High Tunnel Winter Cropping Systems

Farming the Backside of the Garden Calendar
The traditional growing season in West Virginia limits local food production.
2010

Warm Season

Cool Season

Warm Season

Cool Season

Warm Season

Cool Season

Warm Season

Cool Season
What is a High Tunnel?

High tunnels are plastic-covered, solar greenhouses which are used to lengthen the growing season and protect the crop(s) from stresses such as rain, wind, snow/ice, diseases, insects and wildlife.
Soil and air are heat sinks during the winter.
Go to arborday.org to find the zone for your zip code. You can also find trees for planting in your zip code.

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The Winter Harvest Handbook
Year-Round Vegetable Production
Using Deep-Organic Techniques
and Unheated Greenhouses
Eliot Coleman

Walking to Spring
Using High Tunnels to grow produce 52 weeks a year

Paul and Alison Wiediger
of Au Naturel Farm
How do high tunnels accumulate heat?
The graph shows the temperature (in °F) over the course of 24 hours, with two data sets: Ambient and High Tunnel. The temperature fluctuates significantly within the High Tunnel, reaching a peak around the 15th hour, while the Ambient temperature remains relatively stable.
Midday height of sun in winter
>10 hour photoperiod needed for good growth

November 17-January 24
Temperature
Single or Double Plastic Layer

Inflation blower fan
<table>
<thead>
<tr>
<th>Covering</th>
<th>Number of Layers</th>
<th>Percent Transmission¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass (double-strength float, 3.2-mm)</td>
<td>1</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>77</td>
</tr>
<tr>
<td>Glass (low-iron, 3.2-mm)</td>
<td>1</td>
<td>90–92</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>81–85</td>
</tr>
<tr>
<td>FRP (clear, 0.64-mm)</td>
<td>1</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>77</td>
</tr>
<tr>
<td>Polyethylene (4- or 6-mil, 0.10- or 0.15-mm, UV-stabilized)</td>
<td>1</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>76</td>
</tr>
<tr>
<td>Polyethylene (4- or 6-mil, 0.10- or 0.15-mm, IR-absorbing)</td>
<td>1</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>67</td>
</tr>
<tr>
<td>Vinyl, clear²</td>
<td>1</td>
<td>91</td>
</tr>
<tr>
<td>Vinyl, hazy²</td>
<td>1</td>
<td>89</td>
</tr>
<tr>
<td>Polyvinyl fluoride film (4-mil, 0.10-mm)</td>
<td>1</td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>85</td>
</tr>
<tr>
<td>Acrylic panels (8- or 16-mm, 2-layer)</td>
<td>2</td>
<td>83</td>
</tr>
<tr>
<td>Polycarbonate sheet²</td>
<td>1</td>
<td>90</td>
</tr>
<tr>
<td>Polycarbonate panels (6- or 8-mm)</td>
<td>2</td>
<td>79</td>
</tr>
<tr>
<td>Polycarbonate panels (8-mm)²</td>
<td>3</td>
<td>77</td>
</tr>
</tbody>
</table>

¹Light-transmission values for photosynthetically active radiation (PAR, 400–700 nm) and for single sheets are from American Society of Agricultural Engineers (1995), unless otherwise indicated. Transmission values for two layers were computed by squaring the single-layer values.

²Manufacturers' specifications.
Seeding Tools

6-row seeder
Row Cover Tunnels
With row cover

Without row cover

Photo courtesy of Steve Moore
Cool Season Crops
<table>
<thead>
<tr>
<th>Cold Crops</th>
<th>Cool Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinach</td>
<td>Lettuce</td>
</tr>
<tr>
<td>Chard</td>
<td>Carrots</td>
</tr>
<tr>
<td>Claytonia</td>
<td>Watercress</td>
</tr>
<tr>
<td>Leeks</td>
<td>Potatoes (Irish)</td>
</tr>
<tr>
<td>Garlic</td>
<td>Beets</td>
</tr>
<tr>
<td>Mache</td>
<td>Chinese Cabbage</td>
</tr>
<tr>
<td>Radish</td>
<td>Celeriac</td>
</tr>
<tr>
<td>Turnip</td>
<td>Celery</td>
</tr>
<tr>
<td>Onion</td>
<td></td>
</tr>
<tr>
<td>Scallions</td>
<td></td>
</tr>
<tr>
<td>Kale</td>
<td></td>
</tr>
<tr>
<td>Kohlrabi</td>
<td></td>
</tr>
<tr>
<td>Collards</td>
<td></td>
</tr>
<tr>
<td>Brussels Sprouts</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td></td>
</tr>
</tbody>
</table>
“The dependable spinach crop”
• 40-60 days from seeding
• Tolerant of low light
• Tolerant of cold temperature
• 12-20 oz/ft²

Spinach
(Spinacia oleracea)
‘Space’ Spinach
Chard

(Beta vulgaris)
Kohlrabi

*(Brassica oleracea)*

- Cold tolerant
- Enlarged stems and young leaves are edible.
- Sweet, cabbage flavor
Kale

(Brassica oleracea)

• Very cold tolerant

‘Red Russian’
‘Winterbor’
Dinosaur Kale
Collards

(\textit{Brassica oleracea})
Asian Greens

Mizuna
Chinese Cabbages

Pak Choi
(Bok Choi)

Michihili

Napa
(Wong Bok)
'Mei Quing Choi'
Lettuce

(Lactuca sativa)

- Cold tolerant
- Highly productive
- Downey mildew tolerance
Green Oakleaf
Soil Temperature
Turnips
*(Brassica campestris)*

Very cold tolerant

Roots and tops edible
Carrots

(Daucus carota)

Extremely sweet in winter

Cold tolerant
Downey Mildew on leaf lettuce
Aphids on leaf lettuce
Questions?