



Cool-Season Cover Crops for High Tunnels in the Southeast

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Cool-season cover crops can be grown in high tunnels (HTs) in the fall or winter if you have a window of time between cash crops. Winter cover cropping is a common practice for many growers in the field, but cover crops perform differently in HTs. Additionally, there is often a shorter window for cover crops in HTs because many cash crops can be grown year-round in our region. However, just like in the field, cover crops can provide many benefits within the HT production system. This publication, based on trials in Kentucky, Tennessee and Georgia, outlines the benefits and challenges of several cool-season cover crops that may be used in HTs. This fact sheet complements an introduction to cover crops in HTs ([Covers Under Cover: Managing Cover Crops in High Tunnels; CCD-SP-16](#)) and a fact sheet on warm-season cover crops in HTs ([CCD-SP-19](#)).

Selecting the right cool-season cover crop. Consider your goals for the cover crop: supplying nitrogen, suppressing weeds, adding organic matter, or reducing compaction. Next, consider how much time you have in your rotation for cover crop growth and decomposition. Cover crops, like cash crops, grow very slowly during the winter with low air and soil temperatures, reduced light intensity, and shorter daylength. Therefore, it is important to select a cover crop that is tolerant of the growing conditions, and that will grow enough to meet your goals. You should also consider the amount of biomass the cover crop will produce and the equipment you have to effectively

terminate and incorporate that biomass. To aid in decision-making, Table 1 (Page 4) contains a description of the general traits, benefits and challenges of some specific varieties of cover crops that we have used. Table 2 (Pages 5-8) gives seeding rates and other general information about the cover crop species listed in Table 1, along with other varietal suggestions, but it is not an exhaustive list.

Planting and establishment. Covers Under Cover (CCD SP-16) gives many general tips on establishing cover crops in HT environments. In general, cool-season cover crops should be sown later in HTs than would be typical for cover crops in field settings. Due to higher soil temperatures and evapotranspiration in HTs, establishment can be difficult and plant growth may suffer if cool-season cover crops are sown too early. However, planting too late when temperatures are low may decrease establishment and will likely lead to lower cover crop biomass as well. Additionally, having a way to irrigate your cover crop during establishment is very important.

Managing growth. Unlike in the field, cool-season cover crops may not go dormant in HTs in the winter, but growth will be slowed by cool temperatures and fewer hours of daylight. Irrigation may be needed over the course of cover crop growth, though less regular irrigation will likely be necessary for cool-season cover crops. On cool, overcast days, be careful to not irrigate too much to reduce po-



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Figure 1. Oats in a high tunnel at the University of Kentucky Horticulture Research Farm.

tential for disease. The soil should not stay saturated. If high biomass production is a goal for cool-season cover crops, it may require earlier planting (which will require terminating a late summer/early fall cash crop earlier), or later termination (which will require planting a spring cash crop later). For example, from our experience in Kentucky and Tennessee, a cover crop planted in late October in a high tunnel will not reach peak biomass until late March, with much of the growth occurring during February as temperatures warm and light becomes more abundant. Lower cover crop biomass may be advantageous in some cases – if limited equipment is available for termination, or to avoid potential nitrogen immobilization (see below). It is important to consider your goals for using a cover crop when determining planting and termination dates. Alternatively, biomass may be managed by mowing at desired height before termination to keep grazing/mowing-tolerant cover crops smaller.

For quick, early growth in the fall, select fast-establishing cool-season cover crops that generally do well in the open field in your location. Options include oats (Fig. 1) or other small grains including wheat and crimson clover. If your cash crop rotation includes brassica crops (kale, turnip greens, etc.), then avoid brassica cover crops such as mustards and canola.

Termination and decomposition. Be sure to consider termination timing and method, and allow a few extra weeks for the cover crop to decompose before planting your next cash crop. If your goal is to maximize the amount

of nutrients and biomass in the cover crop, cool-season cover crops should be terminated when legumes are flowering, or grasses and small grains are at a “soft dough” stage (soon after a head forms and you can see immature seeds/grains). You can terminate the cover crops early with mowing and incorporation (i.e., without herbicides), but you may get some regrowth. A thick cool-season cover crop can be very lush and require drying time (two to three days) before it can be effectively incorporated into the soil. A second tillage pass about a week after the first is often required. Vetches and other vining cool-season cover crops can be difficult to manage and bind around mowing equipment. As we discuss in the Covers Under Cover: Managing Cover Crops in High Tunnels fact sheet (CCD SP-16), HT cover crop residue management may require a “less is more” strategy; therefore, early termination when there is less biomass can make the cover crop residue easier to manage.

Termination timing must also be balanced with weed management – primarily, the need to avoid adding weed seeds to the soil, but also being aware of weeds as potential hosts of pest insects and diseases. Weed suppression by cover crops can depend on multiple factors, including weed pressure, cover crop type, evenness and thickness of the cover crop stand, air temperature, and moisture. High tunnel trials in Tennessee found winter wheat (Fig. 2) to be very effective at smothering winter annual weeds but less so in Kentucky, where weed pressure was dominated by common chickweed. By irrigating the cover crops, weed growth was also increased and common chickweed produced seeds prior to cover crop termina-



Figure 2. Thick winter wheat cover crop in a HT in Knoxville, TN (left) compared to a more weedy winter wheat cover crop in Lexington, KY (right), both in late winter.

tion. Therefore we inadvertently added weed seeds to the soil. This demonstrates an important point - you should always be aware of weeds growing in the cover crop and, if necessary, terminate the cover crop before these produce seed. If terminated prior to seed production, the cool-season weeds contribute to the total biomass. Chickweed samples were tested for nitrogen content and were 4% nitrogen, which is better than some covers in terms of scavenging ability!

It is important to allow enough time for the cover crops to decompose, or they will immobilize nutrients. Cover crops decompose more slowly if the soil is cool, too dry, or if there is a large amount of carbon relative to the amount of nitrogen in the cover crop. This means decomposition of a cool-season cover crop can take longer than at warmer times of the year. It also means that the soil must be consistently moist (but not saturated) for the cover crop to decompose, so be sure to have a way to irrigate in place to aid decomposition. In general, grasses grown alone will take longer to decompose than when grown in a mixture with legumes or other broadleaves, or legumes grown alone. As a general rule, allow two to three weeks after cover crops are tilled in to the soil prior to planting your next crop. If you can see remaining cover crop residue in the soil when you are preparing the bed for the next crop, this material should be raked out of the bed or given additional time to decompose.

Considering plant-parasitic nematodes. One other factor to consider when choosing a cool-season cover crop for your HT rotation is if pest nematodes are a problem in your area. Southern root-knot nematode (*Meloidogyne incognita*; RKN) is a common plant parasite that infects and feeds on plant roots. As a result of the feeding, plant roots form galls, or knots. The feeding reduces a crop's ability to take up nutrients and water, which can decrease subsequent crop yields and even lead to plant death. If RKN infects root crops, this can also affect marketability of the crop. Knowing the host suitability of a particular cover crop is useful because it can help indicate whether the RKN population is likely to increase, decrease or stay the same when in the presence of the cover crop. If a cover crop is a good host for a plant-parasitic nematode, that nematode population is likely to increase during the cover crop's lifecycle. Being a poor host indicates that the nematode does not easily infect and reproduce in the presence of that cover crop and

the specific nematode population (not all nematodes) will likely decrease. Your local Cooperative Extension Service or plant diagnostic laboratory can help you determine if these plant parasitic nematodes are present in your soil. If you know you have RKN in your soil, you should avoid planting crops and cover crops that are known hosts for RKN. Keep in mind that different cultivars within a cover crop species can have different levels of host suitability (for example, 'Chinese Red' cowpea is a poor host, but 'Iron Clay' cowpea is a good host).

Cover Crop Seed Sources

Albert Lea Seed (Albert Lea, Minnesota)

Website: <https://www.alseed.com>

Phone: (800) 352-5247

Center Seeds (Sidney, Ohio)

Website: <https://centerseeds.com/>

Phone: (855) 667-3943

Johnny's Selected Seeds (Winslow, Maine)

Website: www.johnnyseeds.com

Phone: (877) 564-6697

Seven Springs Farm (Check, Virginia)

Website: www.7springsfarm.com

Phone: (800) 540-9181

Petcher Seeds (Fruitdale, Alabama)

Website: www.petcherseeds.com

Phone: (251) 827-6594

Southern Exposure Seed Exchange (Mineral, Virginia)

Website: www.southernexposure.com

Phone: (540) 894-9480

Hancock Seed Company (Dade City, Florida)

Website: www.hancockseed.com

Phone: (800) 552-1027

Cover Crop Resources

Managing Cover Crops Profitably

(free download from USDA-SARE):

<https://www.sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition>

Southern Cover Crops Council

Website: www.southerncovercrops.org

Midwest Cover Crops Council

Website: <https://mccc.msu.edu/>



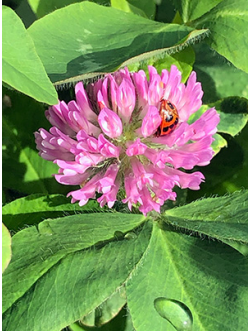
Table 1. A sampling of cover crops varieties tested in high tunnels in Kentucky, Tennessee and Georgia, and their traits.

Cover Crop	Traits						Tolerance			Comments
	N Fixing	N Scavenging	Soil Builder	Weed Suppression ^a	Host for Southern root-knot nematode	Quick Growth	Cold	Drought	Low Fertility	
Clover, Crimson, Dixie	Yes	Good	Good	Very Good	Yes	Good	Fair	Fair	Good	Not tolerant of poorly drained or highly alkaline soils.
Clover, Common Mammoth	Yes	Good	Good	Very Good	Unknown ^b	Fair	Very Good	Fair	Fair	Dependable.
Hairy Vetch, variety not stated	Yes	Fair	Fair	Good	Yes	Fair	Good	Good	Fair	Slow early growth. Excellent for N source. Excessive biomass can be a challenge. Reseeds and can become a weed
Mustard, Pacific Gold	No	Excellent	Very Good	Very Good	Yes	Very Good	Good	Very Good	Fair	Not heat tolerant. Rapidly maturing. Do not use with other brassicas in rotation
Oat, Bob	No	Very Good	Very Good	Excellent	No	Excellent	Poor	Fair	Good	Easier to terminate and earlier to mature than rye.
Oilseed Radish, Sodbuster	No	Excellent	Very Good	Excellent	No	Very Good	Poor-Fair	Fair	Fair	Breaks up soil compaction. Scavenges N from deeper soil level. Do not use with other brassicas in rotation
Rye, Cereal, Wren's Abruzzi	No	Excellent	Excellent	Excellent	No	Excellent	Very Good	Very Good	Excellent	Southern-adapted rye cultivar.
Annual Ryegrass, Marshall	No	Good	Good	Good	No	Good	Good	Fair	Good	Effective N scavenger. Tolerant of cool soils for germination.
Triticale, Triticale 102	No	Good	Very Good	Good	Unknown ^c	Good	Good	Good	Good	High saline tolerance. Later fall planting tolerance. Fibrous root system.
Winter Wheat	No	Very Good	Very Good	Very Good	Variable ^d	Very Good	Good	Good	Good	Easier to terminate than rye. Not likely to become weed problem.

^aWeed suppression can vary depending on the cover crop stand and biomass produced. ^bHost status is unknown for this particular variety; however, most clover varieties are hosts for RKN.

^cHost status is unknown for this particular variety; however, other triticale varieties are hosts for RKN. ^dHost status for winter wheat depends on the variety; some are non-hosts and some are hosts for RKN.

Table 2. Seeding rates, potential benefits and challenges for selected cool-season cover crop species listed in Table 1. For some species, other varieties are suggested, but the variety recommendations are not meant to be exhaustive.

<p>Annual Ryegrass</p> <ul style="list-style-type: none"> • Seeding rate: 25 lbs/acre; 9-10 oz/1000 sq. ft. • Potential benefits: <ul style="list-style-type: none"> • Seed is readily available • Generally winter hardy • Good weed suppression and biomass production if stand is well-established • Potential challenges: <ul style="list-style-type: none"> • Germination and establishment can be difficult at high soil temperatures in late summer • Other varieties: Attain, Bruiser, Gulf, Rival 	
<p>Clover, Crimson</p> <ul style="list-style-type: none"> • Seeding rate: 15-20lbs/acre; 5-7 oz/1000 sq. ft. • If seed is pre-inoculated, check the label for information on the mass of the seed coating and adjust seeding rate accordingly. For example, if label indicates 70% seed and 30% coating by weight, increase the seeding rate by approx. 40% (the coating weight is approx. 40% of the seed weight). • If seed is not pre-inoculated, mix with inoculum for best N fixation • Potential benefits: <ul style="list-style-type: none"> • Generally winter hardy • Fixes N • Decomposes rapidly • Easy to establish • Potential challenges: <ul style="list-style-type: none"> • Can be vigorous and re-grow if not effectively terminated • Host for Southern root-knot nematode • Varieties: AU Robin and AU Sunrise (early maturing), Kentucky Pride 	
<p>Clover, Red</p> <ul style="list-style-type: none"> • Seeding rate: 10-12 lb/acre; 3.5-4.5 oz/1000 sq. ft. See inoculation notes for crimson clover. • Potential benefits: <ul style="list-style-type: none"> • Generally winter hardy • Fixes N • Decomposes rapidly • Easy to establish • Potential challenges: <ul style="list-style-type: none"> • May be slower to establish than crimson clover 	

Hairy Vetch (*Vicia villosa*)

- Seeding rate: 15 lbs/acre; 5.5 oz/1000 sq. ft. See inoculation notes for crimson clover.
- Potential benefits:
 - Very winter hardy, can be seeded after many other cool-season covers
 - Fixes N
 - Decomposes rapidly
 - Easy to establish
 - Good companion to cool-season grasses due to vining growth habit
- Potential challenges:
 - May be difficult to mow due to vining growth habit
 - Not competitive with winter annual weeds
 - Host for Southern root-knot nematode
 - May have volunteer vetch plants in subsequent years due to hard seed that does not germinate in the year it is planted.
- Varieties: Purple Bounty, Purple Prosperity, AU Merit



Mustards

- Seeding rate: 10 lbs/acre; 3.5 oz/1000 sq. ft.
- Potential benefits:
 - Quick growth
 - Easy to establish
 - May be effective biofumigant for some plant-parasitic nematodes
 - Quickly shades out broadleaf weeds
- Potential challenges:
 - May be a host to diseases and insects of Brassica crops, so avoid if you grow brassicas as a cash crop
 - Termination and incorporation **must** be managed correctly to be effective biofumigant
 - May be a host for Southern root-knot nematode. Host status differs by variety.
- Varieties: Idagold, white mustard, yellow mustard



Oats, spring

- Seeding rate: 100 lbs/acre; 2.3 lb/1000 sq. ft.
- Potential benefits:
 - Easy to establish
 - Quickly shades out weeds
 - Earlier maturing than other cool-season grasses
 - Less biomass than other cool-season grasses, such as cereal rye
- Potential challenges:
 - Don't use bin run seed. Although cheaper can contain weed seeds.
- Varieties:
 - Coker 227, Cosaque
 - Forage varieties such as Horizon 720 and Legend 567 produce more leaves
 - Graham (shorter variety)
 - Shelby, Saber



Rye, Cereal

- Seeding rate: 80 lbs/acre; 1.8 lb/1000 sq. ft.
- Potential benefits:
 - Easy to establish
 - Quickly shades out weeds
 - Very cold-tolerant
 - May be seeded later than other cool-season cover crops
 - Poor host for Southern root-knot nematode
- Potential challenges:
 - Later maturing than other cool-season grasses
 - May produce more biomass than can be handled with small-scale equipment
 - Don't use bin run seed. Although cheaper can contain weed seeds.
- Varieties:
 - Aroostook, Elbon, Florida 401 (earlier maturing), Wheeler, Wintergrazer



Radish, Oilseed

- Seeding rate: 8 lbs/acre; 3 oz/1000 sq. ft.
- Potential benefits:
 - Taproots reduce soil compaction
 - Relatively easy to establish
- Potential challenges:
 - Must be established early to achieve large taproot growth, which can be difficult in warm tunnel soils
 - May be a host to diseases and insects of Brassica crops
 - Must factor in to your rotation if you grow brassicas as a cash crop
- Varieties: Ecotill, Tapper



Triticale

- Seeding rate: 80 lbs/acre; 1.8 lb/1000 sq. ft.
- Potential benefits:
 - Less biomass than rye, but with good winter hardiness
 - Easy to establish
 - Effective weed competitor
- Potential challenges:
 - Can tie up nitrogen if sufficient time is not given for biomass breakdown
- Varieties: NF 201, Trical 342 (forage varieties)



Winter Wheat

- Seeding rate: 120 lbs/acre; 2.75 lb/1000 sq. ft.
- Potential benefits:
 - Easy to establish
 - Effective weed competitor
 - Good companion with clovers, as matures around same time
- Potential challenges:
 - Don't use bin run seed. Although cheaper can contain weed seeds.



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*Photos courtesy of Erin Haramoto, University of Kentucky (Figure 1 and Figure 2, right, and annual ryegrass, mustards, oats and radish, Table 2); Jenny Moore, University of Tennessee (Figure 2, left, and winter wheat, Table 2), Julia Gaskin, University of Georgia (crimson clover, triticale and cereal rye, Table 2); Kristi Durbin, University of Kentucky (hairy vetch, Table 2); and Steve Diver, University of Kentucky (red clover, Table 2). **June 2021***
