



# Covers Under Cover: Managing Cover Crops in High Tunnels

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## High Tunnels: Intensively Cropped, Irrigated Deserts

High tunnels (HTs) are unheated, plastic-covered structures in which temperature is passively controlled by opening and closing the plastic covering on the sides and/or ends of the structure. Crops are generally grown in soil, rather than in pots or growing media. High tunnels can extend the growing season by a month in the fall and spring for warm-season crops, and allow for year-round production of some cool-season crops. High tunnels have been growing in popularity in the Southeastern U.S. due to cost-share programs like the Natural Resource Conservation Service's Environmental Quality Incentives Program (NRCS EQIP) Seasonal High Tunnel Initiative, as well as state specific programs. They have great potential to increase production of local foods and producer profitability by allowing for year-round production in the Southeastern U.S.; however, due to the intensive cropping practices in HTs, problems may arise over time. Because the soil in HTs is not exposed to leaching rains, salts and phosphorus may accumulate, resulting in desert-like soils (Fig. 1). Lack of rain exposure also means that irrigation is required to satisfy all demands for crop growth and for decomposition of crop residues. While fall and spring warming is beneficial, HTs experience more temperature extremes compared to the field. A HT may become quite warm on a cold, sunny winter day, but once the sun goes down the inside temperature of a HT may be very similar to the outside temperature. There is little



**Figure 1.** Soil salinity impacts on tomato crop. Notice the much smaller plants in the front of the picture where sodium content is 10 times greater than the back of the picture. The greater sodium content indicates an accumulation of salts in the soil.

to no heat retention. The warmer environment in a HT causes faster rates of organic matter breakdown and nutrient mineralization in the soil. Also, this warmer environment speeds up crop growth, potentially worsening nutrient deficiencies. These problems often build up over years and crop productivity may decline. Because of intensive tillage often employed in HTs, breakdown of soil structure and organic matter are often exacerbated compared to in-field production. Due to all of these reasons, if soil health is not maintained in HTs, production in soil can decline enough that producers may need to move the structures or switch to container production, such as “bag culture” systems.



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**Table 1.** Potential benefits and challenges of using cover crops in high tunnels.

Benefits	Challenges
<ul style="list-style-type: none"> <li>• Provide nitrogen (legumes)</li> </ul>	<ul style="list-style-type: none"> <li>• Availability of equipment that can be used in HTs to terminate cover crop</li> </ul>
<ul style="list-style-type: none"> <li>• Suppress weeds</li> </ul>	<ul style="list-style-type: none"> <li>• Residue management to promote decomposition</li> </ul>
<ul style="list-style-type: none"> <li>• Disrupt disease cycles</li> </ul>	<ul style="list-style-type: none"> <li>• Time and space lost to valuable cash crop production</li> </ul>
<ul style="list-style-type: none"> <li>• Suppress plant-parasitic nematodes</li> </ul>	<ul style="list-style-type: none"> <li>• May provide habitat for insect or other pests, such as plant-parasitic nematodes</li> </ul>
<ul style="list-style-type: none"> <li>• Increase soil organic matter and microbial diversity</li> </ul>	
<ul style="list-style-type: none"> <li>• Improve soil texture and drainage; reduce compaction</li> </ul>	
<ul style="list-style-type: none"> <li>• May have biofumigation potential</li> </ul>	

### Cover Crops for Productive Rotations: Benefits and Challenges

In field settings, the numerous benefits of cover crops have been well studied. Several years of cover crop use may help alleviate some of the specific problems that arise in HT production. However, the unique conditions in HTs can make the use of cover crops challenging (Table 1). First, irrigation is required to germinate and grow the cover crop. Assuming successful establishment and adequate irrigation, cover crops often accumulate more biomass in the HTs than in the field because of warmer temperatures. Thus, termination of the cover crop can be more difficult in HTs than in the field as the necessary equipment may not fit in the tunnels. After termination, irrigation is needed again to allow the residue to decompose. Also, the timing of cover crops in HTs can be even more difficult than in the field due to the potential loss of revenue when taking the “high value real estate” of HTs out of cash crop production. Even with these challenges, experiments and on-farm trials are beginning to show that with proper planning, cover crops can be worked into HT crop rotations with positive results.

### Key Management Considerations

*Planting times.* Winter and summer generally provide the best windows to work cover crops into HT rotations in the South. Cool-season cover crops can

be sown in late fall, but must be established before temperatures become too cold for germination and day light too short for plant growth. Some studies have shown that inter-seeding cover crops in between actively growing crop rows, such as peppers, can be successful for establishing a good winter cover crop (Perkus et al., 2019). However, timing is important as seeding too early can potentially reduce yields if there is competition between the cash and cover crop. During the heat of summer, air temperature in HTs often reaches over 100°F, which is unsuitable for most cash crops; however, heat tolerant cover crops can be successfully grown. A general planting schedule and strategies for working cover crops into a HT crop rotation are listed in Table 2 on Page 3. For additional information on species, seeding rates, and other strategies for warm-season and cool-season cover crops, please see the Center for Crop Diversification’s *Cool-Season Cover Crops for High Tunnels* and *Warm-Season Cover Crops for High Tunnels* Extension publications (coming soon!).

Recommended Heat-Tolerant Covers
<b>Grasses:</b> sorghum-sudangrass, Japanese millet, annual ryegrass
<b>Legumes:</b> sunn hemp, cowpeas
<b>Broadleaf:</b> sunflowers

**Table 2.**  
General planting schedule & strategies for working cover crops into a high tunnel crop rotation

Cover Crop Type	Rotation Timing	Suggested Planting Schedule
Cool-Season Cover Crops	Overwintering – Planted in place of winter cash crop	After HT soils cool, up to 4-6 weeks after covers would be planted in the open field.
Warm-Season Cover Crops	Summer – Planted after a spring cash crop and/or before a fall cash crop	Generally one month earlier than in the open field.
	Winter-killed – Planted after a summer cash crop.	At least 6-8 weeks prior to frost in HTs. Generally 4-6 weeks prior to frost in the open field.

*Planting methods.* Cover crop seeds can be broadcast by hand or planted with a walk-behind seeder and then raked in to lightly bury them and ensure good soil contact (this will ensure better seed germination). Soils do not necessarily need to be tilled prior to seeding cover crops, but having loose soil to cover the seeds and ensure good soil contact is essential. Be careful not to seed cover crops too densely – when converting from field seeding rates to the smaller areas in the HT, the amount of seed needed may be surprisingly small. Overhead watering is best for germinating the cover crop, as drip line must be removed prior to incorporating the cover crop and this can be difficult if the biomass is lush at termination. In addition, drip irrigation can cause uneven cover crop germination with good growth only right around the drip line.

*Managing growth.* Planning is key to ensure the cover crop does not interfere with cash crop plans. Residue can interfere with establishment of small-seeded crops and make transplanting more difficult. Residue decomposition requires moisture from irrigation and sufficient time. Producers must leave ample time for complete termination and sufficient residue decomposition prior to planting. Because of these concerns and in the confined space of a HT, sometimes “less is more” when it comes to cover crop biomass. Choosing a less vigorous cover crop can be a good strategy if your window for growing a cover crop is short. Also, keep in mind that cover crops mature more quickly with the added warmth of a HT, often reaching maturity in six to eight weeks. Some cover crops may have sufficient growth to provide the desired benefit in just four weeks.

*Termination.* With the “less is more” concept in mind, it is important to plan termination carefully. As with

cover crops in the field, terminate the cover crop before it sets seed to get the most nitrogen from the biomass and to prevent the cover crop from becoming a weed. The most common method for termination is to mow, and then till in the residue; mowing helps the residue break down faster. If your field equipment for mowing cover crops will not fit in your tunnel, you must plan for how you will terminate the crop. String mowers, push mowers, smaller riding mowers and walk-behind tractors can be good options. With these options, the chopped residue can then be tilled in, or raked to serve as mulch for the next crop. One strategy for being ready for an early spring planting of tomatoes or peppers could be to plant a warm-season cover in late fall that will winter kill, such as buckwheat, Japanese millet, or cowpea. This crop will likely grow in the high tunnel into December or January (barring any extreme early freezes) and then freeze before biomass becomes too much. This strategy reduces equipment needs and allows more time for residue decomposition in the late winter/early spring period.

*Timing for growth and decomposition.* The dry environment of HTs will prevent the biomass from breaking down, so it is essential to water the soil and cover crop residue regularly to ensure that it is decomposed sufficiently before planting your next crop. Plan for two to three weeks for the cover crop residue to decompose. Although grass cover crops can be effective scavengers of nutrients already in the soil, they can tie up nutrients and stunt the next crop if they have not been given enough time and moisture to break down (Fig. 2). Legumes and legume-grass mixes tend to decompose more rapidly than grasses alone, due to the nitrogen contribution from the legume speeding up the decomposition rate.





**Figure 2.** Stunted growth in tomatoes grown in bed after incomplete breakdown of winter wheat cover (right) compared to crimson clover cover (left).

### Selecting the Right Cover Crops for You

Cover crops work best when you think carefully about what benefits you want them to provide. For example, if you want a cover crop to help manage a nematode problem, you need to select a cover crop species and variety that has been shown to reduce nematode populations. Second, you need to determine a time that you can devote HT space to a cover crop and for how long. You should plan on at least six weeks for adequate growth and time for decomposition. If the cover crop you need to address a particular problem cannot be grown during the timeframe you want to use, you will have to look for other cover crop options or rework the crop schedule for the HT to accommodate the cover crop.

See the publications below for information on specific cover crops recommended for high tunnels, ideal planting and seeding rates, termination tips, and more. Note that some practices discussed in Options for Including Cover Crops in High Tunnel Rotations in the Northern United States may not work for conditions in the Southern United States.

### Resources

- Cool-Season Cover Crops for High Tunnels and Warm-Season Cover Crops for High Tunnels, Extension publications (coming soon!)

- Perkus, E., A. Pfeiffer, C. Thurston, F. Li, & J. Grossman. 2019. Options for Including Cover Crops in High Tunnel Rotations in the Northern United States. eOrganic. <https://eorganic.org/node/25214>
- National Resources Conservation Service, High Tunnel System Initiative. <https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/?cid=stelprdb1046250>
- Southern Cover Crops Council. <https://southern-covercrops.org/>



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*Photos courtesy of Tim Coolong (Figure 1) and Jenny Moore (Figure 2)* **July 2020**

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