DISADVANTAGES OF COVER CROPS

While cover crops have many potential benefits, they also have a few disadvantages that may be minimized by careful management.

- Additional expenses: These include cover crop seeds, labor and equipment costs for planting, and any alternative equipment required because of greater amounts of residue.
- Competition with cash crops: Unmanaged or incompletely managed cover crops can behave like weeds, competing with cash crops for water, light, and nutrients. In dry years, cover crops may leave less water in the soil for cash crops.
- Pests: Just as cover crops may harbor beneficial organisms, they may also harbor pests. This may be reduced by selecting cover crops that don't provide a "green bridge" for pests of the following (or nearby) cash crop. For example, clover root curculio is a common pest of red clover that can also attack alfalfa.

RESOURCES FOR MORE INFORMATION

Clark, A. *Managing Cover Crops Profitably.* 3rd ed. Beltsville, Md.: Sustainable Agriculture Network, 2007. www.sare.org.

Curran, W. S., et al. *Cover Crops for Conservation Tillage Systems.* Conservation Tillage Series 5. University Park: The Pennsylvania State University, 2006. pubs.cas.psu.edu/FreePubs/pdfs/uc128.pdf.

Penn State Agronomy Guide, 2009–2010. University Park: The Pennsylvania State University, 2009. agguide.agronomy.psu.edu.

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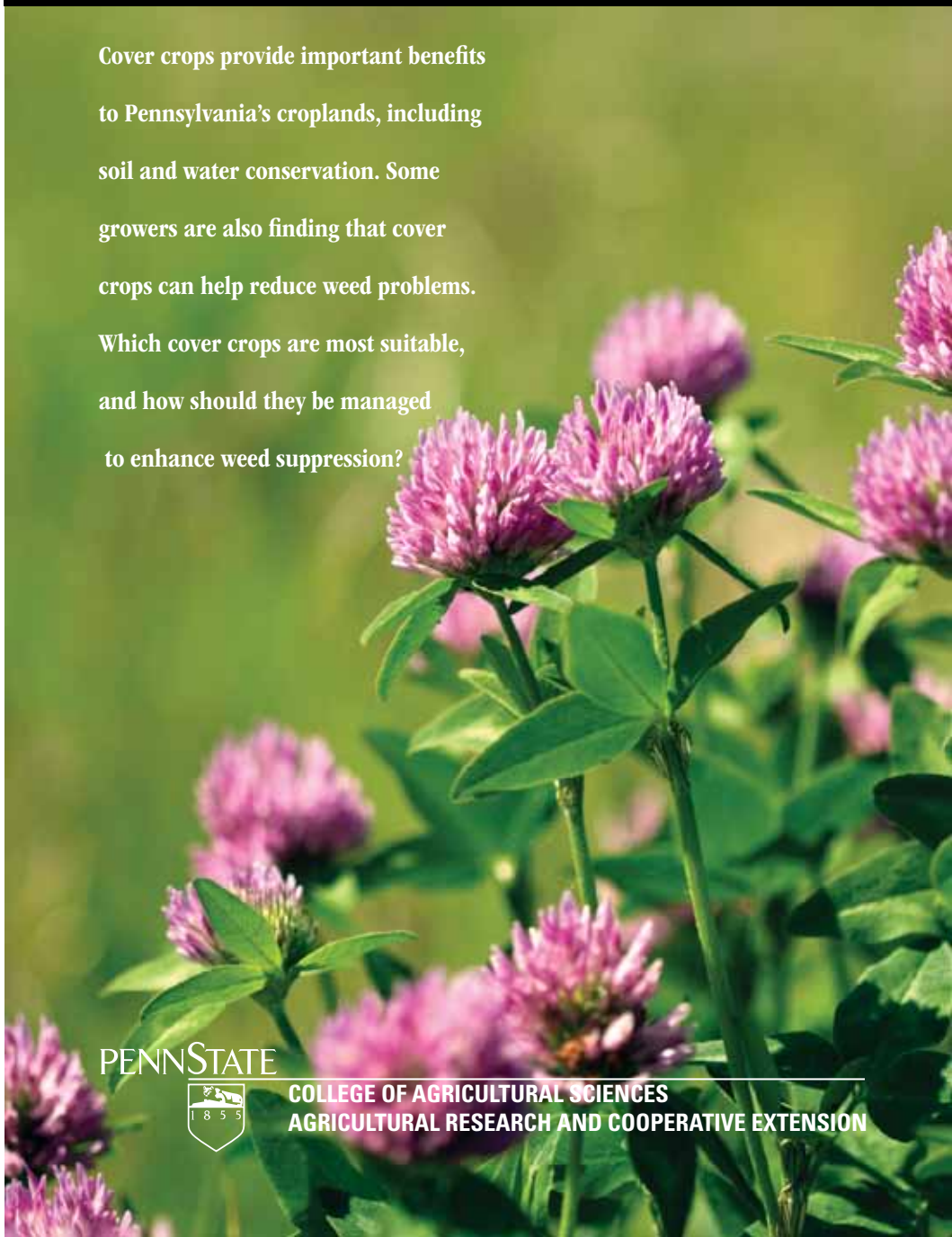
AGROECOLOGY IN PRACTICE

Suppressing Weeds Using Cover Crops in Pennsylvania

Cover crops provide important benefits to Pennsylvania's croplands, including soil and water conservation. Some growers are also finding that cover crops can help reduce weed problems. Which cover crops are most suitable, and how should they be managed to enhance weed suppression?



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TYPES OF COVER CROPS

The life history of a plant species affects how it may be used as a cover crop. Summer or winter annuals, biennials, and perennials can be used for cover crops where needed. The choice of cover crop species will depend on management goals. Winter annual cover crops can generally fit into a crop rotation without requiring that land be fallowed.

Legume cover crops provide an important source of nitrogen and can replace or reduce the need for nitrogen fertilizer. This is of particular importance preceding nonlegume crops. Grass cover crops are particularly beneficial in erosion reduction because they have a fibrous root system and can produce many stems.

In some cases, cover crop mixtures may be better than individual cover crops. For example, oats may be used as a nurse crop for hairy vetch planted in early fall. The oats grow more quickly in the fall, providing partial soil coverage and nutrient-trapping benefits before they are winter-killed, which prevents competition with the hairy vetch in the spring.

ESTABLISHMENT OF COVER CROPS

Cover crop planting should take into account the fertility of the soil. A soil test is a good way to begin. Pest history should also be considered, as should the history of herbicide application.

Cover crops can be established by conventional, no-till, or broadcast seedings, though broadcast seeding is generally less successful. Frost seeding may be effective for the establishment of cover crops in early spring. Aerial seeding can allow a cover crop to be established before the cash crop is harvested.

MANAGING COVER CROPS TO HELP SUPPRESS WEEDS

- **Species selection:** Choose cover crops based on your objectives. If weed suppression is an objective, select an aggressive species that will cover the ground quickly. If you desire a cover crop that will protect the soil through the fall and winter and suppress winter annual weeds, plant a winter cereal in late summer or early fall. See the cover crop species information table and the accompanying phenology chart to determine which cover crops may be suitable to meet your objectives.
- **Establishment date:** Establishing a hardy winter cover, such as cereal rye, as early in the fall as possible will result in greater cover crop biomass over the winter and rapid growth during the spring. Other establishment dates may be preferable for different cover crops depending on the species and your objectives.
- **Seeding rate, row spacing, and planting arrangement:** The seeding rate and arrangement of the cover crop can influence weed suppression. Planting at higher-than-normal seeding rates and in narrow rows can influence the amount of soil cover, particularly in the first several weeks after seeding. Thick, dense cover crop stands can help reduce the establishment of weeds.
- **Soil fertility:** It is important to provide adequate soil fertility to cover crops to ensure they are competitive and successful. This is particularly true for small grains like cereal rye and wheat, which require adequate nitrogen. Lime may be necessary to maintain or raise the soil pH for legumes like hairy vetch and red clover. Regular soil tests will help you determine how best to manage your cover crops so as to maximize their beneficial effects on weed suppression and soil quality.
- **Termination timing:** Allowing a cover crop to grow as long as possible before controlling it reduces weed populations through competition for light, nutrients, and moisture. In no-till, letting the cover crop achieve maximum dry matter production (often at flowering or beyond) will increase weed suppression. This may mean delaying termination and cash crop planting until the cover crop has achieved sufficient growth to suppress weeds (weed suppression may require dry matter production of 4,000 pounds per acre or more). Keep in mind, however, that high-biomass cover crops can be more challenging to manage, may need shorter-season cash crops to allow for adequate cover crop growth, and may require specialized planting equipment or may increase the potential for some insect pest problems.

CONTROL OF COVER CROPS

Control of a cover crop is important to avoid interference with cash crops.

- Tillage controls cover crops and incorporates cover crop residues into the soil. This speeds up degradation and the release of nutrients for the primary crop but does not create a weed-suppressive mulch layer. Tillage targeted for a certain time period to interfere with emergence of a problem weed may be useful in addition to cover crops.
- Mowing can be an effective control if it occurs after flowering, but some cover crops can regrow after mowing.
- Rolling with a roller/crimper can effectively control some cover crops, especially when rolling occurs after the cover crop has begun to flower. Rolling creates a longer-lived mulch layer than mowing.
- Herbicides can also be effective controls of cover crops, but product selection and application timing are important. In general, allow at least one week between application and primary crop planting to allow complete cover crop kill.

OTHER BENEFITS OF COVER CROPS

Cover crops can be a useful tool for suppressing weeds in cash crops, but they also have many other benefits.

- **Erosion control:** Soil that is covered is less prone to erosion for at least three reasons. First, living leaves and plant residues soften the impact of raindrops, reducing the amount of soil they dislodge. Second, plant stems and residues reduce the speed of water flowing over the soil surface. Third, roots hold the soil particles, preventing them from washing away.
- **Organic matter and soil tilth:** Soil organic matter is important in promoting good soil structure, which increases drainage and aeration. Organic matter is also important for cation exchange (nutrient-holding) capacity. Cover crops can be a great source of organic matter and can help maintain (or gradually increase) soil organic matter.
- **Nitrogen fixation:** Legume cover crops, through their association with certain soil bacteria, are able to fix nitrogen from the atmosphere. This nitrogen is slowly released for cash crops when the cover crop residues decay.
- **Nutrient trapping or scavenging:** Cover crops that are actively growing during seasons when the soil would otherwise be bare can trap nutrients that might otherwise be lost, either through leaching or runoff, which can affect water quality.
- **Beneficial organisms:** Cover crops may improve the soil environment for organisms that improve soil quality or prey on pests.
- **Feed and forage:** Some cover crops, especially grasses, can be used for livestock feed, either by grazing or mechanical harvest.

(continued on back panel)

WEED-SUPPRESSIVE COVER CROPS FOR PENNSYLVANIA

A large number of plant species can be effectively used as cover crops. The table below focuses on several common species that are useful for weed suppression across most of Pennsylvania. See the "Resources" section for more information.

Table 1. Selected cover crops.

Species, Life Cycle	Seeding Rate (lb/A)	Seed Cost ($/A)	Advantages	Disadvantages
Hairy vetch *Vicia villosa*, winter annual	20–40	$30.00–100.00	▪ Fixes 60–250 lb/A (avg.110) of N ▪ Cold tolerant and high yielding ▪ Relatively drought tolerant ▪ Adapted to wide range of soil types	▪ Slow establishment in early fall; little winter cover ▪ Late maturation in spring ▪ High P and K requirement for max. growth ▪ Potentially weedy in small grains ▪ Winter hardiness and maturity of cultivars can differ
Red clover *Trifolium pratense*, short-lived perennial	7–18	$7.00–27.00	▪ Fixes 100–110 lb/A of N ▪ Deep taproot ▪ Adapted to wet soils, humid areas, and shade ▪ Flexible; can be used as a forage (usually mixed with grass)	▪ Slow initial growth, high P and K requirement for max. growth ▪ Pure-stand forage use causes bloat ▪ Vulnerable to several pathogens and insects
Cereal rye *Secale cereale*, winter annual	60–200	$7.00–38.00	▪ Excellent scavenger of nutrients, esp. N ▪ Cold tolerant, late seeding possible, fast fall growth ▪ Rapid growth aids weed suppression ▪ Flexible; can be harvested for grain	▪ Regrowth may occur if control is incomplete; difficult to manage when mature ▪ Possible crop suppression caused by allelopathy or nutrient immobilization ▪ Potentially weedy in small grains ▪ May harbor small grain insects and diseases
Winter wheat *Triticum aestivum*, winter annual	120	$12.00–24.00	▪ Excellent scavenger of nutrients, esp. N ▪ Cold tolerant, late seeding possible, fast fall growth ▪ Flowers later than rye and can be harvested for grain ▪ Rapid growth aids weed suppression	▪ Produces less biomass than rye; possible crop suppression caused by nutrient immobilization ▪ May harbor small grain insects and diseases
Oats *Avena sativa*, summer annual	100	$6.50–8.50	▪ Excellent scavenger of nutrients, esp. N ▪ Rapid growth in cool weather, ideal for quick fall cover ▪ Winter-kills, can be used as nurse crop for legumes	▪ May be susceptible to disease and insect pests ▪ Minimal spring residue
Forage radish *Raphanus sativa*, annual	12–14	$24.00–35.00	▪ Good nutrient scavenger, esp. N, P, Ca ▪ Quick establishment and growth aids in weed suppression ▪ Tolerates light frost, but winter-kills ▪ Deep, thick roots, drought tolerant ▪ Flexible; can be used as a forage	▪ Low tolerance for wet soils ▪ As forage, potential bloat problems (use > 25% grass) ▪ Occasional pests (flea beetle) ▪ Minimal spring residue

MANAGING COVER CROPS: TERMINATION

Cover crops can be terminated mechanically or with herbicides. Each method has advantages and disadvantages.

Mowing can be effective, but the mulch may degrade quite rapidly because it has been chopped.

Plowing can be an effective physical control for cover crops, but the benefit of a weed-suppressive surface mulch in the subsequent cash crop is lost.

The roller/crimper offers effective physical control of some annual cover crops. It is most effective on winter annuals once they begin flowering, somewhat less effective on legumes, and not effective on perennials. The roller can produce a uniform surface mulch that decays slowly.

HOW DO COVER CROPS SUPPRESS WEEDS?

Cover crops can suppress weeds in multiple ways that affect specific stages of a weed's life cycle. The importance of each impact depends on the cover crop and the primary crop.

◆ **Micro-environment**
Soil moisture
Soil temperature

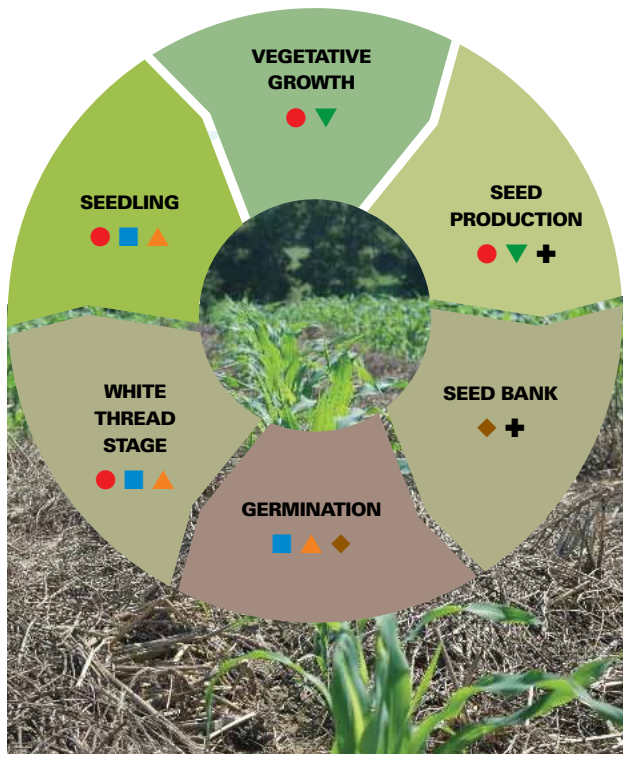
✚ **Natural enemies**
Seed predators
Pathogens

▲ **Physical supression**
Mulch

■ **Allelopathy**
Chemical inhibition

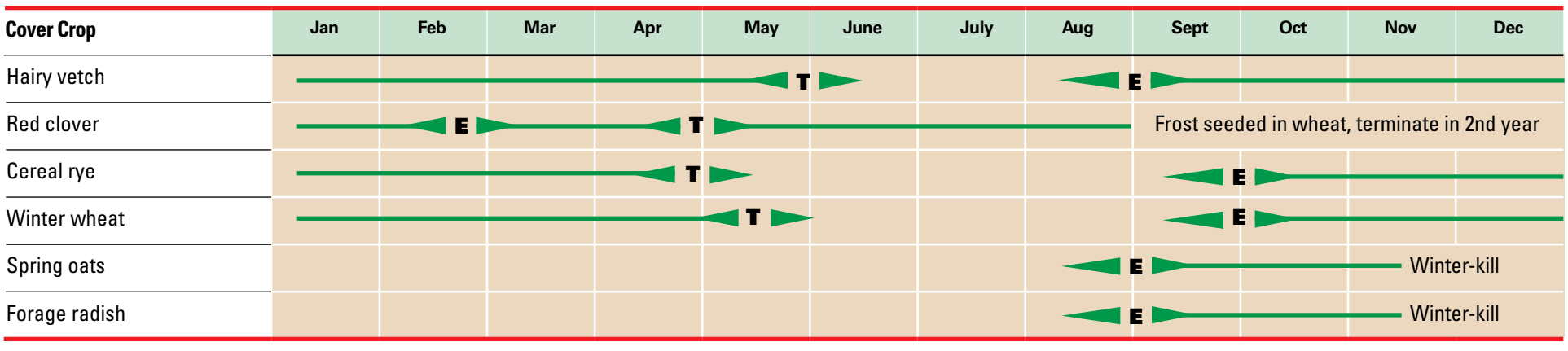
● **Competition**
Space
Nutrients
Light

▼ **Control**
Mowing
Herbicide
Tillage



Cover Crop Phenology

Making the most of cover crops requires considering the best times for establishing and terminating a cover crop, and deciding which cover and cash crops will complement each other on your farm. This chart presents the approximate windows for establishing (E) and terminating (T) several cover crops in Pennsylvania.



Hairy vetch | Red clover | Cereal rye | Winter wheat | Oats | Forage radish