‘Cherokee Purple’ is an early maturing heirloom tomato and produced an excellent flavored fruit but was extremely soft with fruit green shoulder. ‘Mountaineer Pride’ had variable size and significant amount of radial cracking.

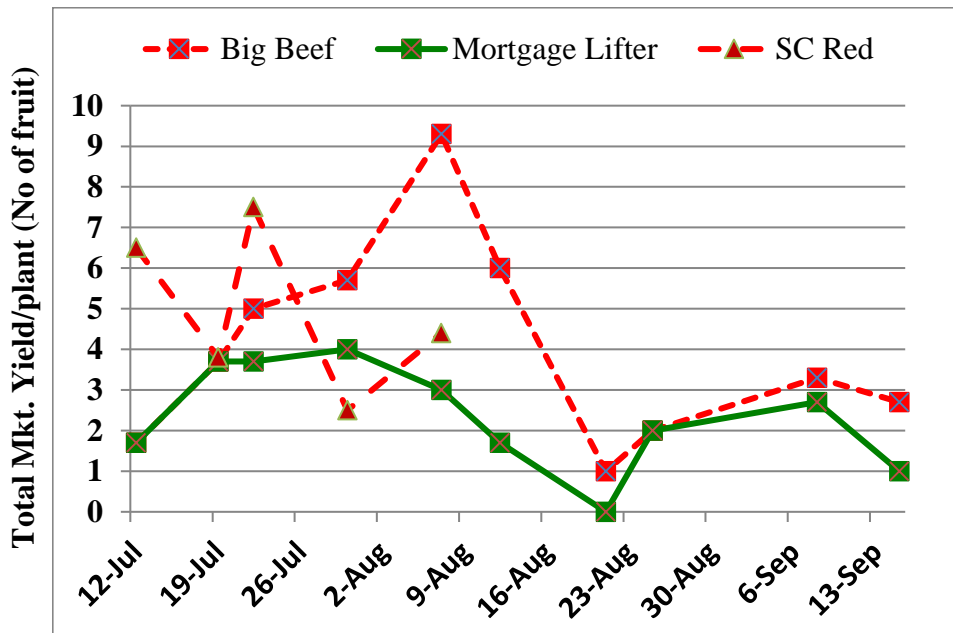
‘Mountaineer Pride’ has shown significant resistance to both late blight and *Septoria* leaf spot.

**Table 2.** Marketable yield of high tunnel tomatoes evaluated in 2018.

<b>Variety</b>	<b>Avg. Wt. (oz.)</b>	<b>U.S. #1/plant (lbs.)</b>	<b>U.S. # 2/plant (lbs.)</b>	<b>Total Mkt. Yield/plant (lbs.)</b>	<b>Marketable (%)</b>	<b>Brix (°)</b>
Big Beef	8.7	15.5	5.0	20.5	81.6	5.2
Caiman	8.7	13.2	4.4	17.6	80.2	4.1
Brandywine	16.8	6.1	4.7	10.8	78.9	5.1
Cherokee Purple	10.9	5.7	5.2	10.9	78.8	5.1
Kellogg’s Breakfast	15.6	7.6	3.8	11.4	79.9	5.3
Mortgage Lifter	14.5	15.4	4.5	19.9	84.7	5.0
Mountaineer Pride	7.2	2.7	3.0	5.7	69.7	4.9
Mr. Stripey	9.3	4.6	7.2	11.8	87.8	6.6
Pineapple Premiere	16.3	7.6	2.4	10.0	78.3	5.8
Striped German	17.7	10.5	3.1	13.6	85.4	4.9
Wynn	15.7	5.4	1.9	7.3	89.4	5.2
<i>Significance</i>	<i>0.6</i>	<i>0.8</i>	<i>0.9</i>	<i>0.6</i>	<i>1.4</i>	<i>0.2</i>

**Table 3.** Marketable yield of high tunnel tomatoes in 2018 (southern WV).

Variety	U.S. #1/plant (lbs.)	U.S. # 2/plant (lbs.)	Total Mkt. Yield/plant (lbs.)
Big Beef	12.9	4.9	17.8
Caiman	16.3	5.4	21.8
Brandywine	10.1	7.7	17.8
Cherokee Purple	7.5	6.9	14.4
Kellogg’s Breakfast	12.4	6.2	18.6
Mortgage Lifter	18.4	5.4	23.8
Mr. Strikey	6.0	9.4	15.4
Pineapple Premiere	17.4	5.5	22.9
Striped German	8.4	2.5	10.9



**Figure 2.** Harvest comparison between hybrid indeterminate (‘Big Beef’), heirloom Indeterminate (‘Mortgage Lifter’) and determinate hybrid (‘Scarlet Red’) tomatoes.

**Discussion:**

Heirloom tomatoes can be successfully produced using high tunnels in West Virginia. The 2018 growing season was marked by above average precipitation which would have decimated open field heirloom tomatoes. Marketable yields of heirloom tomatoes can be competitive with hybrid varieties. However, heirloom varieties have shorter shelf life and are less uniform in size and

shape. To obtain the highest retail price for locally grown tomatoes, one strategy may be to have a mixture of heirloom and hybrid varieties. The heirlooms have excellent flavor and are less likely to be available at most markets.

Tomatoes are easily produced using no till within a high tunnel. The cover crops can be established in mid to late fall and terminated the following spring using tarps or ground cover. The cover crops can provide supplemental nutrients and will readily decay under the tarps. Black, woven ground cover will accelerate early growth but can be covered with straw or hay when ambient temperatures are high in summer. The ground cover mulch reduces weed emergence and soil moisture evaporation. When the crop is finished, the crop residue is placed on the fabric and it is simply dragged from the tunnel leaving a clean seedbed for establishment of the next winter cover crop.

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