The Influence of Cultural Practices on Tomato Diseases in High Tunnels

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Greenhouse vs. High Tunnel

• High tunnel = greenhouse without heat
• Plants may be grown in ground or in pots/bags
• Tomatoes are by far the most common crop in either structure.
## Most Common Tomato Diseases

<table>
<thead>
<tr>
<th>Field</th>
<th>High Tunnel</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Early blight</td>
<td>• Leaf mold</td>
</tr>
<tr>
<td>• Septoria leaf blight</td>
<td>• Gray mold</td>
</tr>
<tr>
<td>• Bacterial spot</td>
<td>• White mold</td>
</tr>
<tr>
<td>• Bacterial canker</td>
<td></td>
</tr>
</tbody>
</table>
Most diseases require leaf wetness and rain for infection and spread.
High tunnels reduce leaf moisture and diseases.
…but high tunnels increase relative humidity.
Relative humidity inside and outside of a high tunnel 8/15/2014

Relative humidity inside and outside of a high tunnel on 8/15/2014.

- RH inside High tunnel 2
- RH for Knox county
Another factor which influences diseases in high tunnels…
…tomatoes planted without crop rotation.
The Diseases

- Leaf mold
- Gray mold
- White mold

Pest/disease resources include the Purdue University Tomato Doctor app; Dan Egel’s blog
<veggiediseaseblog.org>
Leaf mold of tomato

- Affects leaves only
- Survives in crop residue
- Resistant varieties
- Reduce relative humidity
Botrytis Gray mold of tomato

• Affects leaves, stems occasionally fruit
• Survives in crop residue
• Wide host range
• Reduce relative humidity
White mold of tomato

- Stem lesions cause wilt
- Survives soil
- Spread by mushroom spores
- Lower RH, raise temp.

S. Koike
Cultural Controls
Minimizing Diseases in HT

- Reduce crop residue
  - Crop rotation
  - Remove crop
  - Floor covering
- Keep area around HT free of vegetation
- Increase aeration
  - Ventilation
  - Pruning
  - Correct spacing-??
Greenhouse Floor Covering

• Without crop rotation, crop residue accumulates in soil
• Plant pathogens may survive in crop residue
• Floor covering reduces crop residue
Tomatoes in high tunnel with floor covering
Greenhouse floor covering

- White woven ground cover
  - Clean and sanitize at the end of each year
  - Re-use several years
  - $0.14/sq ft.; our cost= $340/HT

- Black landscape fabric
  - Under ground cover
  - One year only
  - $0.03/sq. ft.; our cost=$71/HT
Black landscape fabric
White woven ground cover
Keep area around high tunnel clear

- Reduces insect pressure
- Reduces fungal plant pathogens
- Better ventilation
Ventilation to reduce disease pressure

- Ventilate high tunnels at night to replace humid air
  - Cool temperatures may trump need to ventilate
- Prune plants to increase ventilation
  - Especially with indeterminate tomatoes
- Avoid crowding plants
What is correct spacing for determinate tomatoes in a high tunnel?

• Data in literature only for indeterminate tomatoes
• My observation is that HT’s with too many plants have-
  • Poor ventilation
  • More disease
  • Poor quality or smaller fruit
• Tomato trial in 2014 at SWPAC to study
  • 5 spacing's
  • 2 varieties
High Tunnel plant population study

Tomato plant spacing—
inches
• 16-Florida weave
• 20-Florida weave
• 20-Spanish trellis
• 24-Florida weave
• 28-Florida weave

Tomato hybrids—
determinants
• Mountain Spring
• Red Deuce
Spanish trellis
5 foot centers
Florida weave
Tomato Population Study

• Tomatoes in HT April 7 to September 11
• Fertigated 4X/day (main season)
• 120 gallons per day per high tunnel (420 linear feet)
• Primary fertilizer potassium nitrate KNO3
  • 13.5-0-46.2
• Fruit weight & number collected
• Also took data on disease severity, stink bug damage.
Total tomato yield for both high tunnels all treatments = 143,529 lbs/A
No. of fruit per harvest.

- Mountain Spring
- Red Deuce

Summer 2014
Weight per Linear Foot

Variety

Red Deuce
Mountain Spring

Weight (lbs)

P=0.5075
Total Number of Fruit

No. Tomatoes/ft

Variety

Mountain Spring

Red Deuce

P=0.0004
Total Number of Tomatoes

No. tomatoes/ft.

20 trellis | 16 weave | 20 weave | 24 weave | 28 weave

Plant Spacing in inches

a | ab | ab | b | c

P=0.0003
Mean Fruit Weight

<table>
<thead>
<tr>
<th>Tomato Variety</th>
<th>Weight in lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Deuce</td>
<td>0.31</td>
</tr>
<tr>
<td>Mountain Spring</td>
<td>0.26</td>
</tr>
</tbody>
</table>

P=0.0001
Mean Fruit Weight

<table>
<thead>
<tr>
<th>Plant spacing in inches</th>
<th>Weight in lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>28 Weave</td>
<td>0.30a</td>
</tr>
<tr>
<td>24 Weave</td>
<td>0.30a</td>
</tr>
<tr>
<td>20 Weave</td>
<td>0.29ab</td>
</tr>
<tr>
<td>16 Weave</td>
<td>0.27b</td>
</tr>
<tr>
<td>20 Trellis</td>
<td>0.27b</td>
</tr>
</tbody>
</table>

P=0.0396
Disease Severity by Plant Spacing

Plant Spacing in inches

Disease Severity (AUDPC)

20 weave
16 weave
28 weave
24 weave
20 trellis

P=0.8270
Stink bug damage

• Fruit culled for stink damage as unmarketable
• Data for stink bug damage comes from 8 harvests, mid-July to mid-Sept.
  • 14, 16, 18, 21 Jul; 21 Aug; 5, 8, 11 Sep.
Stink bug damage
Stink bug damage by variety

Stink bug damaged/total no. fruit (%)

Variety

Mountian Spring
Red Deuce

P=0.0060

b

P=0.0060
Stink Bug Damage by Plant Population

Stink bug damaged/total no. fruit (%)

Plant spacing in inches

24 Weave 16 Weave 28 Weave 20 Weave 20 Trellis

P=0.7875
Proportion of Zipper Scars

Variety

Mountain Spring  Red Deuce

No. fruit w zipper scars/total fruit (%)

P=0.0021
Proportion of Zipper Scars

No. Fruit with sipper scars/total fruit

Plant spacing in inches

- 20 Weave
- 16 Weave
- 28 Weave
- 24 Weave
- 20 Trellis

P=0.4766
Tomato High Tunnel Population Experiment

- Leaf mold severity was not affected by in-row spacing.
  - Distance between rows was not considered in exp.
  - Other diseases may be affected by spacing.
- Red Deuce was resistant to leaf mold.
  - Red Deuce not listed as resistant by seed co.
- Weight of tomatoes per plot was not affected by variety or plant population.
- Rows with more closer spacing's had more fruit #.
- Closer spaced plants had smaller fruit.
- Red Deuce had larger fruit; Mt. Spring had more fruit.
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